Process Modelling and Standardization

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Agenda

1. Business Process Management and Lifecycle

2. Process Design
   - Process Implementation
   - Conclusions
Business Process Management and Lifecycle
Why Processes and Workflow?

**Old process**
- Receive Book Order
- Write Bill
- Wrap Book
- Send Book

**New process**
- Receive Book Order
- Check Credit Rating
- Reject Order
- Write Bill
- Wrap Book
- Send Book
Why Processes and Workflow?

1st Reason: Flexibility

• Introduction of a separate process layer
• Functions tend to be stable
• Ordering of functions is subject to change
• Processes become more easy to adapt
Why Processes and Workflow?

Manual process:
1. Receive Book Order: 20 min
2. Check Credit Rating: 5 min
3. Write Bill: 15 min
4. Wrap Book: 20 min
5. Send Book: 5 min
6. Reject Order: 0 min

Automatic process:
1. Receive Book Order: 0 min
2. Check Credit Rating: 0 min
3. Write Bill: 1 min
4. Wrap Book: 5 min
5. Send Book: 5 min
6. Reject Order: 0 min
Why Processes and Workflow?

2nd Reason: Productivity

- Waiting times between functions minimized
- Automatic routing of work items
Why Processes and Workflow?

more reasons:

• Better customer orientation
• Better controlling of processes
• Better documentation of enterprise
• Better communication between different departments
• Avoiding problems
• ...

...
Business Process Lifecycle

- Process Design
- Process Evaluation
- Process Enactment
- Process Monitoring
- Animation, Simulation
- Process Models
- Process Implementation
- Goals, Environmental Analysis, Organizational Analysis
- Other reporting purposes
- Metrics, Targets
- Measure/Improvement
- Target Values
- Process Models
- Implemented Processes

- Metrics
- Targets
- Process Metrics
- Process Metrics
- Other reporting purposes

M. zur Muehlen: Workflow-based Process Controlling, 2004
Modelling Languages for Business Processes and Workflow

- Event-Driven Process Chains (EPC)
- BPEL4WS
- Petri Nets
- XPDL
Workflow Terminology and Glossary

- **Business Process**: (what is intended to happen)
  - is defined by
  - Business Process
    - is managed by
    - Workflow Management System
      - controls automated aspects of the business process
      - via
      - Process Instances
        - (representation of what is actually happening)
      - Include one or more
    - Activities Instances
      - Activities
        - which may be
          - Manual Activities
            - (which are not managed as part of the Workflow System)
          - or
            - Automated Activities
          - composed of
      - Activities Instances
        - which include
          - Work Items
            - (tasks allocated to a workflow participant)
          - and/or
            - Invokes Applications
              - (computer tools or applications used to support an activity)

- **Activities**: is managed by
  - Activities
    - which may be
      - Manual Activities
    - or
      - Automated Activities
    - composed of
      - Sub-Processes

- **Process Definition**: (representation of what is intended to happen)
  - used to create and manage
  - Process Instances
    - (representation of what is actually happening)
  - composed of

- **Design time**
- **Runtime**
Business Process Design

Modelling Processes with Event-Driven Process Chains
Process Design and Implementation

- Event-Driven Process Chains (EPC)
- BPEL4WS
- Petri Nets
- XPDL
Event-Driven Process Chains (EPC)

Folie 14

Process Modelling and Standardization
Purpose of EPCs

- Documentation of business processes
- SAP implementation projects
- Business process re-engineering
EPC Semantics: Transition Relation

Events
- OR Split
- XOR Split

Functions
- AND Split
- AND Join

Cuntz, Kindler, 2004
EPC Semantics: Transition Relation II

OR Join

XOR Join

Non-local semantics
Non-local semantics

deadlock
Vicious Circle
Conclusions

• Circles may lead to ambiguous situations

• It is a good choice to avoid circles and loops (if possible)

• Many Workflow Systems do not allow circles

• For more on EPCs, see www.epk-community.de
Agenda

Business Process Implementation

Standards and Languages for Modelling Workflows
### Recognition of Existing BPM Standard Initiatives

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©2003 Delphi Group
Standardization Bodies

- **OMG**: Object Management Group
- **WfMC**: Workflow Management Coalition
- **BPMI**: Business Process Management Initiative
- **OASIS**: Organization for the Advancement of Structured Information Standards (+ UN/CEFACT)
- **W3C**: World Wide Web Consortium

- academic initiatives
BPM Specifications Overview

- **BPDM**: Business Process Definition Metamodel by OMG
- **BPEL4WS**: Business Process Execution Language for Web Services by OASIS
- **BPML**: Business Process Modeling Language by BPMI
- **BPMN**: Business Process Modeling Notation by BPMI
- **BPSS**: Business Process Specification Schema by OASIS + UN/CEFACT
- **EPML**: EPC Markup Language by academia
- **OWL-S** by academia
- **PNML**: Petri Net Markup Language by academia
- **UML ActD** by OMG
- **WS-CDL**: WS-Choreography Description Language by W3C
- **WSCI**: WS Choreography Interface by W3C
- **WSCL**: WS Choreography Language by Hewlett-Packard
- **WSFL**: WS Flow Language by IBM
- **XLANG** by Microsoft
- **XPDL**: XML Process Definition Language by WfMC
Comparison of BPM Specifications

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Mendling et al.: A Comparison of XML Interchange Formats for BPM, 2004
Process Design and Implementation

Event-Driven Process Chains (EPC)

Process Design

BPEL4WS
Petri Nets
XPDL

Process Implementation
Concepts used in BPEL4WS

- **Partner Links:**
  - Bilateral conversation (my Role, Partner Role)
  - Interface requirements of partners

- **Data and messages:**
  - Variables
  - Properties
  - Correlation Set

- **Activities:**
  - Basic Activities
  - Structured Activities (control flow)
BPEL4WS Example

flow

- Receive Purchase Order
- Assign
- Price Calculation
- Decide on Shipper
- Complete Prod. Scheduling
- Initiate Production Scheduling
- Send Shipping Price
- Receive Invoice
- Receive Schedule
- Reply Process Invoice

Andrews et al.: BPEL4WS 1.1., 2003
Control Flow Problems

- **Deadlock Freedom**
  there is no situation where a process instance has not yet reached a correct final state, but no activity can be finished anymore

- **Termination**
  The flow must terminate exactly once without any residual branch being still under execution

- **Reachability**
  Each activity should be reachable – starting from a correct initial state there must be a valid sequence of activity executions and outputs that will lead to activation of X.
Conclusion

• These control flow problems can only be analyzed for a subset of all BPEL
• BPEL4WS processes without links grant good control flow
• Restrictions on links allows analysis

• For details see Reichert, Rinderle, Dadam: On the modeling of correct service flows with BPEL4WS, 2004.
Process Design and Implementation

Event-Driven Process Chains (EPC)

Process Design

BPEL4WS  Petri Nets  XPDL

Process Implementation
Petri Nets

• **Places** to capture states of a process
• **Transitions** to capture state changes
• **Arcs** to capture control flow
• **Tokens** to capture current state
Soundness of Workflow Nets

Workflow Nets are special Petri Nets

Soundness implies:

• For every state $M$ reachable from state $I$, there exists a firing sequence leading from state $M$ to state $o$.

• State $o$ is the only state reachable from state $I$ with at least one token in place $o$.

• There are no dead transitions.

• For details see e.g. van der Aalst, 2000
Conclusion

- Rich mathematical foundations permits in-depth analysis
- Petri Nets are popular in academia
- There are several workflow engines that use Petri Nets
Process Design and Implementation

Event-Driven Process Chains (EPC)

BPEL4WS  Petri Nets  XPDL
XPDL Concepts

• Standard proposed by Workflow Management Coalition

• Used in open source workflow engine OBE

• Workflow defined by activities and transitions

• Participants, applications, and data fields involved
**XPDL Example**

```
<WorkflowProcess AccessLevel="PUBLIC"
   Id="new-employee" Name="New Employee">
   <Activities>
     <Activity Id="a5" Name="Allocate user ID">
       <Implementation>
         <Tool Id="createNetworkUser" Type="PROCEDURE">
           <ActualParameters>
             ...
           </ActualParameters>
         </Tool>
       </Implementation>
       <Performer>IT</Performer>
       <StartMode><Automatic/></StartMode>
       <FinishMode><Automatic/></FinishMode>
       <TransitionRestrictions>
         <TransitionRestriction>
           <Split Type="AND">
             <TransitionRefs>
               <TransitionRef Id="t3"/>
               <TransitionRef Id="t4"/>
               <TransitionRef Id="t13"/>
               <TransitionRef Id="t25"/>
               <TransitionRef Id="t18"/>
             </TransitionRefs>
           </Split>
         </TransitionRestriction>
       </TransitionRestrictions>
     </Activity>
     ...
   </Activities>
   <Transitions>
     <Transition From="a5" Id="t3" Name="Transition" To="a6"/>
   </Transitions>
</WorkflowProcess>
```
XPDL Schema Problems

- Missing Default values
- Undefined semantics
- Schema errors and ambiguities
- Schema omissions and inconsistencies

Conclusion

• XPDL in its current version needs rework

• Formal analysis is difficult, because of transition conditions

• Yet, some open source workflow engines use XPDL
Modelling Languages for Business Processes and Workflow

- Event-Driven Process Chains (EPC)
- BPEL4WS
- Petri Nets
- XPDL
Workflow Patterns

- Identification of control flow concepts
- List of 20 Workflow Patterns
- Generalization from EPCs, Petri Nets, etc.
- For details see van der Aalst et al., 2003
Conclusion

Process Design and Implementation
Business Process Lifecycle

- Goals, Environmental Analysis, Organizational Analysis
- Process Design
- Process Evaluation
- Process Implementation
- Process Enactment
- Process Monitoring
- Animation, Simulation
- Metrics, Targets
- Other reporting purposes
- Process Metrics
- Process Models
- Target Values
- Measures for Improvement

M. zur Muehlen: Workflow-based Process Controlling, 2004
Overall Conclusion

• Heterogeneity is still a problem

• Standard proposals are often vendor driven

• Analysis of semantics is an important issue

• Workflow Patterns will hopefully be reflected in future standards
Thank you for your attention!

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