An Evaluation of Conceptual Business Process Modelling Languages

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ABSTRACT
Conceptual Business Process Modelling Languages (BPMLs) express certain aspects of processes (e.g. activities, roles, interactions, data, etc.) and address different application areas. To evaluate BPMLs, a general framework is required. Although a lot of BPMLs are available in research and industry, an established evaluation framework as well as a comprehensive evaluation of BPMLs is missing. To bridge this gap, we propose a generic meta-model that captures a wide range of process concepts and evaluate seven BPMLs based on this meta-model.

Keywords
Business process modelling, meta-model.

1. INTRODUCTION
Today, there are a lot of Conceptual Business Process Modelling Languages (BPMLs) available. To adequately describe a business process, many forms of information must be integrated into a process model. Information that people want to extract from process models are what is going to be done, who is going to do it, when and where will it be done, how and why will it be done, and who is dependent on its being done [4]. BPMLs differ in the extent to which their constructs highlight the information that answers these different questions. The differences result from the various source domains (e.g. process or software engineering etc.), as well as from the application areas targeted.

Although BPMLs have been widely used in research and industry, and a comprehensive comparison is missing. Also, a general framework for an evaluation of BPMLs is not available. In this paper, we address these limitations. The goal of this paper is:

- To develop a generic meta-model that captures a wide range of business process concepts, as meta-models represent the core concepts of BPMLs and are a good foundation for an evaluation.
- To evaluate seven well-established BPMLs according to the generic meta-model.

The generic meta-model we have developed (Section 2) is categorised according the framework of Curtis et al. [4]. It consists of four perspectives: organisational, functional, behavioural, and informational. As these perspectives do not capture important business process context information like process goals or the process type, we extended the framework with a further perspective. The meta-model is derived from business process theory and well-established industry and research concepts. We have evaluated seven BPMLs according to the meta-model and additional criteria: UML 2 Activity Diagram, Business Process Definition Metamodel, Business Process Modelling Notation, Event Driven Process Chain, IDEF3, Petri Net, Role Activity Diagram.

The contribution of this evaluation of conceptual BPMLs is:

- It provides a comprehensive evaluation of the most well-established and widely-used BPMLs, and those which have a high potential to become successful in the future.
- It stresses strengths and limitations of BPMLs.
- The evaluation facilitates finding the BPML, which is adequate for a certain purpose.
- The meta-model provides a common foundation for evaluating BPMLs. This ensures an objective evaluation that covers basic process concepts and their relationships.
- The comparison between the BPMLs illustrates the differences and the similarities of the languages.
- The evaluation of seven BPMLs provides a good starting point that can be easily extended with further BPMLs.
- The evaluation shows which BPMLs are targeting future issues like the integration of process models and execution languages.

We describe (Section 3) and evaluate each BPML based on the generic meta-model in Section 4. The BPMLs are assessed in Section 5. Related work is discussed in Section 6.

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2. THE META-MODEL

In this section, we describe the generic meta-model (Figure 1) that serves as the basis for the evaluation of the BPMLs. We apply the conceptual framework of Curtis et al. [4], in order to receive a comprehensive meta-model and to ensure that the basic building blocks of business processes are covered. The framework consists of four perspectives: organisational, functional, behavioural, and informational. As these perspectives do not capture important information like process goals or measures, we extend the framework with a further perspective, namely the business process context perspective. The generic meta-model is inspired by business process theory [5] [6] [8] [16], workflow patterns [20], [21], and the Workflow Management Coalition (WfMC) [22]. In the following subsections, we describe the different perspectives in general and the generic meta-model elements in particular.

2.1 Functional Perspective

The functional perspective represents the process elements which are being performed [4]. The basic elements of a business process are *Activities*. They can be either *Atomic Activities* or *Sub-Processes*, which are recursively refined by activities.

2.2 Organisational Perspective

The organisational perspective represents where and by whom (which agents) process elements are performed [4]. The meta-model elements of this perspective are inspired by the 4 types of workflow participants of the WfMC [22]: the organisational unit, the role, the (individual) human, and the (automatic) resource. In the meta-model in Figure 1, we use the term *Process Participant*, as this work is about business processes. The process participant can be an *Internal* part of the organisation as well as *External* of it e.g., a customer, a supplier, an order system. We identified 3 types of participants that can perform a process: the *Organisational Unit*, the *Role*, and *Software*. If an organisational unit is addressed, its members may perform the activity. If a role is addressed, an activity is performed by a role or skill set. A role in this context is a function a human has within an organisation. Roles and organisational units represent a *Human* in the meta-model. More and more, activities are performed automatically by software. It should be possible to make this transparent in a process model; *Software* can be either an *Application* or a *Service*.

2.3 Behavioural Perspective

The behavioural perspective represents when process elements are performed (e.g., sequencing), as well as aspects of how they are performed through feedback loops, iteration, complex decision-making conditions, entry and exit criteria, and so forth [4]. The *Data Flow* connects atomic activities with information resources. The other meta-model elements of this perspective are adopted from the workflow control patterns [21]. We integrated elements for all basic control patterns [21]: *Sequence, AND Split, AND Join, XOR Split, XOR Join*. All these elements are not workflow specific and also required for business processes. They are also available in a lot of BPMLs. In this paper, the sequence is called *Control Flow*, and the operators are called *Control Nodes*.

Furthermore, we integrated the advanced branching and synchronisation patterns [21] in a way that makes sense for business processes. The patterns cover three types of merge operations addressing three different types of synchronisation. As synchronisation is not an issue for business processes, we integrate an *OR Join* representing all 3 merges as well as the corresponding *OR Split*. Further, we integrate the *N-out-of-M Join* that merges many execution paths. In the following case this join is important, for example, a paper needs to be sent to three external reviewers. Upon receiving two reviews on time the paper can be processed, the third one can be ignored.

2.4 Informational Perspective

The informational perspective represents the informational entities produced or manipulated by a process; these entities include data, artefacts, products (intermediate and end), and objects [4]. The meta-model of the informational perspective is inspired by the workflow data patterns [20] as well as by the input / output view of the Architecture of Integrated Information Systems (ARIS) [18]. The basic elements of the informational perspective (Figure1) are resources and events. An *Event* may trigger an activity. A *Resource* is an entity to be produced or consumed by an atomic activity. We distinguish between traditional and information resources. *Traditional Resources* have been inspired by ARIS [18] and can be either *Tangible* (e.g. a product) or *Non-Tangible* (e.g. service).

Information Resources are inspired by the workflow data patterns [20], which propose three types of environment data: data repositories, applications and services. We created a *Data Repository Resource* and distinguish between a *Database Table* and a *Data Object*, which contains persistent data, e.g. data in a document or a form. *Applications* and *Services* are combined as *Software Resource*, which is located in the informational perspective as well as in the organisational perspective.

2.5 Business Process Context Perspective

The business process context perspective has been developed by the authors in [11] to present the business process from a wide angle. It provides an overview perspective of the process and describes major business process characteristics, such as goals and their measures, the deliverables, the process owner, the process type and the customer at a glance. We have integrated the process characteristics into the meta-model, because they represent essential process theory that should be also made transparent in a process model. People who do not know or do not need to know the process in detail will get a full understanding of the process without working through the complex process logic. All other perspectives cover the detailed sequence of the process and do not address theses important process characteristics.

The meta-model in Figure 1 presents the business process in relation to other process characteristics. A *Business Process* has a certain process type that can be either a *Core Process*, a *Support Process* or a *Management Process* [16]. A core process is either independent from support processes or supported by one or more support processes. A business process satisfies one or more *Customers*. Activities describe a business process in detail.

A *Process Owner* [5] is responsible for one or more business processes. Each business process generates one or more *Deliverables* [8], which are either *Services* or *Products*. Each business process must achieve one or more *Process Goals* [9], which in turn support one or more *Enterprise Goals*. Concrete *Measures* describe the achievement of *Goals* [6], both process and enterprise goals. Each measure has a *To Be Value* assigned, which should be reached by the corresponding process instance. A *Unit* is also assigned to one or more measures.

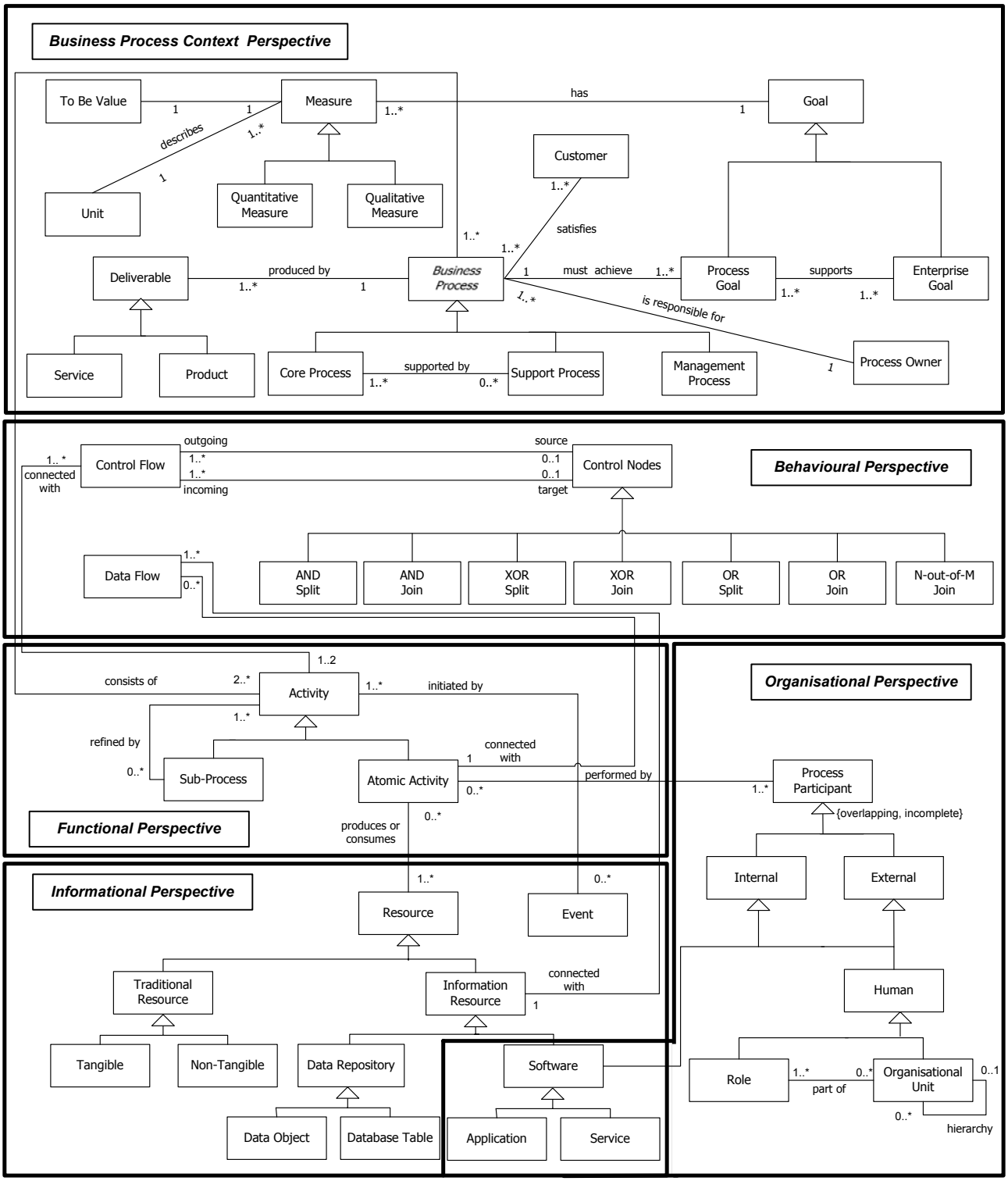

Figure 1. Generic Meta-Model of a Business Process

3. THE BPMLs – AN OVERVIEW

In this section, we describe the BPMLs which have been chosen for evaluation because they have either a future potential or are well-established in research or industry.

UML 2.0 Activity Diagram (AD): The AD [15] is designed for modelling business processes and flows in software systems. The origin of the AD lies in the development of software. The main concepts of the AD are actions and swimlanes, whereby the latter represent roles.

Business Process Definition Metamodel (BPDM): The BPDM [15] developed by the Object Management Group (OMG) and offers a generic meta-model for business processes. The BPDM does not provide its own graphical notation, but is specified as a UML 2.0 profile. The intention of the BPDM is to define a generic meta-model in order to support the mapping between different tools and languages.

Business Process Modelling Notation (BPMN): The BPMN [3] is designed for modelling business processes and their transformation into an execution language, namely the Business Process Modelling Language, (BPML) [2]. The main concepts of BPMN are similar to AD.

Event Driven Process Chain (EPC): The EPC [18] has been developed for modelling business processes with the goal to be easily understood and used by business people. The basic elements of EPC are functions and events. Functions model the activities of a business process, while events are created by processing functions or by actors outside of the model.

Integrated DEFinition Method 3 (IDEF3): IDEF3 [12] is designed to model business processes and sequences of a system. It provides two perspectives: the process schematics (model of the process sequence) and the object schematics (model of objects and their changing states throughout a particular process).

Petri Net: A Petri Net [17] is designed for modelling, analysis and simulation of dynamic systems with concurrent and non-deterministic procedures. Petri Nets are utilised for modelling workflows. A Petri Net is a directed graph that mainly consists of two different nodes, places and transitions. Places represent possible states of the system. Transitions are events or actions which cause the change of state.

Role Activity Diagram (RAD): The origin of the RAD [7] lies in the modelling of coordination. Today, the RAD is used for modelling business processes [16]. It shows roles, their activities and interactions, together with external events.

4. THE EVALUATION

In this section, we evaluate seven BPMLs based on the meta-model developed in Section 2. The results are shown in the appendix in Table 4, 5 and 6. The rows represent the elements of the meta-model. The columns represent the different BPMLs. Because the majority of the BPMLs do not offer a meta-model, we have not focused on the comparison of meta-model elements, but rather on notation elements and on concepts. Table 1 shows the BPMLs, which provide a meta-model and an own notation. The evaluation shows two symbols addressing one element of a BPML. The first symbol illustrates if a certain BPML offers a specific graphical notation element to explicitly symbolise a certain element of the generic meta-model. The second symbol shows, if the BPML provides a concept that somehow allows describing this meta-model element with a workaround. For example, the UML AD does not offer a specific graphical notation element for a database table, but a DataStore Node could be utilised. The symbol "+" characterises a success, otherwise it is denoted with a "-". Beside the two symbols, the name of the concept representing the element is shown in the table.

Table 1. Meta-Model and Notation of BPMLs

BPML	AD	BPDM	BPMN	EPC	IDEF3	Petri Nets	RAD
Meta-Model	+	+	-	+	-	-	-
Notation	+	+ UML 2.0 Profile	+	+	+	+	+

More and more BPMLs support the direct translation of the conceptual process model into executable code. Table 2 shows the execution languages a BPML can be translated into. Execution languages increase the efficiency of business process implementations and improve the flexibility of processes to ever changing market requirements.

Table 2. Execution Languages of BPMLs

BPML	Execution Language
AD	BPEL4WS [8]
BPDM	BPEL4WS [8]
BPMN	BPEL4WS [8], BPML [2]
EPC	EPML [14], academic proposal
IDEF3	none
Petri Nets	PNML [1], academic proposal
RAD	none

According to Ould [16], a business process has three different purposes: description, analysis and enactment. Modelling to describe a process is required to communicate it to other people, to define it or to share it across a group of people. Modelling to analyse a process is required for changing the ordering of activities, changing responsibilities, improving the process etc. Modelling to enact a process means to transfer it into executable code. In Table 3, we show the purpose and the source domain of each BPML. The BPMLs focus either on the description or / and on the enactment of processes, except the EPCs. Their purpose is beside the description of processes their analysis. All BPMLs have their roots either in software or in process engineering, except the Petri Nets. They were developed in the 1960ties and at that time the term software engineering was not known, but system engineering deals with very similar requirements.

Table 3. Purpose and Source Domain of BPMLs

BPML	Purpose	Source Domain
AD	Description, Enactment	Software Engineering
BPDM	Enactment	Process Engineering
BPMN	Description, Enactment	Process Engineering
EPC	Description, Analysis	Process Engineering
IDEF3	Description	Software Engineering
Petri Nets	Enactment	System Engineering
RAD	Description	Software Engineering

5. ASSESSMENT OF RESULTS

Basically, it was quite hard to evaluate the BPMLs, because an accurate description is very often missing, elements have sometimes ambiguous meanings and meta-models are not available for four out of seven BPMLs. Some BPMLs have complex definitions, while others are inaccurate and leave the usage of elements up to the interpretation of the user.

Generally, the functional and the behavioural perspectives are very well represented in all BPMLs, while the organisational and informational perspectives are only partly supported. But a lack of the models is that the business process context perspective is not explicitly supported.

The organisational perspective is to some degree provided by almost all BPMLs. Exceptions are IDEF 3 and Petri Nets, which have their origin in system and software engineering. All other BPMLs of this evaluation focus much more on the business process and include therefore a role concept. No BPML represents software in an explicit concept and only the AD shows explicitly if a role belongs to the organisation or if it is external. A lot of BPMLs utilise one concept to represent all types of process participants (e.g. AD, RAD, BPMN) and do not distinguish between the different types. This differentiation could be very helpful for BPMLs with a focus on process enactment.

The informational perspective is better developed for more recent BPML's like AD, BPDM, BPMN, and EPC. Their support for execution languages is also very good. Only the EPC provides an explicit notation element for traditional resources and is therefore well suited for process analysis.

6. RELATED WORK

A number of publications on the evaluation of BPMLs is available. They evaluate a very limited number of BPMLs. The evaluation concepts are mainly based on meta-models representing a very technical perspective. We address these limitations with a comprehensive meta-model and the evaluation of seven state-of-the-art BPMLs.

Söderström et al. developed a generic meta-model for comparing BPMLs in [19]. The meta-model shows technical concepts of business processes, and captures a definition and an execution level similar to workflow management systems. Events and control nodes are defined in detail, but roles and resources are described at a very high level. The paper compares only three different BPMLs: the EPC, the UML 1.3 State Diagram and the Business Modelling Language, the BPML of a commercial tool.

Lin et al. analysed 10 BPMLs in [10] and derived eight generic concepts: activity, resource, behaviour, event, information, relation, agent and entity. This bottom-up approach requires more detail for an evaluation of BPMLs, as the basic concepts are represented in all BPMLs.

UML 2 Activity Diagrams are evaluated by Wohed et al. based on workflow control flow patterns in [23]. These patterns are very detailed by nature and focus on the execution of business processes. Concepts that target business users, like traditional resources or goals are not addressed at all.

Mendling et al. address the heterogeneity of business process interchange formats in [12]. Based on 13 high-level business process meta-model concepts, the paper compares the interchange formats of 15 BPMLs and business process execution languages. The meta-model elements are very technical (e.g. instance, identity, events, exceptions, transactions, task address) and have a strong focus on the execution of business processes.

7. CONCLUSION

In this work, we proposed a generic meta-model and evaluated seven BPMLs based on this meta-model. It was categorised according to four perspectives: organisational, functional, behavioural, and informational. We extended these 4 perspectives with the business process context perspective in order to address context information, like process goals or the measures.

Basically, the functional and the behavioural perspectives are very well represented in all BPMLs, while the organisational and informational perspectives are only partly supported, and business process context is not explicitly supported.

To improve the flexibility of business processes, there is a need to reduce the time between process modelling and the transformation into executable code. Therefore, future BPMLs must provide execution languages and in turn, offer more explicit notation elements on all perspectives. But a huge number of different elements will be confusing for process description purposes, thus a basic set of elements, like the BPMN offers is also needed.

8. ACKNOWLEDGMENTS

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9. REFERENCES

[1] Billington, J., Christensen, S., van Hee, K. E., Kindler, E., Kummer, O., Petrucci, L., Post, R., Stehno, C. and Weber, M. The Petri Net Markup Language: Concepts. Technology, and Tools. In *Proceedings of the 24th International Conference Applications and Theory of PetriNets* (ICATPN 2003), Lecture Notes in Computer Science, 2003.

[2] Business Process Management Initiative: *Business Process Modeling Language*. Specification Version 1.0, November 13, 2002, http://www.bpmn.org/

[3] Business Process Management Initiative: *Business Process Modeling Notation*. Specification Version 1.0, May 3, 2004, http://www.bpmn.org/

[4] Curtis, B., Kellner, M. and Over, J. Process Modeling. *Communication of the ACM*, Vol. 35, No.9, 1992.

[5] Hammer, M. *Beyond Reengineering – How the process-centered organization is changing our work and our lives*. Harper Collins Publishers, 1996.

[6] Harrington, J.H. *Business Process Improvement – The breakthrough strategy for total quality, productivity, and competitiveness*. McGraw-Hill, 1991.

[7] Holt, A., Ramsey, R. and Grimes, J. Coordinating System Technology as the Basis for a Programming Environment. *Electrical Communication*, Vol. 57, No. 4 (1983), pp. 307-314.

[8] Jacobson, I., Ericson, M. and Jacobson, A. *The Object Advantage – Business Process Reengineering with Object Technology*. ACM Press, Addison-Wesley Publishing, 1995.

[9] Kueng, P. and Kawalek, P. Goal-based business process models: creation and evaluation. *Business Process Management Journal*, Vol. 3, No. 1, April 1997.

[10] Lin, FR., Yang, MC. and Pai, YH. A generic structure for business process modeling. *Business Process Management Journal*, Vol. 8. No.1, Emerald, 2002.

[11] List, B. and Korherr, B. A UML 2 Profile for Business Process Modelling. In *Proceedings of the 1st International Workshop on Best Practices of UML (BP-UML 2005) at the 24th International Conference on Conceptual Modeling (ER 2005)*, Springer Lecture Notes in Computer Science LNCS 3770, 2005.

[12] Mayer, R., Menzel, C., Painter, M., Perakath, B., de Witte P. and Blinn T. *Information Integration For Concurrent Engineering (IICE) - IDEF3 Process Description Capture Method Report*. Technical Report September 1995 http://www.idef.com/pdf/idef3_fn.pdf

[13] Mendling, J., Neumann, G. and Nüttgens, M. A Comparison of XML Interchange Formats for Business Process Modelling. In *Proceedings of the EMISA 2004 Workshop "Information Systems in E-Business and E-Government"*, Vol. 56 of Lecture Notes in Informatics (LNI), 2004.

[14] Mendling, J. and Nüttgens, M. *EPC Markup Language (EPML) - An XML-Based Interchange Format for Event-Driven Process Chains (EPC)*. Technical Report JM-2005-03-10. Vienna University of Economics and Business Administration, Version 2005-03-10, http://wi.wu-wien.ac.at/~mendling/publications/TR05-EPML.pdf.

[15] Object Management Group. *Business Process Definition Metamodel*. Version 1.0.2 (January 12th 2004), http://www.bpmn.org/Documents/BPDM/OMG-BPD-2004-01-12-Revision.pdf.

Object Management Group: Unified Modelling Language. Version 2.0., http://www.omg.org/docs/formal/05-07-04.pdf

[16] Ould, M. *Business Processes – Modelling and Analysis for Re-engineering and Improvement*. John Wiley & Sons, 1995.

[17] Petri, C. A. *Kommunikation mit Automaten*. Dissertation, Schriften des IIM Nr. 2, Institut für Instrumentelle Mathematik, Universität Bonn, 1962.

[18] Scheer, A.-W. *ARIS – Business Process Modeling*. Springer Verlag, 1999.

[19] Söderström, E., Andersson. B., Johannesson, P., Perjons, E. and Wangler B. Towards A Framework for Comparing Process Modelling Languages. In *Proceedings of the 14th International Conference on Advanced Information Systems Engineering (CAiSE 2002)*, Springer Verlag, 2002.

[20] Russell, N., ter Hofstede, A. H.M. and Edmond, D. *Workflow Data Patterns*. QUT Technical report, FIT-TR-2004-01, Queensland University of Technology, Brisbane, 2004, http://is.tm.tue.nl/research/patterns/documentation.htm

[21] van der Aalst, W.M.P., ter Hofstede, A. H.M., Kiepuszewski, B. and Barros, A.P. Workflow Patterns. *Distributed and Parallel Databases*, 14(3), pages 5-51, July, Kluwer Academic Publishers, 2003.

[22] Workflow Management Coalition. Interface 1: *Process Definition Interchange Process Model*, WfMC TC-1016-M (1998) , http://www.wfmc.org/standards/docs/if19807m.pdf

[23] Wohed, P., van der Aalst, W.M.P., Dumas, M., ter Hofstede, A. H.M., and Russell, N. Pattern-based Analysis of the Control-flow Perspective of UML Activity Diagrams. In *Proceedings of the 24th International Conference on Conceptual Modelling (ER 2005*), Springer Verlag, 2005.

APPENDIX

Table 4. Evaluation: Business Process Context Perspective

BPML Element	AD		BPDM		BPMN		EPC		IDEF3		Petri Nets		RAD	
Business Process Context Perspective														
Business Process	-/+	Activity	-/+	Stereotype SubProcess	-/+	Sub Process	-/+	Complex Function	-/+	Unit of Behaviour	-/+	Transition Hierarchy	-/+	Activity
Core, Support, Management	-/-		-/-		-/-		-/-		-/-		-/-		-/-	
Customer	-/+	Activity Partition	-/+	Role/ Participant	-/+	Pool	-/+	Organi-sational Role	-/-		-/-		-/+	Role
Deliverable	-/+	Object N.	-/-		-/-		+/+	Input/Output	-/+	Object	-/-		-/+	Resource
Service	-/+	Object N.	-/-		-/-		-/+	Input/Output	-/+	Object	-/-		-/+	Resource
Product	-/+	Object N.	-/-		-/-		-/+	Input/Output	-/+	Object	-/-		-/+	Resource
Process Owner	-/-		-/-		-/-		-/-		-/-		-/-		-/-	
Goal	-/-		-/-		-/-		-/-		-/-		-/-		-/-	
Process	-/-		-/-		-/-		-/-		-/-		-/-		-/-	
Enterprise	-/-		-/-		-/-		-/-		-/-		-/-		-/-	
Measure	-/-		-/-		-/-		-/-		-/-		-/-		-/-	
Quantitative	-/-		-/-		-/-		-/-		-/-		-/-		-/-	
Qualitative	-/-		-/-		-/-		-/-		-/-		-/-		-/-	
To Be Value	-/-		-/-		-/-		-/-		-/-		-/-		-/-	
Unit	-/-		-/-		-/-		-/-		-/-		-/-		-/-	

Legend: +/+ Notation available / possible to present
-/+ Notation not available / possible to present
-/- Notation not available / not possible to present

BPML / Element	AD		BPDM		BPMN		EPC		IDEF3		Petri Nets		RAD	
Organisational Perspective														
Process Participant	+/+	Activity Partition	+/+	Role/Participant Concept	+/+	Pool	-/-		-/-		-/-		+/+	Role
external	+/+	Activity Partition	-/+	Role/Participant Concept	-/+	Pool	-/-		-/-		-/-		-/+	Role
internal	+/+	Activity Partition	-/+	Role/Participant Concept	-/+	Pool	+/+	Organisational Unit	-/-		-/-		-/+	Role
Human	-/+	Activity Partition	-/+	Role/Participant Concept	-/+	Pool	+/+	Organisational Unit	-/-		-/-		-/+	Role
Organisational Unit	-/+	Activity Partition	+/+	Organisation Stereotype	-/+	Pool	+/+	Organisational Unit	-/-		-/-		-/+	Role
Role	-/+	Activity Partition	-/+	Worker Stereotype	-/+	Pool	+/+	Organisational Role	-/-		-/-		-/+	Role
Software	-/+	Activity Partition	-/+	Worker Stereotype	-/+	Pool	-/-		-/-		-/-		-/+	Role
Application	-/+	Activity Partition	-/+	Worker Stereotype	-/+	Pool	-/-		-/-		-/-		-/+	Role
Service	-/+	Activity Partition	-/+	Worker Stereotype	-/+	Pool	-/-		-/-		-/-		-/+	Role
Behavioural Perspective														
Control Flow	-/+	Control Flow	-/+	Control Flow Concept	+ / +	Sequence Flow	+ / +	Control Flow	+/+	Link	+/+	Sequence	-/+	State
AND Split	+/+	Fork Node	+/+	Like AD	+ / +	Parallel Forking	+ / +	AND Split	+/+	AND Junction	-/+	Concurrent Executions	+/+	Concurrent Path
AND Join	+/+	Join Node	+/+	Like AD	+ / +	Parallel Joining	+ / +	AND Join	+/+	AND Junction	-/+	Synchroni-sation	+/+	Thread Combination
XOR Split	+/+	Decision Node	+/+	Like AD	+ / +	Exclusive Decision	+ / +	XOR Split	+/+	XOR Junction	-/+	Alternative Path	-/+	Alternative Path
XOR Join	+/+	Merge Node	+/+	Like AD	+ / +	Exclusive Merge	+ / +	XOR Join	+/+	XOR Junction	-/+	depends on previous split	-/+	depends on previous split
OR Split	+/+	Join Node + Guards	+/+	Like AD	+ / +	Inclusive Decision	+ / +	OR Split	+/+	OR Junction	-/-		-/+	Alternative Path
OR Join	+/+	Merge Node	+/+	Like AD	+ / +	Inclusive Merge	+ / +	OR Join	+/+	OR Junction	-/-		-/+	depends on previous split
N-out-of-M Join	-/-		-/-	Like AD	- / +	Complex D/M	- / -				-/-		-/-	

Table 5. Evaluation: Organisational and Behavioural Perspective

BPML / Element	AD		BPDM		BPMN		EPC		IDEF3		Petri Nets		RAD	
Functional Perspective														
Activity	-/+		-/+		-/+		+/+	Function	+/+	Unit of Behaviour	-/-		+/+	Activity
SubProcess	+/+	Activity	+/+	Stereotype SubProcess	+/+	Sub Process	-/+	Complex Function	-/+	Unit of Behaviour	-/+	Transition Hierarchy	-/+	Activity
Atomic Activity	+/+	Action	+/+	Stereotype Atomic Activity	+/+	Task	-/+	Elementary Function	-/+	Unit of Behaviour	-/+	Transition	-/+	Activity
Informational Perspective														
Event	+/+	AcceptEvent / SendSignal	+/+	Event Stereotype	+/+	Event	+/+	Event	-/-		-/-		+/+	Event
Data Flow	-/+	Object Flow	-/+	Data Flow Concept	+/+	Association	+/+	Data Flow	-/-		-/-		-/+	Resource
Resource	-/+	Object Node	-/-	currently incomplete	-/-		-/-		+/+	Object	-/-		+/+	Resource
Information Ressource	-/+	Object Node	- / -		-/-		-/-		-/-		-/-		-/+	Resource
Data Repository	+/+	DataStore Node	-/+	Entity / Data Object	-/-		-/-		-/-		-/-		-/+	Resource
Data Object	-/+	DataStore Node	-/+	Entity / Data Object	+/+	Data Object	-/-		-/-		-/-		-/+	Resource
Database Table	-/+	DataStore Node	-/-		-/-		+/+	Information Object	-/-		-/-		-/+	Resource
Software	-/+	DataStore Node	-/-		-/-		-/-		-/-		-/-		-/+	Resource
Application	-/+	DataStore Node	-/-		-/-		-/-		-/-		-/-		-/+	Resource
Service	-/+	DataStore Node	-/-		-/-		-/-		-/-		-/-		-/+	Resource
Traditional Resource	-/+	Object Node	-/-		-/-		+/+	Input/Output	-/+	Object	-/-		-/+	Resource
Tangible	-/+	Object Node	-/-		-/-		-/+	Input/Output	-/+	Object	-/-		-/+	Resource
Non-Tangible	-/+	Object Node	-/-		-/-		-/+	Input/Output	-/+	Object	-/-		-/+	Resource

Legend: +/+ Notation available / possible to present
-/+ Notation not available / possible to present
-/- Notation not available / not possible to present

Table 6. Evaluation: Functional and Informational Perspective