

BPEL vs. BPMN 2.0: Should You Care?

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Agenda

Historical Remarks

BPMN Origin and Positioning

The Notion of “Native Metamodel”

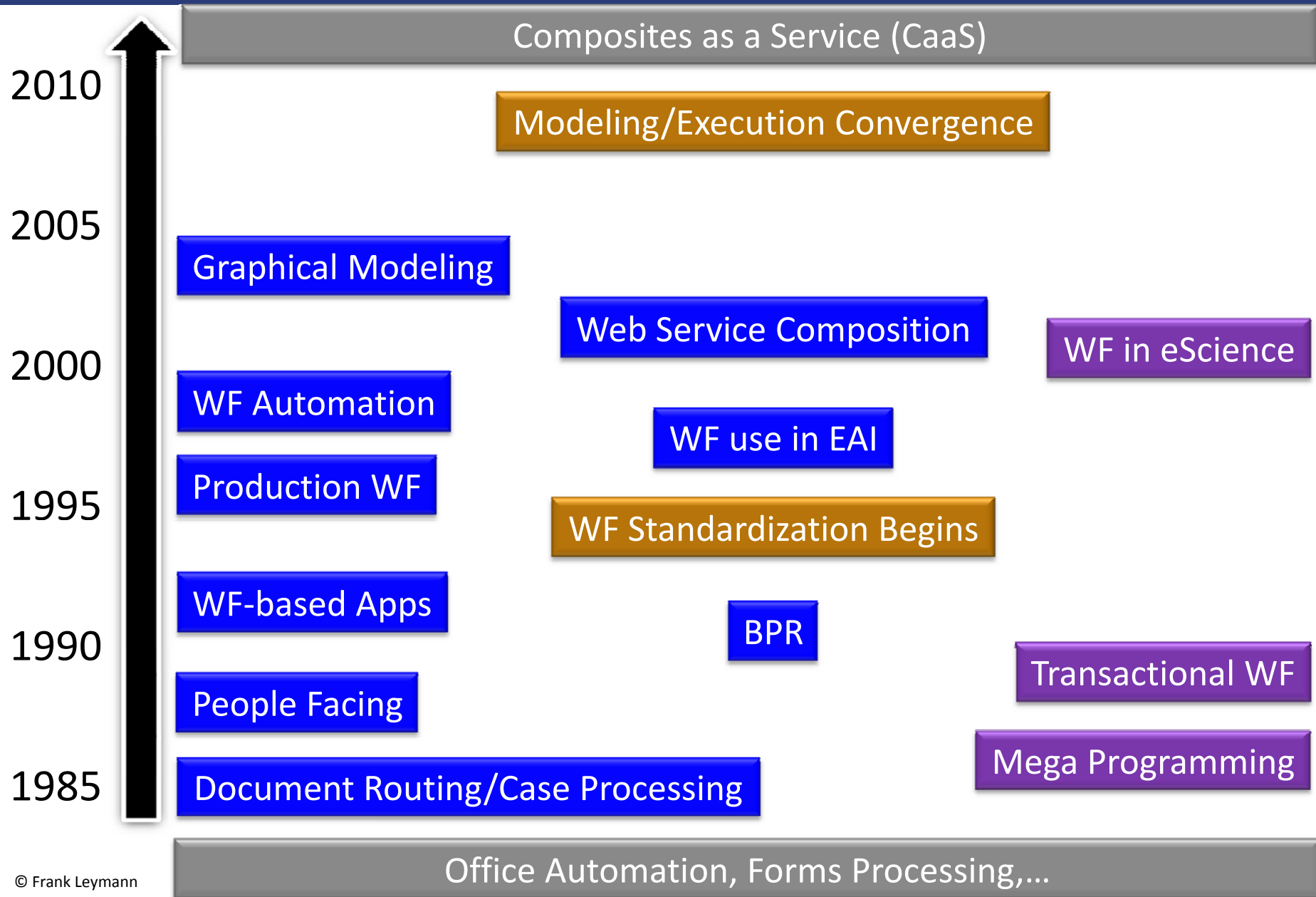
View on Process Engines

Selective BPMN 2.0 Features

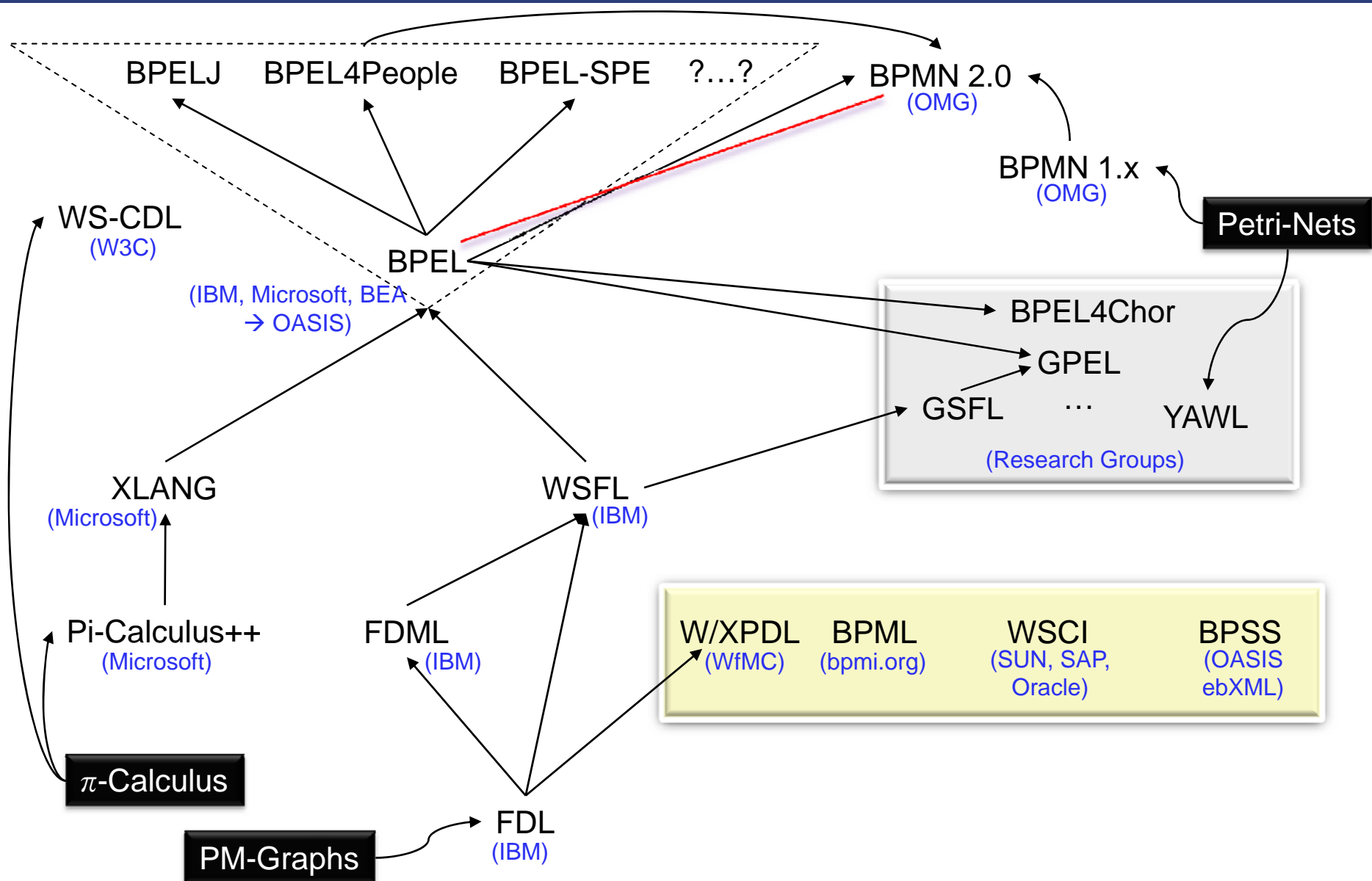
Executable BPMN - BPEL Mapping

Summary

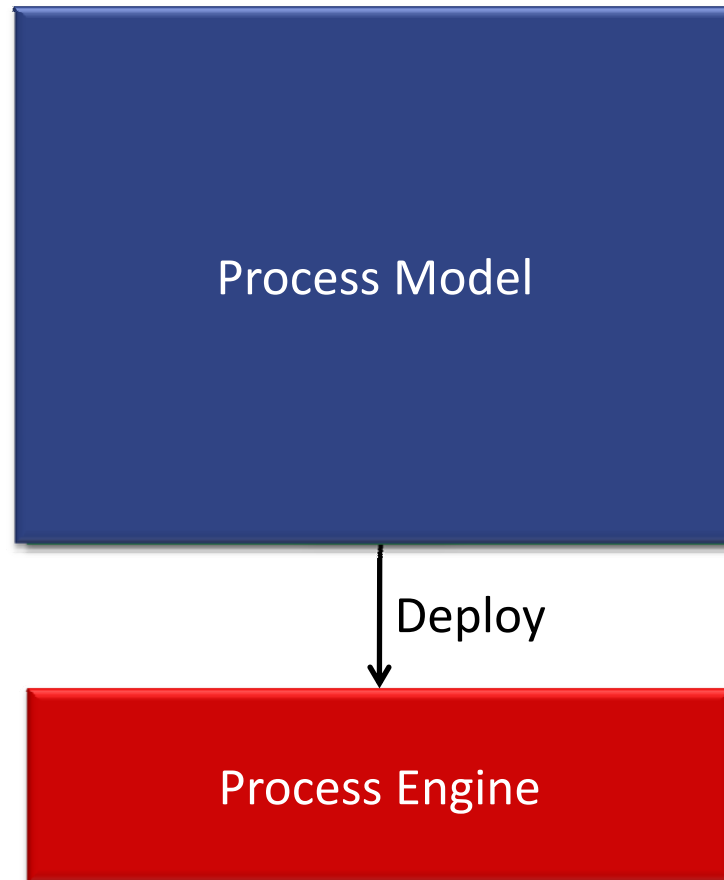
Brief History of Workflow Technology (no scientific rigor intended)



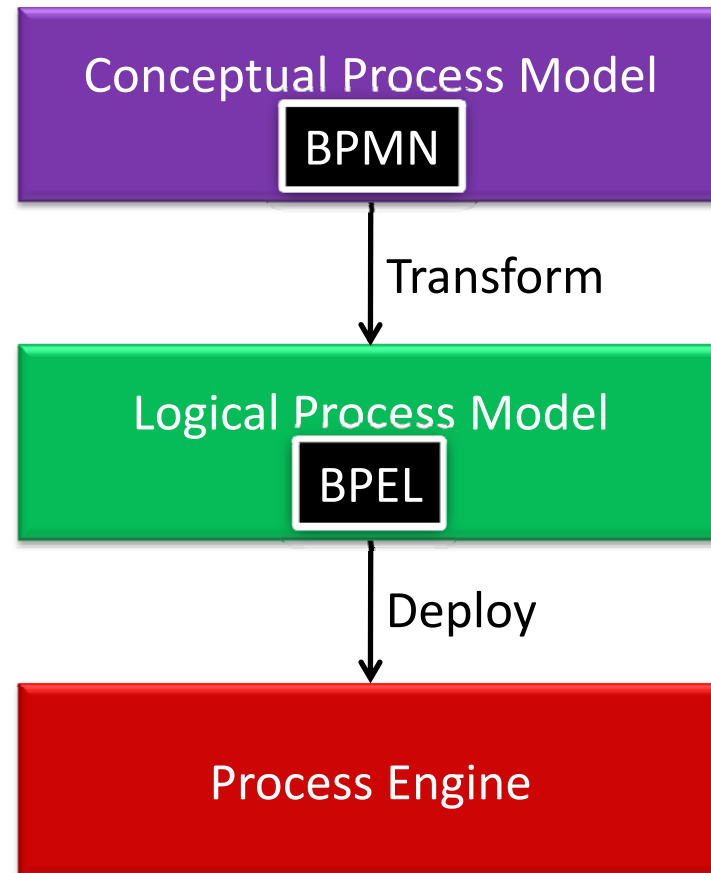
Workflow Language Genealogy



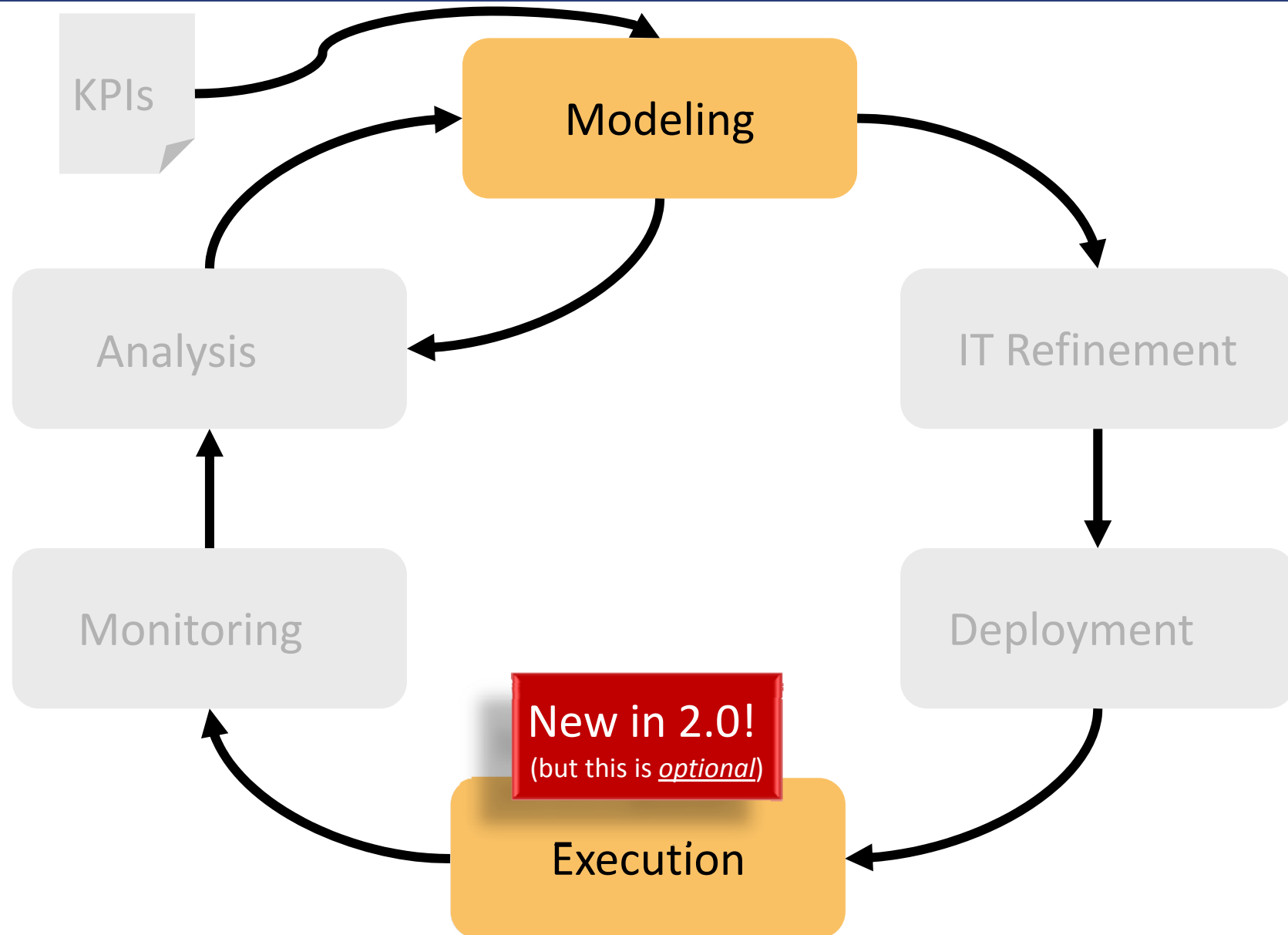
Process Modeling is (has been?) Layered



Process Modeling is (has been?) Layered



BPM Lifecycle: Where BPMN Fits

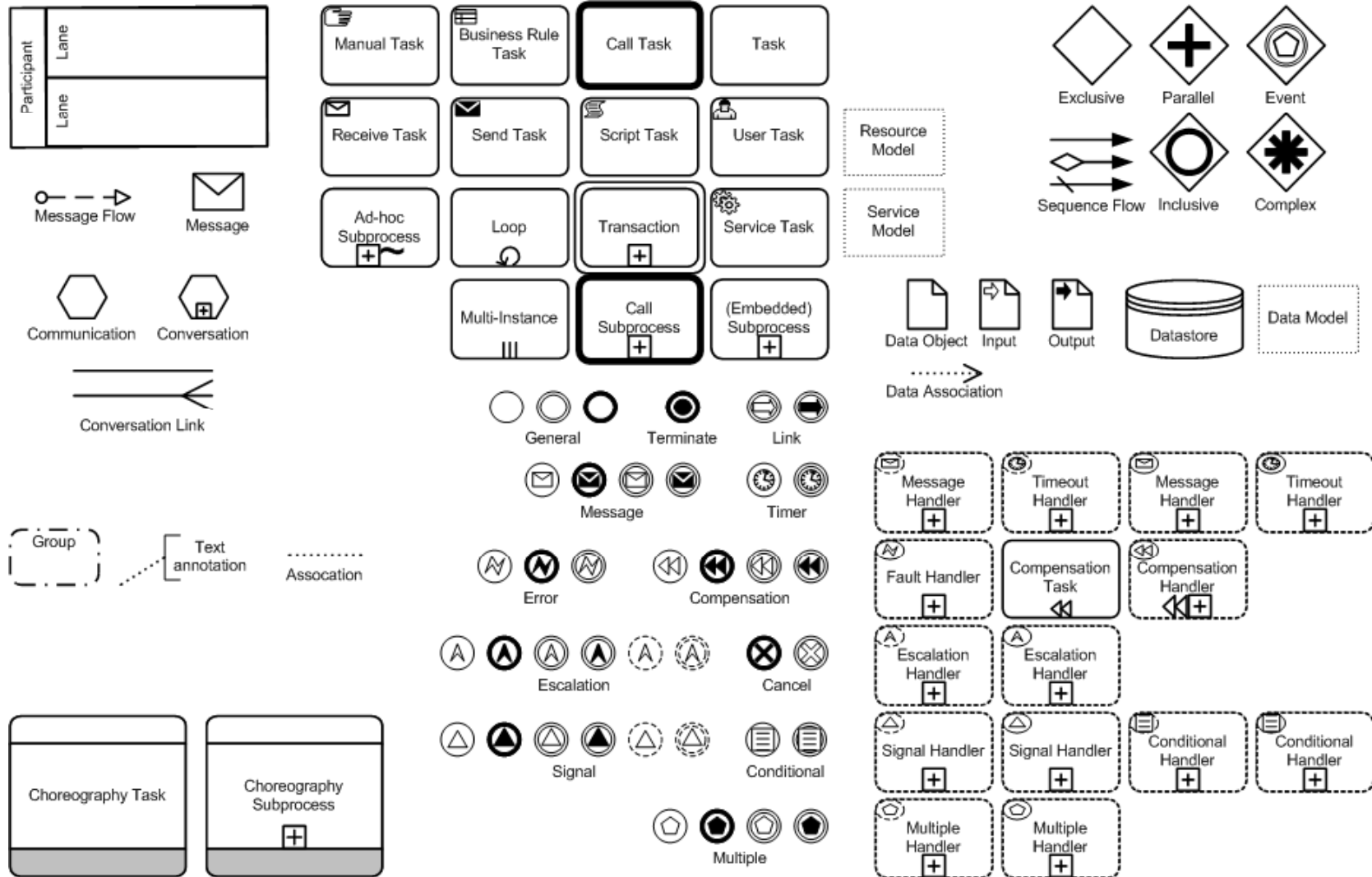


BPMN 2.0 vs. BPMN 1.1

- BPMN 2.0 is based on BPMN 1.1 but additionally contains:
 - An XML-based *interchange format* for BPMN models
 - Clean operational semantics and metamodel (connecting BPMN to OMGs MDA efforts)
 - The metamodel is one of the most important changes, hence the new name (see below)
- The graphical notation is mostly unchanged
 - some new event types, choreography, collaboration,...
- New BPMN “Level”: executable BPMN

BPMN in 1.1: “Business Process Modeling Notation”
BPMN in 2.0: “Business Process Model and Notation”

Overview On All Graphical Artifacts



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The Key Aspect of BPEL


BPEL exists and is supported by most middleware vendors!

- Combination of two modeling paradigms
- Avoided split of WF product market/industries
- The runtime standard
- Well defined syntax & operational semantics
- (Certain degree of) portability across vendors
- (High degree of) tool portability
- Portability of skills

- And, yes, even original authors think it's a chimera, i.e. they don't think it's a beautiful language




BPMN 1.x Filled a Gap

- BPEL focused on language syntax and operational semantics
- It sacrificed time-to-market and ignored visual representations by will
- When looking back this was a BIG mistake! 
- BPEL turned out to be too difficult for mere mortals


- BPMN 1.x filled this gap
- Non-IT experts could communicate about business processes

- Big progress in BPM technology

Chasm between BPMN 1.x and BPEL

- BPEL processes are modeled with their future execution in mind
- This has not been often the case in the past for BPMN
- But more and more, BPMN users wanted their processes to be executed
- Wide-spread support of BPEL in workflow engines required to map BPMN to BPEL
- But BPMN and BPEL metamodels are quite different
- Thus, mapping is not straightforward, even complex
- Many of you understand this much better than me 
- Problem: How to bridge this chasm?

Options to Bridge the Chasm


- Standardize a visual representation for BPEL
 - Can be done as proven by the many graphical tools for BPEL
- But BPMN contains a bunch of constructs without BPEL counterparts
 - Corresponding BPEL extensions are required
 - Very time consuming! (see BPEL4People...)
 - But users ask for a solution asap!
- This was not practical 
- Thus, way chosen is to make (significant subset of) BPMN 2.0 more compatible with BPEL

Most Important Additions of BPMN 2.0

- Clear operational semantics
 - “Native” XML exchange format
 - Event & exception handlers (BPEL compliant)
 - Choreography extensions
- ... and:
- Pattern-based mapping to BPEL (subset of BPMN)
 - Effectively, BPMN 2.0 contains a significant subset isomorphic to BPEL \approx Visual rendering of BPEL!



The Price to Pay

- Complexity of BPMN 2.0 has increased significantly!
 - Well, ensuring executability is always complex! 
- Only a subset of BPMN 2.0 can be mapped to BPEL in a straightforward manner
 - It is still possible to model BPMN processes that have no canonical representation in BPEL
- Some features have no runtime environment yet
 - E.g. corresponding domain is out of scope of BPEL at all
 - See BPEL4Chor
 - New middleware has to be developed

Resulting Viewpoints

Viewpoint 1:

- Subset of BPMN 2.0 is isomorphic to BPEL
 - This subset is canonically transformed to BPEL and can be executed in BPEL engines
- Corresponding subset is a visual layer on top of BPEL

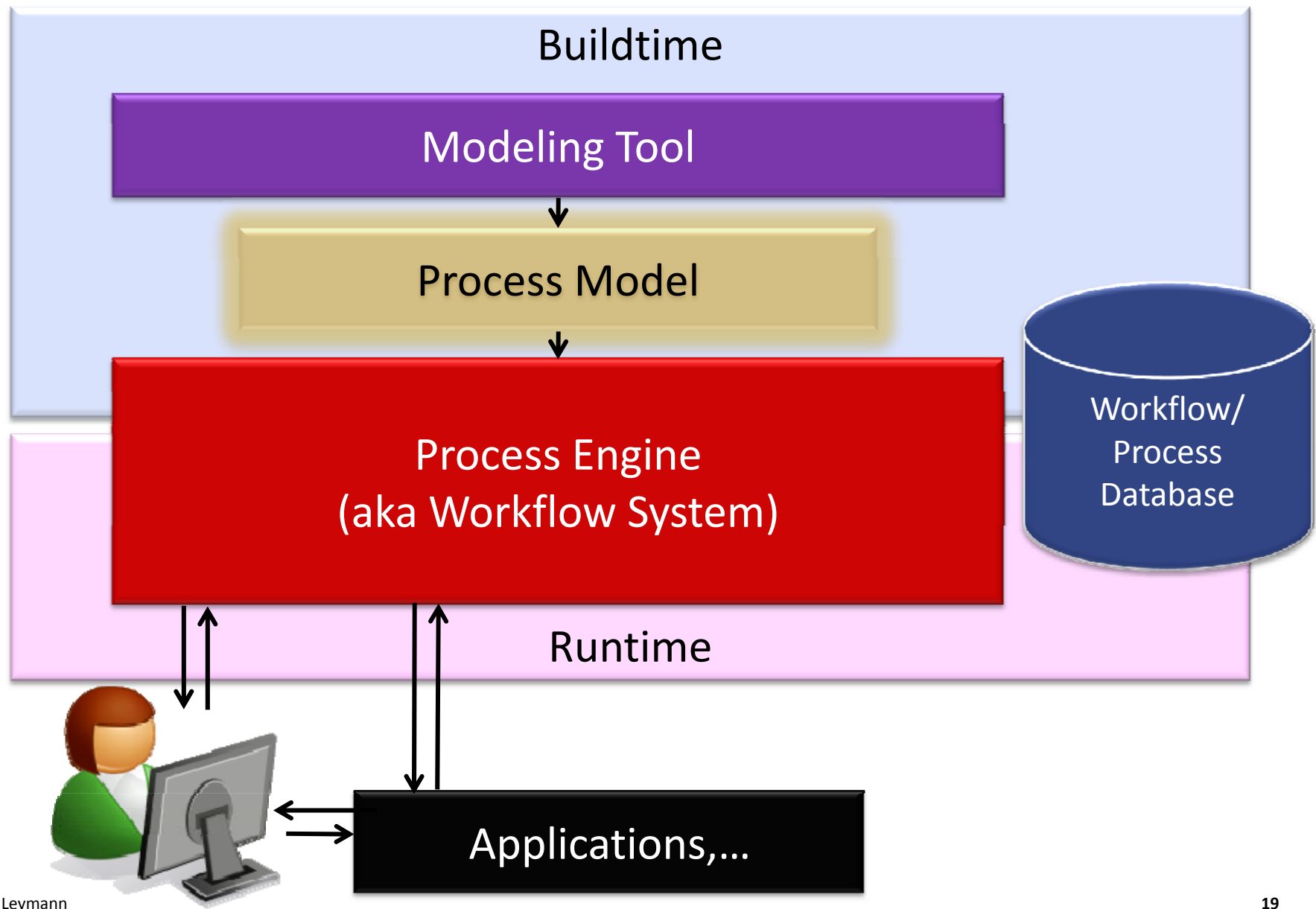
Viewpoint 2:

- BPMN 2.0 is a process language with well-defined operational semantics imprinted by BPEL
- It is possible to build a BPMN 2.0 engine without the need to use a separate BPEL engine

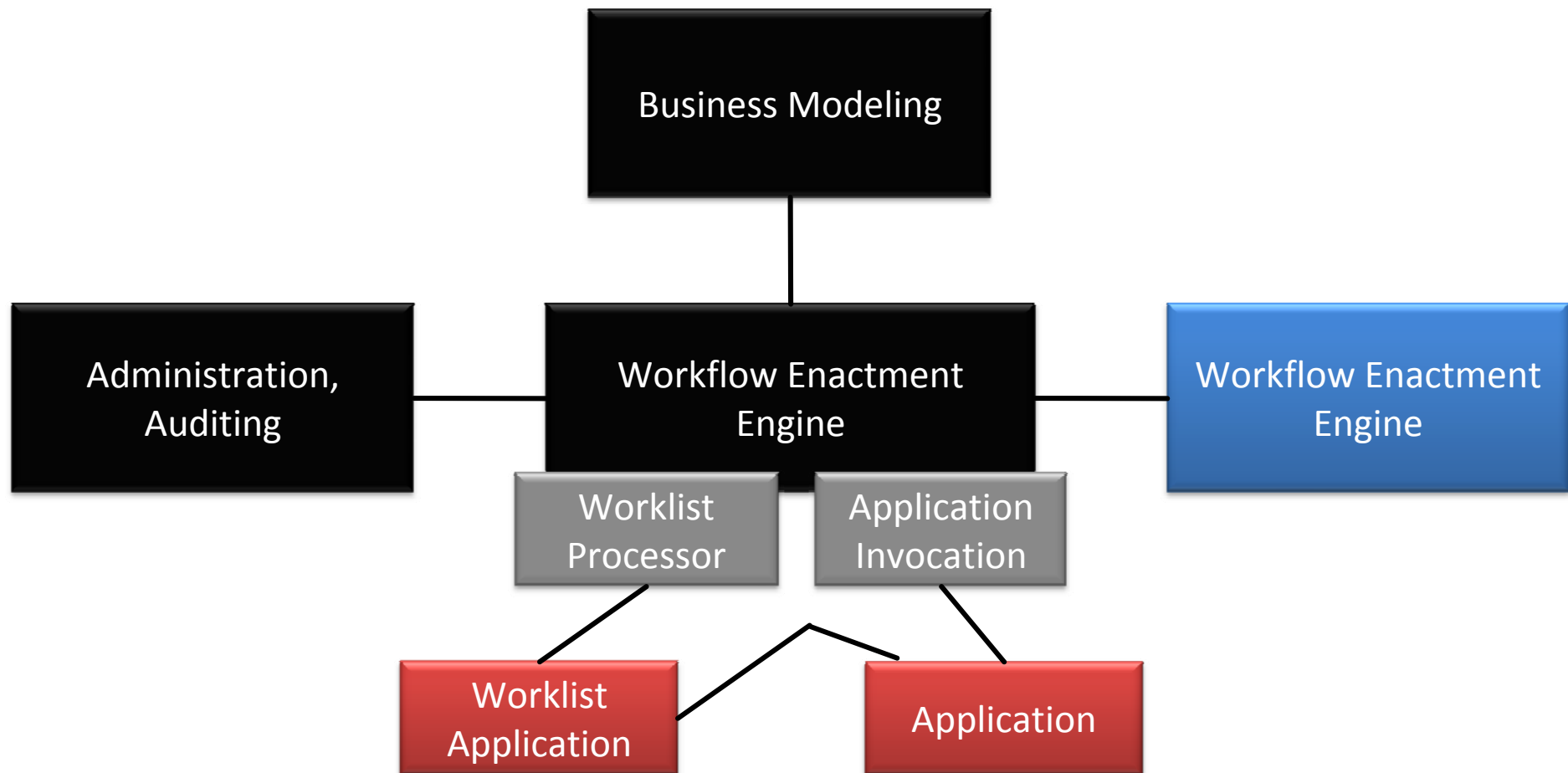
Confusion Ahead!

- Now we have two process languages in the market supported by major vendors
- Very likely, we will be faced with the situation that we will have both, BPEL engines and BPMN engines in the market
- But what does it mean: *BPEL engine?* *BPMN engine?*

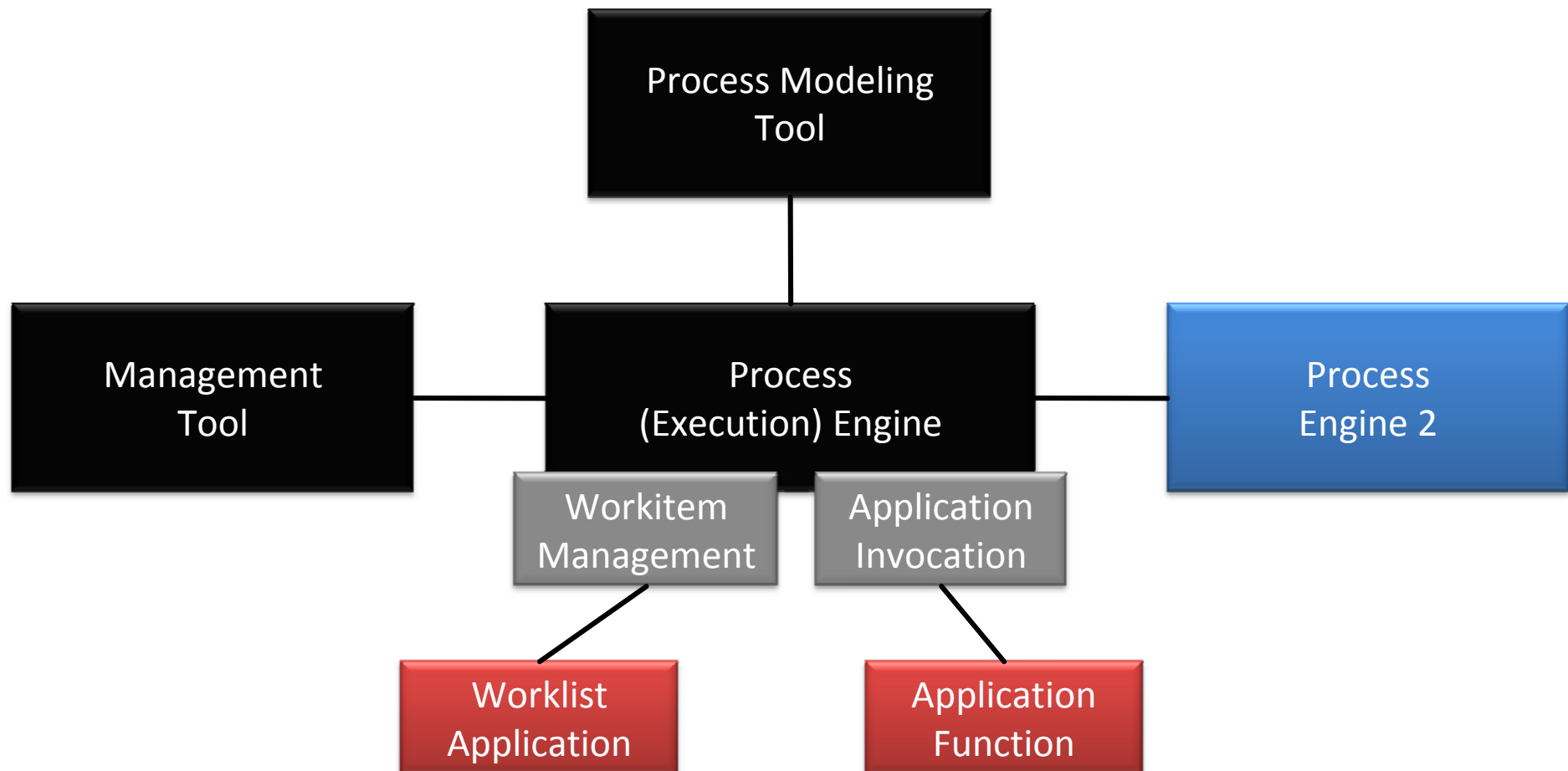
Major Building Blocks of a Process *Engine*



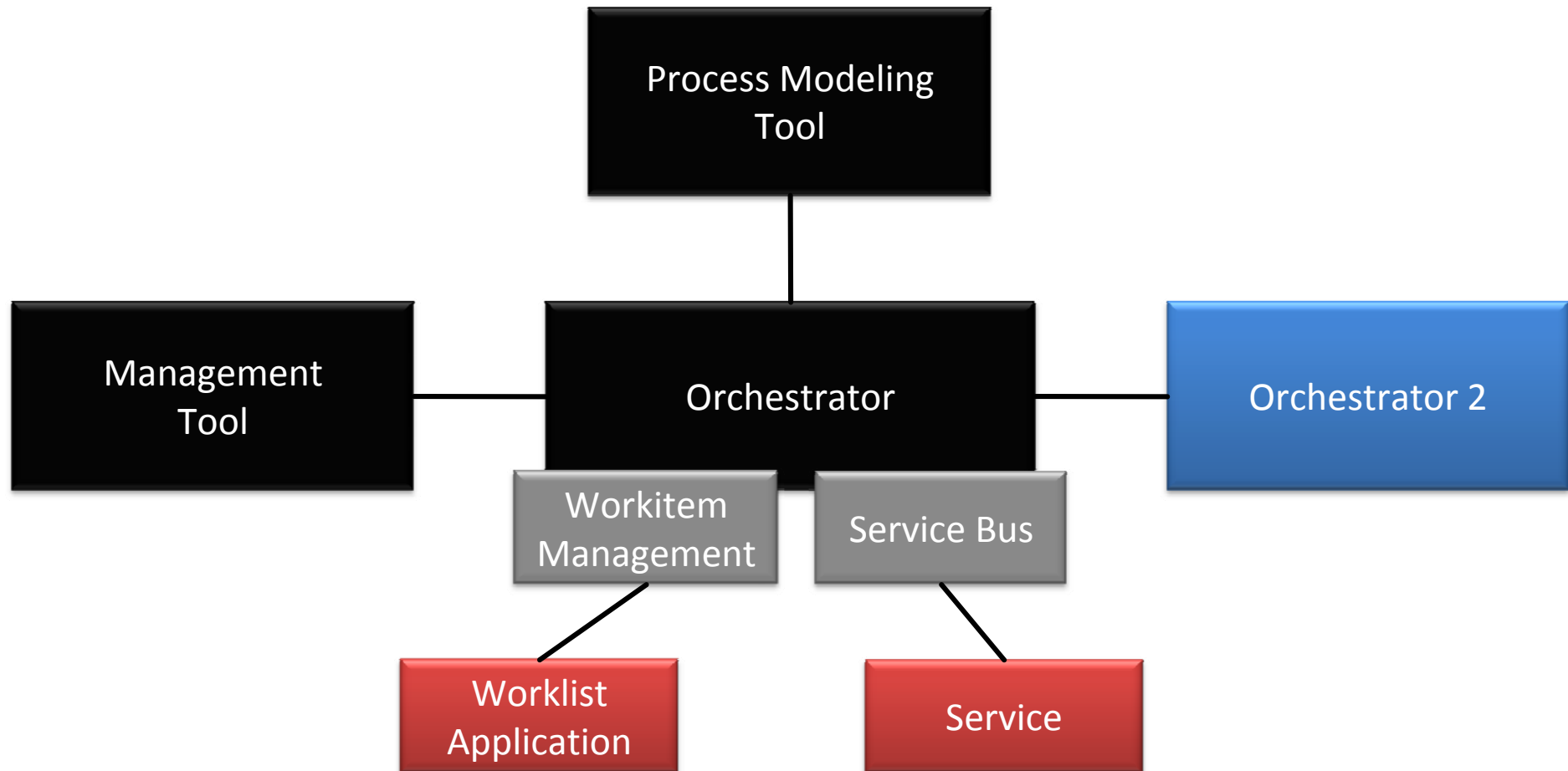
More Detailed View: The WfMC Reference Model



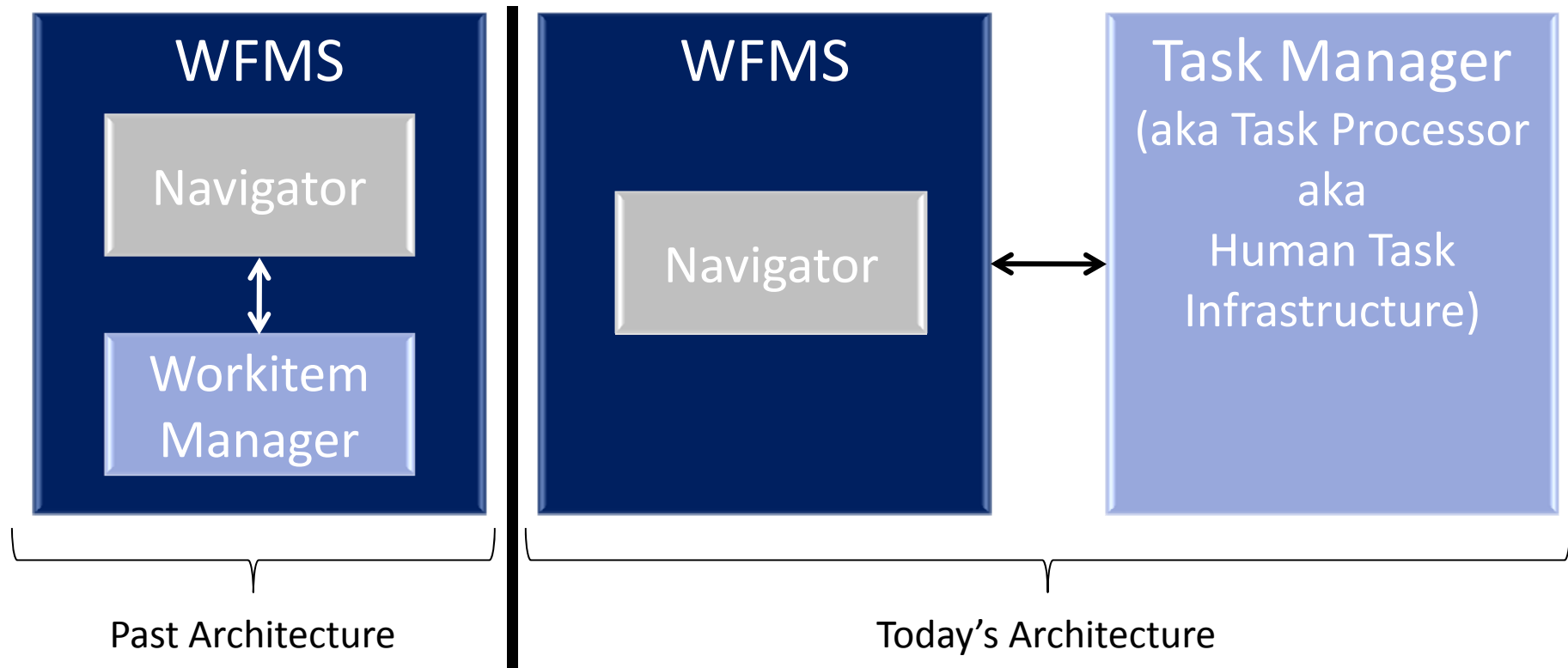
Modern Terminology



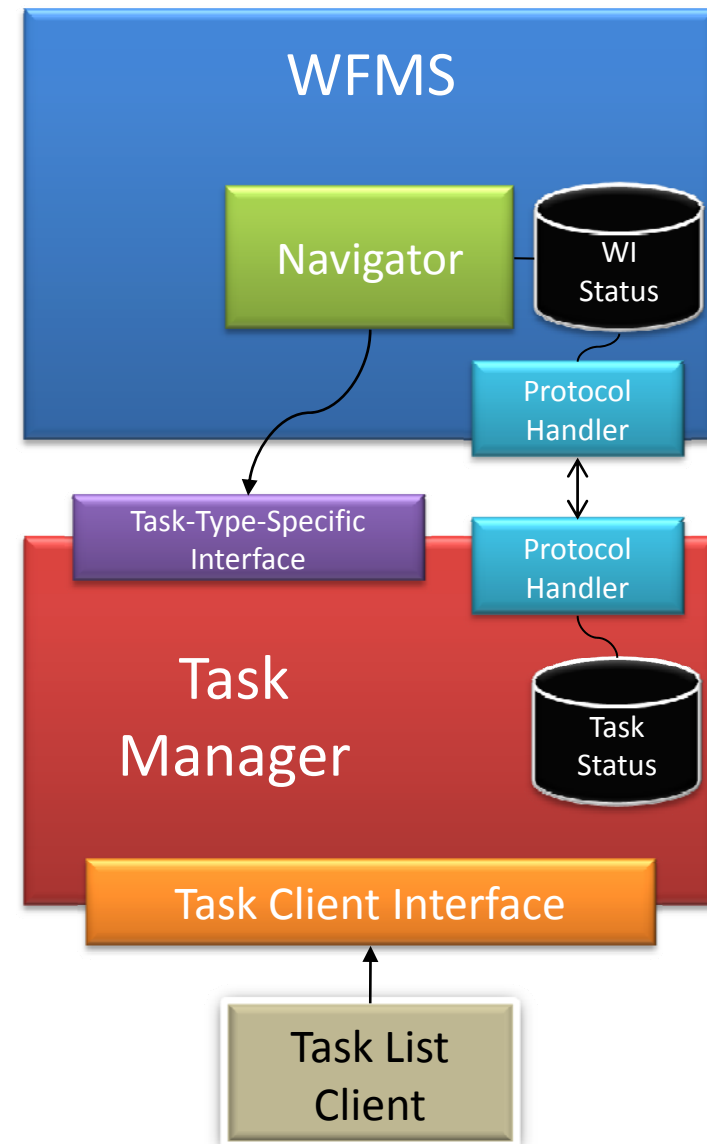
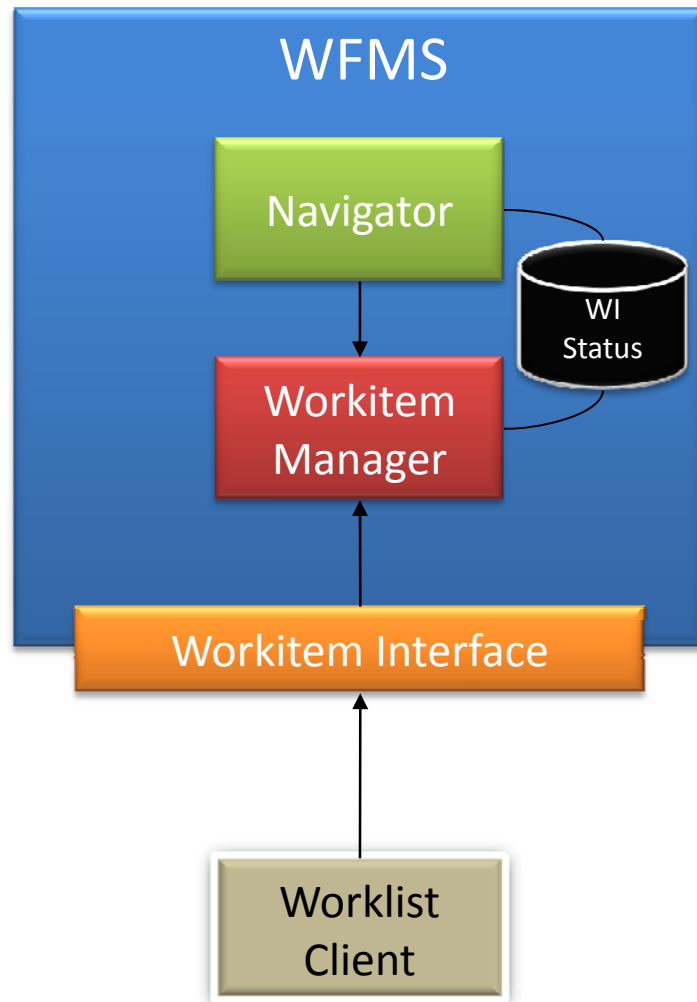
Yet More Modern Terminology



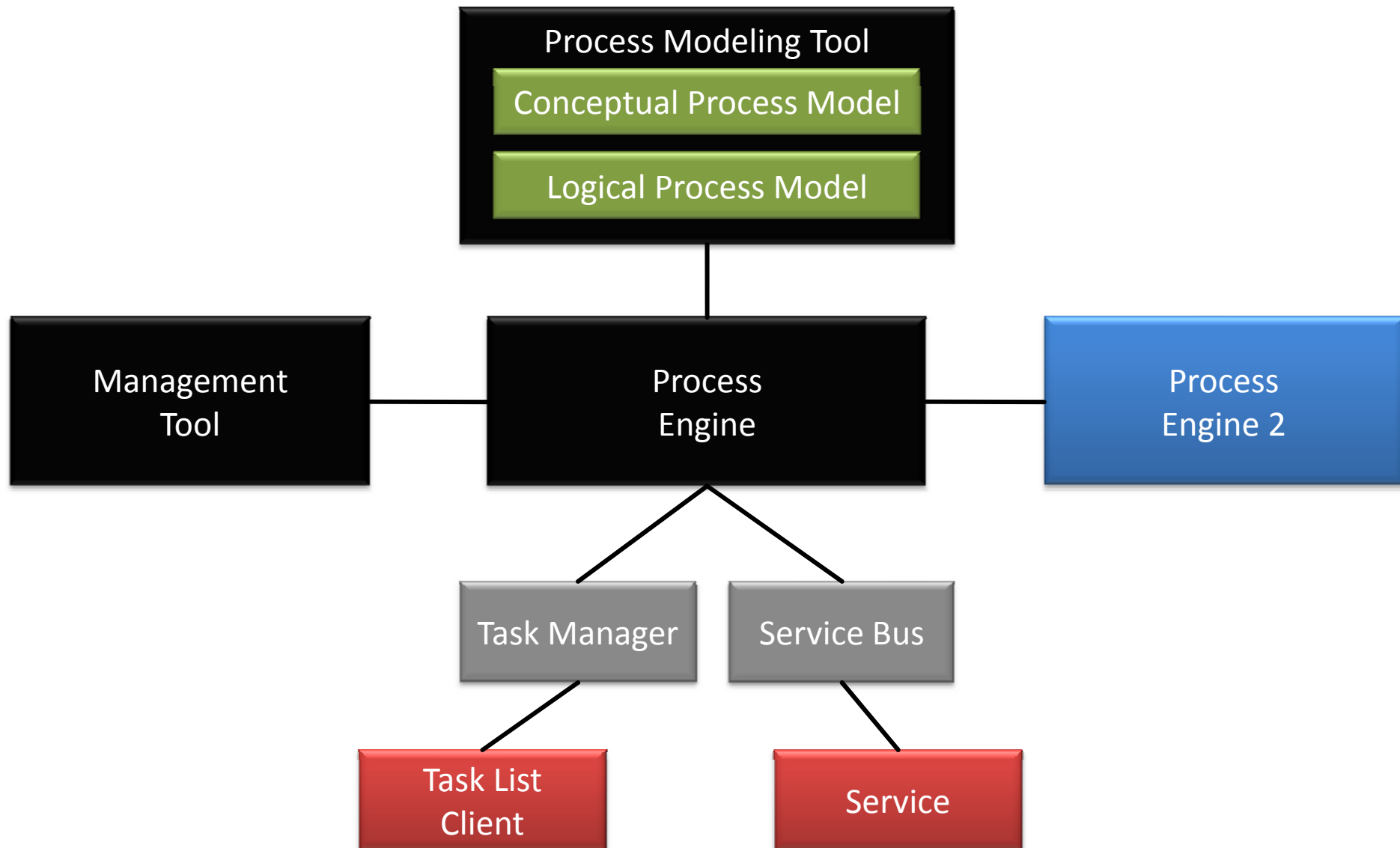
Architectural Impact of BPEL4People



Architectural Impact: Refined View

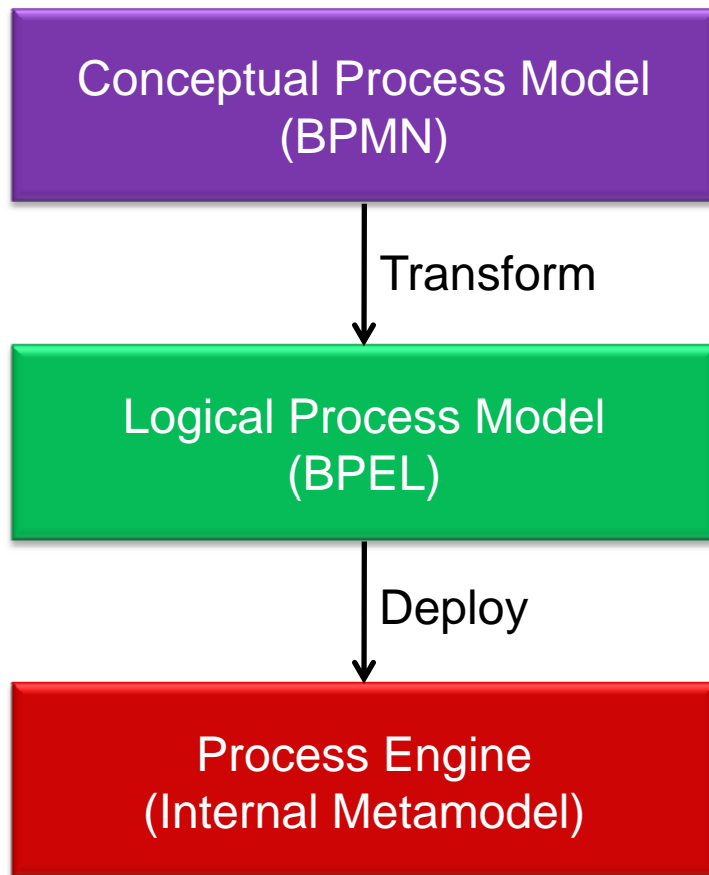


Resulting SOA-View on WfMC Reference Model

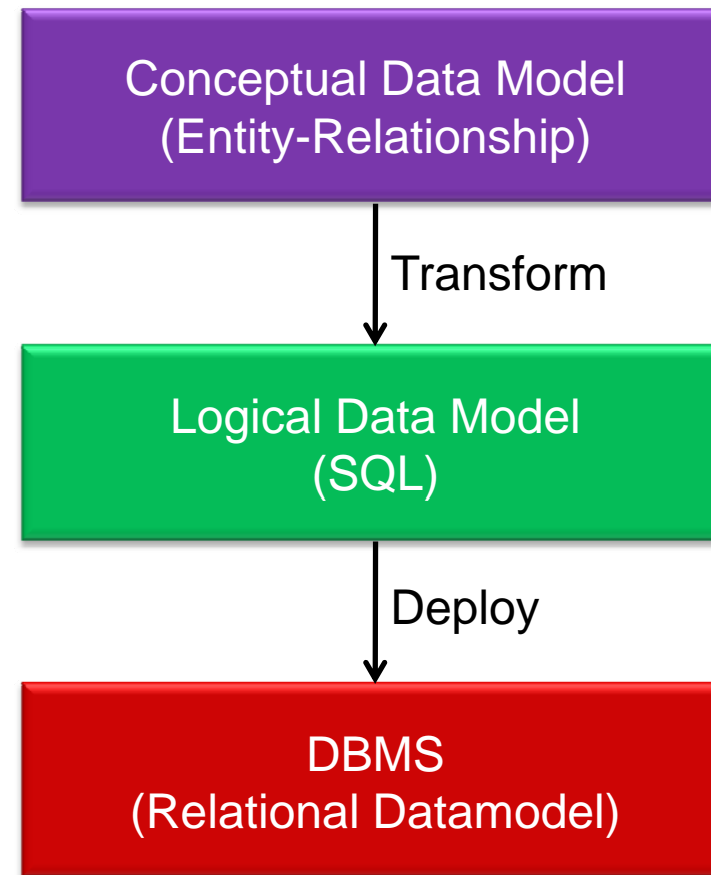


Process Modeling is Layered

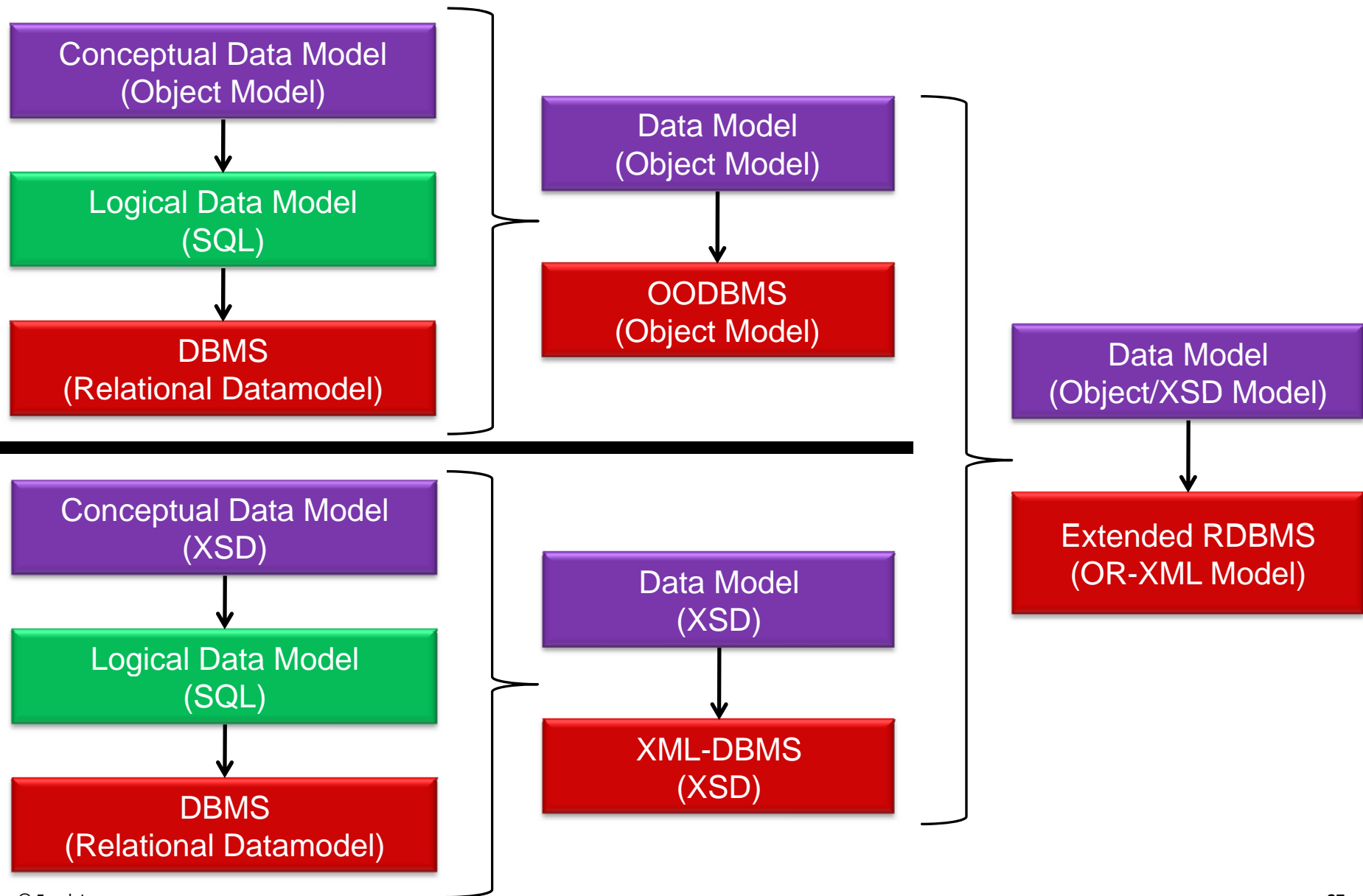
Process Management Stack



Data Management Stack



DBMS: What Happened in the Past



The Open Question

Will history repeat in the “Process World”?

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The Notion of a Native Metamodel

- What does it mean to be a BPEL (BPMN) engine?
- Well, the engine can import process models specified in BPEL (BPMN), instantiate, run, monitor,... them *according to the operational semantics of BPEL (BPMN)*
- Most often, during import BPEL (BPMN) artifacts will be mapped onto internal artifacts of the engine anyway:

Most engines implement their own
proprietary process metamodel
(Native Metamodel)

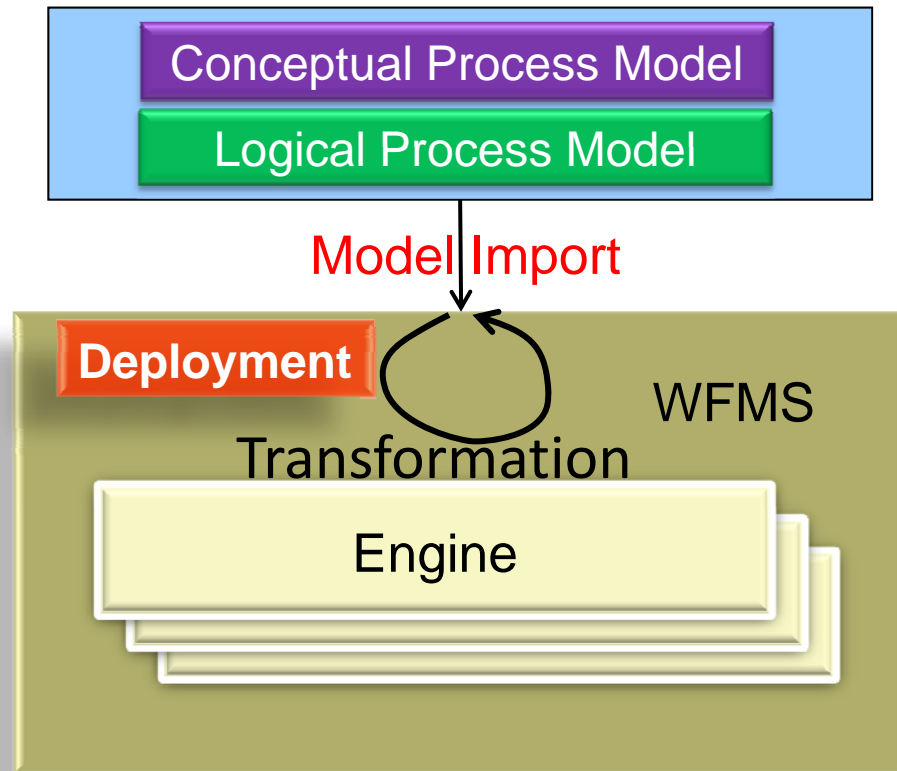
- “Native” BPEL (BPMN) engines are rare exceptions!
 - *Native BPEL (BPMN)* := BPEL (BPMN) is the internal metamodel

What Determines an Engine's Native Metamodel?

- What the engineers building the engine chose to ensure efficiency, scalability etc of the execution!
- Modeling language(s) to be supported at time of creation of first release of process engine has deep impact on its native metamodel
- Good engine engineers take care about generality and extensibility of native metamodel striving towards “straightforward” support of extensions of original modeling language(s) and even new modeling languages

Typically, users of a BPEL engine are not aware of the engine's native metamodel and how different it is from BPEL as a metamodel itself

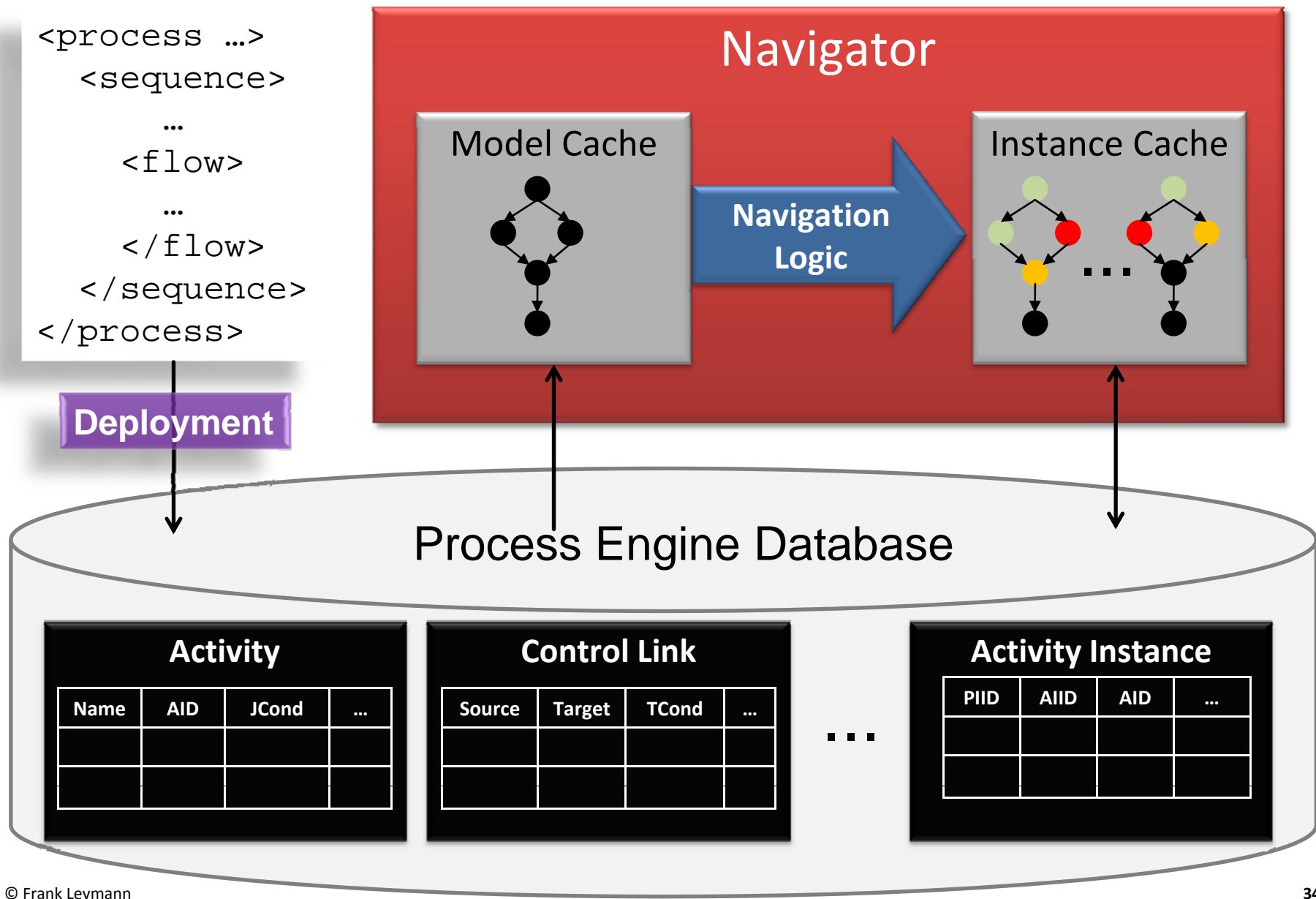
The Role of Deployment



Deployment

- **Deployment** = Putting process model into production
 - I.e. make it ready for execution
- Deployment typically **translates the corresponding model** data into a different format, e.g.
 - Imported model might be specified in a metamodel different from what the WFMS supports directly
 - See next!
- ...plus many other things happen

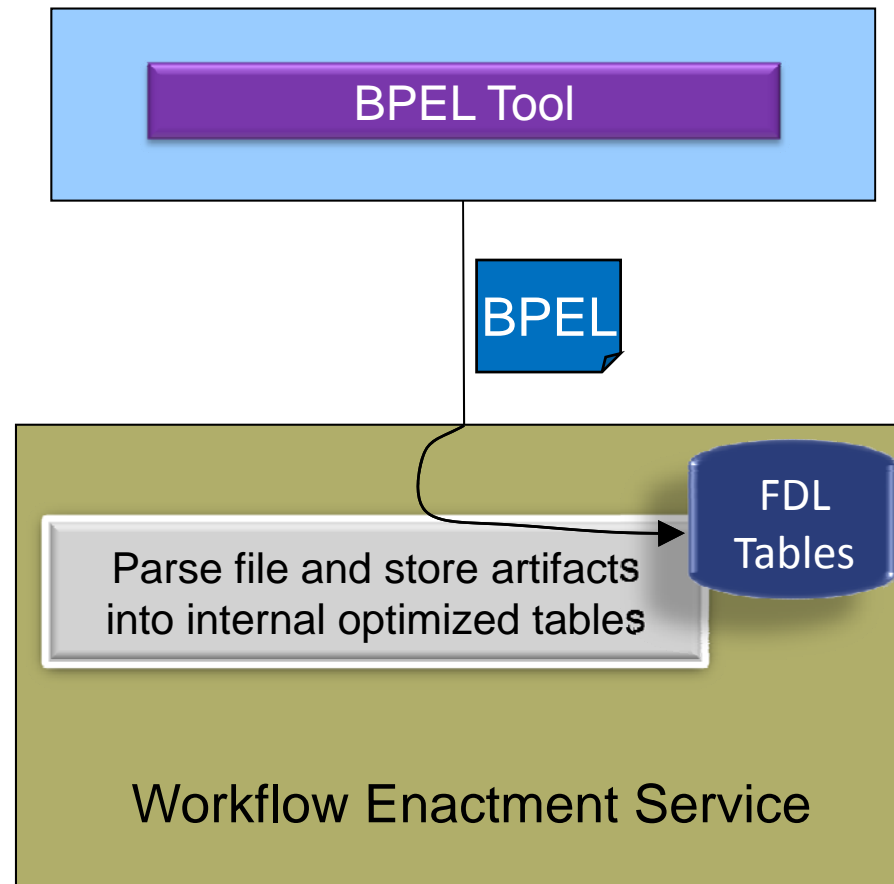
Deployment: Key Aspect



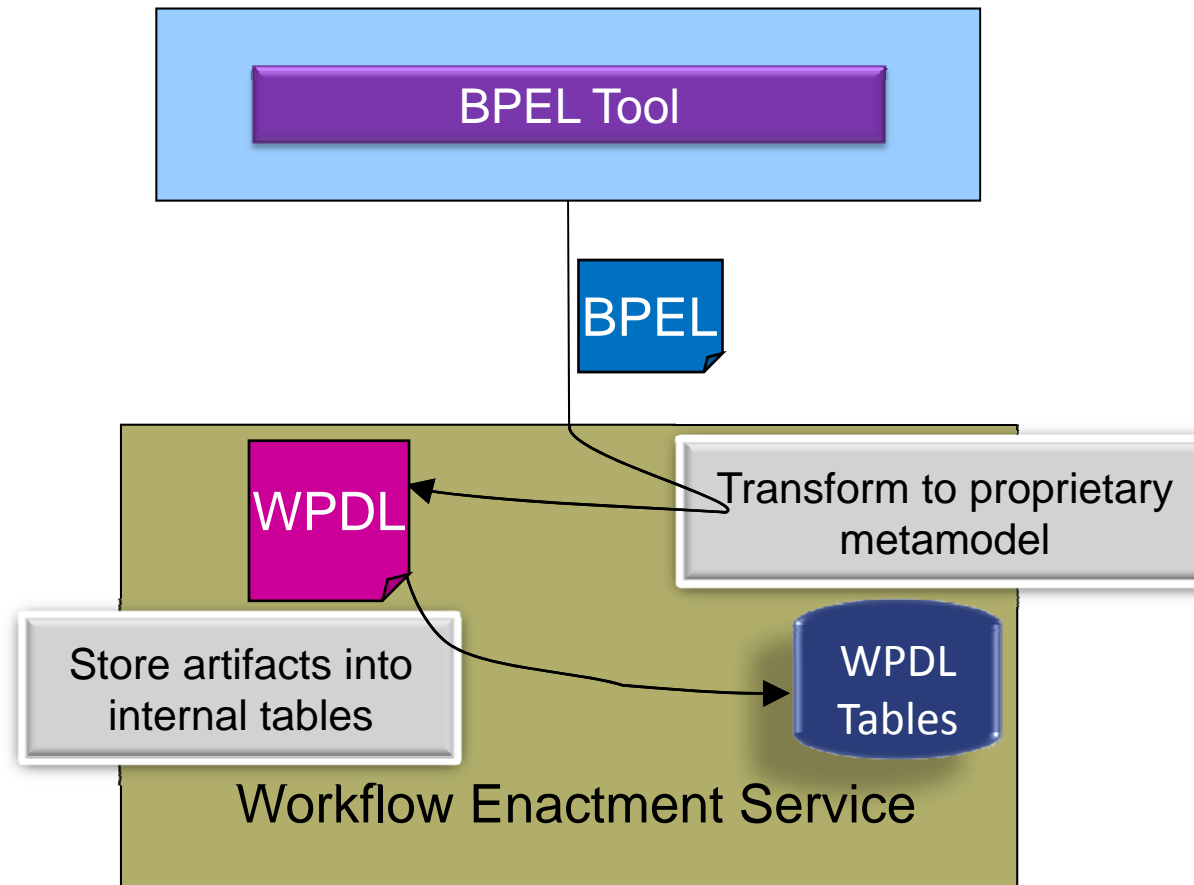
Native Support of a Metamodel

- Each workflow engine supports a particular metamodel **natively**
- Typically, the *native metamodel* supported is...
 - reflected in the database of the WFMS
 - database schema holds instances of metamodel constructs immediately
 - database schema is tuned towards supporting the navigator optimally
 - reflected in the state model of the WFMS
 - all metamodel constructs have a set of states and transitions between them
 - state model is reflected in monitoring model and audit trail
 - directly implemented in the navigator of the WFMS
 - navigator understands each metamodel construct directly, their states and valid transitions, the relation between the states of different artifacts
 - this implementation is “optimal”

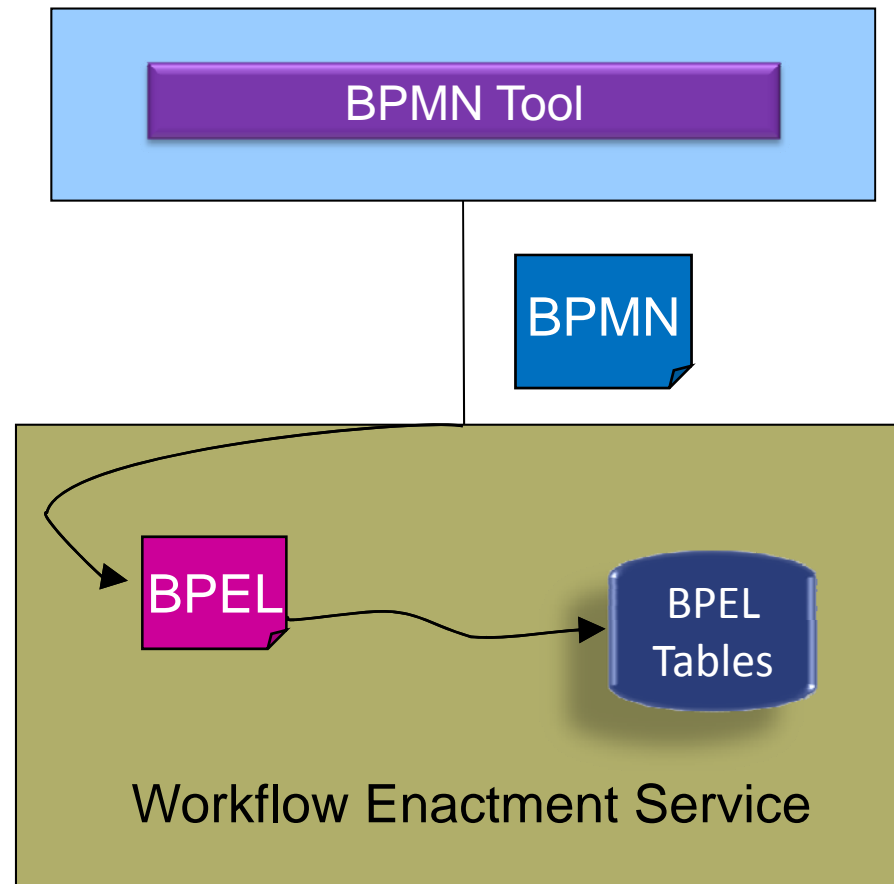
Transformation During Deployment: Example



Transformation During Deployment: Example



Transformation During Deployment: Example



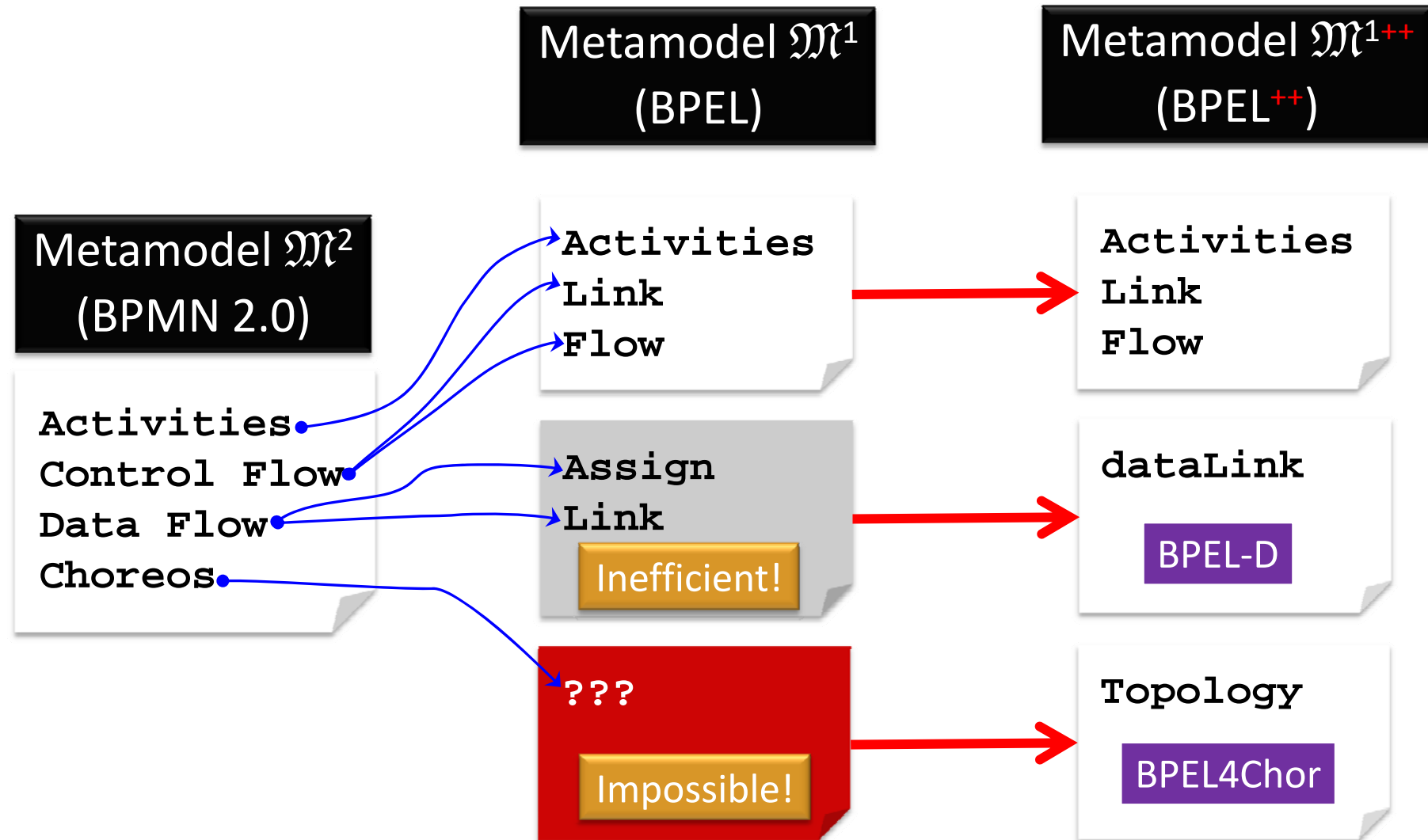
Model Transformations

- Process models specified in a different metamodel than the engine's native metamodel may be transformed into this native metamodel supported by a particular WFMS
- This way, a WFMS supporting WPDN natively may execute a BPEL model after corresponding transformation, for example
- This way, a WFMS supporting BPEL natively may execute a BPMN model after corresponding transformation, for example

Problems of Model Transformations

- Such transformations are not always faithful, i.e. the transformed model has different...
- ...**semantic behavior** than the original model
 - E.g. behavior of the source model has to be “emulated” in the target model – if possible at all
 - E.g. BPEL exception behavior is hard to emulate
- ...**operational behavior** than the original model
 - E.g. the navigator performs the transformed model less efficient than a WFMS supporting the metamodel of the original model
 - E.g. supporting FDL data flow in BPEL is cumbersome

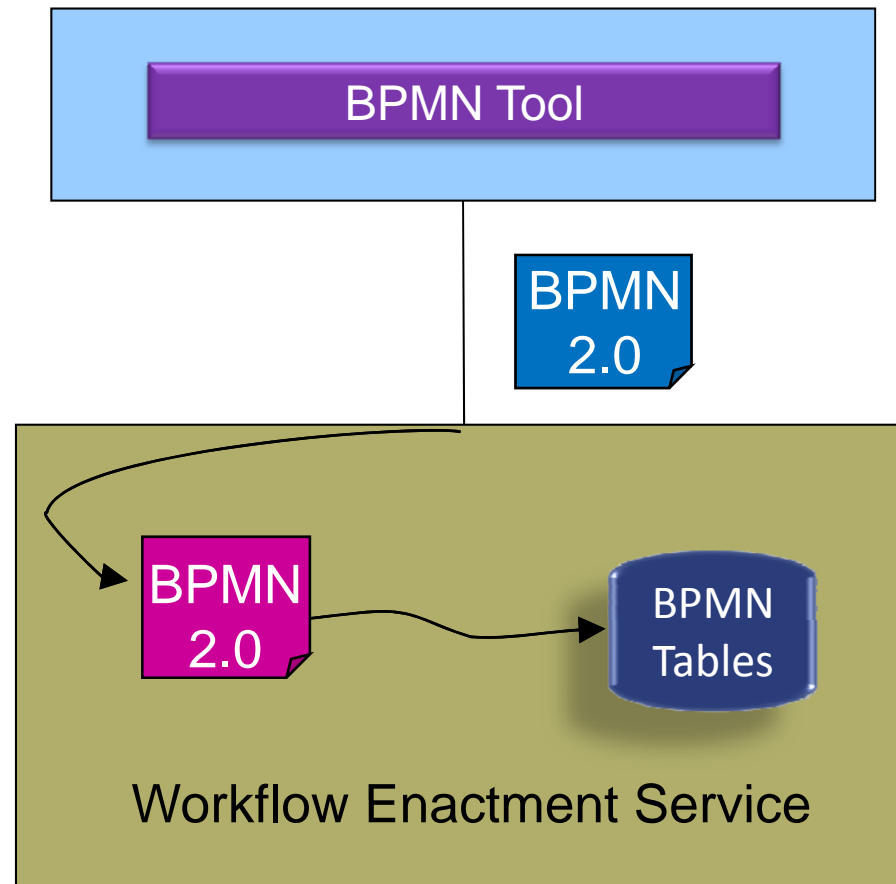
Supporting One Metamodel Within Another



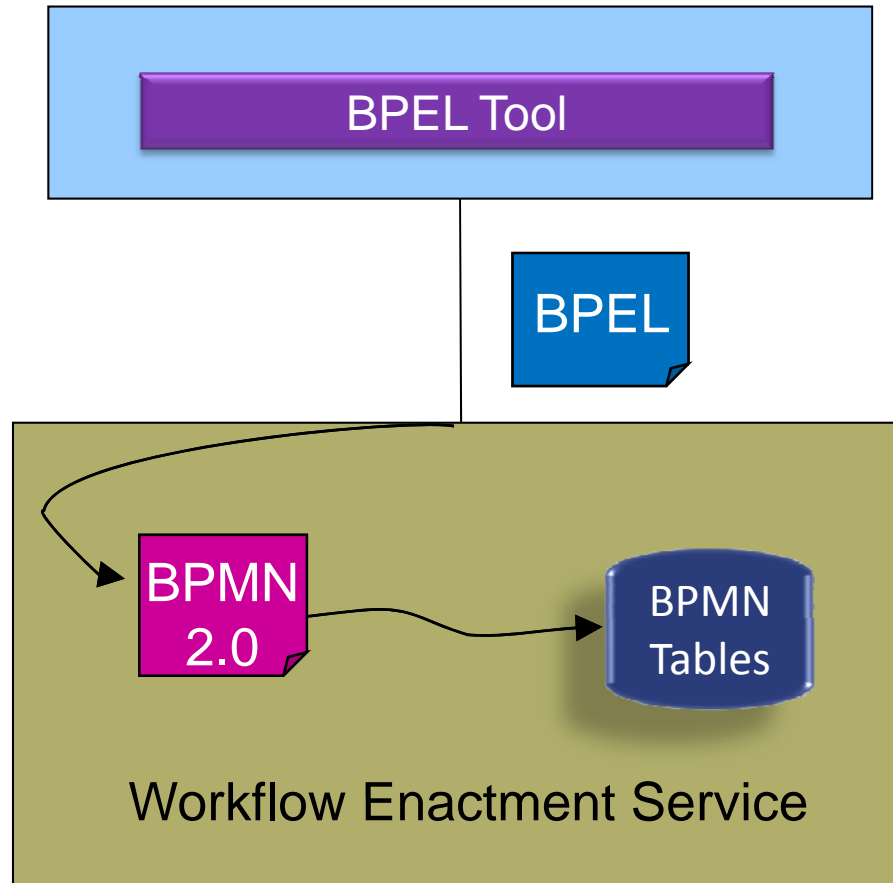
Extending a Given Metamodel

- Assume that models specified in a particular metamodel \mathcal{M}^2 must be “best” supported in an engine with a different metamodel \mathcal{M}^1
- Then, constructs of \mathcal{M}^2 that are hard to emulate in \mathcal{M}^1 must be identified and corresponding constructs must be added to \mathcal{M}^1
- This is why BPEL is designed to be extensible, to allow new constructs to be added to BPEL to facilitate optimal mappings from different metamodels
- That way, an extended variant of a given engine (an \mathcal{M}^{1++} engine) may actually support process models specified in different metamodels $\mathcal{M}^2, \mathcal{M}^3, \dots, \mathcal{M}^n$

The Dawn of BPMN Engines



...and it Might Get Surprising 😊



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Consequence For BPMN 2.0 Engines

- Whether the BPMN 2.0 process model is executed by a BPEL engine or by a *new BPMN 2.0 engine is not important*
- Native metamodel of a BPMN 2.0 engine is likely to be different from BPMN 2.0 as a metamodel anyhow
- Native metamodel of a BPMN 2.0 engine might be one that supports also BPEL today
- I.e. vendor of a BPEL engine that provides import capabilities for BPMN 2.0 process models might become a vendor of a BPMN 2.0 engine based on the very same execution engine
- It is absolutely valid that an intermediate BPEL process model from the BPMN 2.0 process model is generated before the actual import takes place
 - ...users might not even be aware of this intermediate BPEL format at all

What is Important About a Process Engine?

Far more important than the native metamodel of a process engine (BPMN 2.0 engine too) is its robustness, efficiency, scalability etc

- Providers of today's BPEL engines typically have invested a lot into these non-functional properties of their engines
- Thus, such vendors have the capabilities to also offer BPMN 2.0 engines with the very same non-functional properties

A DBMS Analogy

- In the past, new upcoming vendors implemented dedicated object oriented database systems OODBMS
 - The object model was natively supported by these DBMS
- But robustness, efficiency, scale,... was often lacking by such systems
- Over time established RDBMS vendors supported key constructs of the object paradigm while providing robustness, efficiency, scale,...
- OODBMS are no mainstream anymore



Extrapolation to Process Engines

- BPMN 2.0 is significantly more complex than BPEL
- Thus, vendors will subset BPMN 2.0 based on their customers' requirements

It is likely that no vendor will support all of BPMN 2.0 in its product

- BPEL engines will get extended over the time to support key features of BPMN 2.0 that are missing in BPEL and BPEL engines today
- BPEL engines will evolve to support relevant BPMN 2.0 features (those missing in BPEL today)
- So, relax and wait until today's process engines support missing BPMN features (but robust, efficient, scaling,...)

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How Execution is Enabled

- Many execution relevant information is only available via the BPMN 2.0 schema
- I.e. the graphical notation by far does not contain the information required to instantiate a BPMN process model and execute it
- The corresponding syntactical details are given in the BPMN 2.0 spec as UML Class Diagrams and XML Schema Definitions
 - But the given operational semantics does not match this level of detail

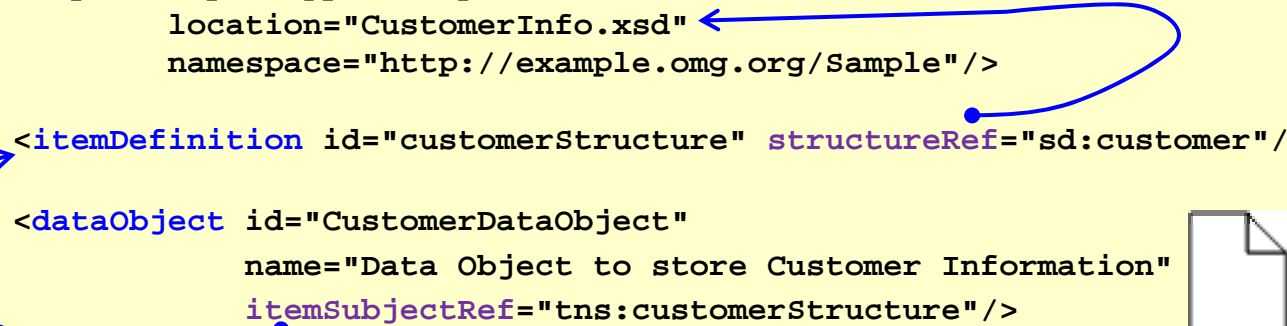


Data Context In Processes

```
<import importType="http://www.w3c.com/XMLSchema"
  location="CustomerInfo.xsd"
  namespace="http://example.omg.org/Sample"/>


<itemDefinition id="customerStructure" structureRef="sd:customer"/>

<dataObject id="CustomerDataObject"
  name="Data Object to store Customer Information"
  itemSubjectRef="tns:customerStructure"/>
```

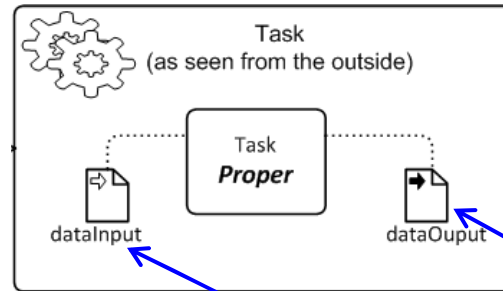


Messages In Processes

```
<itemDefinition id="tasksvcCustomerMessageStructure"  
    structureRef="tasksvc:MyFirstTaskServiceRequestMessage"/>  
  
<message id="myServiceCustomerMessage"  
    name="MyFirstTaskService Request Message"  
    structureRef="tns:tasksvcCustomerMessageStructure"/>
```



Mental Model About Task Input/Output



```
<serviceTask name="Task" id="Task" ... >
...
<iospecification>
  <dataInput id="dataInput" .../>
  <dataOutput id="dataOutput" .../>
</iospecification>

<dataInputAssociation>
  <sourceRef>InputDataObject</sourceRef>
  <targetRef>dataInput</targetRef>
</dataInputAssociation>

<dataOutputAssociation>
  <sourceRef>dataOutput</sourceRef>
  <targetRef>OutputDataObject</targetRef>
</dataOutputAssociation>

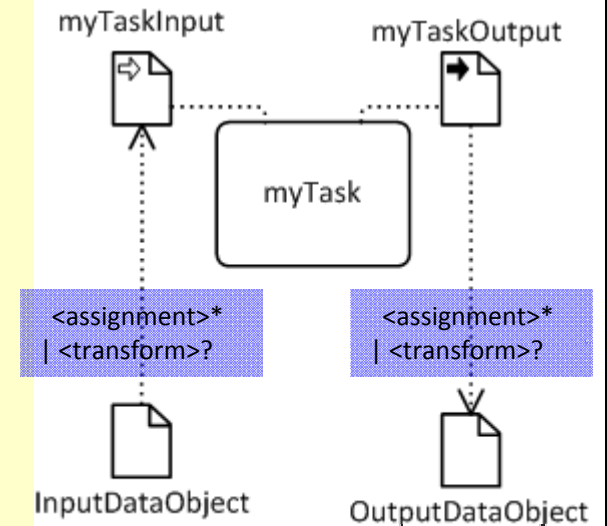
...
</serviceTask>
```

Transforming Data Objects to Task Data

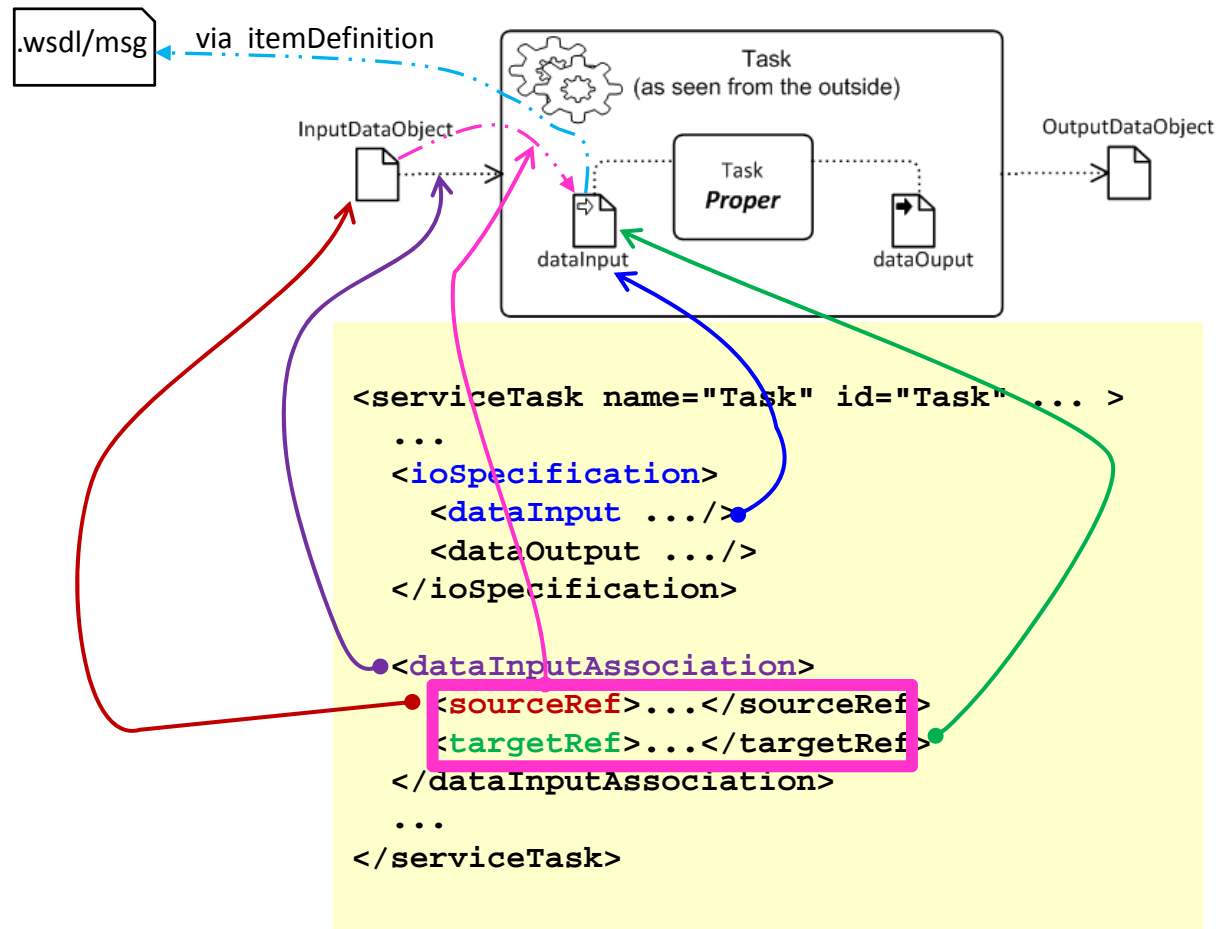
```
<serviceTask name="myTask" id="myTask" ... >
  ...
  <ioSpecification>
    <dataInput id="myTaskInput" .../>
    <dataOutput id="myTaskOutput" .../>
  </ioSpecification>

  <dataInputAssociation>
    <assignment>
      <from>bpmn:getDataObject('InputDataObject')/XPath</from>
      <to>bpmn:getDataInput('myTaskInput')/XPath</to>
    </assignment>
    <sourceRef>InputDataObject</sourceRef>
    <targetRef>myTaskInput</targetRef>
  </dataInputAssociation>

  <dataOutputAssociation>
    <transformation> expression </transformation>
    <sourceRef>myTaskOutput</sourceRef>
    <targetRef>OutputDataObject</targetRef>
  </dataOutputAssociation>
  ...
</serviceTask>
```

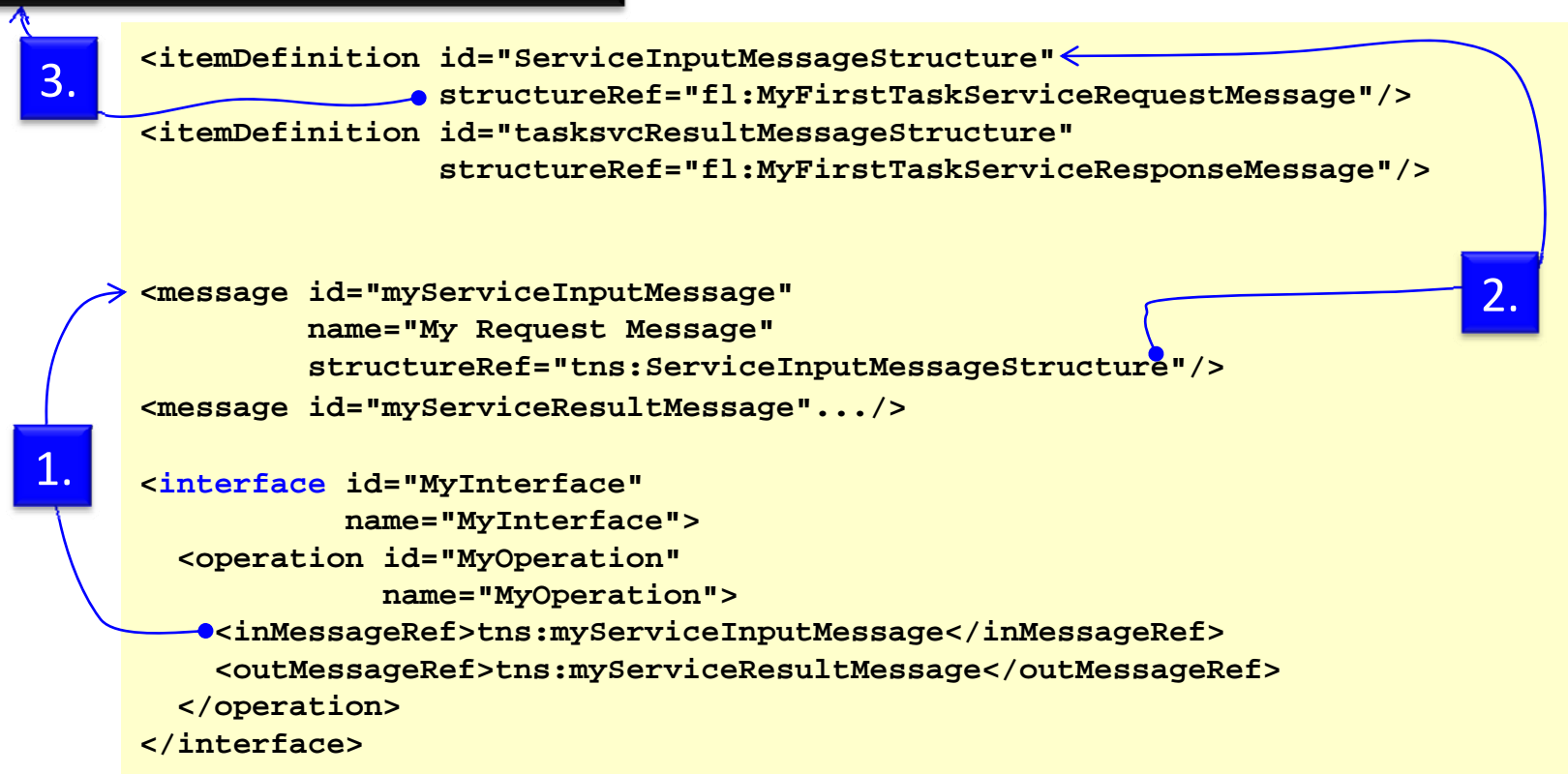


Summary: Important Relations For Input/Output



Defining Interfaces

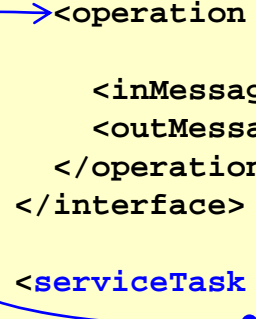
Imported .wsdl (or .xsd or...)



Service Tasks

```
<interface id="MyInterface"
  name="MyInterface">
  <operation id="MyOperation"
    name="MyOperation">
    <inMessageRef>tns:myServiceInputMessage</inMessageRef>
    <outMessageRef>tns:myServiceResultMessage</outMessageRef>
  </operation>
</interface>

<serviceTask id="MyTask" name="MyTask"
  operationRef="tns:MyOperation">
  <ioSpecification>
    <dataInput id="DataInput" name="Data to be send to service" .../>
    <dataOutput id="DataOutput" name="Result Output" .../>
    ...
  </ioSpecification>
  ...
</serviceTask>
```



Early Binding of Interfaces

```
<process id="ServiceTaskProecss" name="My Process">

  <partnerRole id="SvcProviderRole" name="Provider of Service Implementation"/>
  ...
  <collaboration id="MyCollab" name="Service Task Collaboration">
    <participant id="ServiceProvidingPartner"
      name="Partner Providing Service Implementations">
      <partnerRolRef>tns:SvcProviderRole</partnerRoleRef>
      <interfaceRef>tns:BillingInterface</interfaceRef>
      <interfaceRef>tns:PaymentInterface</interfaceRef>
      <endPointRef>tns:MyBillingEndpoint</endPointRef>
      <endPointRef>tns:MyPaymentEndpoint</endPointRef>
    </participant>
    <participant id="OrderProcess"
      name="Process using services">
      <processRef>ServiceTaskProcess</processRef>
      ...
    </participant>
    ...
  </collaboration>
  <endPoint id="MyBillingEndpoint"> e.g. an EPR </endPoint>
  <endPoint id="MyPaymentEndpoint"> e.g. an EPR </endPoint>
```

Endpoint of the implementation of the interface

Multi-Instance Task

```

1. <dataObject isCollection="true" ... id="DataObject1"/>
   <dataObject isCollection="true" ... id="DataObject2"/>

   <serviceTask name="MyMIService" id="MyMIService">

     <multiInstanceLoopCharacteristics isSequential="false">
       <loopDataInput>MultInstServiceInput</loopDataInput>
       <loopDataOutput>MultInstServiceOutput</loopDataOutput>
       <inputDataItem id="singleMemberInput"/>
       <outputDataItem id="singleMemberOutput"/>
     </multiInstanceLoopCharacteristics>

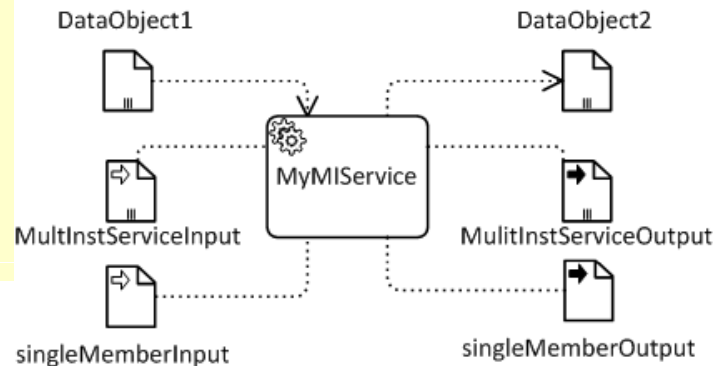
     <ioSpecification>
       <dataInput id="MultInstServiceInput" ... isCollection="true"/>
       <dataOutput id="MultInstServiceOutput" ... isCollection="true"/>
     </ioSpecification>

     <dataInputAssociation ...>
       <sourceRef>DataObject1</sourceRef>
       <targetRef>MultInstServiceInput</targetRef>
     </dataInputAssociation>
     <dataOutputAssociation ...>
       <sourceRef>MultInstServiceOutput</sourceRef>
       <targetRef>DataObject2</targetRef>
     </dataOutputAssociation>

   </serviceTask>
  
```

An "internal" multi-instance data object for each element of which a separate instance of the task is created

An element (i.e. "item") of the multi-instance loop data input/output



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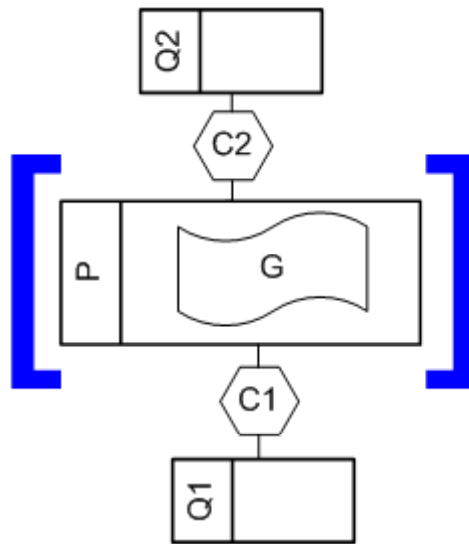
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Summary

Basic Principle

- A (recursive) function **[..]** is specified that allows to map a subset of BPMN to BPEL
- This map is specified by describing:
 1. [t] for all elementary BPMN tasks t that can be mapped to BPEL
 2. [e] for all elementary BPMN events e that can be mapped to BPEL
 3. [s] for all BPMN structures s that have a straight-forward mapping to BPEL
- This constructively defines the BPMN subset that can be mapped, as well as the associated map **[..]** itself

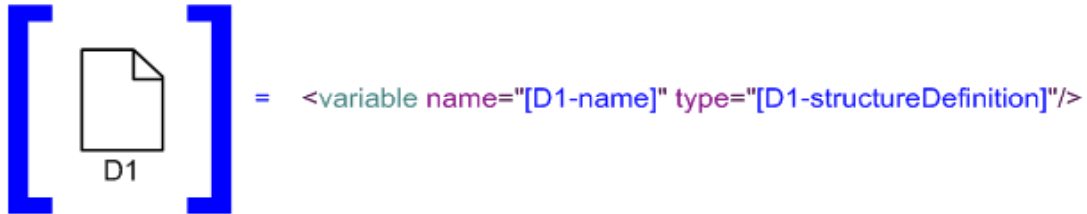
Mapping a Process

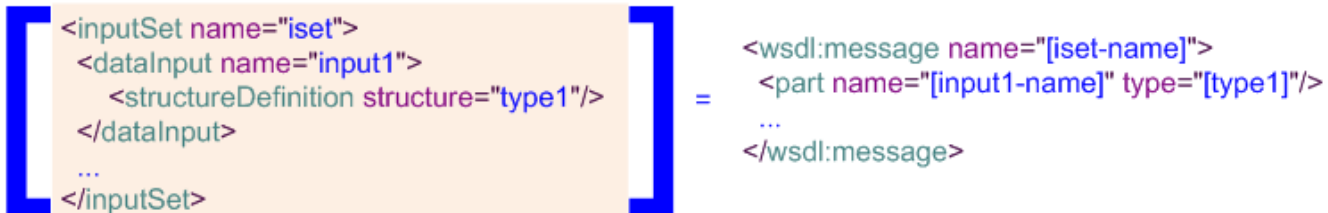


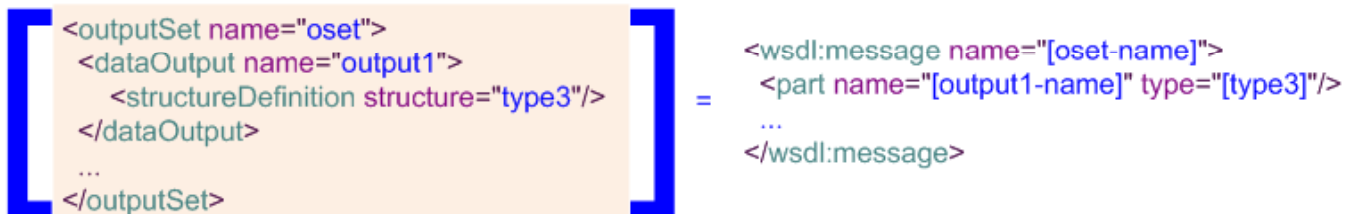
=

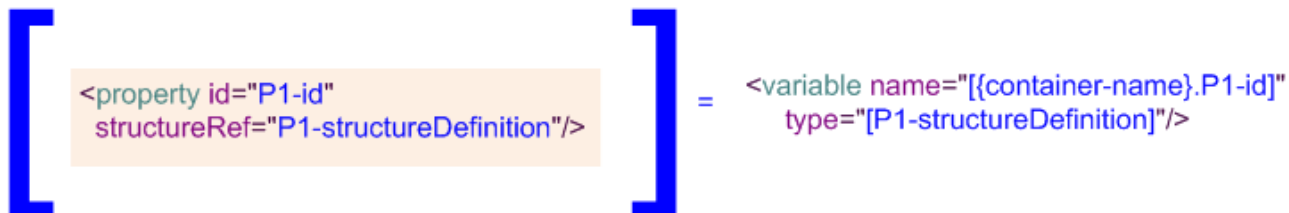
```
<process name="[P-name]"
  targetNamespace="[targetNamespace]"
  expressionLanguage="[expressionLanguage]"
  suppressJoinFailure="yes"
  xmlns="http://docs.oasis-open.org/wsbpel/2.0/process/executable">
  <partnerLinks>
    [ {P-Interfaces} UNION {Qi-Interfaces} ]
  </partnerLinks>
  <variables>
    [ {dataObjects} UNION {properties} ]
  </variables>
  <correlationSets>
    [ {Ci-CorrelationKeys} ]
  </correlationSets>
  [G]
</process>
```

Mapping Data

 = `<variable name="[D1-name]" type="[D1-structureDefinition]"/>`

 = `<wsdl:message name="[iset-name]">
<part name="[input1-name]" type="[type1]"/>
...
</wsdl:message>`

 = `<wsdl:message name="[oset-name]">
<part name="[output1-name]" type="[type3]"/>
...
</wsdl:message>`

 = `<variable name="[container-name].P1-id]" type="[P1-structureDefinition]"/>`

Mapping Messages and Interfaces

```
[ <Message name="msg-name">
  <StructureDefinition typeLanguage=
    "http://www.w3.org/2001/XMLSchema">
    xmlSchema
  </StructureDefinition>
</Message> ] = <wsdl:message name="[msg-name]">
  [xmlSchema]
</wsdl:message>
```

```
[ <Interface name="if-name">
  <Operations>
    <Operation name="op1-name">
      <inMessageRef ref="msg1i-name"/>
      <outMessageRef ref="msg1o-name"/>
      <errorRef ref="error1a-name"/>
      ...
    </Operation>
    ...
  </Operations>
</Interface> ] = <wsdl:portType name="[if-name]">
  <operation name="[op1-name]">
    <wsdl:input message="[msg1i-name]" />
    <wsdl:output message="[msg1o-name]" />
    <wsdl:fault name="[error1a-faultname]"
      message="[error1a-name]" />
    ...
  </operation>
  ...
</wsdl:portType>
```

Mapping Correlations

```
<KeyBasedCorrelationSet name="c-set">
  <Key name="k-name1" type="k-type1"
    messageRef="msg-name1">
    <MessageKeyExpression
      expressionLanguage="lang1">
      expr1
    </MessageKeyExpression>
  </Key>
  ...
  <Key name="k-nameN" />
  ...
</KeyBasedCorrelationSet>
```

]

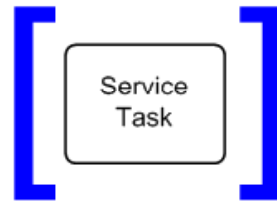
=

```
<vprop:property name="[k-name1]" type="[k-type1]"/>
...
<vprop:property name="[k-nameN]" />

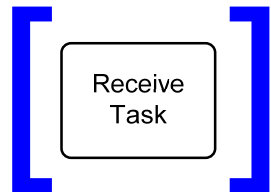
<vprop:propertyAlias propertyName="[kName1]"
  messageType="[msg-name1]"
  part="[expr1-part]">
  <vprop:query queryLanguage="[lang1]">
  [expr1]
  </vprop:query>
</vprop:propertyAlias>
...
<vprop:propertyAlias propertyName="[kNameN]" />

<correlationSets>
  <correlationSet name="[c-set]"
    properties="[k-name1] ... [k-nameN]"/>
  ...
</correlationSets>
```

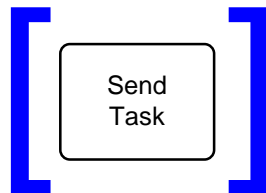
Mapping Tasks



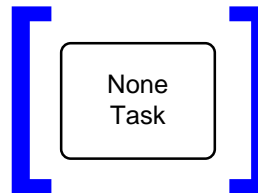
```
= <invoke name="[Task-name]"
  partnerLink="[Q, Task-operation-interface]"
  portType="[Task-operation-interface]"
  operation="[Task-operation]">
  <correlations>
    <correlation set="[Task-messageFlow-conversation-correlationKey]"
      initiate="[initialInConversation? 'join':'no']"/>
  </correlations>
</invoke>
```



```
= <receive name="[Task-name]"
  createInstance="[instantiate? 'yes':'no'"
  partnerLink="[Task-serviceRef]"
  portType="[Task-operation-interface]"
  operation="[Task-operation]">
</receive>
```

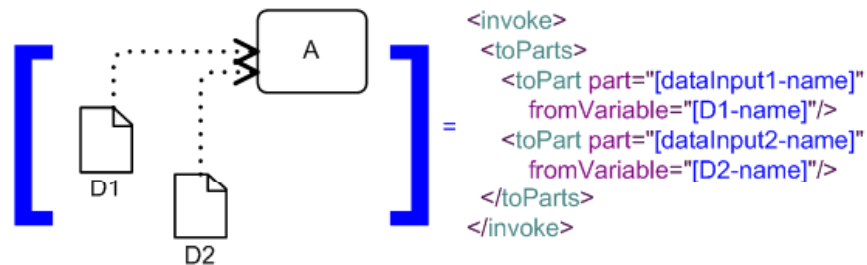
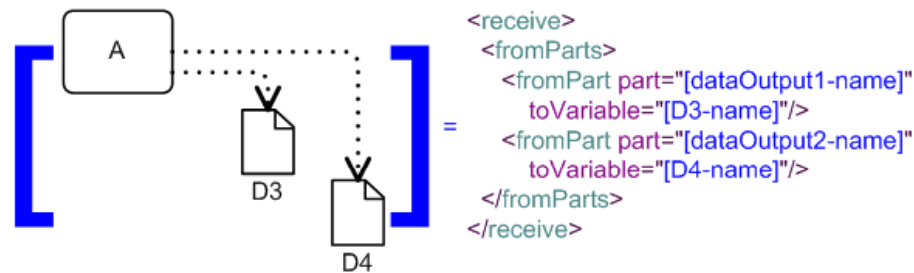
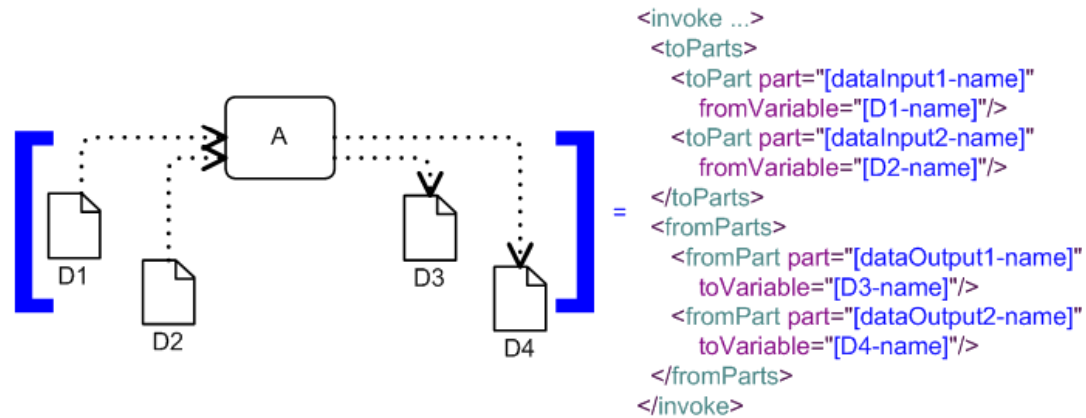


```
= <invoke name="[Task-name]"
  partnerLink="[Task-serviceRef]"
  portType="[Task-operation-interface]"
  operation="[Task-operation]">
</invoke>
```



```
= <empty name="[Task-name]">
</empty>
```

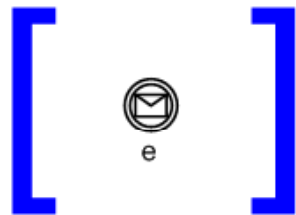
Mapping Task Input/Output



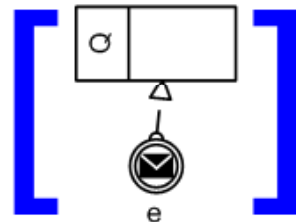
Mapping Events (1/2)



```
<receive name="[e-name]"
createInstance="yes"
partnerLink="[e-operation-interface]"
portType="[e-operation-interface]"
operation="[e-operation]">
</receive>
```



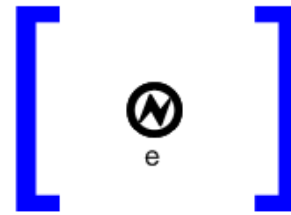
```
<receive name="[e-name]"
createInstance="no"
partnerLink="[e-operation-interface]"
portType="[e-operation-interface]"
operation="[e-operation]">
</receive>
```



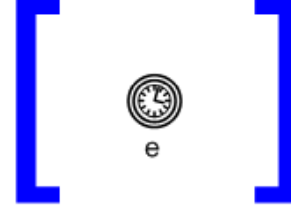
```
<invoke name="[e-name]"
partnerLink="[Q, e-operation-interface]"
portType="[e-operation-interface]"
operation="[e-operation]">
</invoke>
```



```
<invoke name="[e-name]"
partnerLink="[Q, e-operation-interface]"
portType="[e-operation-interface]"
operation="[e-operation]">
</invoke>
```

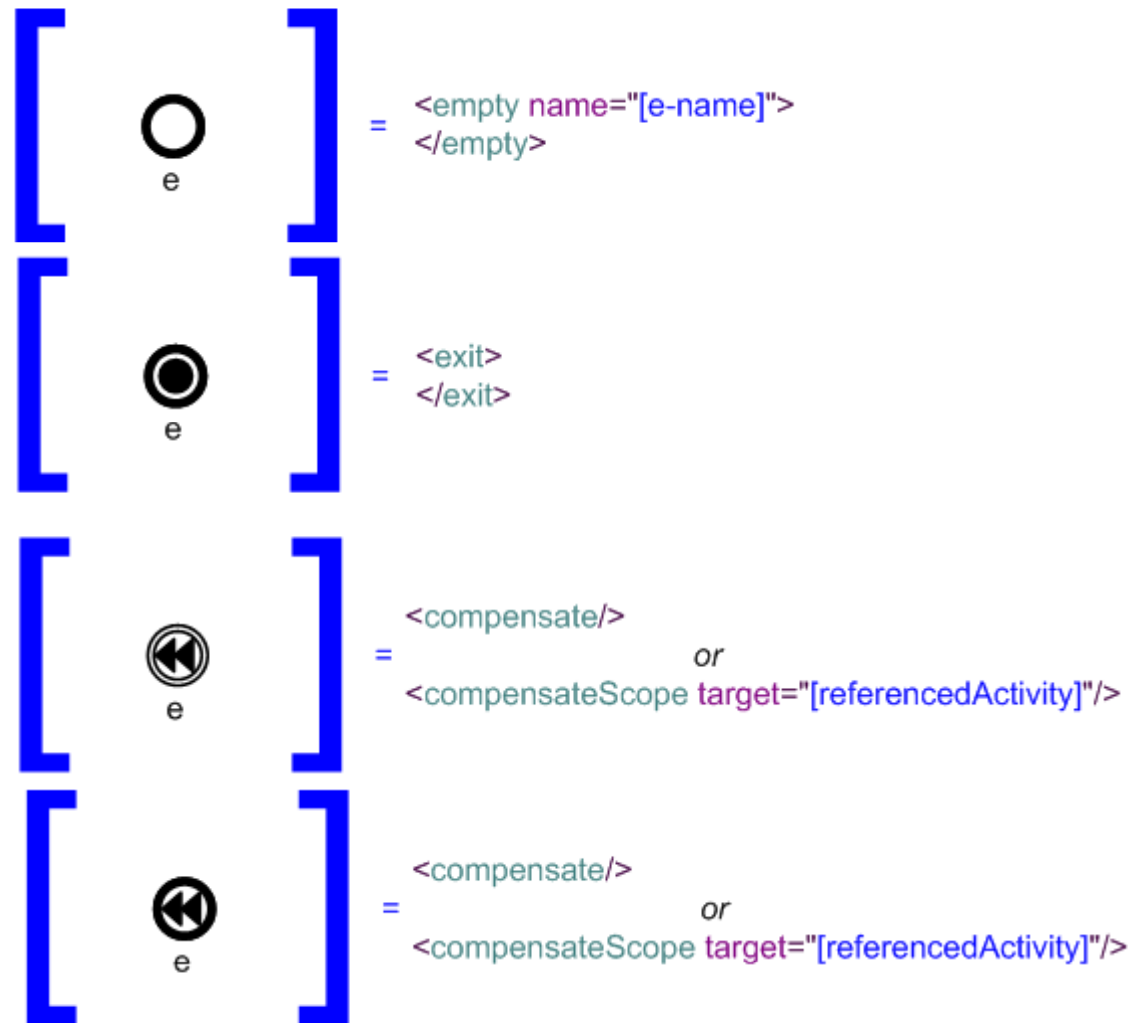


```
<throw faultName="[e-name]">
</throw>
```

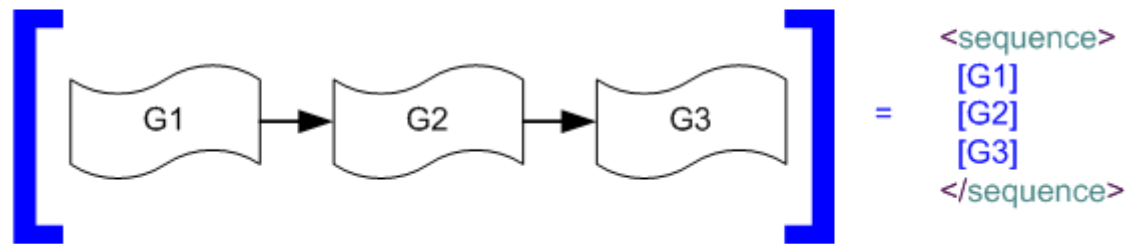


```
<wait name="[e-name]" for="[e-TimeCycle]"/>
or
<wait name="[e-name]" until="[e-TimeDate]"/>
```

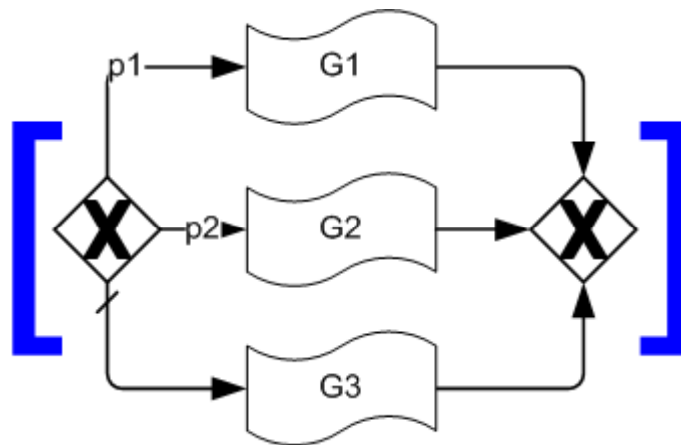
Mapping Events (2/2)



Mapping Sequences



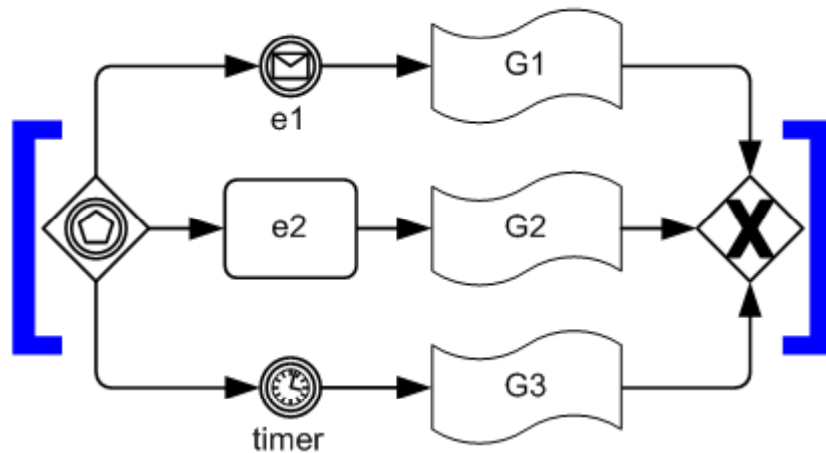
Mapping If-Then-Else



=

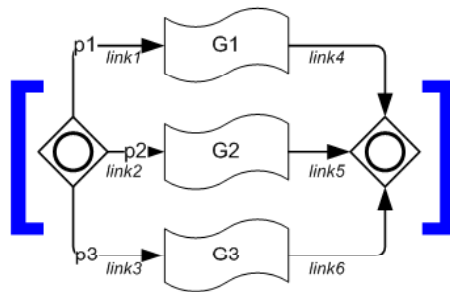
```
<if><condition>[p1]</condition>  
  [G1]  
<elseif><condition>[p2]</condition>  
  [G2]  
</elseif>  
<else>  
  [G3]  
</else>  
</if>
```

Mapping Pick



```
<pick createInstance="[instantiate? 'yes':'no']">  
  <onMessage partnerLink="[e1-operation-interface]"  
    operation="[e1-operation]">  
    [G1]  
  </onMessage>  
  <onMessage partnerLink="[e2-operation-interface]"  
    operation="[e2-operation]">  
    [G2]  
  </onMessage>  
  <onAlarm>  
    [timer-spec]  
    [G3]  
  </onAlarm>  
</pick>
```

Mapping Flow



```

<flow>
<links>
  <link name="[link1]"/>
  ...
  <link name="[link6]"/>
</links>

<empty>
<sources>
  <source linkName="[link1]">
    <transitionCondition>[p1]</transitionCondition>
  </source>
  <source linkName="[link2]">
    <transitionCondition>[p2]</transitionCondition>
  </source>
  <source linkName="[link3]">
    <transitionCondition>[p3]</transitionCondition>
  </source>
</sources>
</empty>

<flow>
  <targets><target linkName="[link1]"/></targets>
  <sources><source linkName="[link4]"/></sources>
  [G1]
</flow>

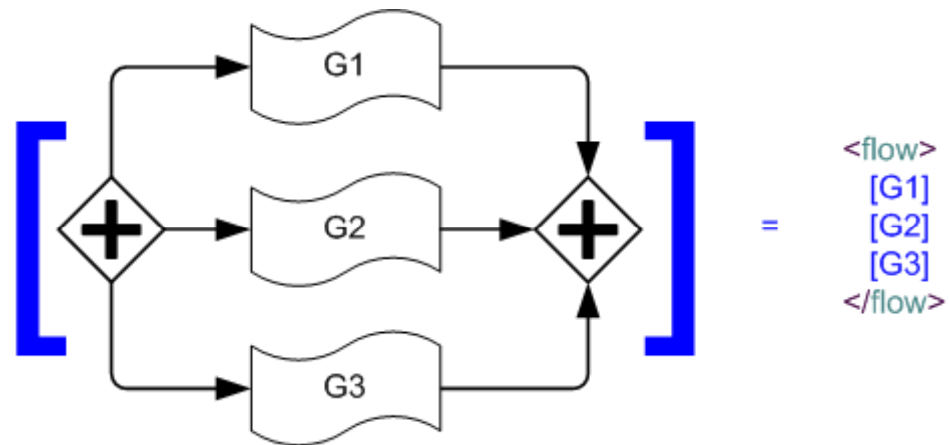
<flow>
  <targets><target linkName="[link2]"/></targets>
  <sources><source linkName="[link5]"/></sources>
  [G2]
</flow>

<flow>
  <targets><target linkName="[link3]"/></targets>
  <sources><source linkName="[link6]"/></sources>
  [G3]
</flow>

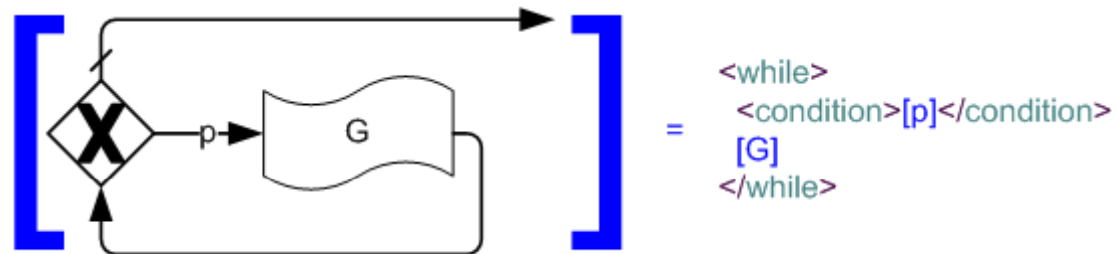
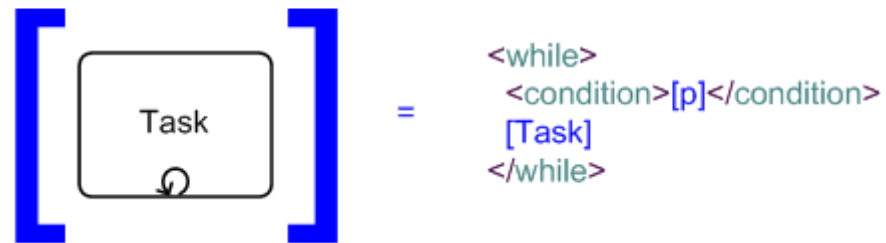
<empty>
<targets>
  <target linkName="[link4]"/>
  <target linkName="[link5]"/>
  <target linkName="[link6]"/>
</targets>
</empty>
</flow>

```

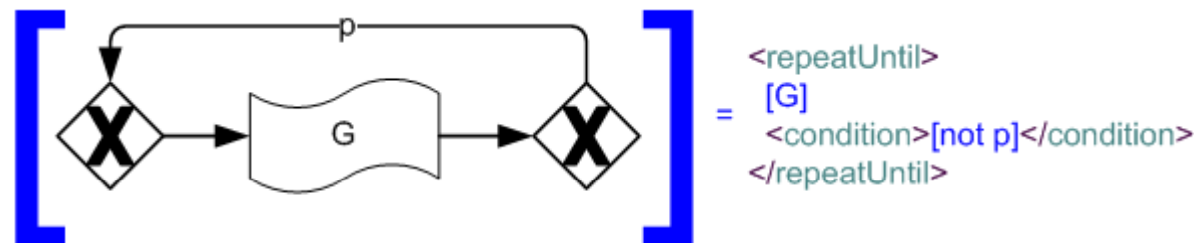
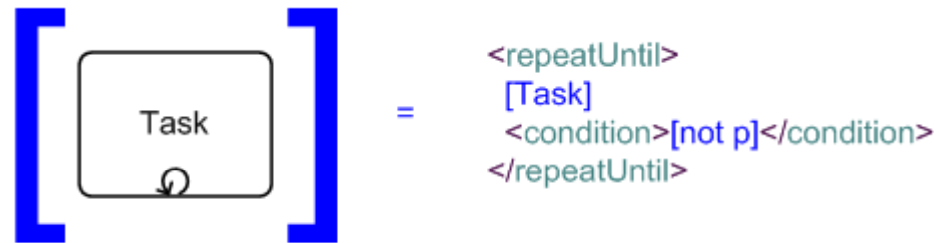
Mapping Parallel



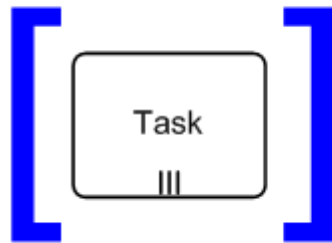
Mapping While-Loops



Mapping Until-Loops

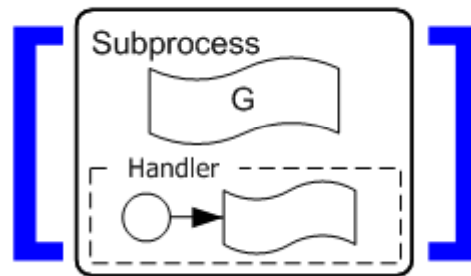


Mapping Multi-Instance-Loop-Characteristics



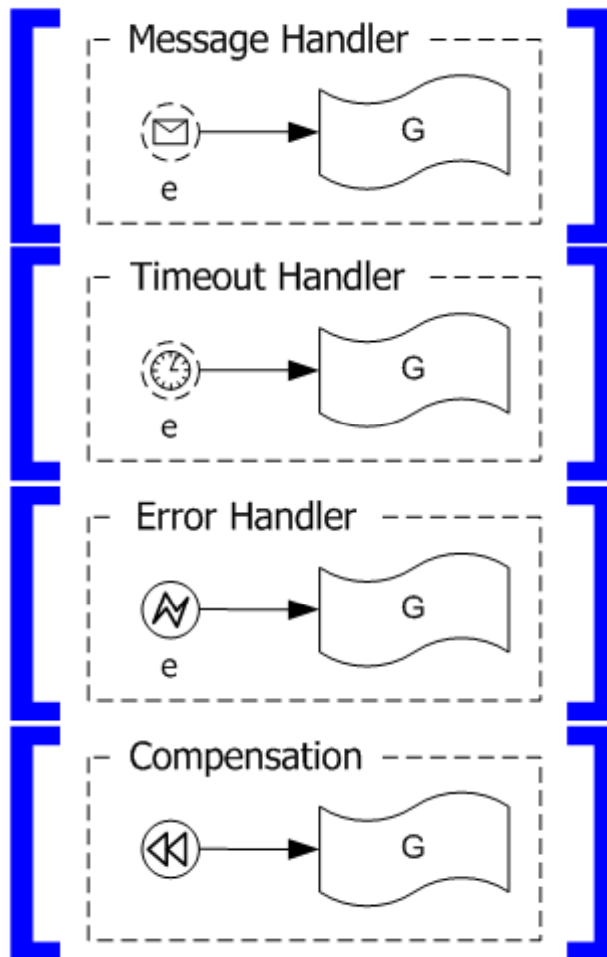
```
<variable name="[counter]" type="xsd:integer"/>  
...  
<forEach counterName="[counter]" parallel="[isSequential? 'no':'yes']">  
  <startCounterValue>1</startCounterValue>  
  = <finalCounterValue>[condition]</finalCounterValue>  
  <scope>  
    [Task]  
  </scope>  
</forEach>
```

Mapping Subprocesses



```
<scope name="[Subprocess-name]">  
  <partnerLinks>  
    [ {serviceRefs} ]  
  </partnerLinks>  
  <variables>  
    [ {dataObjects} UNION {properties} ]  
  </variables>  
  <correlationSets>  
    [ {correlations} ]  
  </correlationSets>  
  [Handler]  
  [G]  
</scope>
```

Mapping Handlers



```
<eventHandlers>
  <onEvent partnerLink="[e-operation-interface]"
    operation="[e-operation]">
    <scope>[G]</scope>
  </onEvent>
</eventHandlers>

=

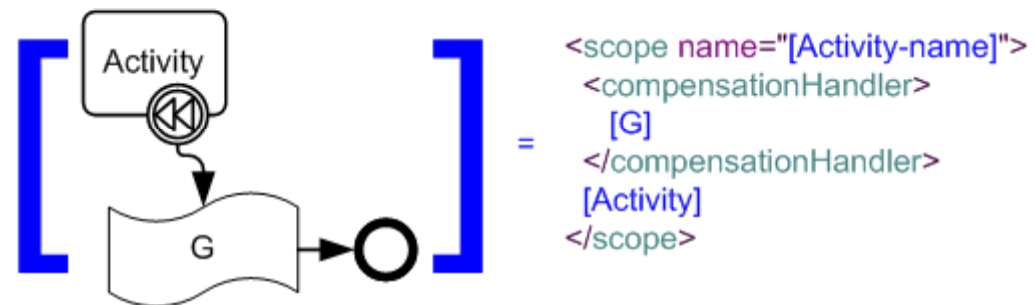
<eventHandlers>
  <onAlarm>[timer-spec]
  <scope>[G]</scope>
</onAlarm>
</eventHandlers>

<faultHandlers>
  <catch faultName="[e-error]">
  [G]
  </catch>
</faultHandlers>

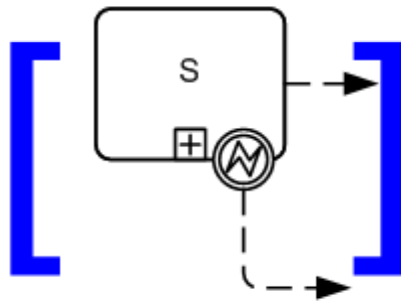
=

<compensationHandler>
= [G]
</compensationHandler>
```

Mapping Boundary Events (1/4)

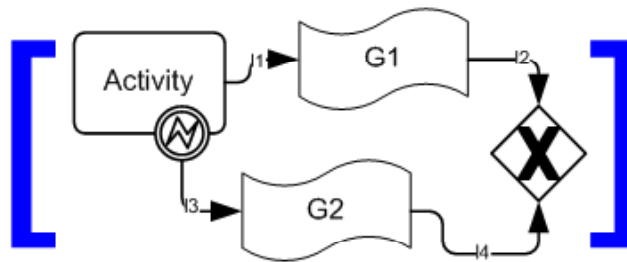


Mapping Boundary Events (2/4)



```
<scope>  
  <faultHandlers>  
    <faultHandler>  
      <catch faultName="...">  
        <empty>  
          <sources><source linkName="faultLink"/></sources>  
        </empty>  
      </catch>  
    </faultHandler>  
  </faultHandlers>  
  [S]  
</scope>
```

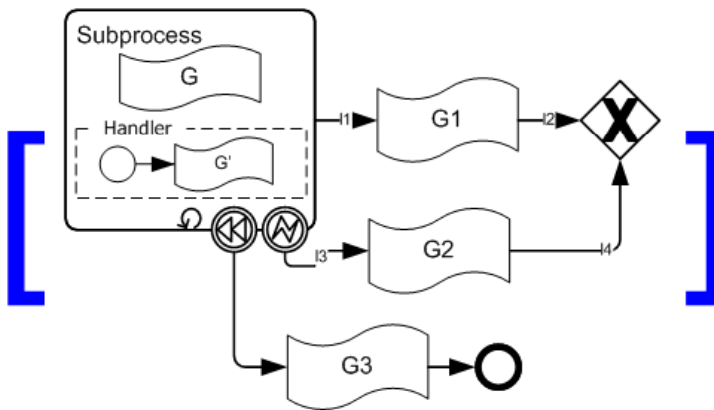
Mapping Boundary Events (3/4)



```

<flow>
  <links>
    <link name="[1]"/>
    ...
    <link name="[4]"/>
  </links>
  <scope>
    <sources><source linkName="[1]"/></sources>
    <faultHandlers>
      <catch faultName="[e-error]">
        <empty>
          <sources><source linkName="[3]"/></sources>
        </empty>
      </catch>
    </faultHandlers>
    [Activity]
  </scope>
  <flow>
    <targets><target linkName="[1]"/></targets>
    <sources><source linkName="[2]"/></sources>
    [G1]
  </flow>
  <flow>
    <targets><target linkName="[3]"/></targets>
    <sources><source linkName="[4]"/></sources>
    [G2]
  </flow>
  <empty>
    <sources><source linkName="[2]"/>
    <source linkName="[4]"/></sources>
  </empty>
</flow>
  
```

Mapping Boundary Events (1/4)



```

<flow>
  <links>
    <link name="[I1]"/>
    ...
    <link name="[I4]"/>
  </links>
  <scope>
    <sources><source linkName="[I1]"/></sources>
    <faultHandlers>
      <catch faultName="[e-error]">
        <empty>
          <sources><source linkName="[I3]"/></sources>
        </empty>
      </catch>
    </faultHandlers>
    <compensationHandler>
      [G3]
    </compensationHandler>
    <while>
      <condition><[p]</condition>
      <scope>
        [Handler]
        [G]
      </scope>
    </while>
  </scope>
  <flow>
    <targets><target linkName="[I1]"/></targets>
    <sources><source linkName="[I2]"/></sources>
    [G1]
  </flow>
  <flow>
    <targets><target linkName="[I3]"/></targets>
    <sources><source linkName="[I4]"/></sources>
    [G2]
  </flow>
  <empty>
    <sources><source linkName="[I2]"/>
    <source linkName="[I4]"/></sources>
  </empty>
</flow>

```

Agenda

Historical Remarks

BPMN Origin and Positioning

The Notion of “Native Metamodel”

View on Process Engines

Selective BPMN 2.0 Features

Executable BPMN - BPEL Mapping

Summary

Takeaways

- BPMN 2.0...
 - ...is a significant extension of BPMN 1.x
 - Choreographies, Collaborations, Conversations,
 - New event types and modes,
 - Event subprocesses,...
 - ...allows to specify executable process models
 - ...contains a subset nearly isomorphic to BPEL
- Especially, “BPMN 2.0 engines” can be build
- Process engines implement their own internal metamodel
 - Native BPEL engines are very rare!
 - So will be native BPMN engines!
- Based on BPMN 2.0 complexity, 100% compliant implementations will take far more than a decade (if they will hit the market at all)
 - Do you know a 100% BPEL compliant engine?
- In practice, most process engines will support both, BPEL and (a subset of) BPMN 2.0

End of Document