

Business Process Management

Business Process Model and Notation (BPMN)

• BPM lessons for "Service-Oriented Software Engineering" and "Sistemi Software" courses; Tor Vergata University.

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Modeling Language Components

- A modeling language consists of three parts:
 - Syntax
 - Set of modeling elements and rules to combine them
 - BPMN syntax includes activities, events, gateways, sequence flows
 - Semantics
 - Bind syntactical elements with textual descriptions to a precise meaning
 - Behavior of BPMN elements
 - Notation
 - Defines graphical symbols for elements

Business Process Model and Notation (BPMN)

- Object Management Group (OMG) standard
 - http://www.omg.org
 - http://www.omg.org/specs/bpmn
 - version 1.0 (2006)
 - version 1.1 (2007)
 - version 1.2 (2009)
 - version 2.0 (2011)
- Provide a notation to describe Business Process understandable by:
 - BP analysts
 - IT developers
 - BP workers and managers

Why BPMN

 Business people are very comfortable with visualizing Business Processes in a flow-chart format

• BPMN *execution semantics* is fully formalized

- BPMN 2.0 has a *formal definition* (metamodel)
 - Precise definition of the constructs and rules for creating models

BPMN Metamodel

- Metamodeling has the following benefits
 - Formalization of models and entities
 - Formalization of relationship between elements
 - Interoperability
- It is not necessary for the modeler to handle the metamodel
- Is the modeling tool that ensure that model is compliant with metamodel

BPMN Metamodel (partial)



BPMN Semantic

- To describe how the BPMN elements behave, the theoretical concept of token is used
 - The "*simulated*" behavior of elements can be defined by describing how they interact with a token
 - The token is not part of the BPMN specification
 - BPMN modeling tools are not required to implement any form of token
- The token will traverse the sequence flows and pass through the elements in the process
 - Token traverse sequence flows instantaneously, so there is no time associated with them
 - When arrives at an element, the token may continue instantaneously or can be delayed depending on the element
- We use this notation for tokens







 Sequence flow connects model elements showing their order of execution

- Each sequence flow has only one source and only one target
 - Model elements can have one or more incoming sequence flow and one or more outgoing sequence flow but usually they have one

• Source and target can be activities, events, gateways



Start Event

- Beginning of the process
 - It has no incoming flows

- A process may have zero, one or more start events
 - If not present, all activities without incoming flows start together
 - If an end event is present, at least one start event is mandatory



End Event

- Where the flow of the process ends
 - It has no outgoing flows
- A process may have zero, one or more end events
 - If not present, all activities that do not have any outgoing flows mark the end of a process path
 - In this case, the Process ends when all parallel paths have completed
- If a start event is present, at least one end event is mandatory

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• Unit of work (atomic activity), the job to be performed

• A task is used when the work in the process cannot be broken down to a finer level of detail

Our First BPMN Model

- A simple BPMN model generally has
 - 1. A start point
 - 2. An end point
 - 3. Some activities
 - 4. Connections between activities





 Used to control how sequence flows interact as they converge and diverge within a process

• Split gateway

- Point where the process flow diverges
- Has one incoming sequence flow and multiple outgoing sequence flows

Merging gateway

- Point where the process flow converges
- Has multiple incoming sequence flows and one outgoing sequence flow



Exclusive Gateway

• Diverging Exclusive Gateway

- Creates alternative paths within a process flow
- The decision is considered as a question with a defined set of alternative answers
- Only one of the paths can be taken (XOR)
- The default path (if defined) is taken if none of the conditional expressions evaluate to true





Exclusive Gateway

• Converging Exclusive Gateway

- Used to merge alternative paths
- Each incoming token is routed to the outgoing sequence flow without synchronization



Exclusive Gateway Example

- Order shipment
 - When a purchase order is received, check stock availability. If the item is available, confirm order and ship product, otherwise reject order.

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Parallel Gateway

• Diverging Parallel Gateway

- Creates parallel paths without checking any conditions
- Each outgoing sequence flow receives a token





Parallel Gateway

- Converging Parallel Gateway
 - Used to synchronize (combine) parallel flows and to create parallel flows
 - Waits for all incoming flows before routing the token to the outgoing flows (AND)



Parallel Gateway Example

- Boarding security check
 - Having the boarding pass, go to security check for luggage and security screening. When passed both go to boarding

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Inclusive Gateway

• Diverging Inclusive Gateway

- Used to create alternative but also parallel paths within a process flow
- Unlike the exclusive gateway, all condition expressions are evaluated
 - All Sequence Flows with a true evaluation will be traversed by a token (OR)
 - The default path (if defined) is taken if none of the conditional expressions evaluate to true





Inclusive Gateway

• Converging Inclusive Gateway

- Used to merge a combination of alternative and parallel paths
- Token arriving at an inclusive gateway may be synchronized with some other tokens that arrive later at the gateway
 - When all the expected tokens have arrived the token moves to the outgoing sequence flow



Inclusive Gateway Example

- Order decomposition
 - When an order is received, get product of type A from warehouse A and products of type B from warehouse B.

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Resource Modeling

• Organizational resource are mapped in pools and lanes

• Pools

- Independent organizational entities (*do not share* any common system that allows them to communicate implicitly)
 - Customer is independent from the Supplier

• Lanes

- Multiple resource classes in the same organization (*share* common systems)
 - Sales department and marketing Department

Pools and Lanes







Message Flow

- Used to show the flow of messages between two participants
 - Participants are prepared to send and receive the messages

- Message flow only connects two separate pools
 - Message flow can be attached to pools, activities, or message events
 - Message flow cannot connect two objects within the same pool

Artifacts

- Additional information that is not directly related to the sequence flows or message flows
 - Associations, groups, text annotations

 Association is used to associate artifacts with process elements

Association





- Provides additional information for the reader of a BPMN diagram
 - Does not affect the flow of the process





Represent data and document exchanged in the process

• Can be used to show input and output of activities

• BPMN defines 5 kind of data objects

Data Objects



- Information traversing the process (email, letters, documents)
- Collection data object
 - Collection of information
- Data input
 - External input necessary to start the activity
- Data output
 - Outcome of the activity or the process
- Data store
 - Place where the process can read and write data (database)











BPMN Process Type

- Orchestration
- Collaborations
- Choreographies

 BPMN uses the terms collaboration and choreography when modeling the interaction between processes

Orchestration Example

- BP *internal* to a specific organization
- Generally called workflow or BPM process



Image from "Business Process Model and Notation (BPMN)", http://www.omg.org/spec/BPMN/2.0

Collaboration

- Collaboration shows *interactions* between two or more participants
 - A pool represents one of the participants in the collaboration

- Collaboration can be shown as two or more processes communicating with each other
 - The message exchanged between the participants is shown by a message flow

Collaboration Example



Image from "Business Process Model and Notation (BPMN)", http://www.omg.org/spec/BPMN/2.0

Specialized Task

Send/Receive message

- Task that send/receive a message to/from an external participant (within the process)
- User activity
 - Task performed by a human with the assistance of a software application
- Manual activity
 - Task performed without the aid of any application
- Service calling
 - Task that uses some sort of external service identified with an URI
- Script
 - Task performed by a business process engine









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Script Task

Event Definition

- The "Event" is the composition of
 - Position
 - Start, Intermediate, End
 - Nature
 - Catch, Throw
 - Impact
 - Interrupting, Non-Interrupting
 - Type
 - Message, Timer, etc.

Event Symbol



Event Position

- Start event
 - initial point of execution flow

- Intermediate event
 - may occur between start and end of the execution flow

- End event
 - stop of the execution flow







Event Nature

Catch event

- All start events and some intermediate events
- When the event is triggered, the token is generated

Throw event

- All end events and some intermediate events are throwing events that may eventually be caught by another event
- Typically the trigger carries information from the scope where the throw event occurred into the scope of the catching events

Events Definition



Events Definition



Events Definition





Event-Based Gateway

- Alternative paths are based on events that occur, rather than the evaluation of expressions
 - Usually the receipt of a message determines the path that will be taken
- When the first event is triggered, then the corresponding path is activated
 - All remaining paths will no longer be valid
 - The event gateway is thus a race condition where the first event that is triggered wins
- Event gateways can be used to start the process according to the event occurred

Event-Based Gateway



- When goods are ready to be sent, the warehouse worker starts packaging the goods and a clerk decides if this is a normal postal or a special shipment.
- If a special shipment is required, the clerk selects a carrier and prepares the paperwork.
- Otherwise a normal post shipment is fine and in this case the clerk checks if an extra insurance is necessary.
- If the extra insurance is required, the logistics manager prepares that insurance. In any case, the clerk has to fill in a postal label for the shipment.

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