Integrating Business Process Models with Ontologies

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Colibra nv/sa (spin off)
Overview of presentation

1. Business Process and BP Model
2. Ontology
3. BP Model & Ontology
4. BP Model & Ontology within BP Management
5. Importing BP Model semantics into Ontology
A business process:
1. Has a Goal;
2. Has specific inputs;
3. Has specific outputs;
4. Uses resources;
5. Has a number of activities that are performed in some order;
6. May affect more than one organizational unit. Horizontal organizational impact;
7. Creates value of some kind for the customer. The customer may be internal or external.
A business process model **describes a business process**, i.e. what an organization or business does and how this is done.

Typically a business process model describes:

- the **events** that initiate the process
- the **participants** in the process
- the **workflow of activities**
- the **results** of the process
1.3. BP Model - Example

Message Flow connecting to Flow Objects within two Pools
2.1. Ontology

- **Definition**: A formal, explicit specification of a shared conceptualization (Tom Gruber, 1993).
- No standard for graphical representation.
- OWL is widely used to represent ontologies, however, many other formats exist.
2.2. Ontology - Example

Integrating Business Process Models with Ontologies
3. BP Model & Ontology

- Both a BP model and an ontology are used to model a specific domain.
- A BP model might be considered as a specialised ontology with focus on processes.
- **Business Process Model Notation** is a graphical representation only for BP models.
- An **ontology** might be used to represent a BP model semantically.
4. BP Management

State of the art BPMS supports the complete business process life cycle!

e.g. ARIS, Intalio, etc.

BPMN

UML, ER, ORM

Image by Paul de Wildt
IBM – Business Model Innovation
4.1. BP Model and Ontology within BP Management
4.2. Agents

Participants within the BP Model

- Software applications
- Web services
- Devices
- Actors (persons, roles, organisations, etc.)
4.3. Information - Modeling

- Developing Ontology Guided Mediation of Agents (DOGMA)
  - Based on Object Role Modeling (ORM)
  - Uses natural language expressions to capture domain knowledge (lexons)
  - Separates generic facts from application specific constraints

DOGMA ontology for information modeling
4.3.1. Object Role Modeling

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Picture from www.orm.net (Terry Halpin)
4.3.2. Lexon base & Ω-RIDL

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```xml
<?xml version="1.0" encoding="UTF-8"?>
<commitment xmlns="http://www.starlab.vub.ac.be/2007-12/OmegaRIDL"
    <lexonSet>
        <lexon id="11">
            <context>SCIE</context>
            <headTerm>care home</headTerm>
            <role>has</role>
            <coRole>is of</coRole>
            <tailTerm>policy</tailTerm>
        </lexon>
    </lexonSet>
```
4.4. Information - Querying

- ORM based ontologies and databases may be queried at the conceptual level
  - Example: ConQuer

![Diagram of ORM query]

DOGMA ontology for information querying

Picture from www.orm.net (Terry Halpin)
4.5. Information - Exchange

Provided by:

- Files (text, spreadsheet, diagram, etc.)
- Databases
- Ontologies
- Agents
- ...

Many different **formats** and **contents**!

Ontology for information exchange (mapping)
4.6. BP Model - Design

- Business process analyst <= Executive
  - Key Performance Indicators Director
  - Participants (roles, persons, Manager
    etc.) Supervisor
  - Activities (processes, tasks) Employee
  - Applications <= DOGMA Ontology
  - Applications
  - Forms
  - Data
  - ...

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4.7. BP Model - Implementation

The Critical IT / Process Divide

Business Experts’ Perspective: Processes

Querying the Process Space

Manual Labor

Ontology

Process Implementation

IT Implementation Perspective

4.8. Agents – Implementation

Semantic Business Process Management

**Business Experts’ Perspective: Processes**

- **SCOPE of SBPM**
- **WSMO**
- **Machine-Accessible Representation of Business Experts’ Requirements**
- **Mechanized Mediation based on Machine Reasoning**
- **Machine-Accessible Representation of Processes, Process Fragments, and IT Infrastructure as Semantic Web Services**

**IT Implementation Perspective**

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4.9. Agents – Interoperability

1. Parties "become known" to each other
2. Agree on semantics & WSD
3. Input Semantics & WSD
4. Interact

Ontology
OWL-S, WSDL-S
Conclusion of SUPER project – Semantics Utilized for Process Management within and between Enterprises

Business Process Analysis techniques can benefit from the use of semantic information; this is possible by annotating the elements that are relevant for analysis with ontological concepts. The benefits are two-fold:
1. by using ontologies and performing analysis at the concept-level, the proposed solutions reduce the gap between the management and the IT worlds in companies
2. the use of ontologies greatly promote the reuse of analysis queries etc.
5. Importing BP Model semantics into Ontology

1. Use Case: PROLIX project
2. XPDL Meta-Model Overview
3. XPDL Example
4. Conversion Rules for XPDL to Lexons
5. BPMOn Software Tool
5.1. BP Model -> Ontology conversion (PROLIX - BT)
XPDL Meta-Model
XPDL Example

```
<Package xmlns:xyz="http://www.xyzeorder.com/workflow" Id="1"
         Name="sample process" xmlns:deprecated="http://www.wfmc.org/2002/XPDL1.0"
         xmlns="http://www.wfmc.org/2004/XPDL2.0alpha"
         xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
         xsi:schemaLocation="http://www.wfmc.org/2004/XPDL2.0alpha
C:\DOCUME~1\ROBERT~1\MYDOCU~1\capevisions\bpmn\schema\bpmnxpdl_20.xsd">
  ...
  <WorkflowProcess Id="3" Name="CreditCheck" AccessLevel="PRIVATE">
    <FormalParameters>
      <FormalParameter Id="accountNumber" Mode="IN">
        <DataType>
          <BasicType Type="INTEGER" />
        </DataType>
      </FormalParameter>
      <FormalParameter Id="status" Mode="OUT">
        <DataType>
          <DeclaredType Id="OrderStatus" />
        </DataType>
      </FormalParameter>
    </FormalParameters>
  ...
```
5.4. Conversion Rules

Lexons:
1) sample process, CreditCheck, is a, subsumes, workflow process
2) sample process, CreditCheck, has input, is input of, accountNumber
3) sample process, CreditCheck, has output, is output of, status
5.5.1 BPMOn Tool

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### 5.5.2 BPMOn Tool

Integrating Business Process Models with Ontologies

![Screen Shot of BPMOn](image)

#### Conversion rules

<table>
<thead>
<tr>
<th>Head term</th>
<th>Role</th>
<th>Co-role</th>
<th>Tail term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order</td>
<td>has external ref</td>
<td>is external ref</td>
<td><a href="http://www.omg.org/spec/BPMN/201001/">http://www.omg.org/spec/BPMN/201001/</a></td>
</tr>
<tr>
<td>Order:Status</td>
<td>has possible val</td>
<td>is possible val</td>
<td>InvalidData</td>
</tr>
<tr>
<td>Order:Status</td>
<td>has possible val</td>
<td>is possible val</td>
<td>ValidData</td>
</tr>
<tr>
<td>Order:Status</td>
<td>has possible val</td>
<td>is possible val</td>
<td>Accept</td>
</tr>
<tr>
<td>Order:Status</td>
<td>has possible val</td>
<td>is possible val</td>
<td>OverLimit</td>
</tr>
<tr>
<td>Order:Status</td>
<td>has possible val</td>
<td>is possible val</td>
<td>BadCredit</td>
</tr>
<tr>
<td>CardType</td>
<td>has external ref</td>
<td>is external ref</td>
<td><a href="http://www.omg.org/spec/BPMN/201001/">http://www.omg.org/spec/BPMN/201001/</a></td>
</tr>
<tr>
<td>CreditInfo</td>
<td>has external ref</td>
<td>is external ref</td>
<td><a href="http://www.omg.org/spec/BPMN/201001/">http://www.omg.org/spec/BPMN/201001/</a></td>
</tr>
<tr>
<td>DEConnection</td>
<td>is a</td>
<td>subsumes</td>
<td>Participant</td>
</tr>
<tr>
<td>Connection</td>
<td>is a</td>
<td>subsumes</td>
<td>SYSTEM</td>
</tr>
<tr>
<td>ORDER</td>
<td>is a</td>
<td>subsumes</td>
<td>WorkflowProcess</td>
</tr>
<tr>
<td>orderString</td>
<td>is a</td>
<td>subsumes</td>
<td>Formal parameter</td>
</tr>
<tr>
<td>ORDER:has formal param...</td>
<td>is a</td>
<td>subsumes</td>
<td>orderString</td>
</tr>
<tr>
<td>transformData</td>
<td>is a</td>
<td>subsumes</td>
<td>Application</td>
</tr>
<tr>
<td>ORDER:has formal param...</td>
<td>is a</td>
<td>subsumes</td>
<td>transformData</td>
</tr>
<tr>
<td>orderStringIn</td>
<td>is a</td>
<td>subsumes</td>
<td>Formal parameter</td>
</tr>
<tr>
<td>transformData</td>
<td>has formal param</td>
<td>has formal param</td>
<td>orderStringIn</td>
</tr>
<tr>
<td>ORDER:has formal param...</td>
<td>is a</td>
<td>subsumes</td>
<td>transformData</td>
</tr>
<tr>
<td>transformData</td>
<td>has formal param</td>
<td>has formal param</td>
<td>orderInfo</td>
</tr>
<tr>
<td>ORDER:has formal param...</td>
<td>is a</td>
<td>subsumes</td>
<td>Application</td>
</tr>
<tr>
<td>checkData</td>
<td>is a</td>
<td>subsumes</td>
<td>Application</td>
</tr>
<tr>
<td>ORDER:has application</td>
<td>has process</td>
<td>transformData</td>
<td>checkData</td>
</tr>
<tr>
<td>checkVendor</td>
<td>is a</td>
<td>subsumes</td>
<td>Application</td>
</tr>
<tr>
<td>statusOut</td>
<td>is a</td>
<td>subsumes</td>
<td>Application</td>
</tr>
<tr>
<td>ORDER:has application</td>
<td>has process</td>
<td>transformData</td>
<td>checkVendor</td>
</tr>
<tr>
<td>amountIn</td>
<td>is a</td>
<td>subsumes</td>
<td>Application</td>
</tr>
<tr>
<td>ORDER:has formal param...</td>
<td>is a</td>
<td>subsumes</td>
<td>amountIn</td>
</tr>
<tr>
<td>accountNumberIn</td>
<td>is a</td>
<td>subsumes</td>
<td>Application</td>
</tr>
<tr>
<td>ORDER:has formal param...</td>
<td>is a</td>
<td>subsumes</td>
<td>accountNumberIn</td>
</tr>
<tr>
<td>enterOrder</td>
<td>is a</td>
<td>subsumes</td>
<td>Application</td>
</tr>
<tr>
<td>ORDER:has application</td>
<td>has process</td>
<td>transformData</td>
<td>enterOrder</td>
</tr>
<tr>
<td>orderInfo</td>
<td>is a</td>
<td>subsumes</td>
<td>Application</td>
</tr>
</tbody>
</table>

#### Terminological ontology

- Workflow Processes
- Process Header
- Formal Parameters
  - Input Type: STRING
  - Output Type: STRING
- Applications
  - Formal Parameters
    - Order String In
    - Order String Out
- Data Types
  - Order
  - Order Status
  - Credit Info
  - DE Connection
  - Connection
  - Order
  - Transform Data
  - Check Data
  - Check Vendor
  - Status Out
  - Amount In
  - Account Number In
  - Enter Order
5.5.2. BPMon Tool

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Integrating BP Models with Ontologies

Thank you!

Questions?

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