Business Process Management systems
Introduction

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people, organizations, systems, and processes
driven by process models
classical flow of work
workflow if product is information
electronic flow of work
the digital and the physical world become more and more intertwined and aligned

Source: UC Berkeley Research Project, How Much Information?, 2003; IDC, Disk Storage System Quarterly Tracker (as of 2006)
Challenge: BPM-in-the-large

- many processes
- complex processes
- frequent changes
- exceptions are the rule (80/20)

“And this is where our ED workflow redesign team went insane.”
Role of models in the BPM lifecycle
Role of models in the BPM lifecycle
Role of models in the BPM lifecycle

- Diagnosis/requirements
- Configuration/implementation
- Enactment/monitoring
- Adjustment
- (re)design
- Models
- Documentation
- Configuration/implementation
- Specification
- Verification
- Performance analysis
- Animation
- Discussion
- Insight
Role of models in the BPM lifecycle

- diagnosis / requirements
- configuration / implementation
- enactment / monitoring
- adjustment

Discussion
- verification
- performance analysis
- animation
- specification
- documentation
- configuration
Role of models in the BPM lifecycle

- **Adjustment**
- **Enactment/Monitoring**
- **Diagnosis/Requirements**
- **Insight**

- **Verification**
- **Performance Analysis**
- **Animation**
- **Specification**
- **Documentation**
- **Configuration**
Role of models in the BPM lifecycle

- Adjustment
- Enactment/monitoring
- Diagnosis/requirements
- Insight/discussion
- Verification/performance analysis
- Specification/documentation
- Configuration
Setup of Course
Overview topics

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- Group assignment (3 points in groups of 3 persons)
- Written exam (7 points)
Practical things

• The lectures are given on **Tuesday 1+2 (8.45-10.30)** and **Friday 5+6 (13.45-15.30)** in Auditorium 2.

• The examination of this course consists of two parts. There is a **group assignment** (3 points, a maximum of 3 persons per group) and a **written exam** (7 points).

• The group assignment is mandatory and will take place during the middle part of quarter.
Relation to Business Process Management (1BM05)

- In the beginning there is a slight overlap with the course Business Process Management (1BM05).
- This partial overlap is in the first 1-2 weeks and is there to allow people to follow BPM and/or BPMS in any order.
Relation to other courses

- The BPMS course is the main introductory course for students interested in business information systems at the Master level.
- Students interested in the simulation part are encouraged to take the Business Process Simulation course (2II75) dedicated to this topic.
- For a better overview of log-based analysis techniques and hands-on experiences, the course Process Mining (new course given by me).
- Another related course is the Metamodeling and Interoperability (2II65) which focuses on language design and relationships between models and processes.
- The Seminar Architecture of Information Systems (2II96) is a seminar-style course with guest lectures, group presentations, research papers, etc.
- Finally, there are two further possibilities to specialize in topics related to the BPMS course. Capita Selecta Architecture of Information Systems (2II99) is an “invitation only” course for people that have shown to have expert knowledge in this area.
Role of models

Emphasis will be on processes and models!
Lectures

1. Introduction business process management systems [5-2-2013]
2. Modeling the control-flow perspective [8-2-2013]
3. Modeling the resource perspective [19-2-2013]
4. Workflow management systems/YAWL [22-2-2013]
5. YAWL & BPM|one [26-2-2013]
6. Workflow patterns [1-3-2013]
7. Overview BPM analysis techniques & Simulation [5-3-2013]
8. Verification of workflows (1) [8-3-2013]
9. Verification of workflows (2) [12-3-2013]
12. Configurable process models [22-3-2013]
13. Service-orientation and BPM [26-3-2013]
14. Question hour/exam preparation [2-4-2013]
Exercises

• There are no instructions (anymore, due to the quarter system).
• Exercises are very, very important (best preparation for exam questions).
• Ask questions during/before/after lectures, not via e-mail!
Often underestimated
(checking/understanding a solution is not the same as providing one)
Material

- See www.yawlbook.com
- The transparencies used during the lectures. (Please refer to the OASE system.)
- The exercises. (Please refer to the OASE system.)
- More papers, reports, standards, etc. will be distributed through OASE.
Assignment (start as soon as possible!)

- Max. 3 points.
- Groups of max. 3.
- At least two workflow processes, each consisting of at least 15 tasks.
- Model using BPM\|one.
- Analyze using ProM 6 (verification) and BPM\|one (simulation).
- Implement using YAWL.
- Run using YAWL.
- Guidance and evaluation:
  - Joos Buijs and Dennis Schunselaar
  - Strict schedule for showing parts of the assignment.
Tools

• For assignment:
  • BPM|one (commercial modeling tool)
  • ProM 6 (analysis tool used for verification)
  • YAWL (open-source workflow management system)

• For last part of course:
  • ProM 6 (various types of analysis, including process mining)
  • Woped, CPN Tools, or Yasper (for quickly making simple WF-nets)
Terminology: WFM&BPM
Workflow management

Goal

To manage the flow of work such that the work is done at the right time by the proper person.

Definitions

A workflow management system (WFMS) is a software package that can be used to support the definition, management and execution of workflow processes.

A workflow system (WFS) is a system based on a WFMS that supports a specific set of business processes through the execution of computerized process definitions.
Relevance of WFM/BPM

- Workflow
- Client Device
- Database System
- Application
- Data
- Application Logic
- Business Rules
- Control Flow

1960s
1970s
1980s
1990s
2000s

- BPMS
- Rules Engine
The basic idea:

- separation of processes, resources and applications
- focus on the logistics of work processes, not on the contents of individual tasks
Business Process Management (BPM)

- "BPM is the discipline that combines knowledge from information technology and knowledge from management sciences and applies this to operational business processes."
- BPM can be seen as an extension of Workflow Management (WFM).
- WFM primarily focuses on the automation of business processes whereas BPM has a broader scope: from process automation and process analysis to process management and the organization of work.
  - On the one hand, BPM aims to improve operational business processes, possibly without the use of new technologies.
  - On the other hand, BPM is often associated with software to manage, control, and support operational processes.
- Compared to WFM more attention for human factors and management support.
The BPM life-cycle

- Process design
- Process enactment
- Implementation/Configuration
- Diagnosis

Initial focus of WFM
Four main activities related to BPM

- **model**: creating a process model to be used for discussion, training, analysis or enactment.
- **enact**: using a process model to control and support concrete cases.
- **analyze**: analyzing a process using a process model and/or event logs (verification, simulation, process mining, etc.).
- **manage**: all other activities, e.g., adjusting the process, reallocating resources, or managing large collections of related process models.
History and Origins of the Domain

1960
application

1975
database system

1985
user interface

2000
BPM system

Skip Ellis, Office Talk, 1979
Michael Zisman, SCOOP, 1977

Business process reengineering

WFM

BPM

Data/Process mining

Data modeling

Office automation

Software engineering

Formal methods

Scientific management

Operations management
20 BPM Use Cases
20 BPM Use Cases

- Use cases to obtain a model [1-5]
- Use cases to obtain a configurable model [6-8]
- Use cases related to enactment [9-13]
- Use cases for model-only-based analysis [14-15]
- Use cases for log&model-based analysis [16-17]
- Use cases to repair, extend or improve process models [18-20]

Notation:

- Human
- Model
- Configurable model
- Information system
- Event data
- Diagnostics

D = descriptive
N = normative
E = executable
Use Case 1: Design model (DesM)
Use Case 2: Discover model from event data (DiscM)

discover model from event data (DiscM)
Use Case 3: Select model from collection (SelM)
Use Case 4: Merge models (MerM)
Use Case 5: Compose model (CompM)
Use Case 6: Design configurable model (DesCM)

design configurable model
(DesCM)
Configurable model
Configurable model: Hiding and Blocking

activate
block
hide
Use Case 7: Merge models into configurable model (MerCM)

merge models into configurable model (MerCM)

variant 1

variant 2
Use Case 8: Configure configurable model (ConCM)
Use Case 9: Refine model (RefM)
Use Case 10: Enact model (EnM)
Use Case 11:
Log event data (LogED)
Use Case 12:
Monitor (Mon)
Use Case 13: Adapt while running (AdaWR)
Use Case 14: Analyze performance based on model (PerfM)
Use Case 15: Verify model (VerM)

verify model

M
E
CD(VerM)
Use Case 16: Check conformance using event data (ConfED)
Use Case 17: Analyze performance using event data (PerfED)
Use Case 18: Repair model (RepM)
Use Case 19: Extend model (ExtM)

- Timestamps in the event log can be used to analyze waiting times in-between activities.
- Resource information in the event log can be used for social network analysis, role discovery, and performance analysis.
- Attributes in the event log can be used for decision point analysis.

Example diagram showing activities a, b, c, d, e, f, g, h with timestamps and resource information.
Use Case 20: Improve model (ImpM)
Use cases to obtain a model [1-5]
Use cases to obtain a configurable model [6-8]
Use cases related to enactment [9-13]
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Use cases for log&model-based analysis [16-17]
Use cases to repair, extend or improve process models [18-20]
WFM architecture
Reference model and example
Reference model of the Workflow Management Coalition (WfMC)

(1993)
Workflow perspectives
Processes dominate!
Focus on "classical" workflow management systems, but ...

Four types of "workflow-like" systems:
1. Information systems with hard-coded workflows (process& organization specific).
2. Custom-made information systems with generic workflow support (organization specific).
3. Generic software with embedded workflow functionality (e.g., the workflow components of ERP, CRM, PDM, etc. systems).
4. Generic software focusing on workflow functionality (e.g., BPM\|one, Staffware, MQSeries Workflow, COSA, Oracle BPEL, Filenet, etc.).
Workflow perspectives

- Process perspective (tasks and the routing of cases)
- Resource perspective (workers, roles, 4-eyes principle, etc.)
- Case/data perspective (process instances and their attributes)
- Operation/application perspective (forms, application integration, etc.)
- ...

...
Process perspective: Protos (extended Petri nets)
Process perspective: BPM|one Process Design

Modeling and analysis (simulation, process mining, etc.) based on Petri nets.
Process perspective: BPM|one Process Control

Enactment based on refined model with emphasis on flexibility.
Process perspective: ILOG JViews (BPMN)
Process perspective: bizagi (BPMN)
Process perspective: Oryx (BPMN)
Process perspective: WoPeD (WF-nets)
Process perspective: Yasper (Petri nets)
Process perspective: Staffware
Process perspective: COSA
Process perspective: Baan DEM
Cordys (uses BPMN)
Process perspective: Event driven process chains (ARIS/SAP)
Process perspective: (Oracle)

BPEL

```xml
<sequence name="main">
  <flow name="Flow_1">
    <links>
      <link name="receive-to-assess"/>
      <link name="receive-to-approval"/>
      <link name="approval-to-reply"/>
      <link name="assess-to-setMessage"/>
      <link name="setMessage-to-reply"/>
      <link name="assess-to-approval"/>
    </links>
    <sequence name="sequenceReceive">
      <source linkName="receive-to-assess" transitionCondition="bpws:getVariableData('inputVariable','payload','/client:LoanApprovalProcessRequest/client:amount') &lt; 10000"/>
      <source linkName="receive-to-approval" transitionCondition="bpws:getVariableData('inputVariable','payload','/client:LoanApprovalProcessRequest/client:amount') &gt;= 10000"/>
      <receive name="receiveInput" partnerLink="client" portType="client:LoanApproval" operation="initiate" variable="inputVariable" createInstance="yes"/>
    </sequence>
    <sequence name="sequenceAssess">
      <target linkName="receive-to-assess"/>
      <source linkName="assess-to-setMessage" transitionCondition="bpws:getVariableData('risk') = 'low'"/>
      <source linkName="assess-to-approval" transitionCondition="bpws:getVariableData('risk') != 'low'"/>
      <assign name="initiateAssessor">
        <copy>
          <from variable="inputVariable" part="payload" query="/client:LoanApprovalProcessRequest/client:firstName"/>
          <to variable="invokeAssessor_initiate_InputVariable" part="payload" query="/ns1:AssessorProcessRequest/ns1:firstName"/>
        </copy>
        <copy>
          <from variable="inputVariable" part="payload" query="/client:LoanApprovalProcessRequest/client:name"/>
          <to variable="invokeAssessor_initiate_InputVariable" part="payload" query="/ns1:AssessorProcessRequest/ns1:name"/>
        </copy>
        <copy>
          <from variable="inputVariable" part="payload" query="/client:LoanApprovalProcessRequest/client:amount"/>
          <to variable="invokeAssessor_initiate_InputVariable" part="payload" query="/ns1:AssessorProcessRequest/ns1:amount"/>
        </copy>
      </assign>
      <invoke name="invokeAssessor" partnerLink="Assessor" portType="ns1:Assessor" operation="initiate" inputVariable="invokeAssessor_initiate_InputVariable" />
      <receive name="receiveAssessor" partnerLink="Assessor" portType="ns1:AssessorCallback" operation="onResult" variable="receiveAssessor_onResult_InputVariable" createInstance="no"/>
      <assign name="completeAssessor">
        <copy>
          <from variable="receiveAssessor_onResult_InputVariable" part="payload" query="/ns1:AssessorProcessResponse/ns1:level"/>
          <to variable="risk"/>
        </copy>
      </assign>
    </sequence>
    <sequence name="sequenceNoApproval">
      <target linkName="assess-to-setMessage"/>
      <source linkName="setMessage-to-reply"/>
      <assign name="setAccepted">
        <copy>
          <from expression="'Accepted'"/>
          <to variable="outputVariable" part="payload" query="/client:LoanApprovalProcessResponse/client:result"/>
        </copy>
      </assign>
    </sequence>
  </flow>
</sequence>
```
Process perspective: BPEL (IBM Websphere)
Process perspective: YAWL
(extended Petri nets)
Preliminaries: Petri-net-based process modeling and analysis
Petri nets as a basis

- The process perspective is the most dominant one.
- There are many modeling techniques and tools
  - BPMN, UML activity diagrams, EPCs, BPEL, DFD, ISAC, SADT, PN, HLPN, PA, FC,...
  - Simulation tools, design tools, CASE tools, WFMS, ...
- Focus on the essential concepts rather than (system) specific languages.
- Approach in this course (1) first master workflow modeling in terms of workflow nets (a subset of Petri nets), and (2) only then look into mappings to and from (system-)specific languages.
Example of a process model: A Petri net modeling order processing
Exercises, see OASE
"BPMS-instruction-1-refresher-questions.pdf"
Address your "deficiencies"

- See Studyweb for exercises.
- Study the book “Modeling Business Processes: A Petri Net-Oriented Approach” (2011) if you are new to this.
- For the instruction this week make the Business Information Systems exam of 25-1-2010 (see OASE).

http://mitpress.mit.edu/catalog/item/default.asp?ttype=2&tid=12548
Exercise: Train system (2)

- Consider a railroad system with 4 tracks (1,2,3,4) and 2 trains (A,B). No two trains should be at the same track at the same time and we want to distinguish the two trains.