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A Notation Evaluation of BPMN and UML Activity Diagrams

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Presentation Overview

- **Research subject**
- **Research problems and questions**
- **Research methods**
- Introduction to BPMN
- Introduction to UML AD
- Workflow patterns-framework & findings
- BWW-model & findings
- Concluding remarks
- Questions & Comments
Research Subject

- We compare two notations: (BPMN) version 1.1 and unified modeling language activity diagrams (UML AD) version 2.0.

- Viewpoint: representation power
  - Ability to model real world phenomena
  - Are there processes that cannot be modelled with these notations?
  - Our study omits tool support, mapping to executable languages, but this does not mean that they are not important issues also.

- We study the representation power of notations with two frameworks:
  - Workflow patterns –framework
  - Bunge-Weber-Wand –model (BWW-model)

- There are many earlier studies with both Workflow patterns –framework and BWW-model.
Research Problem and Research Questions

- **Research problem**: Are there any differences in the representation power between the given notations?

- **Research questions**: Are there any differences between the given notations when they are analyzed with workflow patterns -framework? Are there any differences between the given notations when they are analyzed with BWW-model?
Research Methods

- Workflow patterns -framework and BWW-model are not used directly by our group – earlier findings in literature are summed up instead

- Main research method: Literature analysis
  - Google Scholar was found better than UMI Proquest and Nelli portal
  - Key Words: BPMN, “business process modeling notation”, UML "activity diagram", "unified modeling language", "activity diagram", BPMN UML, BPMN UML "activity diagram", BWW model, workflow pattern
  - Key words divided between group members
  - Went through ~45 articles
  - About twenty articles selected for further analysis
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Introduction to BPMN

- The primary goals
  - Make business process modeling easier
  - Reduce the gap between technical and business people
- Typically used to model
  - Business process (only)
- Has three levels of abstraction
  - A Private (Internal) Business Process
  - An Abstract (Public) Business Process
  - A Collaboration (Global) Business Process
- Defines Business Process Diagram (BPD)
- BPD has four basic categories of elements
  - Flow Objects
  - Connecting Objects
  - Swimlanes
  - Artifacts
Introduction to UML AD

- The primary goals
  - Elements can be used for various purposes
  - Modeling is straightforward and easy to read
- Typically used to model
  - Business process workflow
  - Flow within a use case
  - Business rules logic
  - Functional processes
  - UI screen flows
- Activity Diagrams show flow of control and data flow
- Has five main categories of elements
  - Actions
  - Sub Activities
  - Data Objects
  - Control nodes
  - Partition
UML AD: Business process with different parties
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What Is Workflow Patterns –framework?

- General set of business process patterns that can be evaluated against a notation to find out, if there are some patterns that a notation cannot model.

\textit{Pattern 1: Sequence}

An activity in a workflow process is enabled after the completion of another activity in the same process.
Three classes of patterns

- Control flow patterns
  - Describe the flow of control in systems
- Data patterns
  - Patterns that are related to data and data-objects
- Resource patterns
  - The distribution of work to the resources and the management of this work
Control-flow patterns
Control-flow patterns: Basic pattern

<table>
<thead>
<tr>
<th>Control-flow patterns</th>
<th>Description</th>
<th>BPMN</th>
<th>UML AD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Control-flow Patterns</td>
<td>An activity in a workflow process is enabled after the completion of another activity in the same process.</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>
## Control-flow patterns: Advanced pattern

<table>
<thead>
<tr>
<th>Control-flow patterns</th>
<th>Description</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Interleaved Parallel Routing</td>
<td>A set of activities is executed in an arbitrary order: Each activity in the set is executed, the order is decided at run-time, and no two activities are executed at the same moment (i.e. no two activities are active for the same workflow instance at the same time).</td>
<td>+/-</td>
<td>-</td>
</tr>
</tbody>
</table>
Control-flow patterns: Interleaved Parallel Routing and BPMN
Data patterns
Data patterns

- There are many differences in how BPMN and UML AD support data patterns.
- However, when these forty data patterns are categorized, most of the pattern groups are equally well supported by both notations.
# Data Visibility 1/3

**Table 3**  
*Data patterns (Babel 2006)*

<table>
<thead>
<tr>
<th>Data patterns</th>
<th>Description</th>
<th>BPMN</th>
<th>UML AD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Data Visibility Patterns</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case data</td>
<td>Data elements are supported which are specific to a process instance or case of a workflow. They can be accessed by all components of the workflow during the execution of the case.</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Workflow data</td>
<td>Data elements are supported which are accessible to all components in each and every case of the workflow and are within the control of the workflow system.</td>
<td>-</td>
<td>+</td>
</tr>
</tbody>
</table>
Data Visibility 2/3

Figure 15
Case level data visibility. Variable X is visible for all tasks throughout a workflow case. (BABEL)
Data Visibility 3/3

Figure 16
Workflow data visibility. Variable X is visible globally throughout all workflow cases. (BABEL)
External Data Interaction

- UML AD does not support external data interactions at all
  - E.g. if data should be stored to a database which is in an external process and not a part of the workflow that can not be modeled
Resource patterns
Resource patterns

- BPMN and UML AD support the same resource patterns
- According to BPMN specification modeling resources will not be a part of BPMN
- Other UML diagram types might be more suitable for modeling resources
- Some resource patterns are however supported
  - E.g. direct and role based resource allocation pattern is supported because both notations use pools and lanes
Workflow patterns - Results

- BPMN has a better representation power in control flow and data patterns
  - UML AD has a lack of external data interactions support
- Both notations give equally weak results in resource patterns
- Representation power of BPMN can be seen better than UML AD
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What Is BWW–model?

- A reference model that can be used to find out how well a given notation can model real world phenomena generalized by the BWW-model
  - BWW-model can be used to analyze the ontological strengths and weaknesses of modelling techniques
- Can be divided in four classes of constructs
  - **Things**, the properties of things and the types of things. Things are the basic unit of BWW-model. A thing refers to an entity in a real world. Two or more things can in composition be also accounted for a thing
  - **States of things**. State refers to all of the properties of a thing in a given point in time
  - **Events and transformations that can happen on things**. Events refer to an occurrence that changes the state of a thing. Transformation on the other hand is the mapping between two states of a thing
  - **Systems, that are build around things**. This refers to that things can be composed to systems, which may have subsystems and interfaces to the system’s environment
- The BWW-model has been used over twenty research projects
BWW-model – Results

- Construct deficit suggest, that the notation is no able to model all the concepts of real world
  - Both notations have a hard time modelling states and system structures
- Construct redundancy means that for one real-world concept, there might be many representations in the used notation
  - The biggest difference found between these notations seems to be construct redundancy, which was not found in UML AD
- Construct excess means that there are some constructs a notation that bear no meaning in the real-world and construct
  - Both notations have some construct excess
- Construct overload means that some constructs in the notation can represent many real-world BWW-concepts
  - Both notations have construct overload
- On the whole: differences revealed by BWW-model are not big
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Concluding Remarks

- Differences between in representation power of BPMN and UML AD are not big
  - Though, BPMN could be seen to have only a little more representation power than UML AD
- These differences are relevant but in practice some other issues might weight more
- Representation power might not be the best attribute to compare notations with
- Optional viewpoints for further research
  - Usability of a notation
  - Learnability of a notation
  - Notations suitability for communication
  - Tool support for a notation
  - Mapping to executable languages
Thank you!
Questions – Comments