

Composition of Web Services

Oxford University

Software Engineering Programme

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Business Process Management

- Hammer & Champy [1993] “A collection of activities that takes one or more kinds of input and creates an output that is of value to the customer.”
- Davenport [1992] “A structured, measured set of activities designed to produce a specific output for a particular customer or market. It implies a strong emphasis on how work is done within an organization, in contrast to a product focus’s emphasis on what.”



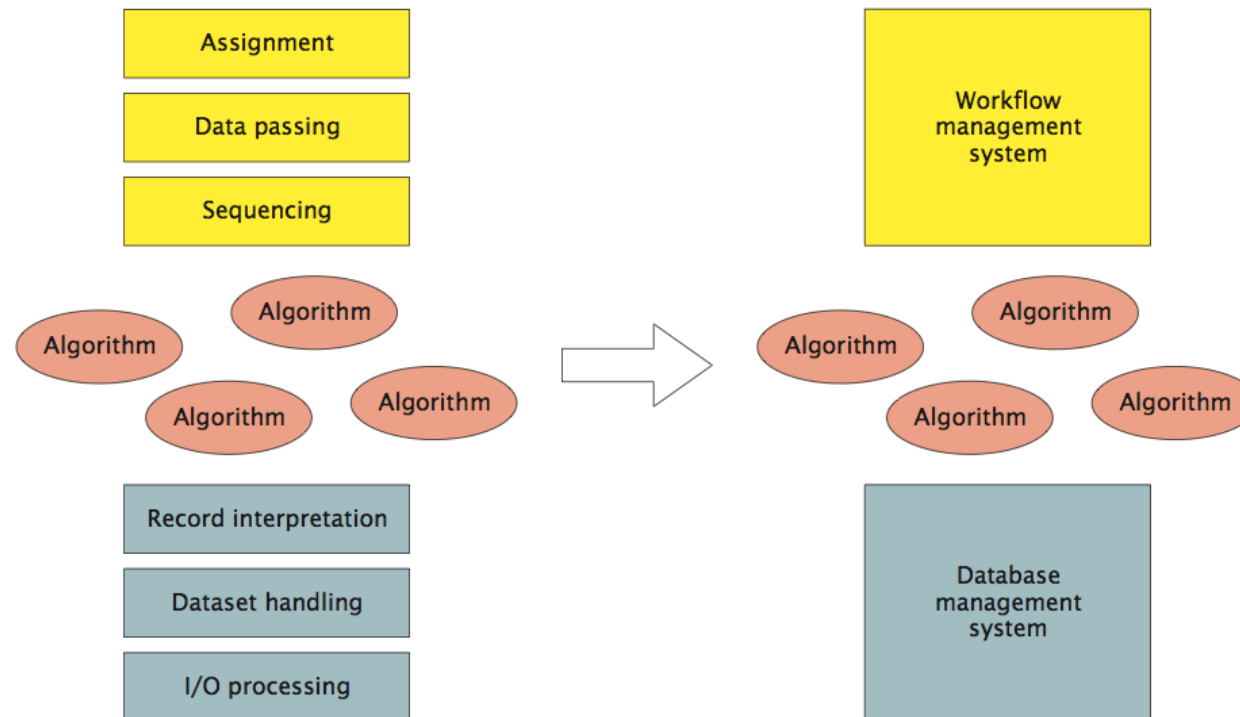
Composition

- Services provide *platform- and language-independent access to software components*
- But these components are *isolated*: they need to be *assembled* into *service-oriented architectures*
- Ideally, they should be recursively *composable* to form composite services in their own right
- *Workflow* languages for scripting or ‘glue’ between individual services
- BPMN, WSCI, WSFL, XLANG, BPEL. . .
- beyond mere *business protocol specifications* like RosettaNet, which are essentially paper specifications so can’t be automated and won’t scale



Removal of Dependencies (Leymann and Roller)

- DBMS provides independence from data *representation*; workflow provides independence from control or data *flow*.



Heritage

- *Enterprise application integration (EAI)*
 - resolving heterogeneity, typically via asynchronous *message brokers*
- *Workflow management systems (WfMS)*: automating interactions
 - origins in *office automation*: admin processes
- *Production workflows*: from information between people to integration of systems
 - often associated with *business process re-engineering*: assessment, analysis, modelling, definition, implementation
- Service composition = EAI + WfMS



Motivations

- Model Business Processes
 - Understand what happens?
 - Who is responsible?
 - What is involved?
- Simulate
 - Improve and model
- Execute
 - Automate processes
 - Improve them more quickly
- Monitor
 - Get a real-time health status of processes



Orchestration vs Choreography



<http://www.flickr.com/photos/herrolm/>



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Orchestration vs Choreography

- *Orchestration*
 - Describes procedure
 - instructs participants globally – imperative; centralized
 - typically deterministic: ‘must’
- *Choreography*
 - Describes protocol
 - Constraints on interaction, but participants act locally – declarative; no ‘current state’
 - Usually non-deterministic: ‘may’
- Orchestra has a conductor, Ballet does not



WS-Choreography Description Language

- <http://www.w3.org/TR/ws-cdl-10/>
- Never got past Candidate Recommendation
- Captures the flow of messages between parties
- Temporal and logical dependencies between messages
- features sequencing rules, correlation, exception handling and transactions
- Not executable

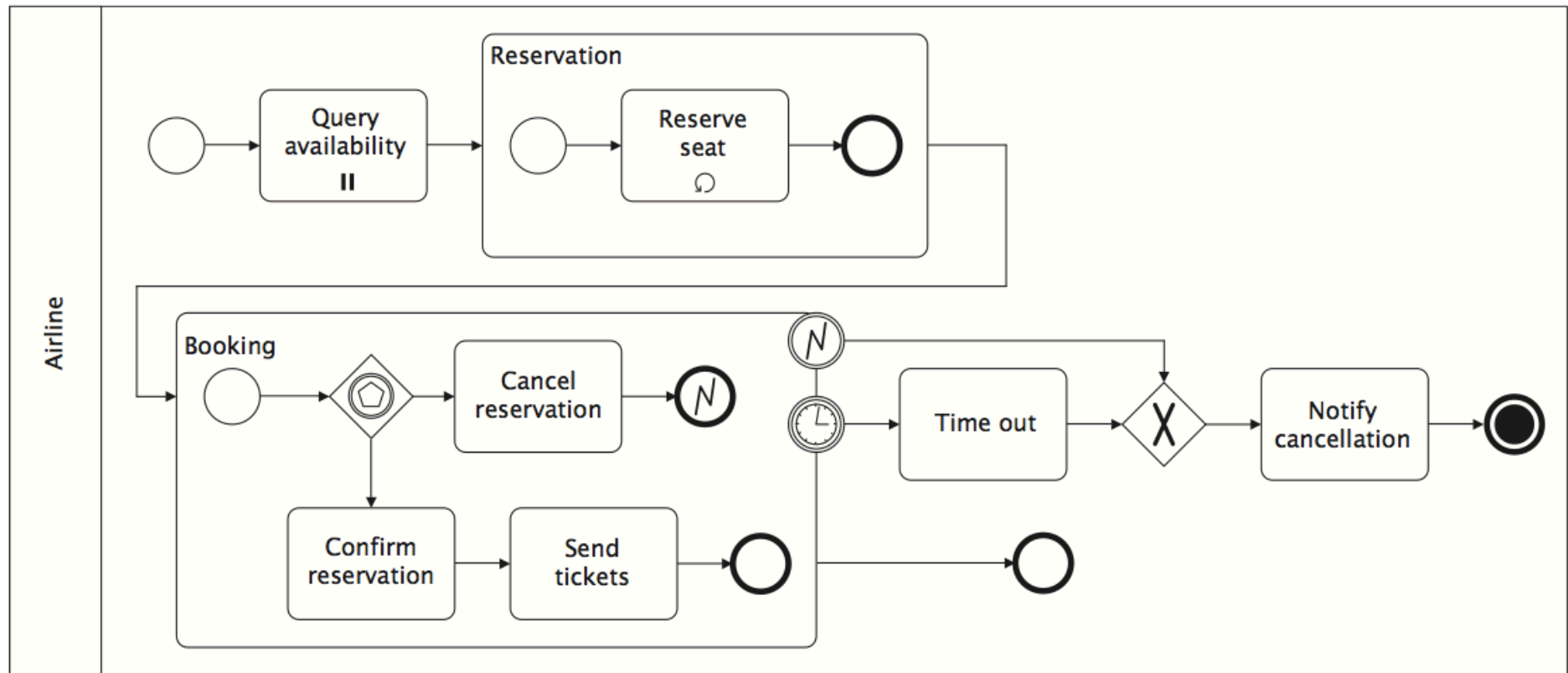


BPMN 1.1

- Designed to allow process designers to communicate
 - Think UML
- Activities, Gateways, Events
- Control and Data Flow
- Organization modelling (Pools, Swimlanes)

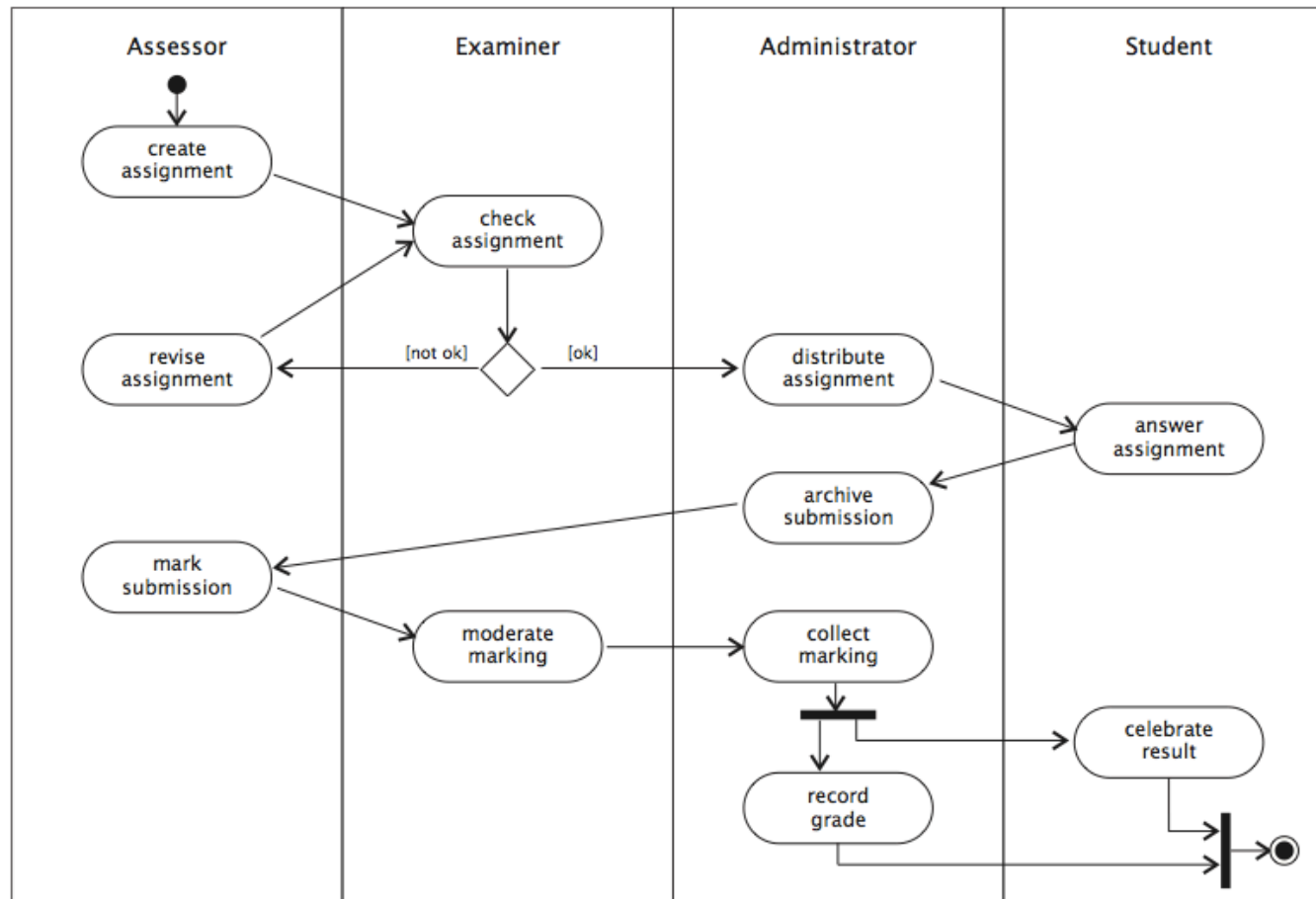


BPMN Example



Swimlanes:

partition an activity diagram into the responsibilities of different entities



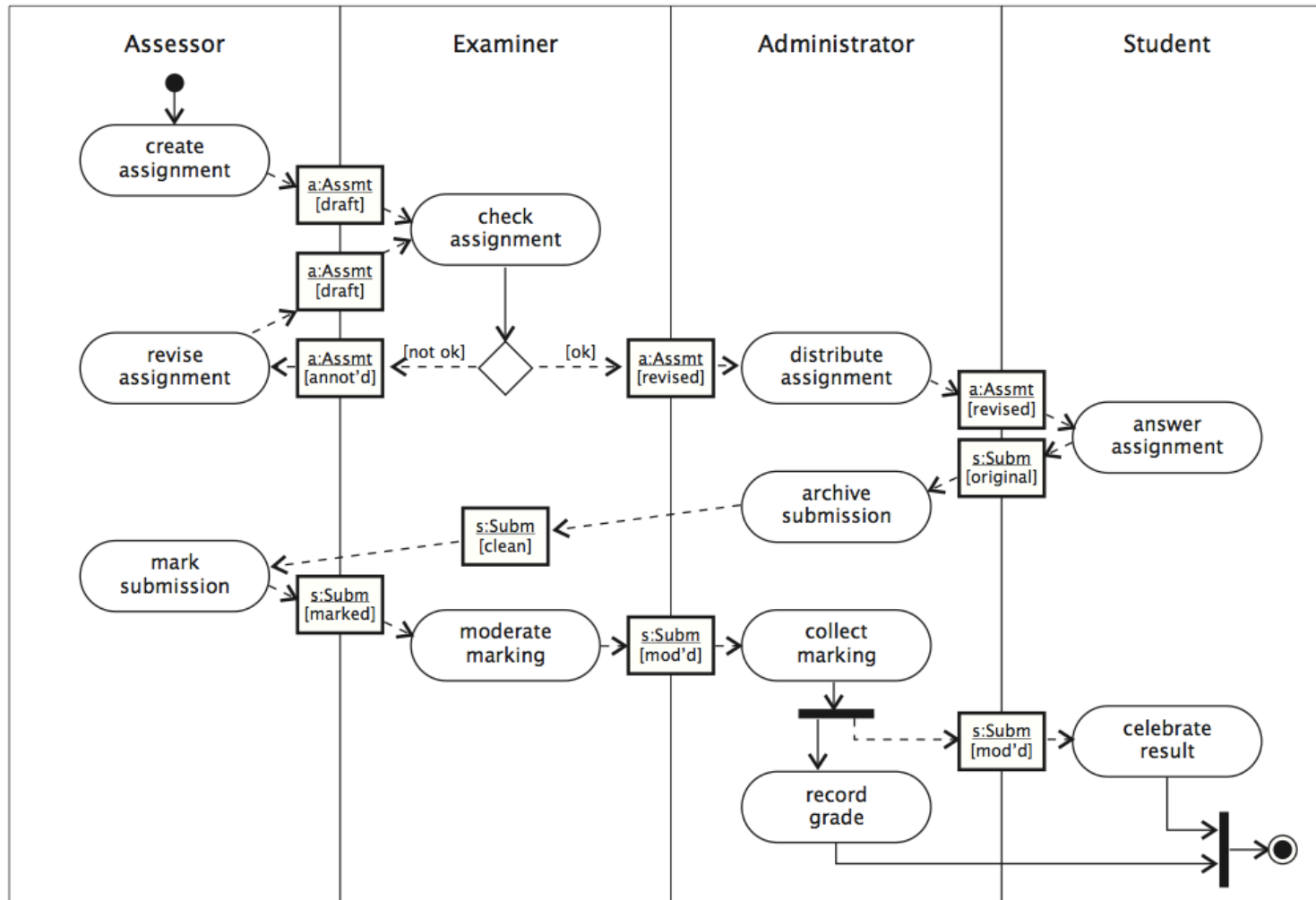
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Data Flow

- Transitions between activities represent *control dependencies*: one activity must complete before another can start
- Workflows also have *data dependencies*: one activity produces a result that another requires
- UML activity diagrams allow *object flow* as well as *control flow*
- Dependent data is shown as an object icon (rectangle with underlined name and type)
 - *dependencies* shown as dashed arrows from generating activity to object, and from object to consuming activity(s)
 - same object may occur multiple times in an activity diagram, typically in different *states* (shown in square brackets after object name)



Example Object Flow



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Business Process Execution Language (BPEL)

- Standardised XML language for executable processes
- Well defined execution
 - No deadlocks
 - Graphs must be acyclic
- Tied to WSDL concepts
- No built in support for human activities (though this has been added)
- No graphical notation



BPMN + BPEL

- In theory:
 - Process experts design and model in BPMN
 - Developers/Implementors implement in BPEL
- No standard bridging/mapping
 - Double the effort

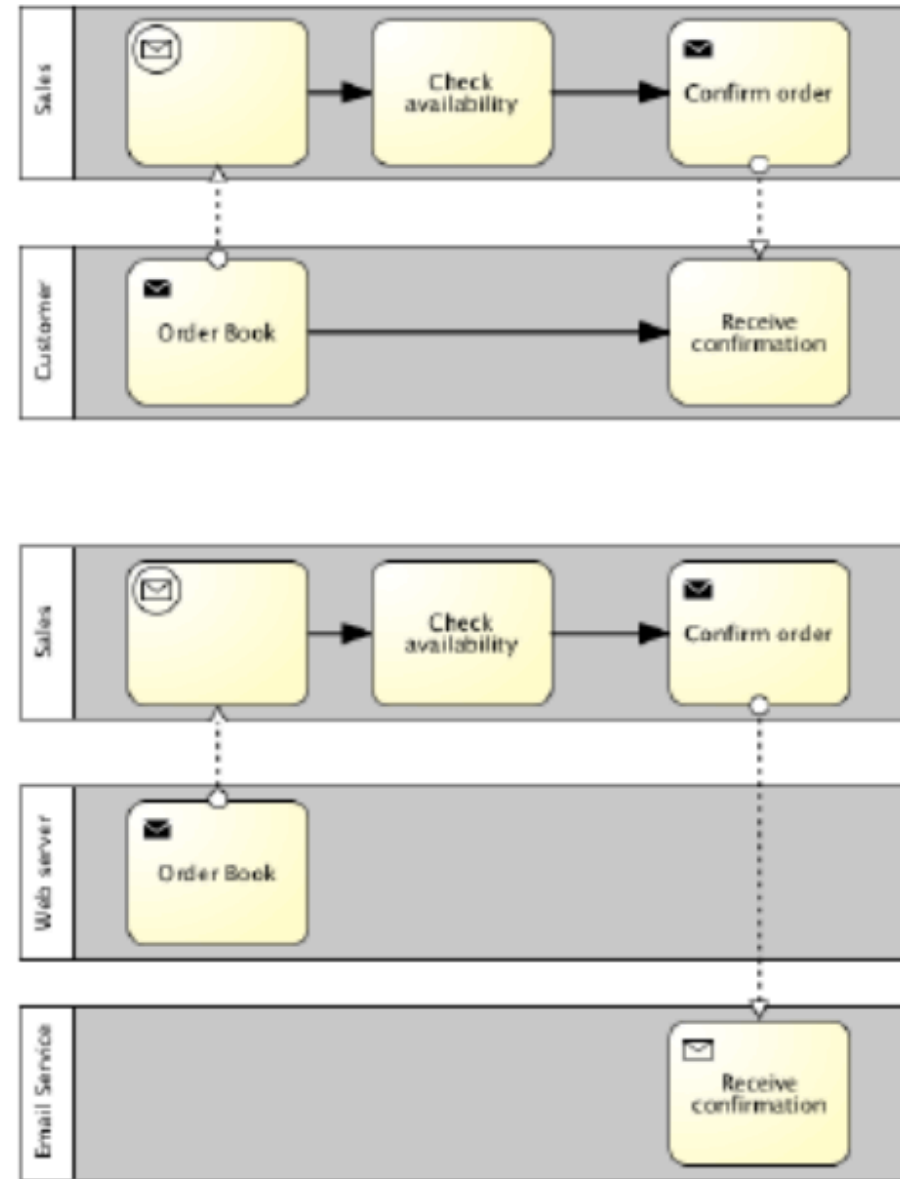


BPMN 2.0

- A notation for a subset of BPEL
- Execution semantics for BPMN
- Notational support for choreography
- The best of both worlds?



BPMN 2.0



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How much BPMN do you need?

How Much Language is Enough?
Theoretical and Practical Use of the
Business Process Management Notation

http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2038665

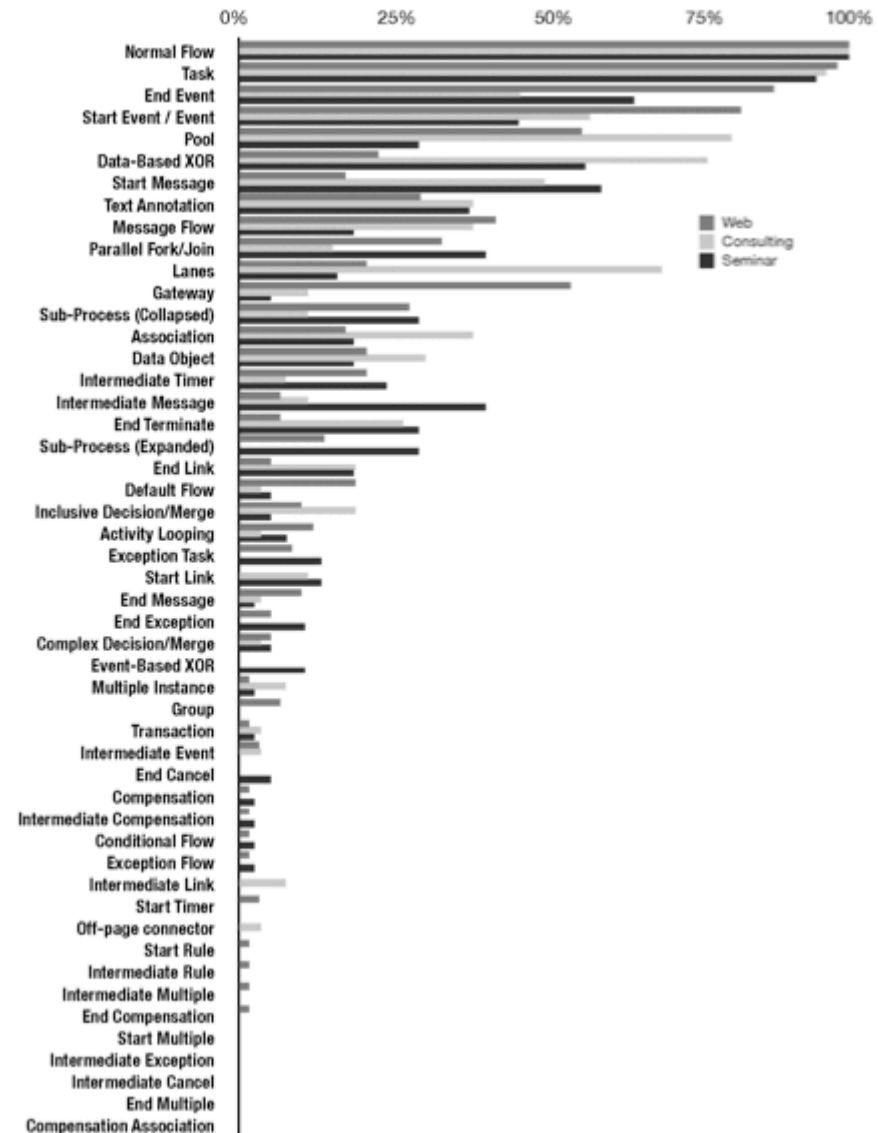
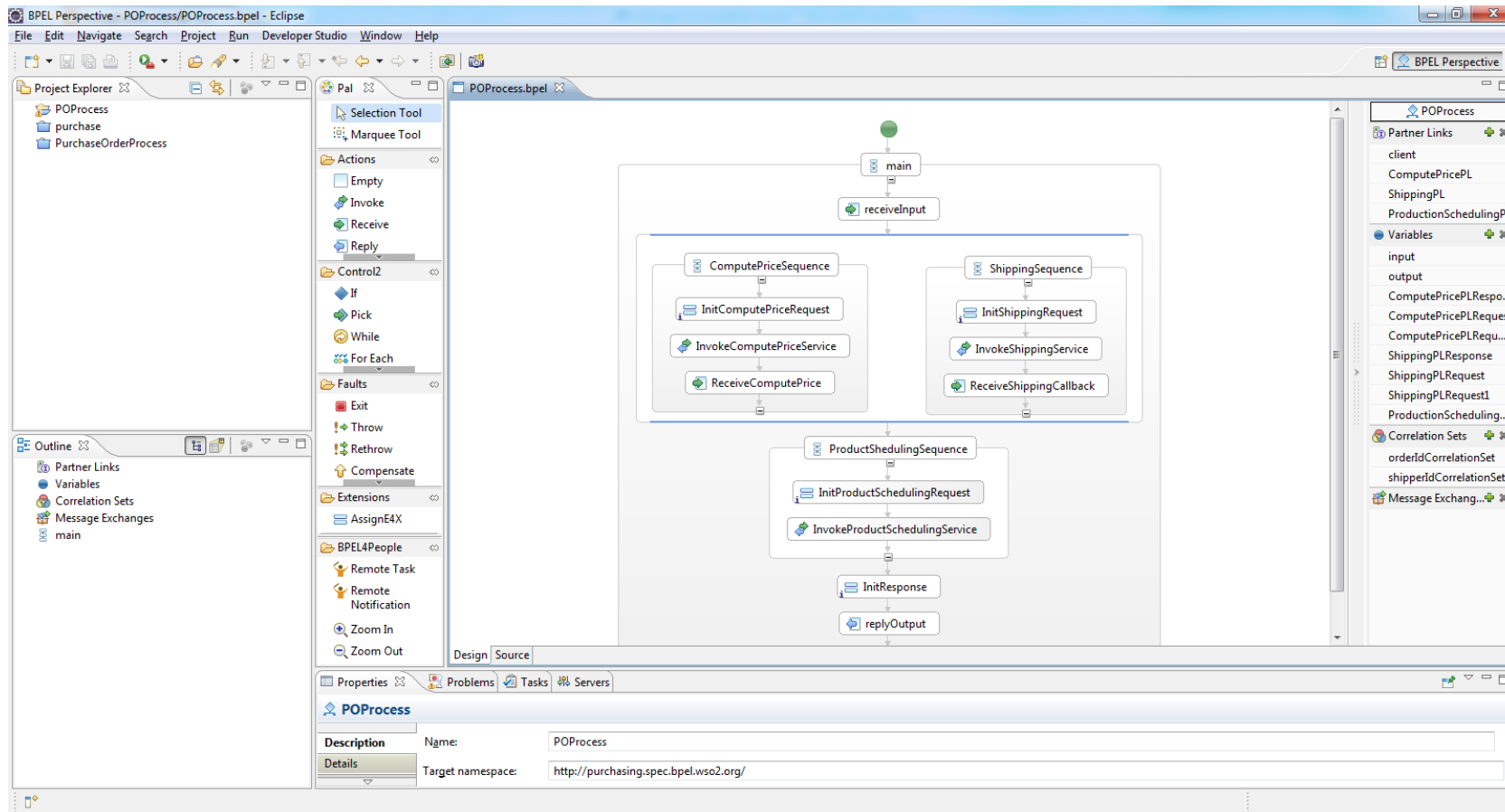


Fig. 1. Occurrence Frequency of BPMN Constructs



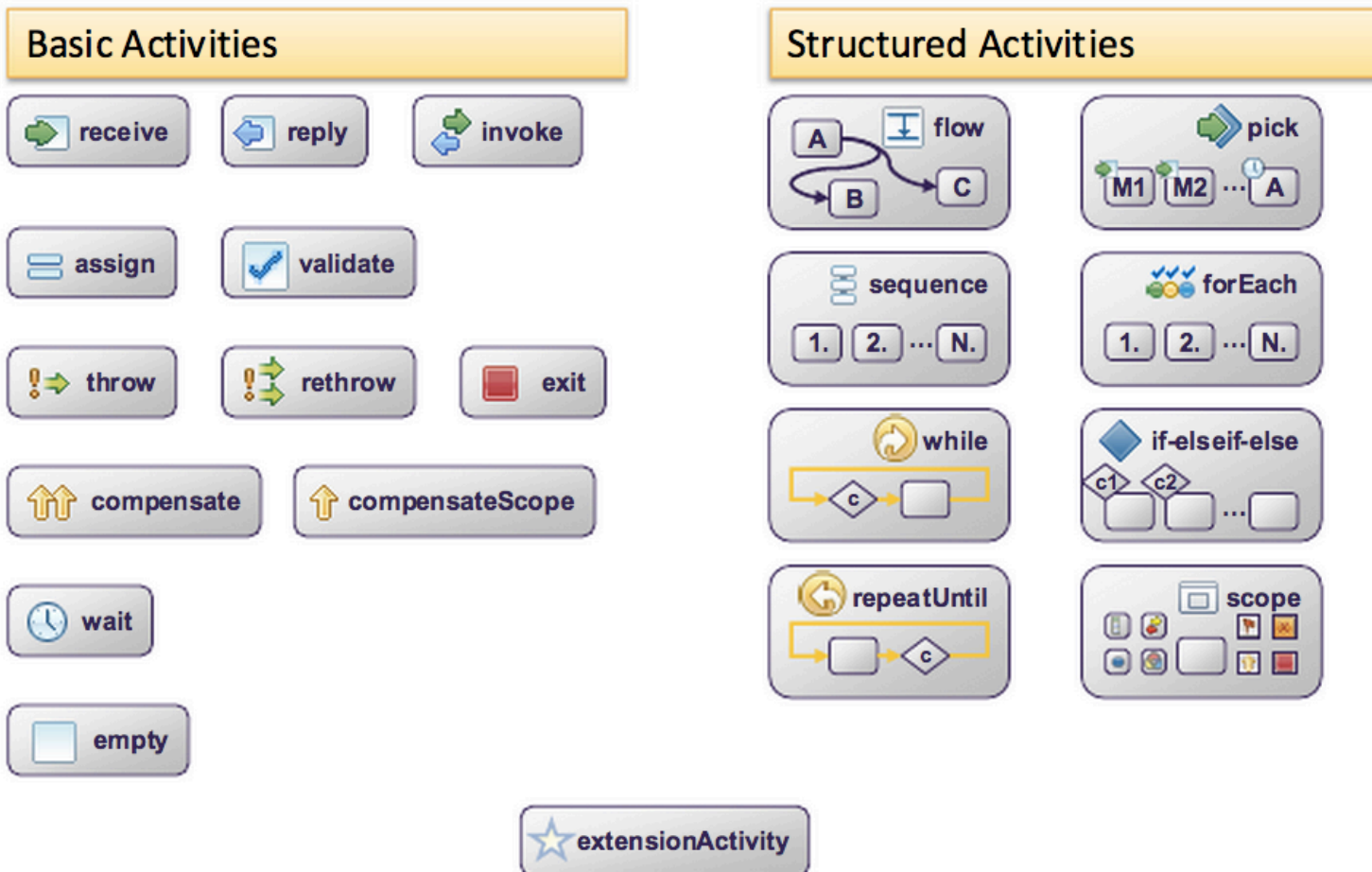
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BPEL

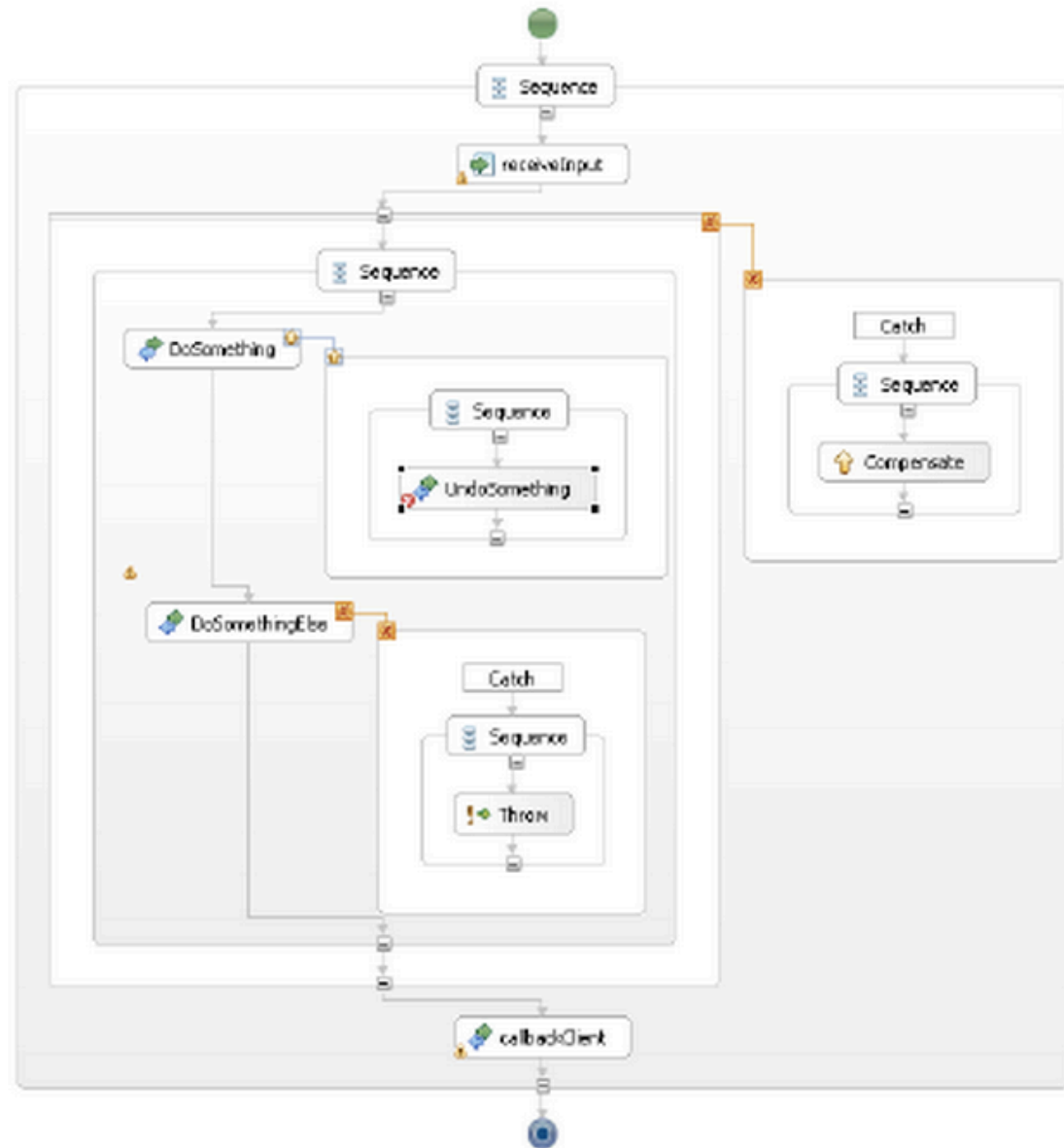


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BPEL Activities



Fault Handling



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Partner Links

- Interactions between business process and external parties
 - Partner link type defines one (for unidirectional links) or two (for bi-directional) roles of corresponding port type
- Partner links instantiate partner link types, specifying myRole (played by this process) and/or partnerRole (played by external party)
 - bindings of actual partners to external roles are omitted
- Who takes what role?
- A key concept for asynchronous messaging



BPEL data

- Control flow not data flow
- Variables are assigned on:
 - Input
 - Return
 - <assign>
- Often need to jump into XSLT
 - Cumbersome

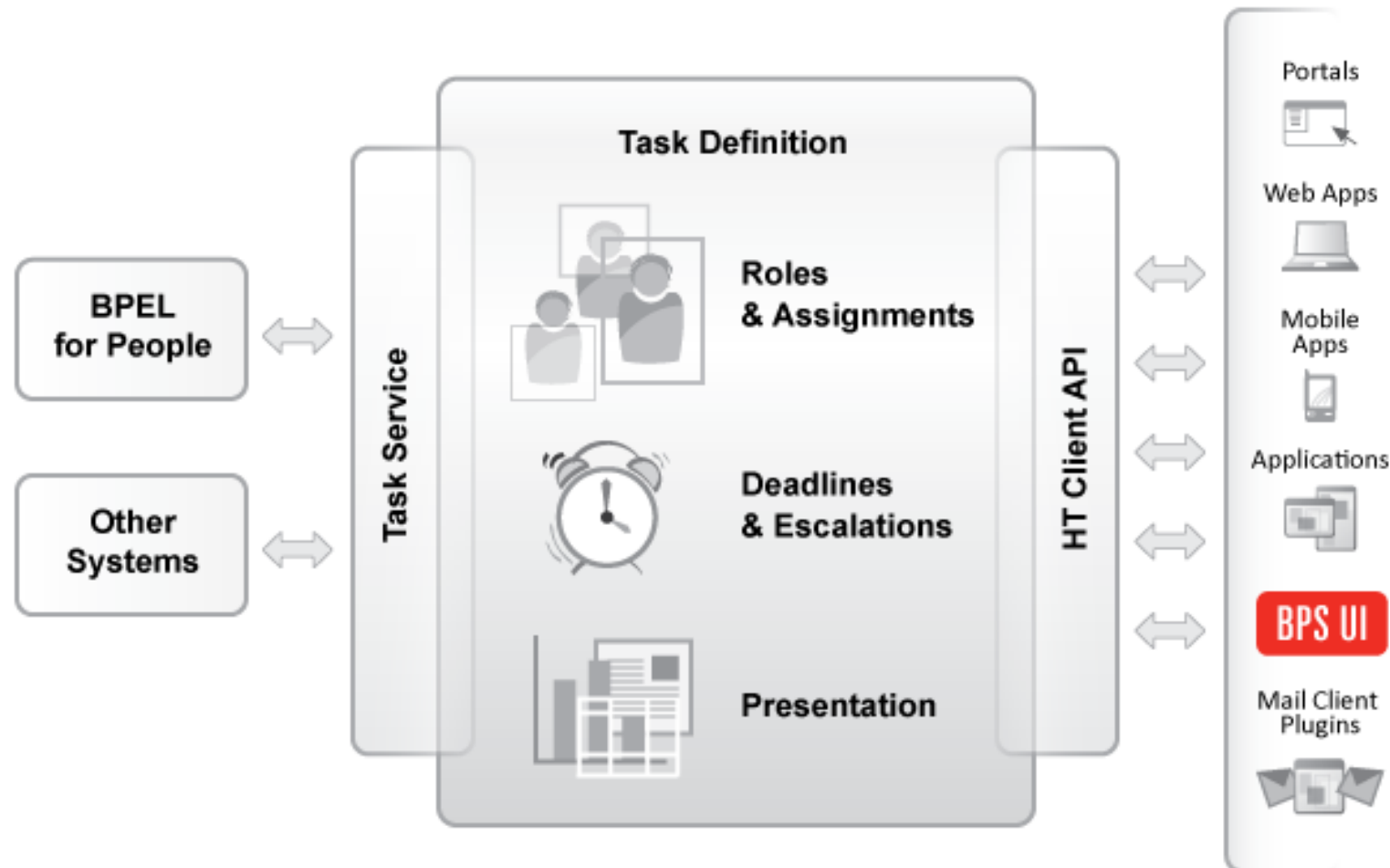


BPEL extensions and extras

- BPEL4People/WS-HumanTasks
 - How people interact with BPEL
- BPELlight
 - WSDL-less BPEL
- BPEL JS/E4X
 - Simplified assignment
- BPELScript/simBPEL/SimPEL
 - DSL/textual notations for BPEL

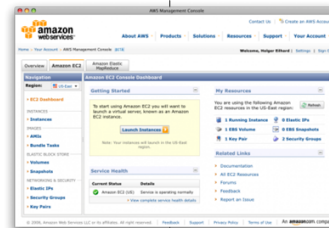
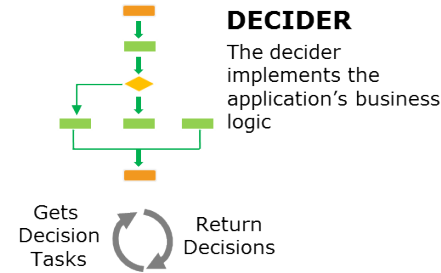


Human Tasks



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Amazon Simple Workflow Service



Amazon SWF

- Maintains distributed application state
- Tracks workflow executions
- Ensures consistency of execution history
- Provides visibility into executions
- Holds and dispatches tasks
- Provides control over task distribution
- Retains workflow execution history

<http://aws.amazon.com/swf/>

Get Activity Tasks → Return Results

Cloud



Workers for Activity 1

Get Activity Tasks → Return Results

Mobile



Workers for Activity 2

Get Activity Tasks → Return Results

On Premises



Workers for Activity 3



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Summary

- Process Management has a strong place in composing SOA systems
 - Externalising dependencies
 - Agility
 - Sharing with the business owners
- BPEL is the most common and standard model today
- BPMN 2.0 is gaining a lot of mindshare
- Other approaches like Amazon SWF may also appear

