Enhancing Business Processes Using Semantic Reasoning

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Presentation Outline

- Industry landscape
- Standards landscape
- Needs for and use of semantic reasoning
- Forward progress and examples
- Opportunities

Industry Landscape [1 of 3]

- Business Processes and BPM

  'Classic' BPM: Assessment, analysis, modeling, definition and subsequent operational implementation of the core business processes of an organization (or other business entity)

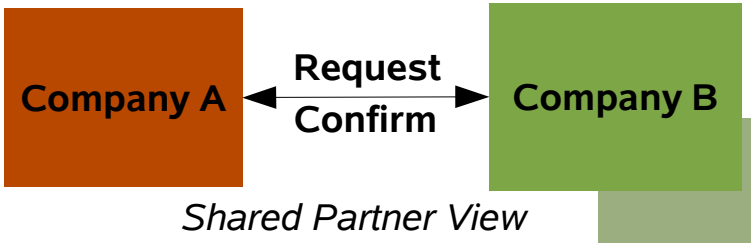
- Multiple terms / levels of understanding
  - Classic workflow (human interaction)
  - Automated processes
    - Visualize, abstract, and execute/monitor
  - Models: Notations, semantics, constraints...
    - Conceptualize
    - Describe or declare

Industry Landscape [2 of 3]

- Where do processes fit?
  - With applications (now discrete or composed services)
  - Within an entity or domain of control
  - Across entities or domains of control
- (very) Basic common terminology
  - Orchestration: Running processes under centralized control or from one view
  - Choreography: Message exchange sequence
  - Collaboration: Partner interactions across domains of control (may include choreography)

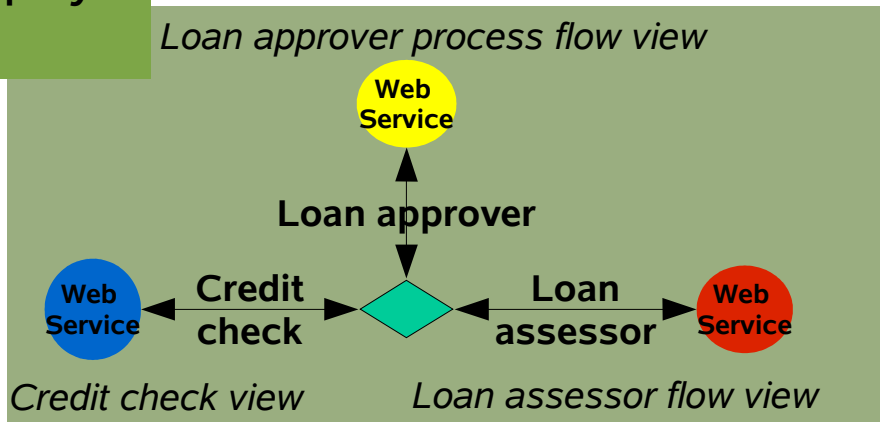
Industry Landscape [3 of 3]

Business Collaboration
Business obligation to respond in 2 days
Provide non-repudiation
Business signal required



Shared Partner View

Orchestration
Loan approver requests a credit check.
If error in processing, fault occurs.
The loan approver process instance correlates its request a subsequent credit check process.



Choreography
Loan approver requests either a credit check or assessment.
Passive observation or active control that may recognizes sequence of messages of executable process views.

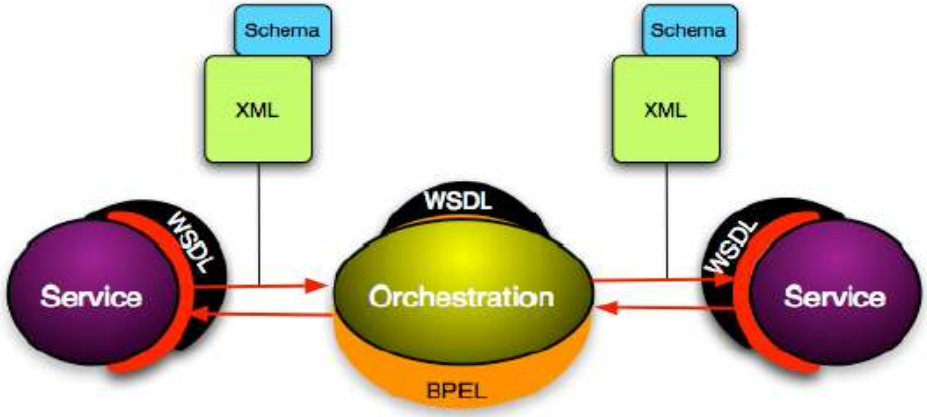
Standards Landscape (1 of 4)

- BPM-related standards / specifications 'in play' include:
  - JSR 208 Java™ Business Integration
  - WS-Business Process Execution Language (WS-BPEL)
  - ebXML Business Process Specification Schema (BPSS)
  - WS-Choreography Description Language (WS-CDL)
  - Business Process Management Language (BPML)
  - Business Process Modeling Notation (BPMN)
  - BP Definition Metamodel (BPDM)
  - Unified Modeling Language™
  - UN/CEFACT Modeling Methodology (UMM), and
  - PSL, CL, EPC, XPDL, XLANG, WSFL, WSCL, WSCI...

Standards Landscape (2 of 4)

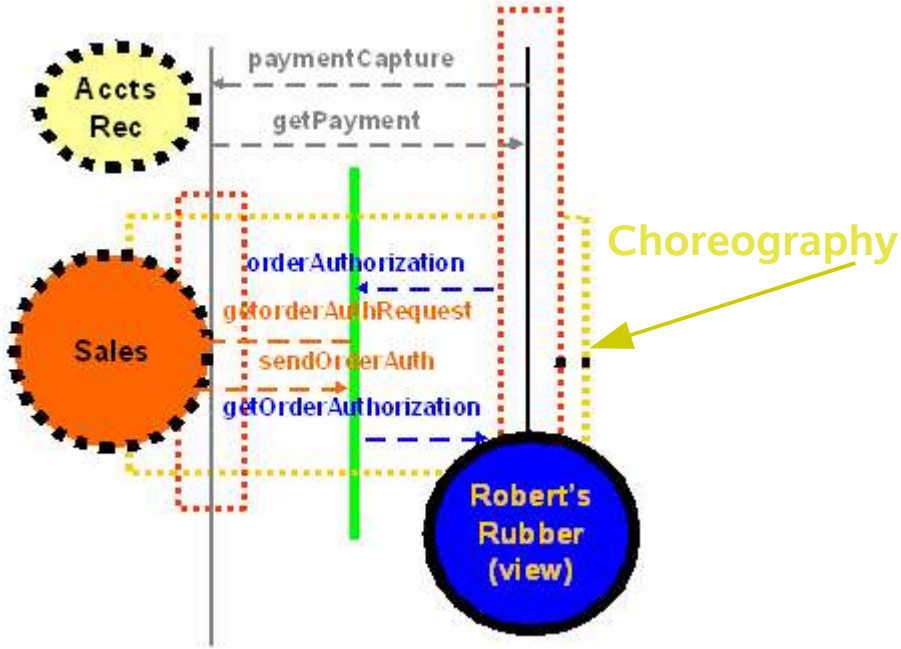
- Orchestration

```
...<invoke partnerLink="customer"
portType="sns:shippingServiceCustomerPT"
operation="shippingNotice"
inputVariable="shipNotice">
<correlations>
<correlation set="shipOrder" pattern="out"/>
</correlations>
</invoke>
</sequence>
</case>...
```



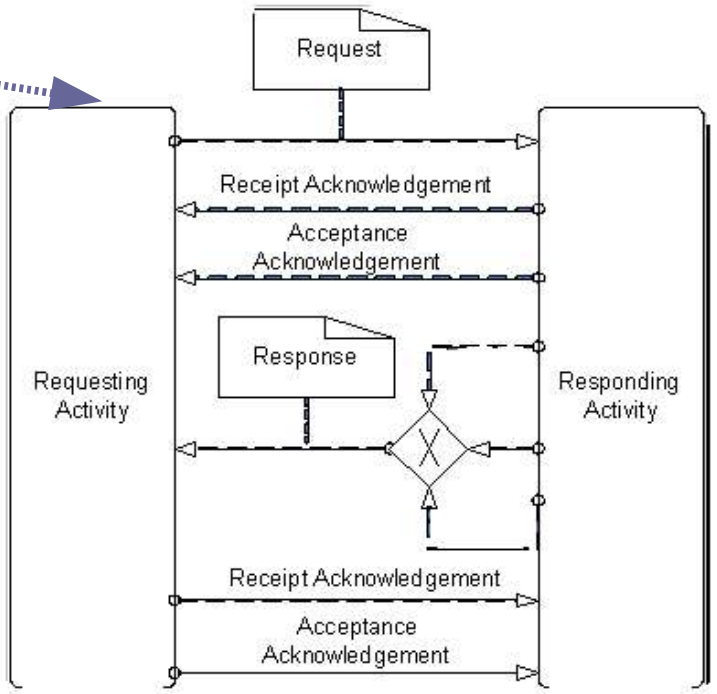
- Choreography

```
...<interaction name="Shipper sends delivery details to buyer"
operation="deliveryDetails" channelVariable="DeliveryDetailsC">
<description type="description">Pass back shipping details to the
 buyer</description>
<participate relationshipType="ShipperBuyer"
fromRole="ShipperRoleType" toRole="BuyerRoleType" />
<exchange name="sendDeliveryDetails"
informationType="DeliveryDetailsType" action="request">
</exchange>
</interaction>
</sequence>
</choice>
</sequence>
</choreography>
</package>
```



Standards Landscape (3 of 4)

- Collaboration
- Modeling: BPMN, UML2




```
...
<ComplexBusinessTransactionActivity name="PrimaryDeliveryProcesses"
  nameID="Z5000" businessTransactionRef="DAZ5000"
        hasLegalIntent="true">
            <TimeToPerform duration="P1D"/>
            <Performs initiatingRoleRef="Despatch1" currentRoleRef="Shipper"/>
            <Performs currentRoleRef="MeBuyer"/>
            <!--  BTAs in ComplexBTA -->
            <BusinessTransactionActivity name="Forward to Buyer 500Z"
  nameID="Z500" businessTransactionRef="DA5" hasLegalIntent="true">
                <TimeToPerform duration="PT6H"/>
                <Performs initiatingRoleRef="Despatch2"
                    currentRoleRef="MeSeller5000"/>
                <Performs respondingRoleRef="A5" currentRoleRef="Buyer500"/>
        </BusinessTransactionActivity>...
</ComplexBusinessTransactionActivity
```

Standards Landscape (4 of 4)

- Focus evolving to:
  - Mathematical logic
  - Association
  - Simulation
  - Metamodels
  - State machines
  - Petri nets
  - Service models
  - more...
- Building blocks

	BPDM	BPEL4WS	BPML	BPMN	BPSS	EPML	OWL-S	PNML	UML Act.D.	WS-CDL	WSCI	WSCL	WSFL	XLANG	XPDL
Task I/O	?	+	+	+	+	-	+	-	+	+	+	+	+	+	+
Task Address	?	+	+	+	-	-	+	-	-	+	+	+	+	+	+
Quality Attributes	?	-	-	-	+	-	+	-	-	-	-	-	+	-	-
Protocol	?	+	-	+	-	-	+	-	-	+	+	+	+	+	-
Control Flow	?	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Data Handling	?	+	+	+	-	-	-	-	+	+	-	-	+	-	+
Instance Identity	?	+	+	-	-	-	-	-	-	-	+	-	+	+	-
Roles	?	+	+	+	+	-	+	-	+	+	+	-	+	+	+
Events	?	+	+	+	-	+	-	-	-	-	-	-	+	+	+
Exceptions	?	+	+	+	+	-	-	-	+	+	+	-	+	+	+
Transactions	?	+	+	+	+	-	-	-	-	+	+	-	-	+	-
Graphic Position	?	-	-	+	-	+	-	+	+	-	-	-	-	-	-
Statistical Data	?	-	-	-	-	-	-	-	-	-	-	-	-	-	+

Mendling et al.: A Comparison of XML Interchange Formats for BPM, 2004

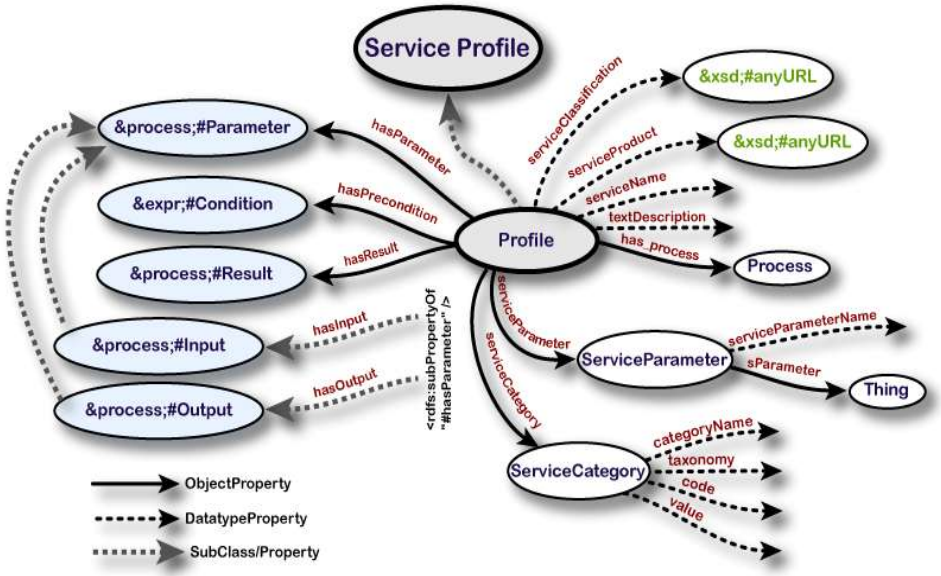
Semantic Reasoning Building Blocks

- Where does semantic reasoning fit in a pragmatic world? (short list)
  - Expression reasoning
  - Metadata for design and usage
  - Conditions and constraints, policy, context
  - Domain vocabularies that support content
  - Process matching and compatibility
- Why pragmatism (iterative progress)?
  - Emphasis on saving costs, productivity and business justification to change

Semantic Reasoning Building Blocks

Quote: OWL-S

..."To make use of a Web service, a software agent needs a computer-interpretable description of the service, and the means by which it is accessed. An important goal for Semantic Web markup languages, then, is to establish a framework within which these descriptions are made and shared. Web sites should be able to employ a standard ontology, consisting of a set of basic classes and properties, for declaring and describing services, and the ontology structuring mechanisms of OWL provide an appropriate, Web-compatible representation language framework within which to do this..."



http://www.daml.org/services/owl-s/1.1/overview/

Building Towards 'Certainty'

- Evidence of ongoing progress (short list)
  - Semantic variables
  - Conformance typing and mathematical mapping
  - Domain content and process reasoning
    - For semantic understanding and assembly of content
    - For reasoning on content and processes
- Goal: Flexibility and business agility
  - Example: 'Adaptive trading networks' where partners respond quickly to global demands
    - Forrester Research, 21 April 2005
  - Provides basis for use of ontological approaches

Reasoning Example [1 of 5]

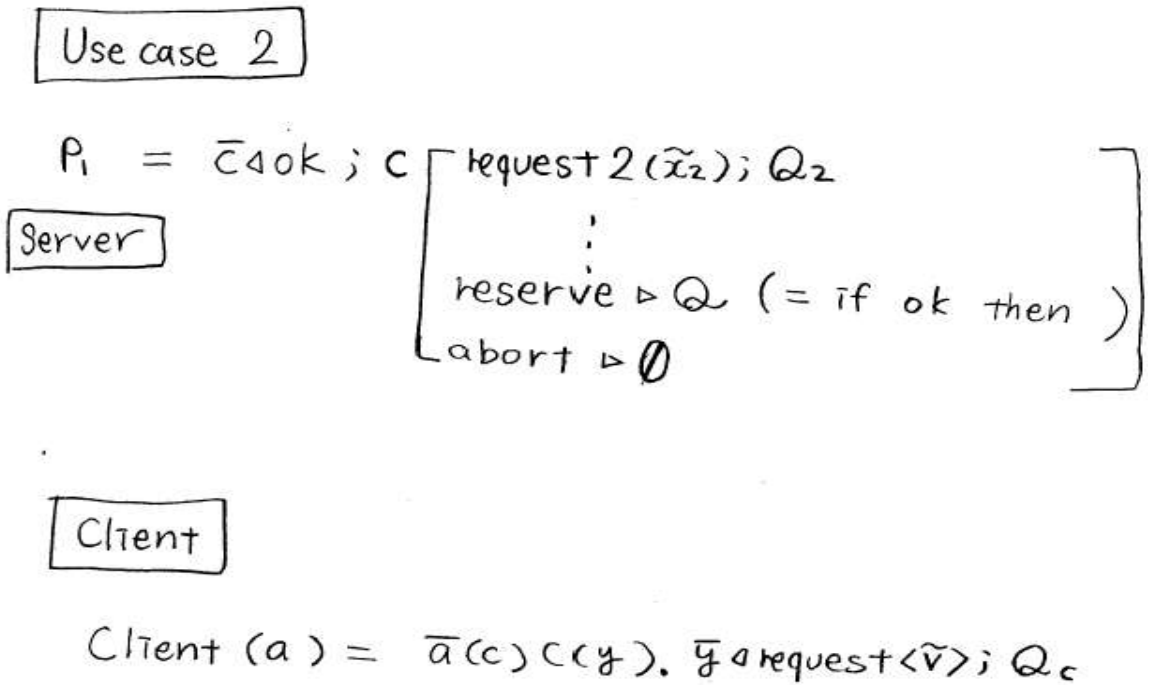
- Semantic variables: Elements used to bind semantics to other objects
  - Condition expressions
  - Triggers, events
  - Content characteristics
  - Activities themselves

Simplistic example:

```
<Variable  name="PO Accepted" nameID="H7YIUSOP"
   businessTransactionActivityRef="ID122A39C23"
   businessDocumentRef="ID1012">
     <ConditionExpression expressionLanguage="XPath1"
   expression="//POAck[@status='Reject']"/>
</Variable>
```

Reasoning Example [2 of 5]

- Conformance typing system
  - π (pi-) calculus based: Session and causality types proposed to prevent deadlock
  - Branching and, on match, selection of client-server of request-response
  - Static/ dynamic checking



Reasoning Example [3 of 5]

- Formal choreography
  - Based on roles and interactions
  - Describes conversations in π
  - Defines CL_P (semantic auxiliary language)
  - Maps conversations to semantics

$$C_P ::= \mathbf{0} \mid m \mid C_P;C_P \mid C_P|C_P \mid C_P + C_P$$
$$m ::= (\rho_A, \rho_B, o, \tilde{x}, \tilde{y}, dir)$$

(Interaction)
$$(\rho_A, \rho_B, o, \tilde{x}, \tilde{y}, dir) \rightarrow \mathbf{0}$$

(Sequence)
$$\frac{C_P \rightarrow C'_P}{C_P; D_P \rightarrow C'_P; D_P}$$

(Parallel)
$$\frac{C_P \rightarrow C'_P}{C_P \mid D_P \rightarrow C'_P \mid D_P}$$

(Choice)
$$\frac{C_P \rightarrow C'_P}{C_P + D_P \rightarrow C'_P}$$

(Structural Congruence)
$$\mathbf{0}; C_P \equiv C \qquad C_P \mid \mathbf{0} \equiv C_P \qquad C_P + \mathbf{0} = C_P$$
$$C_P + D_P \equiv D_P + C_P \qquad C_P \mid D_P \equiv D_P \mid C_P$$
$$(C_P + D_P) + E_P \equiv C_P + (D_P + E_P)$$
$$(C_P \mid D_P) \mid E_P \equiv C_P \mid (D_P \mid E_P)$$

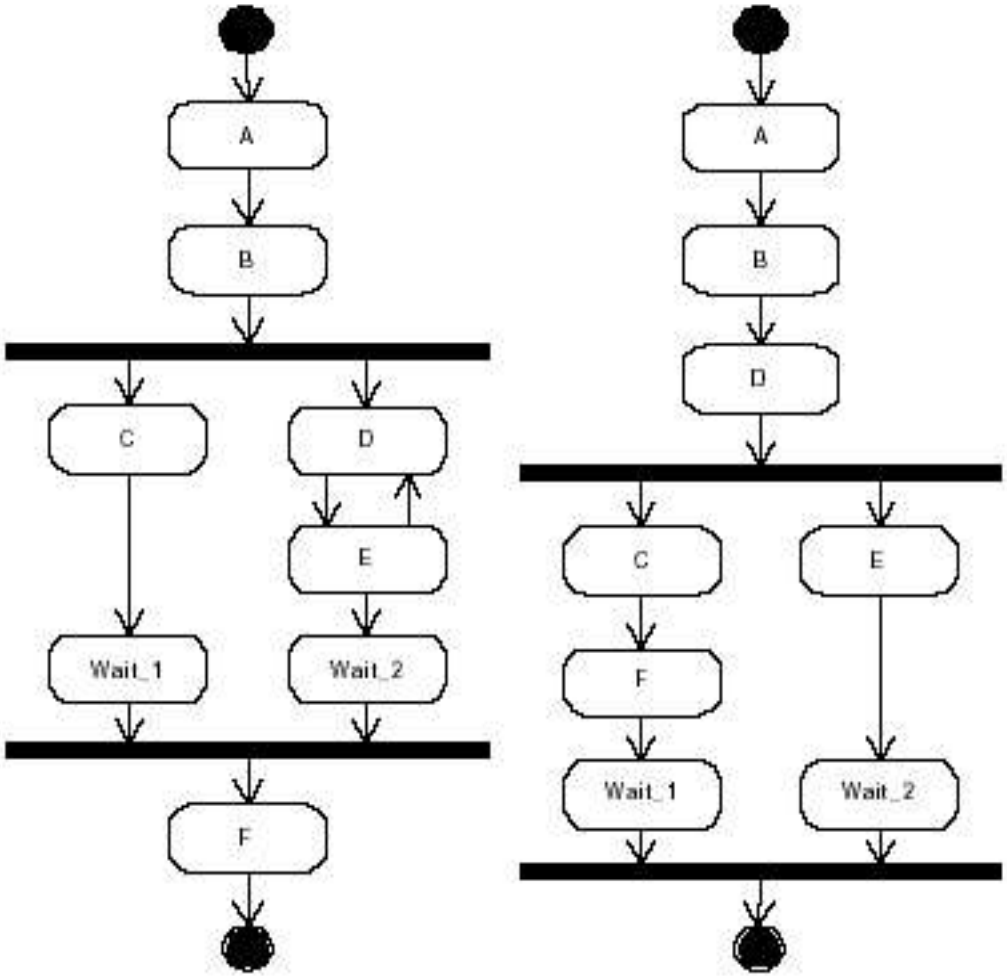
Link: http://www.cs.unibo.it/~lucchi/pubbl.html

Reasoning Example [4 of 5]

- Semantic reasoning and services
  - OWL-S, SWRL, WSMO
  - WSDL, UDDI, SOAP, WS-BPEL, etc.
- Emerging mechanisms
  - Metadata and semantic models
  - Similarity measures (moving to semantic reasoning)
  - Abstract service descriptions
  - Process effects: pre- and post-conditions, triggers, etc.
  - Mathematical logic and computation

Reasoning Example [5 of 5]

- Process matching
  - Equivalency between activities within a process
    - Structure
    - Content
    - Intent
  - Recognize parallelism occur in processes
  - Combine set theory, bi-simulation, state transitions



Summary and Future Opportunities

- Leverage today
  - Evidence of building blocks
  - BPM momentum
  - Process complexity (as an asset)
- Exploit tomorrow
  - Identify opportunities to use semantic reasoning to solve operational problems
  - Take iterative steps to build, leverage and use ontological approaches to enable BPM

Some Relevant Links

- A Comparison of XML Interchange Formats, Jan Mendling et al, August 2004, http://wi.wu-wien.ac.at/~mendling/publications/04-EMISA.pdf
- Process Modelling and Standardization, Jan Mendling, http://www.erpanet.org/events/2004/budapest/presentations/JanMendlingErpanet2004.pdf
- Conformance Type System use cases, related to W3C work, Nobuko Yoshida, July 2004, http://lists.w3.org/Archives/Public/public-ws-chor/2004Jul/0071.html
- OWL-S Overview, http://www.daml.org/services/owl-s/1.1/overview/
- Towards a formal framework for Choreography, N. Busi et al, http://www.cs.unibo.it/~lucchi/pubbl.html
- Process matching, http://www.idealliance.org/papers/xmle03/ebxmlslides/folmer/folmer.pdf and http://www.openxchange.org/
- OWL-S' Relationship to Selected Other Technologies, Nov 2004 W3C, http://www.w3.org/Submission/2004/SUBM-OWL-S-related-20041122/#bpel
- NIST Test Bed Activity Update, Serm Kulvatunyou et al, http://www.openapplications.org/downloads/meetings/20050503-gaithersburg/Weds/2005-05-04-OAGMeetingNISTB2BTestbedActivitiesUpdate.pdf
- JSR-208: Java™ Business Integration, http://www.jcp.org/en/jsr/detail?id=208
- WS-BPEL, OASIS, draft, May 2005,http://www.oasis-open.org/committees/document.php?document_id=12791&wg_abbrev=wsbpel
- BPMN, BPMI, 2004: http://www.bpmn.org; BPML, BPMI, http://www.bpmi.org
- OASIS ebBP, April 2005 core: http://www.oasis-open.org/committees/document.php?document_id=12259&wg_abbrev=ebxml-bp
  - Note: Signal, supplements and artifacts packages available on site.
- W3C WS-Choreography, WS-CDL, December 2004, http://lists.w3.org/Archives/Public/public-ws-chor/2004Dec/0042.html
- BPDM, Object Management Group, http://www.omg.org/cgi-bin/doc?bei/2003-1-6 (RFP)
- UN/CEFACT Modeling Methodology, N090/R10, http://www.ifs.univie.ac.at/untmg/

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