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An Evaluation of Conceptual Business Process Modelling Languages

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- Comprehensive comparison of Business Process Modelling Languages (BPMLs) is missing
- General framework for an evaluation of BPMLs is not available

1. Generic business process metamodel that captures a wide range of business process concepts

2. Evaluation of seven well-established BPMLs according to the generic metamodel

- Metamodel provides a **foundation for an evaluation**
- **Stresses strengths** and **limitations** of BPMLs
- **Comparison** between the BPMLs **illustrates** the **differences** and the **similarities**
- **Evaluation can be easily extended** with further BPMLs
- **Facilitation of finding the right BPML** for a certain purpose

Outline

- The Generic Business Process Metamodel
- Evaluation Criteria
- Comparison of Business Process Model Languages
- Conclusion
- Outlook and Future Work

└ **The Generic Business Process Metamodel**

- Evaluation Criteria
- Comparison of BPMLs
- Conclusion
- Outlook and Future Work

The Generic BPML Metamodel

- Serves as a basis for the evaluation
- Categorisation of metamodel elements based on the conceptual framework of Curtis (1992)
- Four perspectives:
 - Functional
 - Organisational
 - Behavioural
 - Informational
- Extension of the framework with a further perspective:
 - Business Process Context Perspective

The four Perspectives

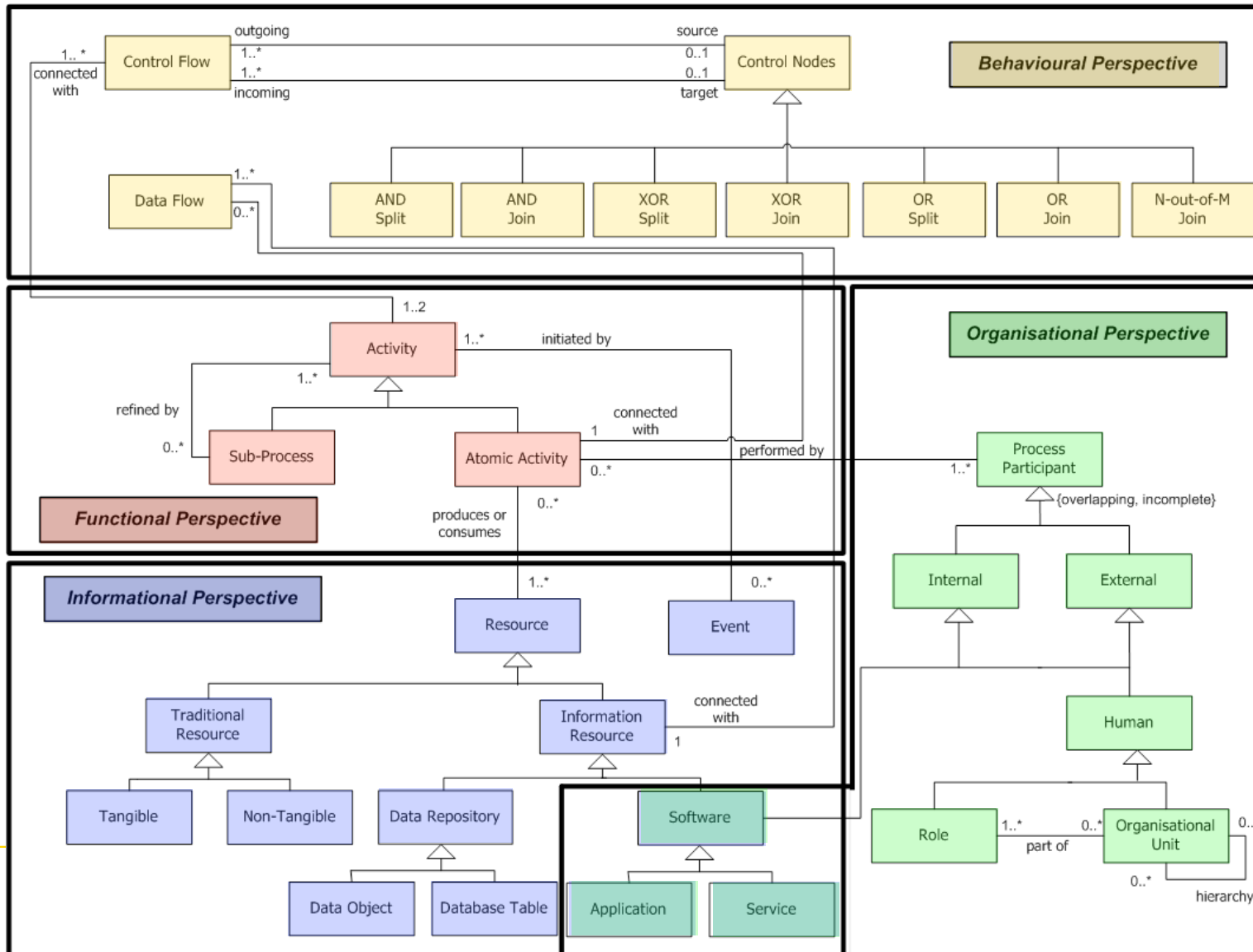
Behavioural Perspective

**Functional
Perspective**

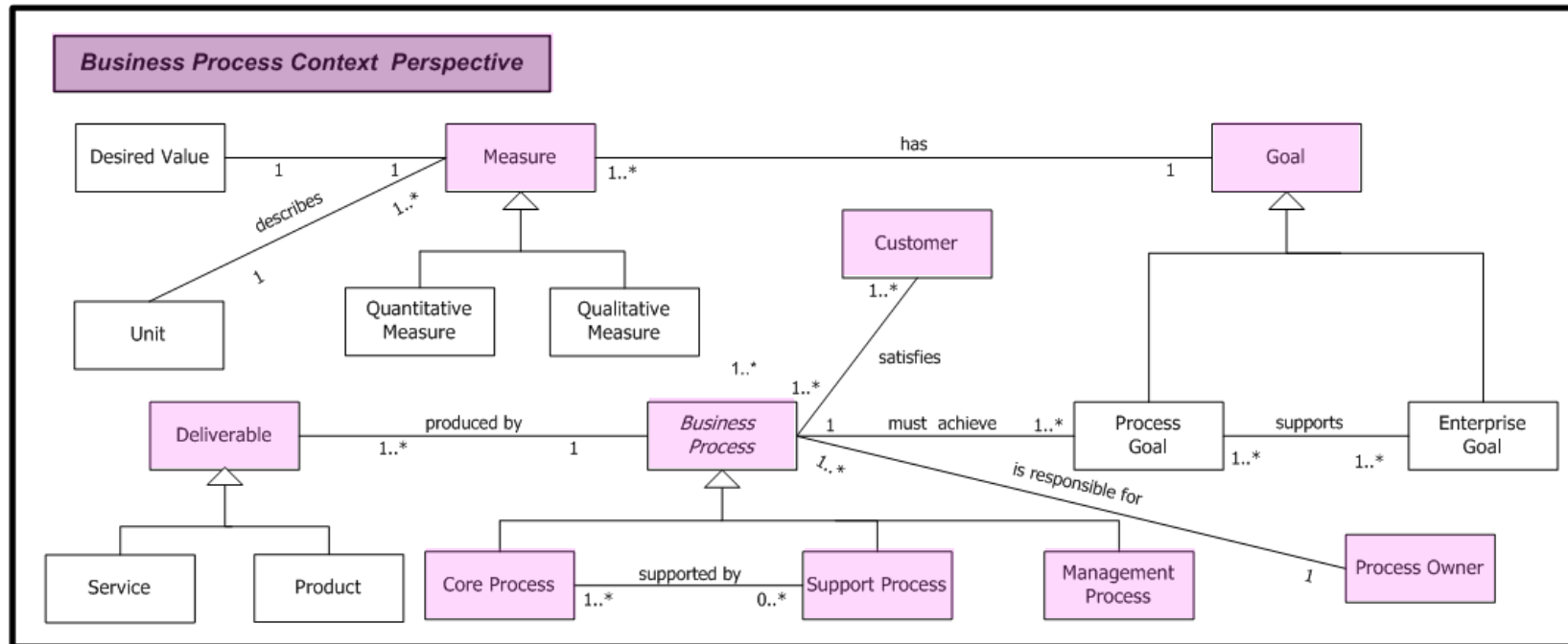
**Informational
Perspective**

**Organi-
sational
P.**

Metamodel - The Four Perspectives



Metamodel – BP Context Perspective



- The Generic Business Process Metamodel

└ **Evaluation Criteria**

- Comparison of BPMLs
- Conclusion
- Outlook and Future Work

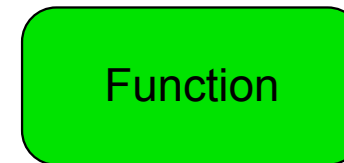
Evaluation 1/2

- Comparison based on notation elements and concepts
- No focus on metamodel elements, because the majority of BPMLs has no metamodel

BPML \	AD	BPDM	BPMN	EPC	IDEF3	Petri Nets	RAD
Metamodel	+	+	-	+	-	-	-
Notation	+	UML 2.0 Profile	+	+	+	+	+

Evaluation 2/2

Languages	EPC
Perspectives	
Functional Perspective	
Activity	⊕ / ⊕
SubProcess	- / +
Atomic Activity	⊖ / ⊕



BPML offers no specific graphical notation / possible to present

- The Generic Business Process Metamodel
- Evaluation Criteria
- └ **Comparison of BPMLs**
- Conclusion
- Outlook and Future Work

- UML 2.0 Activity Diagram (AD)
 - Designed for modelling business processes and flows in software systems
 - Origin lies in the development of software
- Business Process Definition Metamodel (BPDM)
 - Offers a generic metamodel for business processes
- Business Process Modelling Notation (BPMN)
 - Designed for modelling business processes and their transformation into an execution language
- Event Driven Process Chain (EPC)
 - EPC has been developed for modelling business processes with the goal to be easily understood and used by business people

- Integrated DEFinition Method 3 (IDEF3)
 - Designed to model business processes and sequences of a system

- Petri Net
 - Designed for modelling, analysis and simulation of dynamic systems with concurrent and non-deterministic procedures
 - Are utilised for modelling workflows

- Role Activity Diagram (RAD)
 - Origin lies in the modelling of coordination
 - Used for modelling business processes

Later and Earlier BPMLs

- Distinction between **later** and **earlier BPMLs**
 - Differentiation depends on the average integration of all perspectives
- **Later BPMLs:** AD, BPDM, BPMN, EPC
- **Earlier BPMLs:** IDEF 3, Petri Nets, RAD
- Evaluation was sometimes hard:
 - Accurate description is often missing
 - Elements have sometimes ambiguous meanings
 - The metamodel is missing for four out of seven BPMLs

Later BPMLs: Functional & Behavioural P.

Languages \ Perspectives	AD	BPDM	BPMN	EPC
Functional Perspective				
Activity	- / +	- / +	- / +	+ / +
SubProcess	+ / +	+ / +	+ / +	- / +
Atomic Activity	+ / +	+ / +	+ / +	- / +
Behavioural Perspective				
Control Flow	- / +	- / +	+ / +	+ / +
AND Split	+ / +	+ / +	+ / +	+ / +
AND Join	+ / +	+ / +	+ / +	+ / +
XOR Split	+ / +	+ / +	+ / +	+ / +
XOR Join	+ / +	+ / +	+ / +	+ / +
OR Split	+ / +	+ / +	+ / +	+ / +
OR Join	+ / +	+ / +	+ / +	+ / +
N-out-of-M Join	- / -	- / -	- / +	- / -

Earlier BPMLs: Functional & Behavioural P.

Languages	IDEF3	Petri Nets	RAD
Perspectives			
Functional Perspective			
Activity	+ / +	- / -	+ / +
SubProcess	- / +	- / +	- / +
Atomic Activity	- / +	+ / +	- / +
Behavioural Perspective			
Control Flow	+ / +	+ / +	- / +
AND Split	+ / +	- / +	+ / +
AND Join	+ / +	- / +	+ / +
XOR Split	+ / +	- / +	- / +
XOR Join	+ / +	- / +	- / +
OR Split	+ / +	- / -	- / +
OR Join	+ / +	- / -	- / +
N-out-of-M Join	- / -	- / -	- / -

Later BPMLs: Informational P.

Languages \ Perspectives	AD	BPDM	BPMN	EPC
Informational Perspective				
Event	+ / +	+ / +	+ / +	+ / +
Resource	- / +	- / -	- / -	- / -
Data Flow	- / +	- / +	+ / +	+ / +
Information Ressource	- / +	- / -	- / -	- / -
Data Repository	+ / +	- / +	- / -	- / -
Data Object	- / +	- / +	+ / +	- / -
Database Table	- / +	- / -	- / -	+ / +
Software	- / +	- / -	- / -	- / -
Traditional Resource	- / +	- / -	- / -	+ / +

Earlier BPMLs: Informational P.

Languages Perspectives	IDEF3	Petri Nets	RAD
Informational Perspective			
Event	- / -	- / -	+ / +
Resource	+ / +	- / -	+ / +
Data Flow	- / -	- / -	- / +
Information Ressource	- / -	- / -	- / +
Data Repository	- / -	- / -	- / +
Data Object	- / -	- / -	- / +
Database Table	- / -	- / -	- / +
Software	- / -	- / -	- / +
Traditional Resource	- / +	- / -	- / +

Later BPMLs: Organisational P.

Languages Perspectives	AD	BPDM	BPMN	EPC
Organisational Perspective				
Process Participant	+ / +	+ / +	+ / +	- / -
external	+ / +	- / +	- / +	- / -
internal	+ / +	- / +	- / +	+ / +
Human	- / +	- / +	- / +	+ / +
Organisational Unit	- / +	+ / +	- / +	+ / +
Role	- / +	+ / +	- / +	+ / +
Software	- / +	+ / +	- / +	- / -

Earlier BPMLs: Organisational P.

Languages Perspectives	IDEF3	Petri Nets	RAD
Organisational Perspective			
Process Participant	- / -	- / -	+ / +
external	- / -	- / -	- / +
internal	- / -	- / -	- / +
Human	- / -	- / -	- / +
Organisational Unit	- / -	- / -	- / +
Role	- / -	- / -	- / +
Software	- / -	- / -	- / +

Later BPMLs: Business Process Context P.

Languages \ Perspectives	AD	BPDM	BPMN	EPC
Business Context Perspective				
Business Process	- / +	- / +	- / +	- / +
Core Process	- / -	- / -	- / -	- / -
Support Process	- / -	- / -	- / -	- / -
Management Process	- / -	- / -	- / -	- / -
Customer	- / +	- / +	- / +	- / +
Deliverable	- / +	- / -	- / -	+ / +
Service	- / +	- / -	- / -	- / +
Product	- / +	- / -	- / -	- / +
Process Owner	- / -	- / -	- / -	- / -
Goal	- / -	- / -	- / -	- / -
Measure	- / -	- / -	- / -	- / -

Earlier BPMLs: Business Process Context P.

Languages	IDEF3	Petri Nets	RAD
Perspectives			
Business Context Perspective			
Business Process	- / +	- / +	- / +
Core Process	- / -	- / -	- / -
Support Process	- / -	- / -	- / -
Management Process	- / -	- / -	- / -
Customer	- / -	- / -	- / +
Deliverable	- / +	- / -	- / +
Service	- / +	- / -	- / +
Product	- / +	- / -	- / +
Process Owner	- / -	- / -	- / -
Goal	- / -	- / -	- / -
Measure	- / -	- / -	- / -

- The Generic Business Process Metamodel
- Evaluation Criteria
- Comparison of BPMLs

└ **Conclusion**

- Outlook and Future Work

Conclusion

- **Functional** and **behavioural perspectives** are very well represented in all BPMLs

- **Organisational** and **informational perspectives**
 - partly supported in later BPMLs
 - hardly supported in earlier BPMLs
 - Petri Nets do not support these perspectives at all

- **Business process context perspective** is not explicitly supported in any BPMLs

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└ **Outlook and Future Work**

- **Söderström et al.** developed a generic metamodel for comparing BPMLs
 - The metamodel shows technical concepts of business processes
 - Compares only three different BPMLs: the EPC, the UML 1.3 State Diagram and the BPML of a commercial tool
- **Lin et al.** analysed 10 BPMLs and derived eight generic concepts:
 - 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
- **Mending et al.** compares the interchange formats of 15 BPMLs and business process execution languages

- Extending an existing BPML according to the metamodel with missing concepts and notations
 - [KoLi06] Birgit Korherr and Beate List: **Aligning Event-Driven Process Chains with Software**, To appear in the CAiSE Forum of the 18th Conference on Advanced Information System Engineering (CAiSE'06), June 2006, Luxembourg, 2006.
 - [StLiKo05] Veronika Stefanov, Beate List and Birgit Korherr: **Extending UML 2 Activity Diagrams with Business Intelligence Objects**, Proceedings of the 7th International Conference on Data Warehousing and Knowledge Discovery (DaWaK 2005), August 2005, Copenhagen, Denmark, Springer Verlag, Lecture Notes in Computer Science.
- In the sense of Model Driven Development
 - Transformation of an adopted Business Process Model to an Execution Language

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Purpose and Source Domain of BPML's

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

Support of Execution Languages

BPML	Execution Language
AD	BPEL4WS
BPDM	BPEL4WS
BPMN	BPEL4WS, BPML
EPC	EPML, academic proposal
IDEF3	none
Petri Nets	PNML, academic proposal
RAD	none

Business Context Perspective

BPML	AD		BPDM		BPMN		EPC		IDEF3		Petri Nets		RAD	
Element														
Business 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 C.	-/+	Pool	-/+	Organisational 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	-/-		-/-		-/-		-/-		-/-		-/-		-/-	

Functional and Behavioural Perspective

Element \ BPML	AD	BPDM	BPMN	EPC	IDEF3	Petri Nets	RAD							
Functional Perspective														
Activity	-/+	-/+	-/+	+/+	Function	+/+	Unit of Behaviour							
SubProcess	+/+	Activity	+/+	Sub Process	-/+	Complex Function	-/+	Unit of Behaviour	-/+	Transition Hierarchy	-/+	Activity		
Atomic Activity	+/+	Action	+/+	Task	-/+	Elementary Function	-/+	Unit of Behaviour	+/+	Transition	-/+	Activity		
Behavioural Perspective														
Control Flow	-/+	Control Flow	-/+	Control Flow Concept	+/+	Sequence F.	+/+	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	-/+	Synchronisation	+/+	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	-/-		-/-		-/-		-/-	

Informational Perspective

Element \ BPML	AD	BPDM	BPMN	EPC	IDEF3	Petri Nets	RAD
Informational Perspective							
Event	++	AcceptEvent A. / SendSignal A.	++	Event Stereotype	++	Event	++
Data Flow	-/+	Object Flow	-/+	Data Flow Concept	++	Association	++
Resource	-/+	Object Node	-/-	currently incomplete	-/-		-/-
Information Ressource	-/+	Object Node	-/-		-/-		-/-
Data Repository	++	DataStore Node	-/+	Entity St. / Data Object C.	-/-		-/-
Data Object	-/+	DataStore Node	-/+	Entity St. / Data Object C.	++	Data Object	-/-
Database Table	-/+	DataStore Node	-/-		-/-	Information Object	++
Software	-/+	DataStore Node	-/-		-/-		-/-
Application	-/+	DataStore Node	-/-		-/-		-/-
Service	-/+	DataStore Node	-/-		-/-		-/-
Traditional Resource	-/+	Object Node	-/-		-/-	Input/Output	++
Tangible	-/+	Object Node	-/-		-/-	Input/Output	++
Non-Tangible	-/+	Object Node	-/-		-/-	Input/Output	++

Organisational Perspective

Element \ BPML	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