Modeling Business Processes with BPMN

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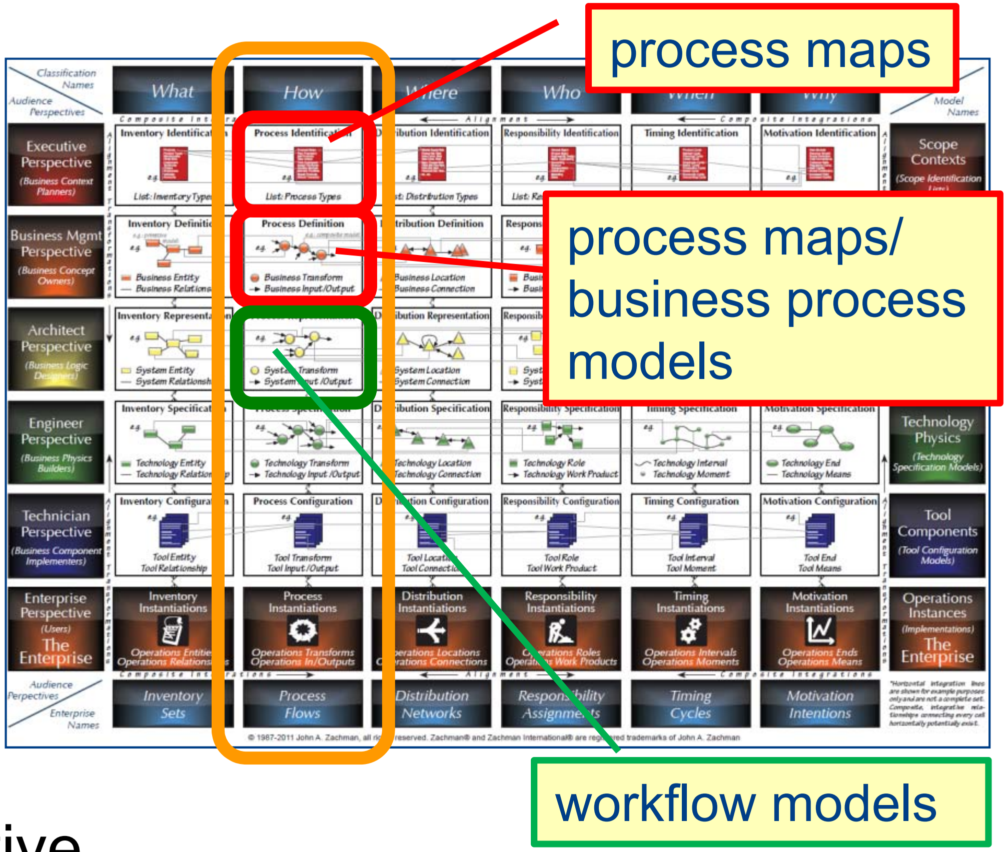
The Business Process Perspective on Enterprise Architecture

- From the *business process perspective*, enterprise architecture achieves enterprise integration through
  - capturing and describing processes, strategies, organisation structures, information and material flow, resources etc.
  - concentration on how to perform core business processes in an organisation
  - considering the information and material flow in the entire process
- In this sense, business process management (BPM) relies on enterprise architecture

(Bernus et al. 2003, p. 9f)

Zachman Framework: Business Processes in different Perspectives

- Vertical Relationships relate the business process represented in the different perspectives
  - A "process map" is an overview of the enterprise's business processes linking them to the value chain
  - A "business process model" is a process diagramm from the business perspective.
  - A "workflow model" or "process implementation" represents the process from the IT perspective



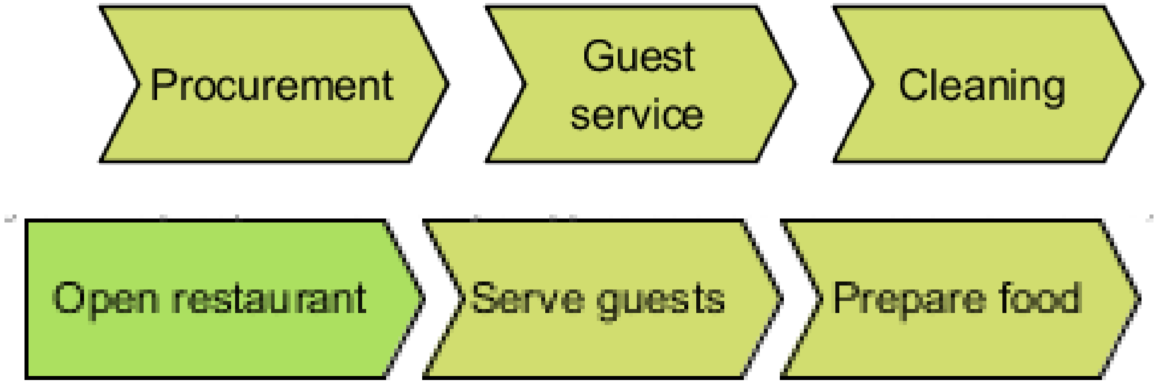
process maps

process maps/ business process models

workflow models

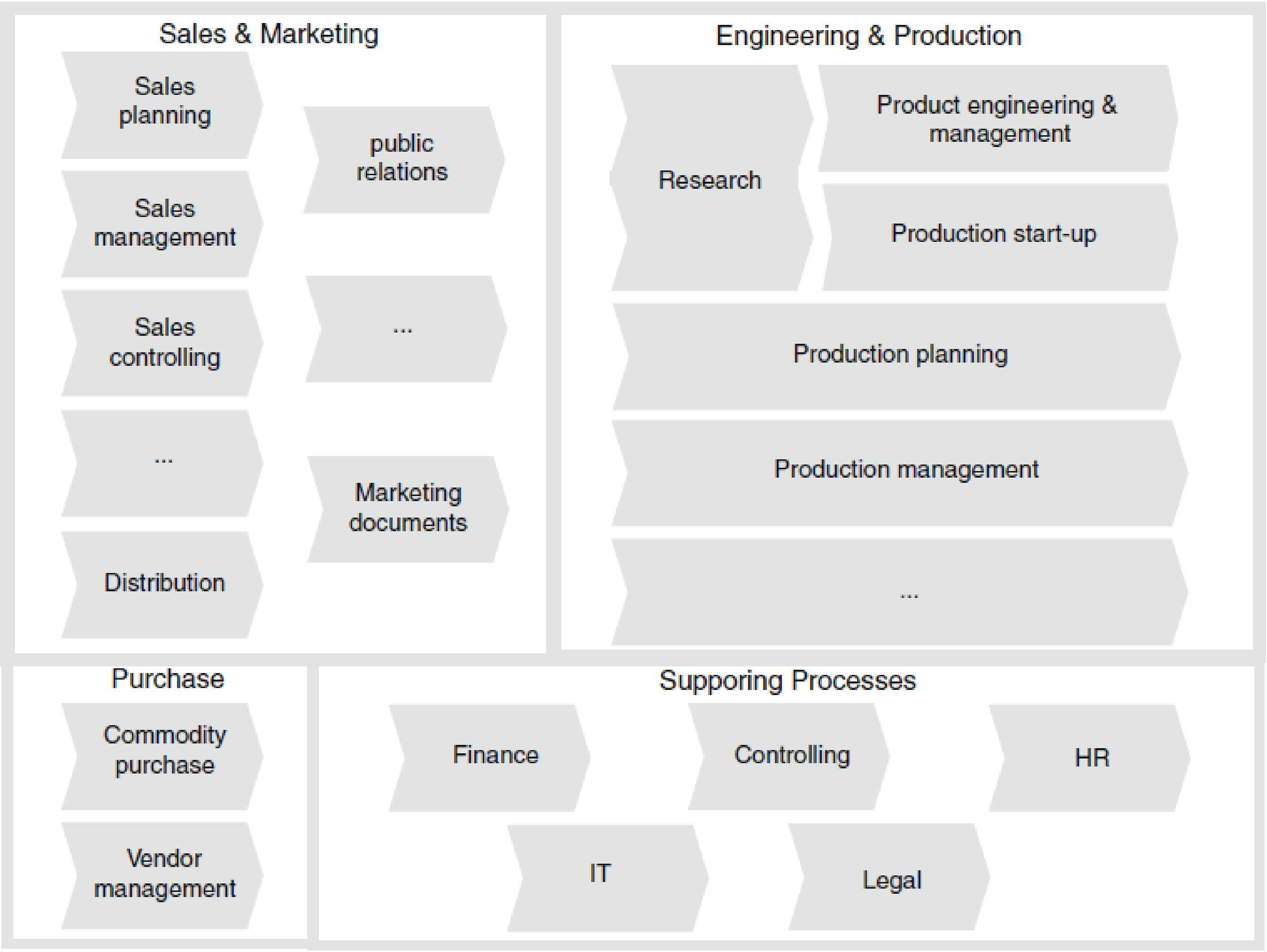
The Workflow Management Coalition defines "workflow" as the automation of a business process

Process Maps



- Process maps give an overview of the business processes on a high level of abstraction
- Each element of a process maps represents a business process
- Process maps represent relationships between processes
  - grouping processes
  - logical ordering (e.g. procurement → production → sales)
- But: process maps do not represent control flow, i.e. a predecessor does not necessarily trigger ist successor

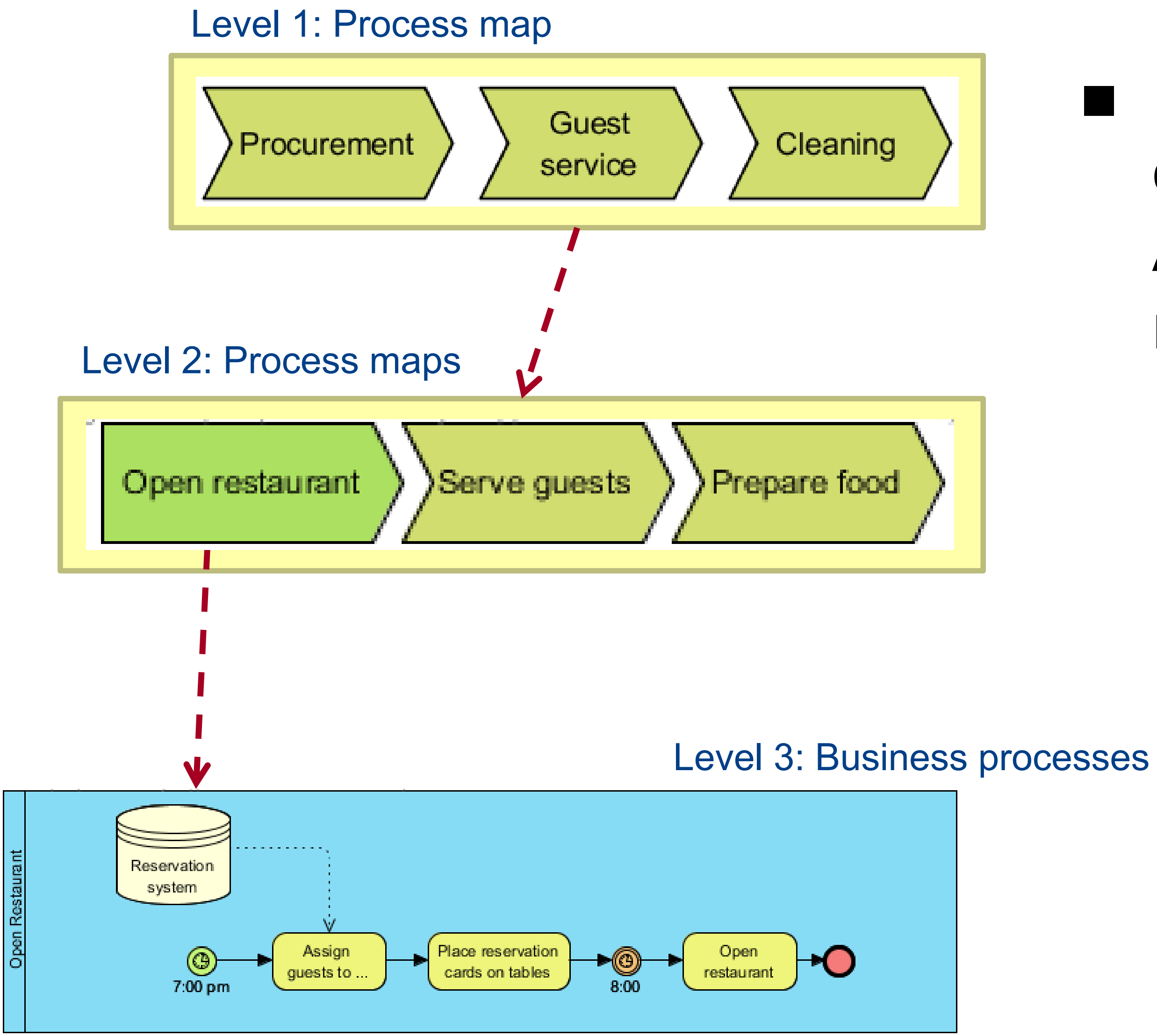
Example of a Process Map



- This example represents a process map as a cluster diagram.
- Business processes on the value-chain level create the “umbrella” clusters, each of which contains a set of sub-processes.
- For example, the sub-process “sales planning” is assigned to its parent process, “sales and marketing”.

(Hanschke 2010, p. 75)

Hierarchical Process Maps

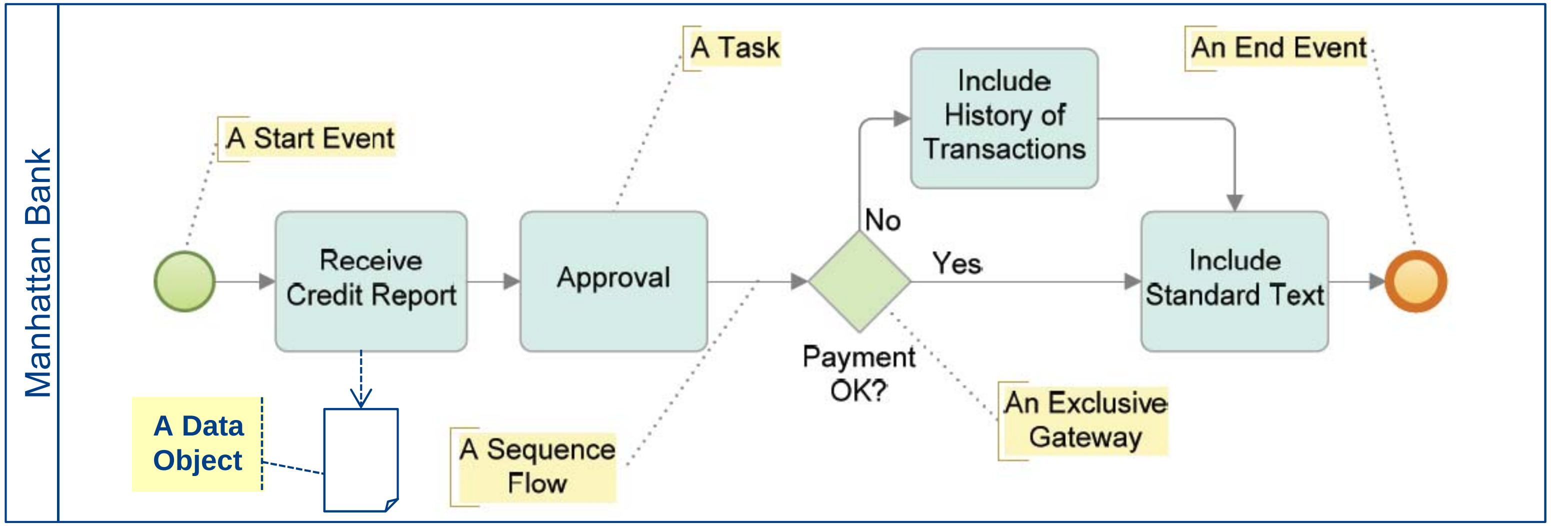


- Process maps can be organized hierarchically. An element either represents
  - another set of processes (i.e. a process map)
  - a business process (e.g. in BPMN)

BPMN

BPMN – Business Process Model and Notation

- BPMN is a graphical modeling notation for business processes that is independent of a specific implementation environment

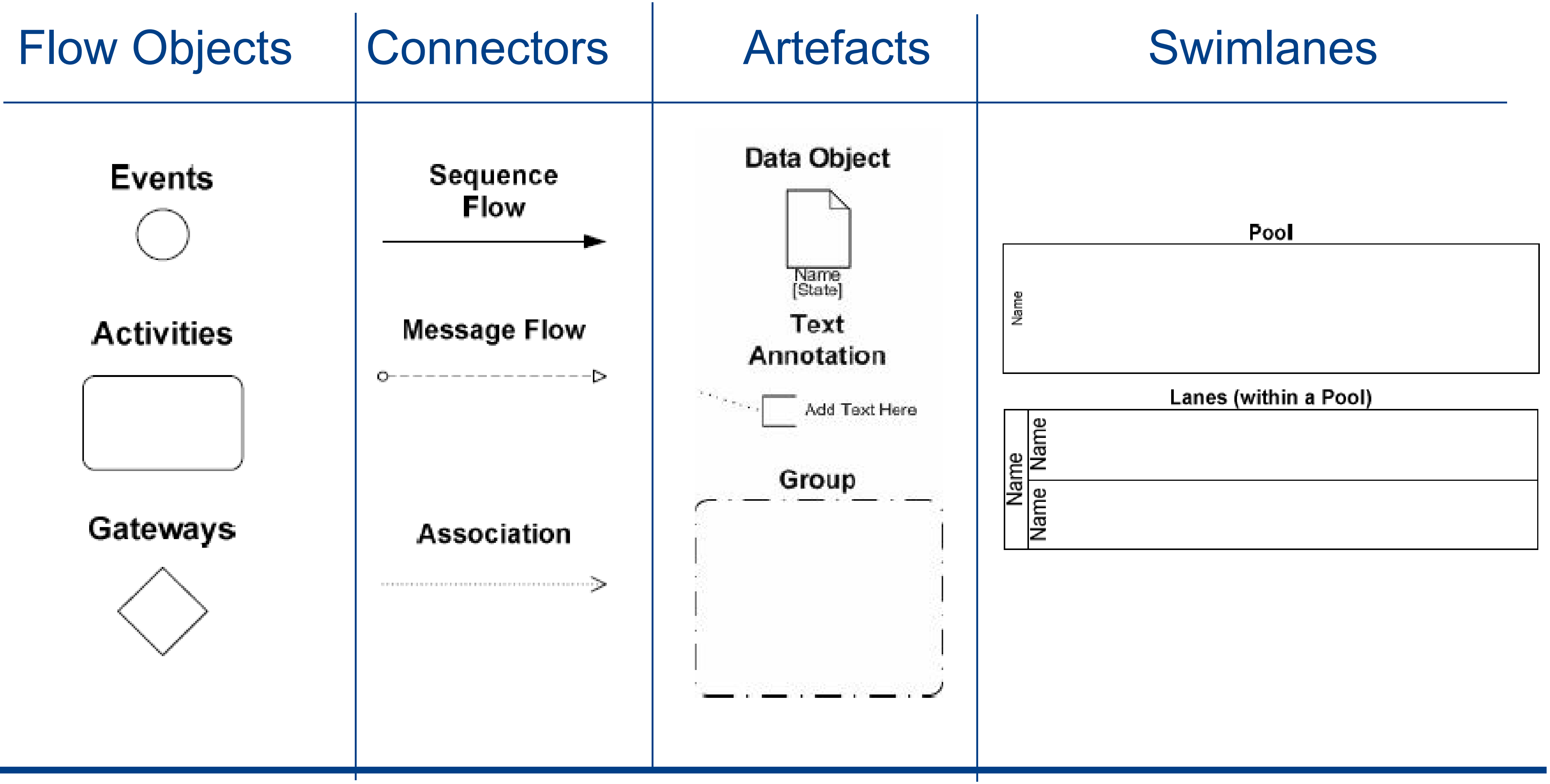


- BPMN was officially adopted as an OMG specification in 2006, updated in 2008 and now available in version 2.0 (http://www.omg.org/spec/BPMN/2.0/)

- BPMN provides a standardized bridge for the gap between the *business process design* and *process implementation*

Elements of BPMN

Elements of BPMN can be divided into 4 categories:



Flow Objects | Connectors | Artefacts | Swimlanes

Events

Activities

Gateways

Sequence Flow

Message Flow

Association

Data Object

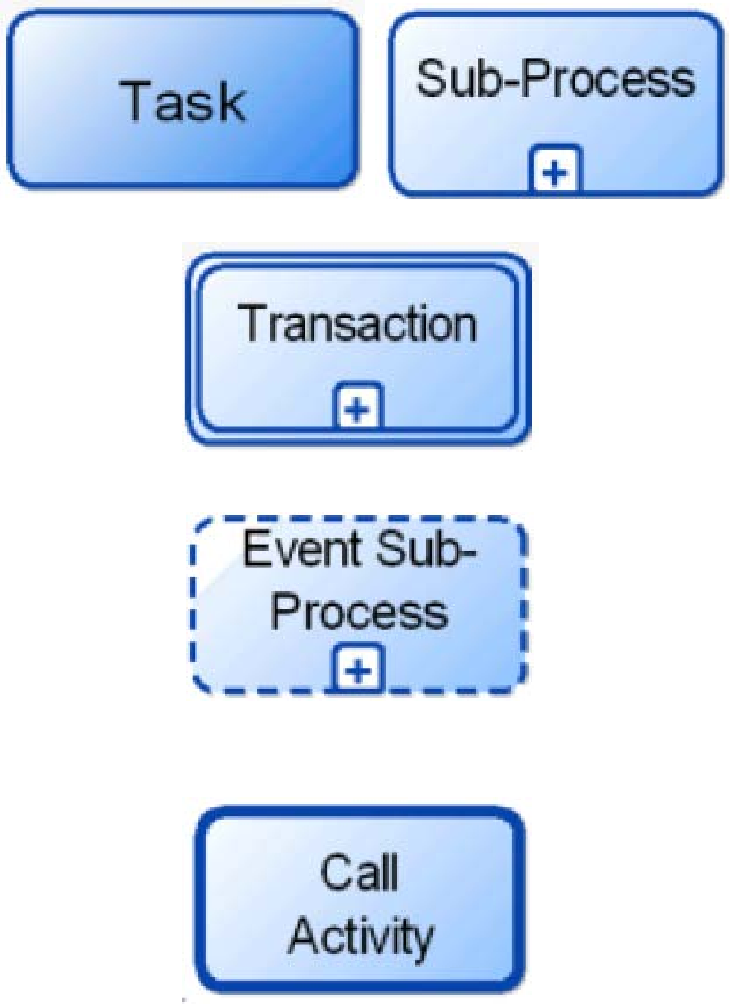
Text Annotation

Group

Pool

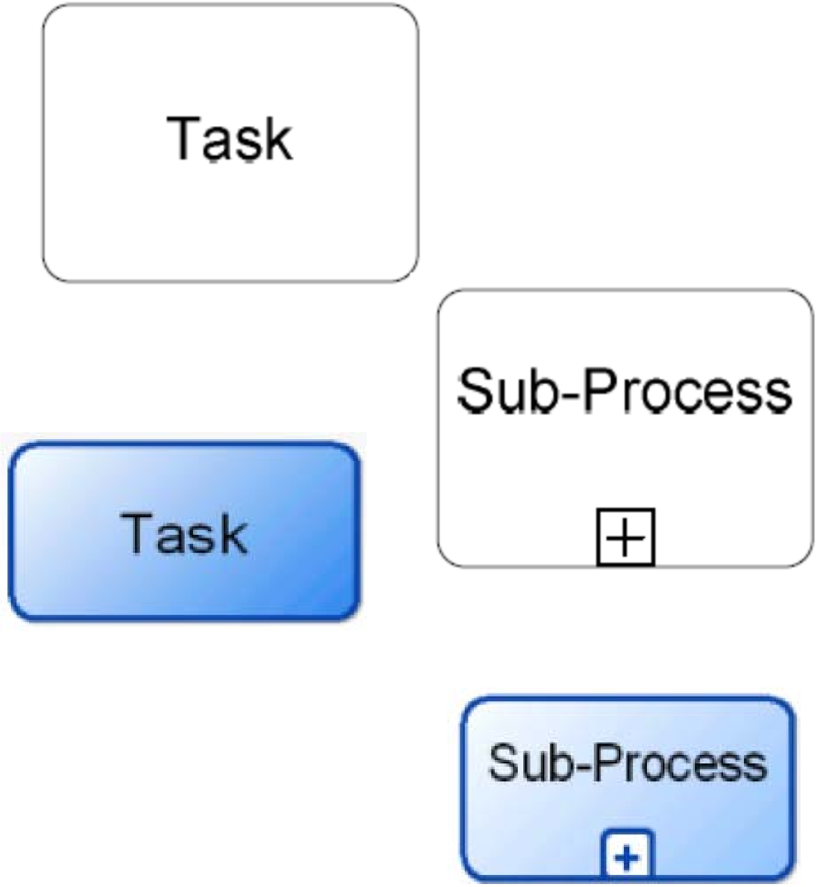
Lanes (within a Pool)

Activities



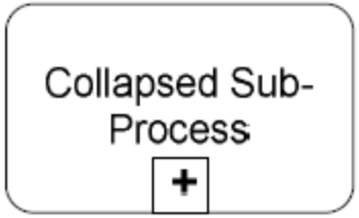
- A **Task** is a unit of work, the job to be performed. When marked with a [+] symbol it indicates a **Sub-Process,** an activity that can be refined.
- A **Transaction** is a set of activities that logically belong together; it might follow a specified transaction protocol. .
- An **Event Sub-Process** is placed into a Process or Sub-Process. It is activated when its start event gets triggered and can interrupt the higher level process context or run in parallel (non-interrupting) depending on the start event.
- A **Call Activity** is a wrapper for a globally defined Sub-Process or Task that is reused in the current process.

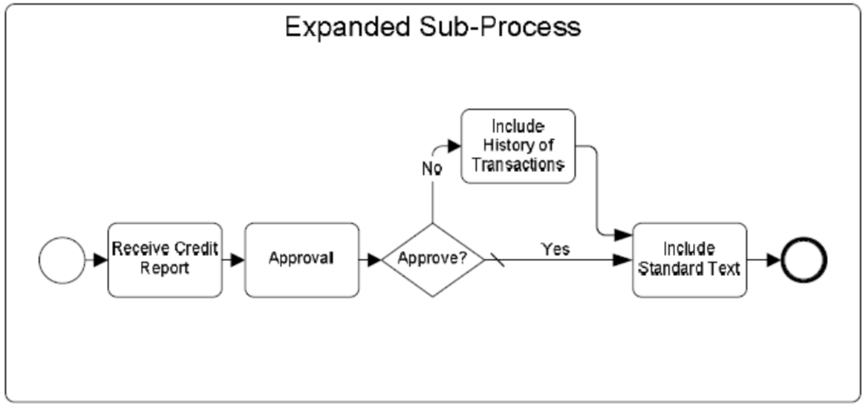
Activities



- An activity is work that is performed within a business process.
- Typically an activity is one step of a larger business process.
- Activities are rounded rectangles (some tools use colors)
- There are twp types of activities :
  - A **Task** is a unit of work, the job to be performed.
  - When marked with a [+] symbol it indicates a **Sub-Process**, an activity that can be refined.

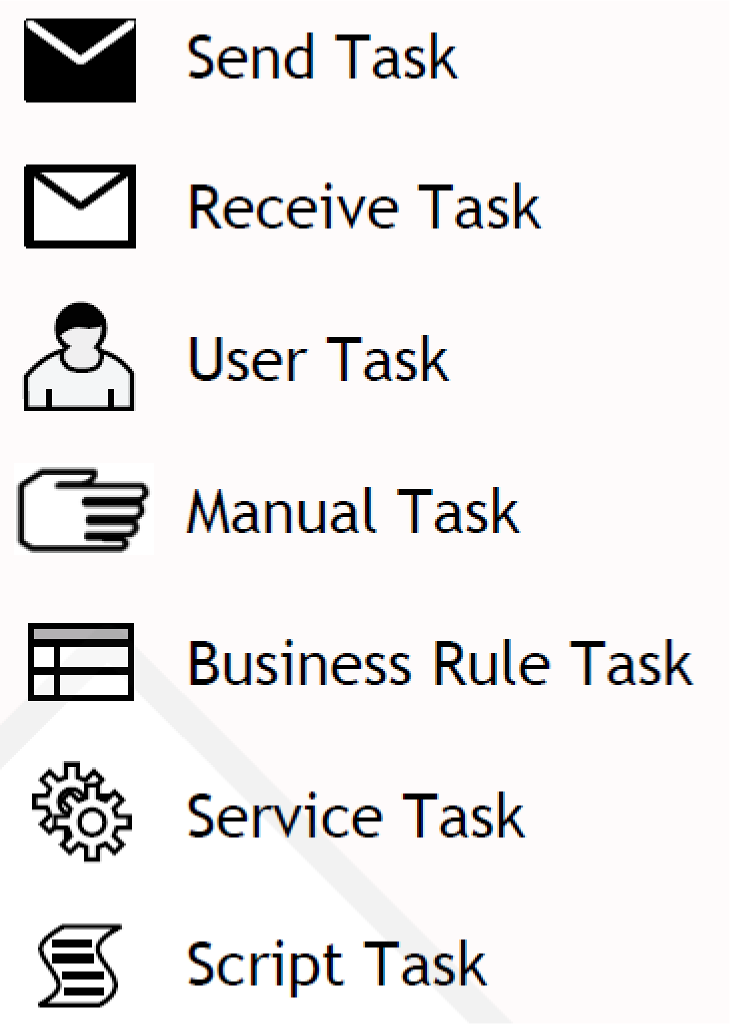
Sub-Processes





- A Sub-Process is a compound activity that is included within a Process.
  - A process can be broken down into a finer level of detail through a set of sub-activities
- Two kinds of representation
  - Collapsed: the details of the Sub-Process are not visible in the Diagram. A “plus” sign in the lower-center of the shape indicates that the activity is a Sub-Process and has a lower-level of detail.
  - Expanded: the details (a Process) are visible within its boundary.

Task Types



Send Task

Receive Task

User Task

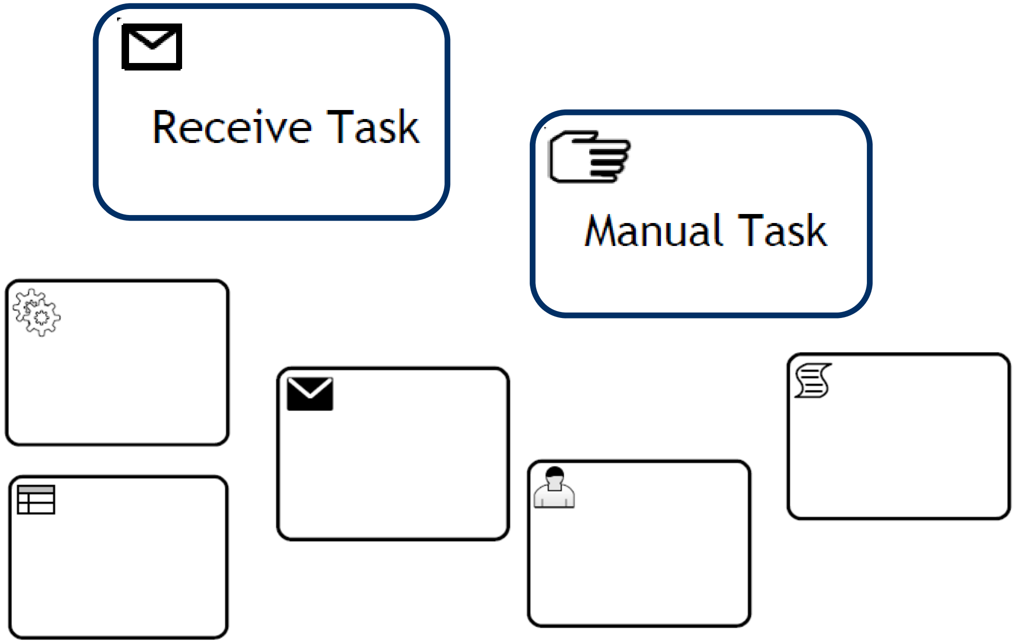
Manual Task

Business Rule Task

Service Task

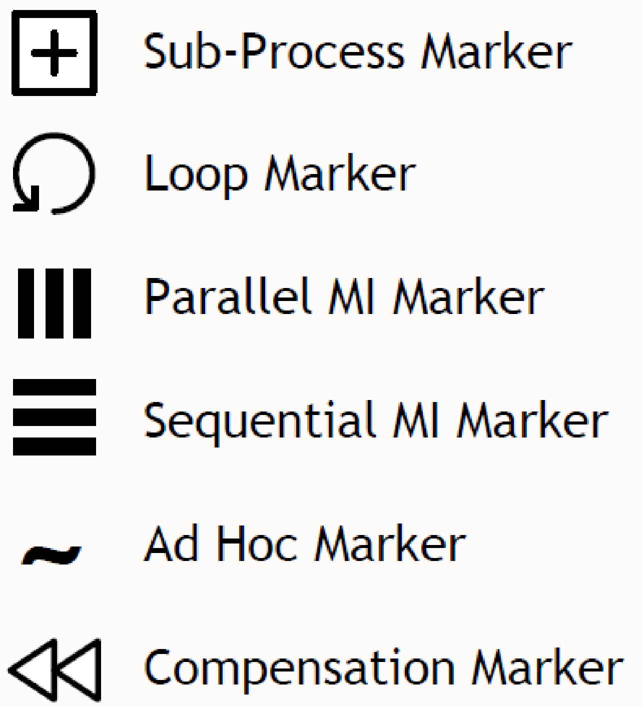
Script Task

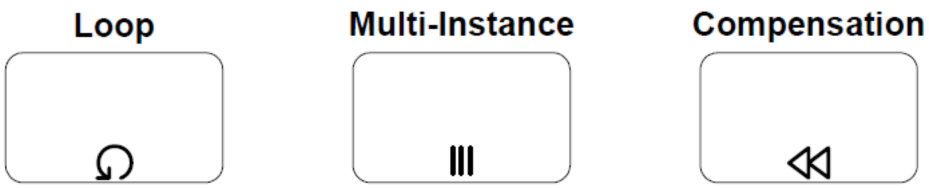
- Types specify the nature of the action to be performed.
- They can be identified by a symbol inside the object.



Activity Markers

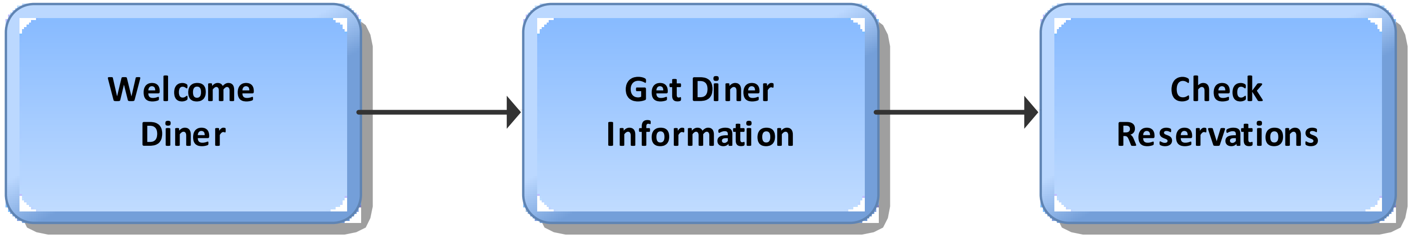
- Markers indicate execution behavior of activities / subprocesses





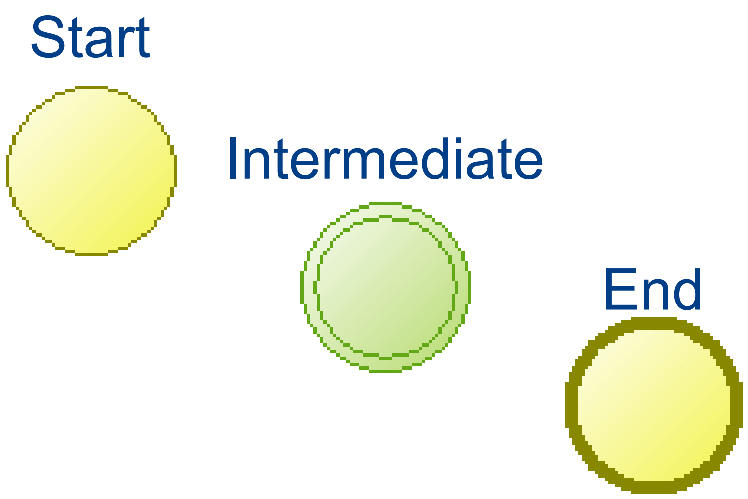
Sequence Flow

- A Sequence Flow is used to show the order that activities will be performed in a Process
- The source and target must be one of the following objects
  - Events
  - Activities
  - Gateways
- In a sequence of activities, the subsequent activitiy is performed after the previous activities is finished

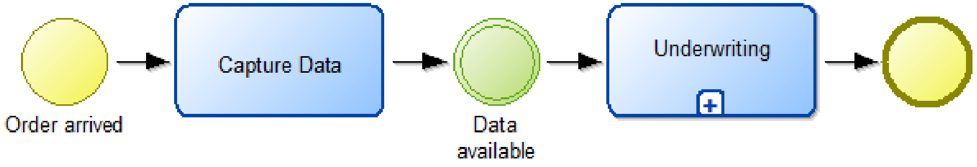


(Bridgeland & Zahavi 2009, p. 106)

Events

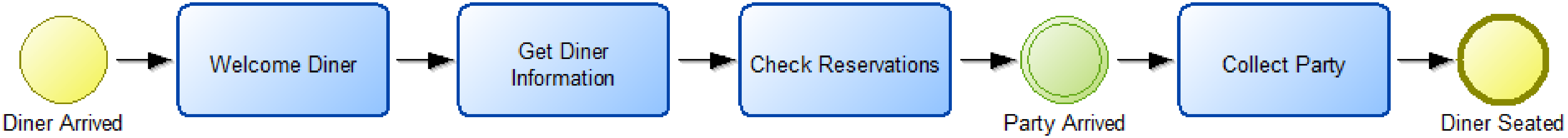


- Events are states that affect the flow of the process
  - they start, interrupt and finish the flow
  - they can trigger an activity or are its result
- Events are represented as circles. The type of boundary determines the type of Event
  - Start Event
  - Intermediate Event
  - End-Event



Events can have descriptions, just as tasks.

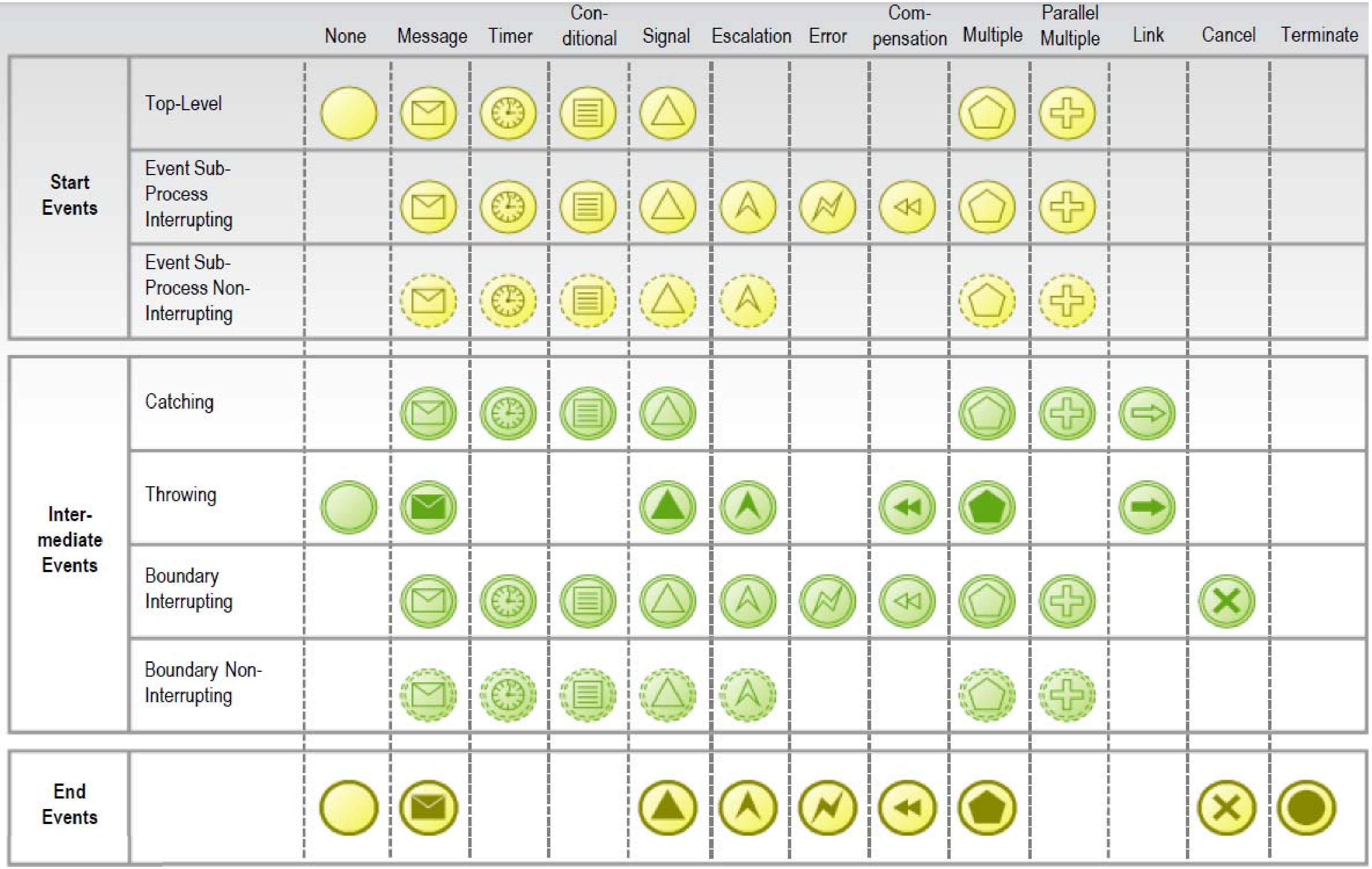
Example: A simple End-to-End Process



- A process begins with a start event and ends with an end event
  - **Diner Arrives** is the start event
  - **Diner Seated** is the end event
- An intermediate event happens after the process starts and before it ends
  - **Party Arrived** is a catching intermediate event that models a delay: When the first diner of a party arrives the host checks the reservations but does not seat the diner until the rest of the party arrives.
- Note that the difference in the naming of events and activities:
  - Activity names are typically imperative sentences, they sound like command. The verb is at the beginning of the name.
  - Event names are typically declarative sentences, describing a state or something that happens

(Bridgeland & Zahavi 2009, p. 108f)

Event-Types

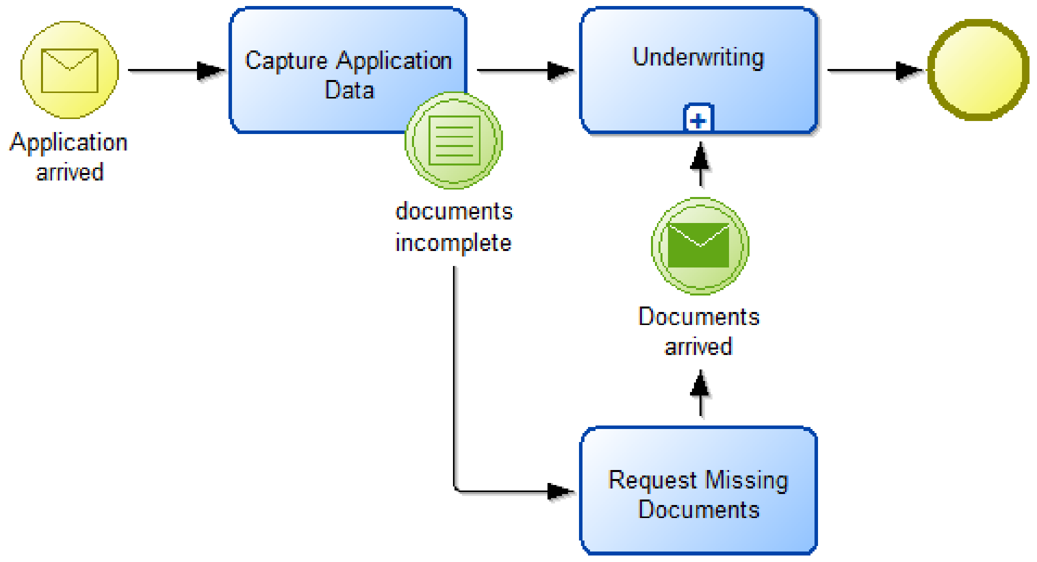


		None	Message	Timer	Conditional	Signal	Escalation	Error	Compensation	Multiple	Parallel Multiple	Link	Cancel	Terminate
Start Events	Top-Level	○	✉	◷	▤	△				⬠	✛			
	Event Sub-Process Interrupting		✉	◷	▤	△	⮝	↯	⏪	⬠	✛			
	Event Sub-Process Non-Interrupting		✉	◷	▤	△	⮝			⬠	✛			
Intermediate Events	Catching		✉	◷	▤	△				⬠	✛	⇨		
	Throwing	○	✉			▲	⮝		⏪	⬟		➡		
	Boundary Interrupting		✉	◷	▤	△	⮝	↯	⏪	⬠	✛		✕	
	Boundary Non-Interrupting		✉	◷	▤	△	⮝			⬠	✛			
End Events		○	✉			▲	⮝	↯	⏪	⬟			✕	●

Event Types

- **None:** Untyped events, indicate start point, state changes or final states.
- **Message:** Receiving and sending messages.
- **Timer:** Cyclic timer events, points in time, time spans or timeouts.
- **Conditional:** Reacting to changed business conditions or integrating business rules.
- **Signal:** Signalling across different processes. A signal thrown can be caught multiple times.
- **Escalation:** Escalating to an higher level of responsibility.
- **Error:** Catching or throwing named errors.
- **Compensation:** Handling or triggering compensation.
- **Multiple:** Catching one out of a set of events. Throwing all events defined
- **Parallel Multiple:** Catching all out of a set of parallel events.
- **Link:** Off-page connectors. Two corresponding link events equal a sequence flow.
- **Cancel:** Reacting to cancelled transactions or triggering cancellation
- **Terminate:** Triggering the immediate termination of a process.

Properties of Events



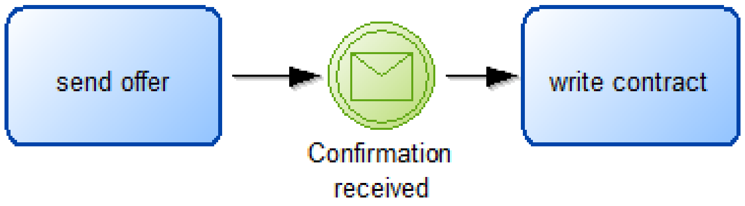
- Start-Events:
  - Top-level
  - Event Sub-Process Interrupting
  - Event Sub-Process Non-Interrupting
- End-Event

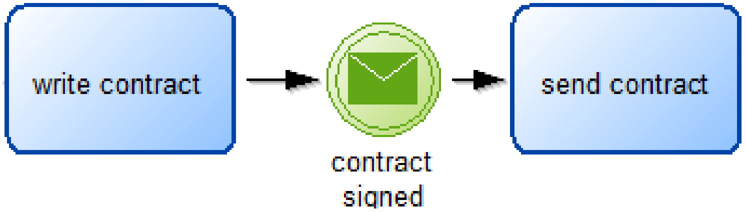
- Intermediate Events

  Between Activities:
  - Throwing
  - Catching

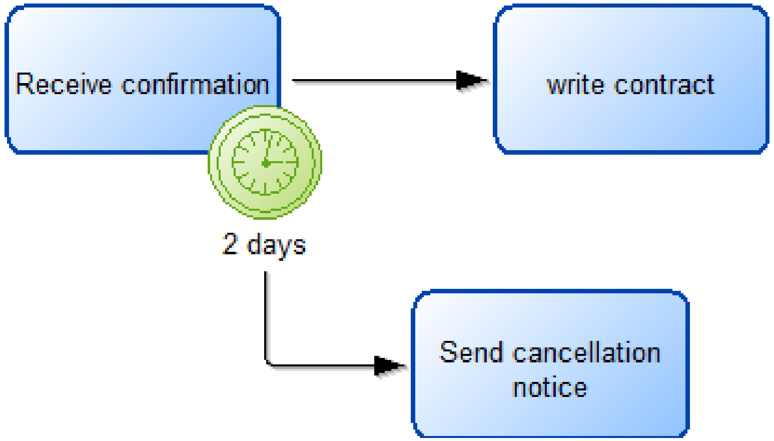
  On the boundary of activities
  - Boundary Interrupting
  - Boundary Non-Interrupting

Intermediate Events



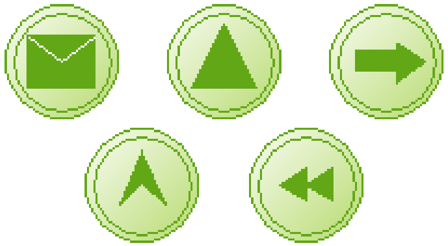


- Events that are placed within the process flow represent things that happen during the normal operations of the process. They can represent …
  - …a «trigger» that initiates an activity – catching
  - …the result of an activity – throwing

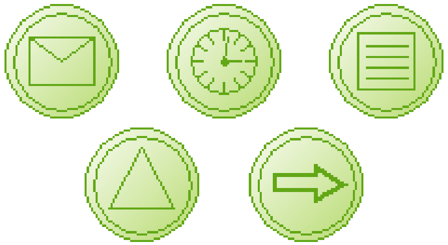


- Events that are attached to the boundary of an activity can occur during the activity. They can …
  - …interrupt the activity (solid lines)
  - …open an additional path without interrupting (modelled with dashed line)

Catching and Throwing Events



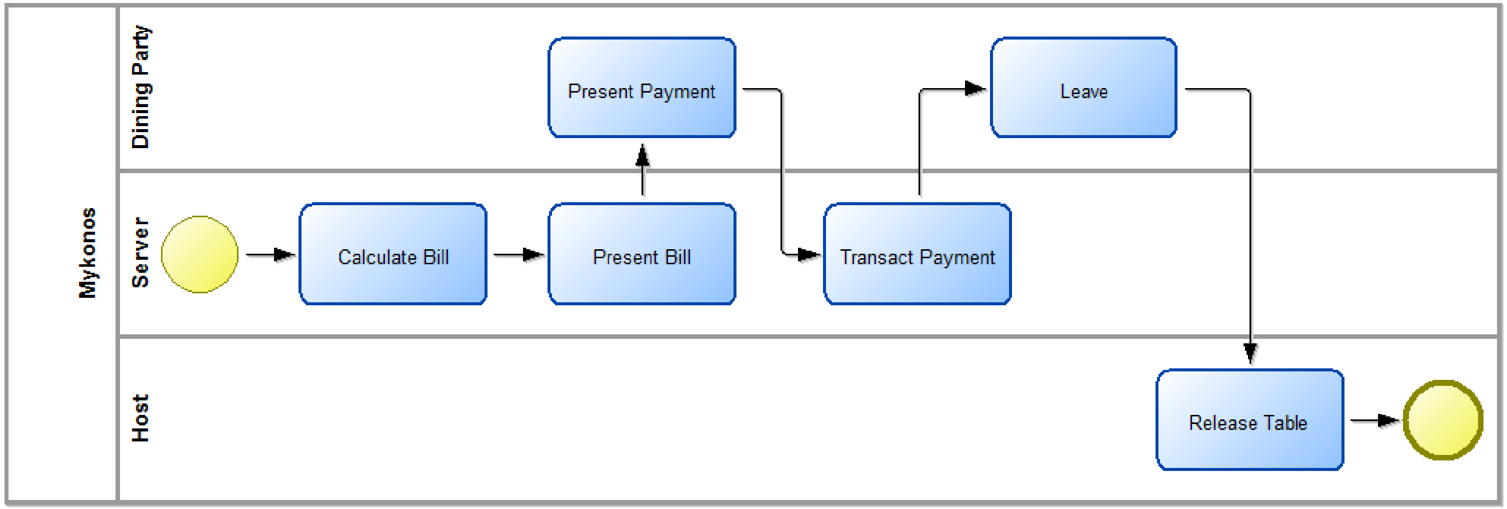
- A **throwing** intermediate event, with the black icon inside, means the process generates the trigger signal



- A **catching** intermediate event, with the wide icon inside, means the process waits for the trigger signal
  - A catching event interrupts a process and waits for the trigger signal to arrive
  - When the trigger signal arrives, the process resumes on the sequence flow out of the event

Swimlanes – Pools and Lanes

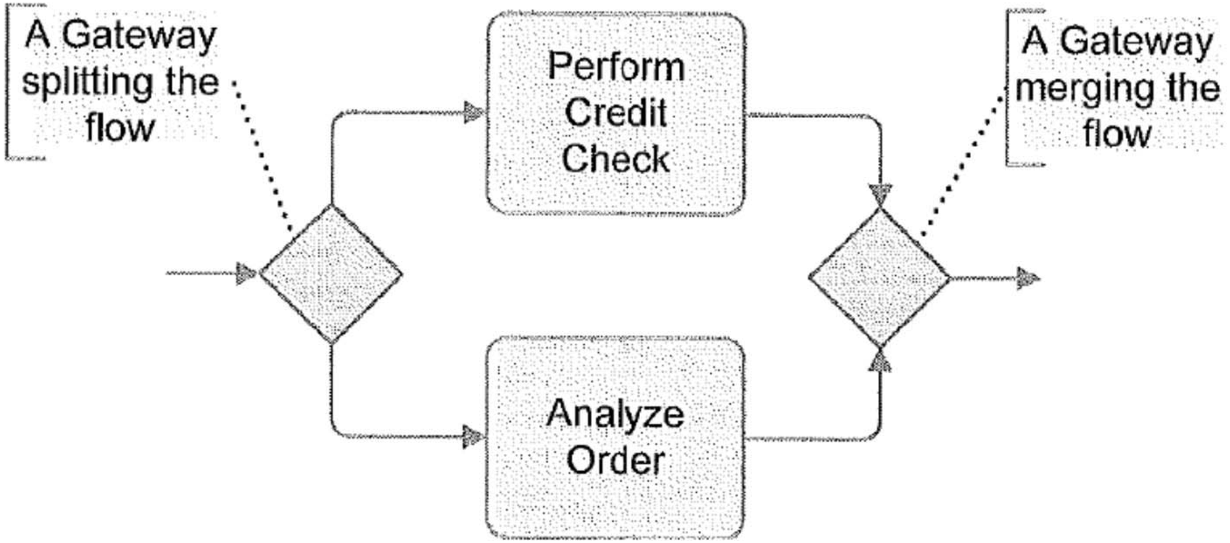
- A pool is a container for a business process or a participant in a collaboration
- A lane is an optional subdivision of a process level. They are typicalle used to associate process activities with particular actors.
  - Each participant that performs activities in a business process has a lane.
  - A lane can represent a role, an organisational unit or a system.



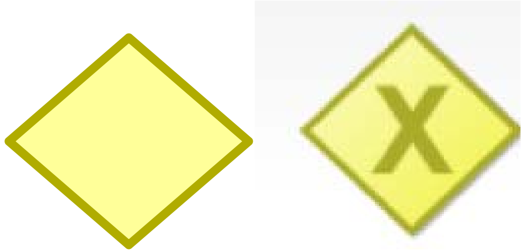
(Bridgeland & Zahavi 2009, p. 110f)

Gateways

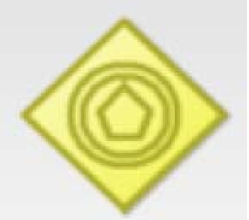
- **Gateways** model sequence flow alternatives, i.e. they represent points of control
- They split and merge the flow of a Process
- All types of Gateways are diamonds
- The underlying idea is that Gateways are unnecessary if the Sequence Flow does not require controlling



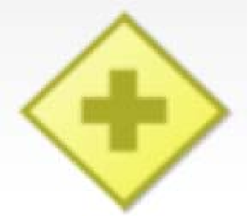
Gateways – Splitting and Merging



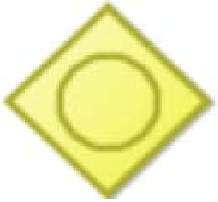
Exclusive Gateway: When splitting, it routes the sequence flow to exactly one of the outgoing branches. When merging, it awaits one incoming branch to complete before triggering the outgoing flow.



Event-based Gateway: Sequence flow is routed to the subsequent event/task which happens first.



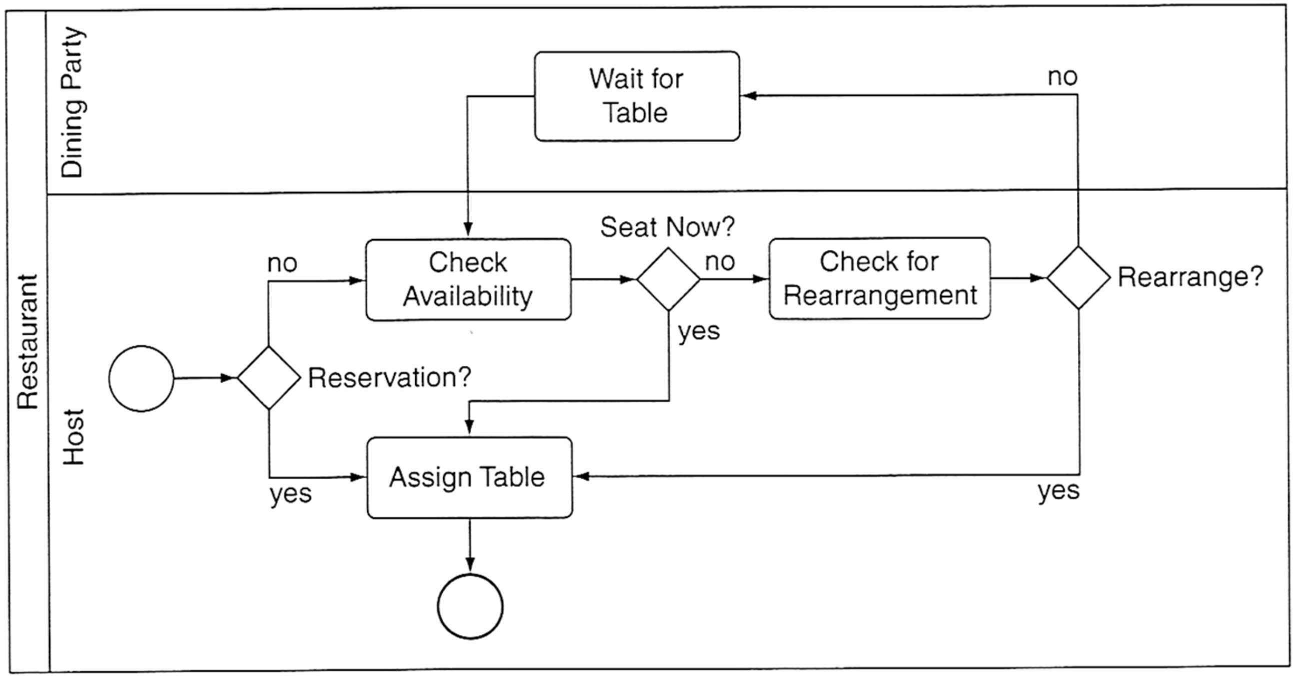
Parallel Gateway (AND): When used to split the sequence flow, all outgoing branches are activated simultaneously. When merging parallel branches it waits for all incoming branches to complete before triggering the outgoing flow.



Inclusive Gateway (OR): When splitting, one or more branches are activated. All active incoming branches must complete before merging.

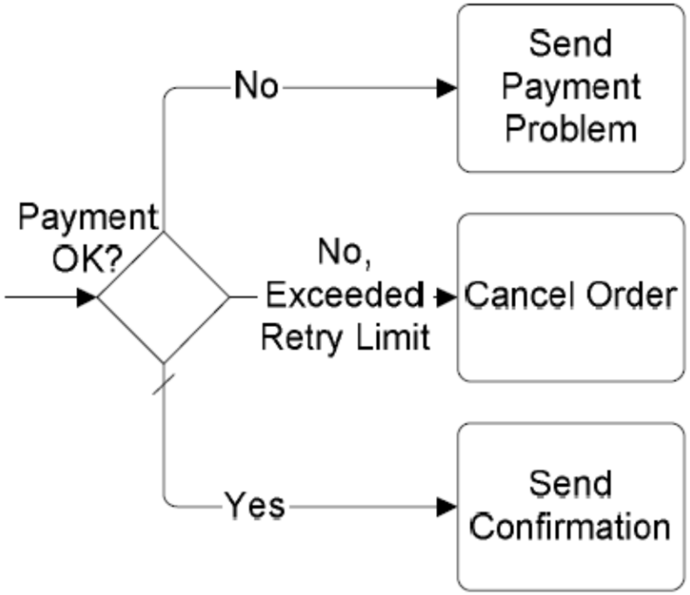
Exclusive Gateways

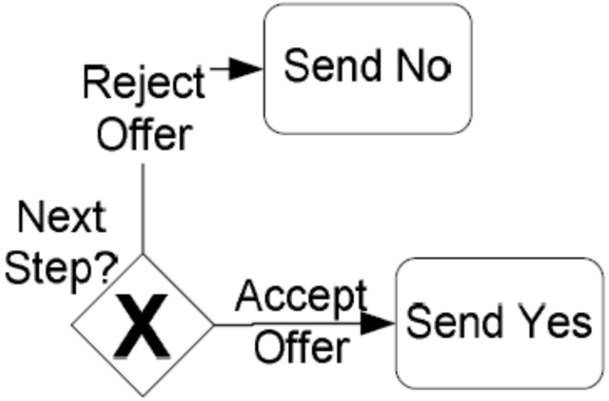
- For exclusive Gateways exactly one of the following sequence flows is selected
- The name of the gateway is a question with the alternative answers to the questions as labels on the outgoing sequence flows



(Bridgeland & Zahavi 2009, p. 113f)

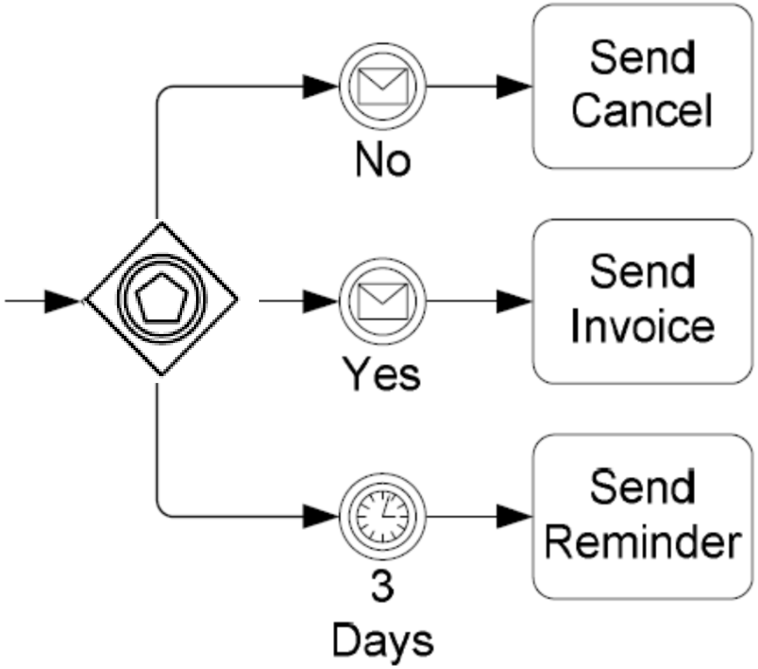
Exclusive Gateways based on Data





- The Gateway (Decision) creates alternative paths based on defined conditions.
- Exclusice Gateways based on Data are the most commonly used Gateways
- They can be shown with or without an internal „X“ marker. Without is the most common use.

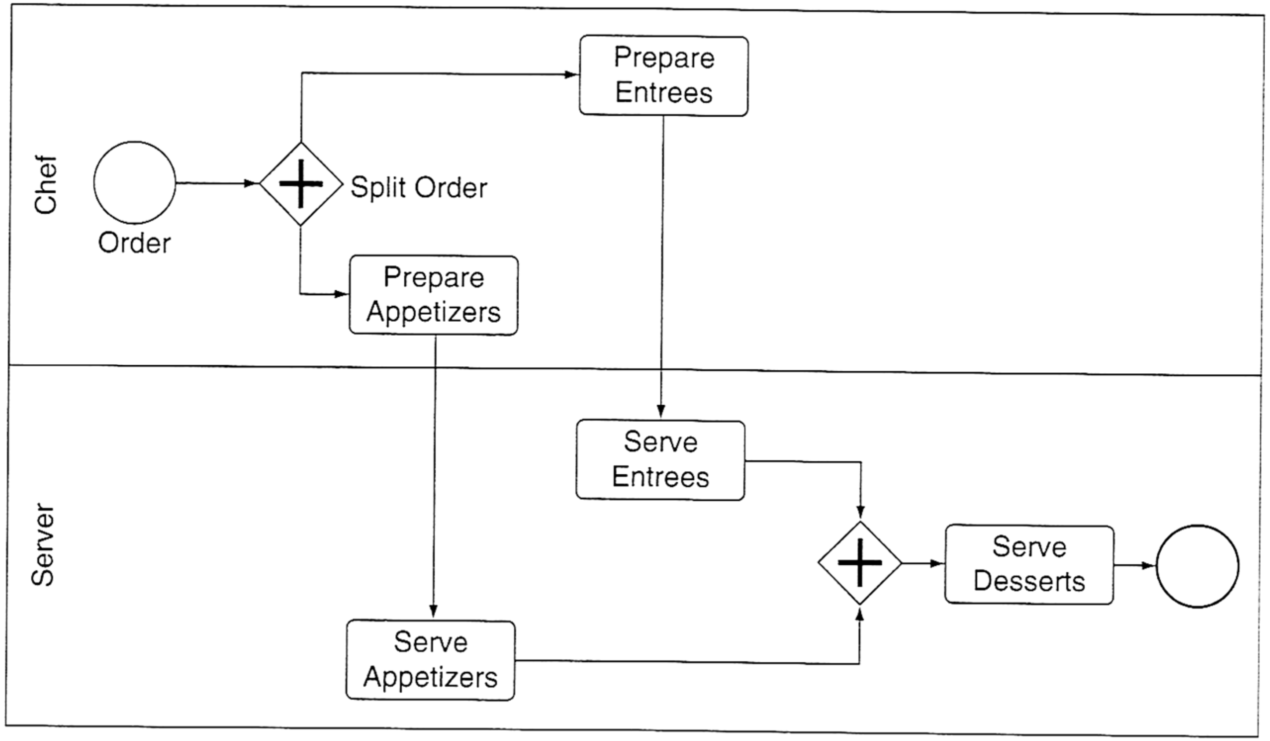
Exclusive Gateways based on Events



- Alternatives in this Decision are based on events that occur at the point in the proces rather than conditions
- The Multiple Intermediate Event is used to identify this Gateway
- The Events that follows the Gateway Diamond determine the chosen path
  - The first Event triggered wins

Parallel Gateway

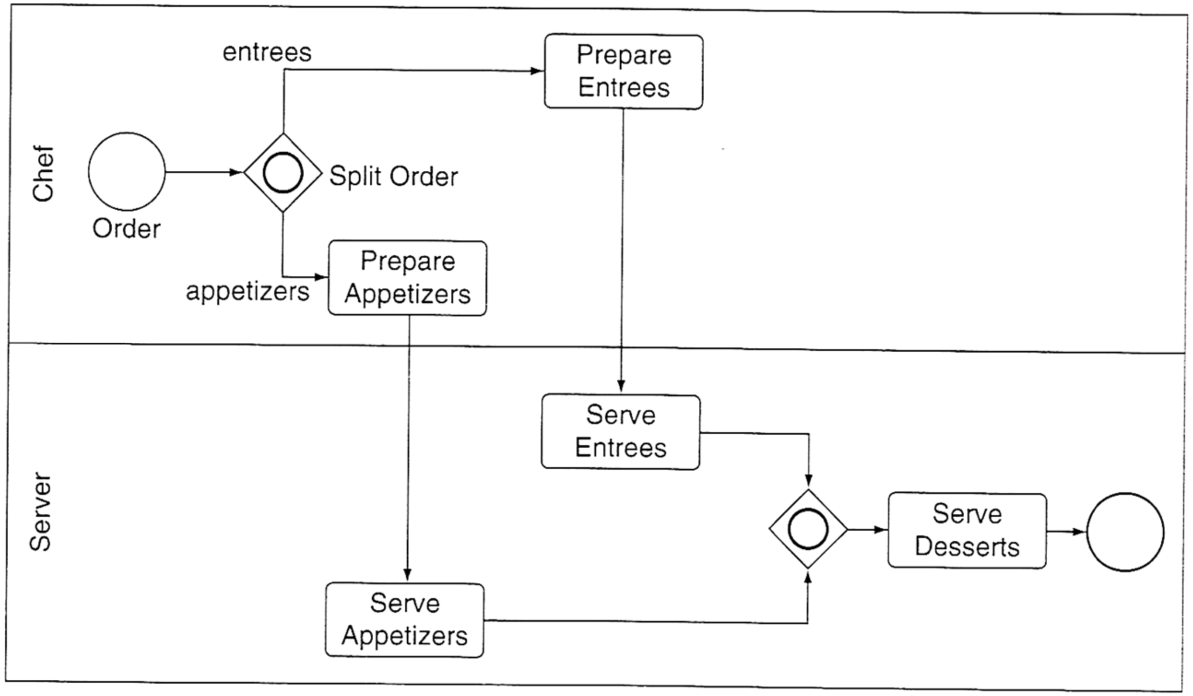
- A parallel gateway
  - starts parallel work, i.e. two (or more) sequence flows that then progress at the same time
  - parallel flows are joined back together by another parallel gateway



(Bridgeland & Zahavi 2009, p. 114f)

Inclusive Gateway

- An inclusive gateway allows either of the outgoing sequence flow to be taken or several in parallel.
- They usually are followed by a corresponding merging Inclusive Gateway
- Example: The following process shows a process where the guests do not have both appetizers and entrees but can have only one of them.



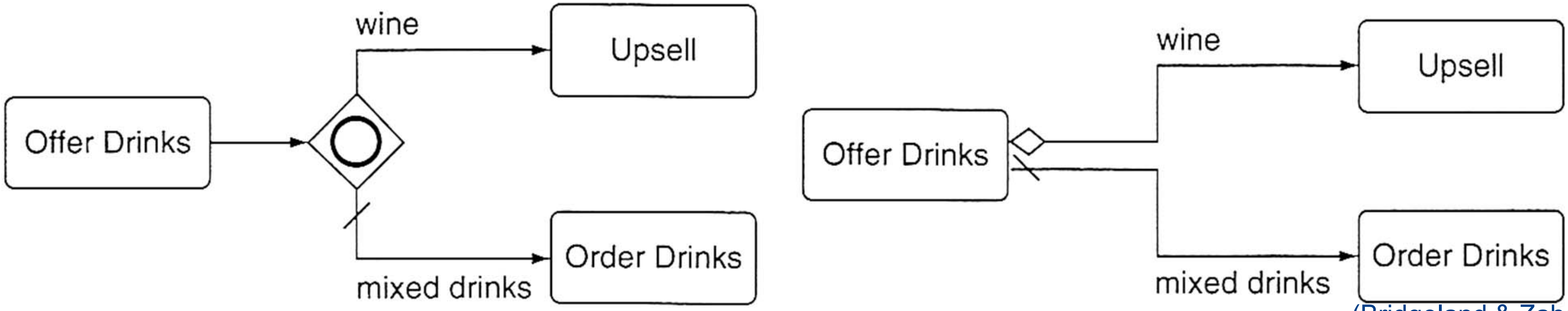
(Bridgeland & Zahavi 2009, p. 114f)

Default Sequence Flow and Conditional Sequence Flow

- One of the outgoing sequence flows from a gateway can be marked as default – the one that is taken if there is no reason to take another sequence flow.
- The default is modeled with a short line crossing the sequence flow.

- The same can be modeled without a gateway using a conditional sequence flow.
- A conditional sequence flow is a sequence flow that includes a condition

Example: Identical process with a gateway and with condional sequence flow

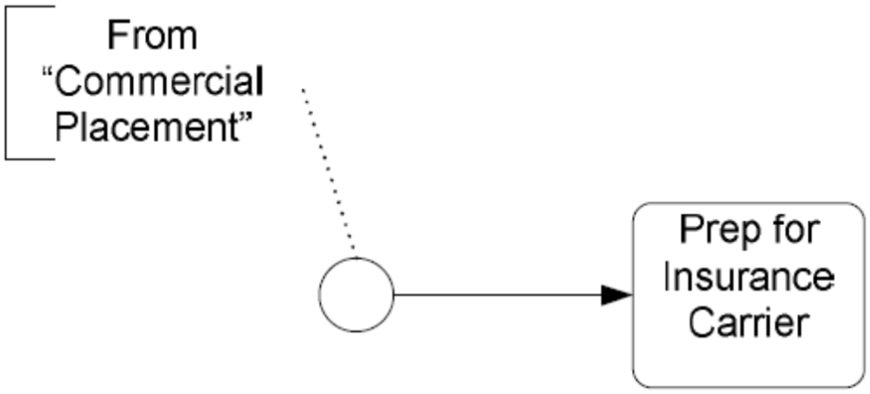


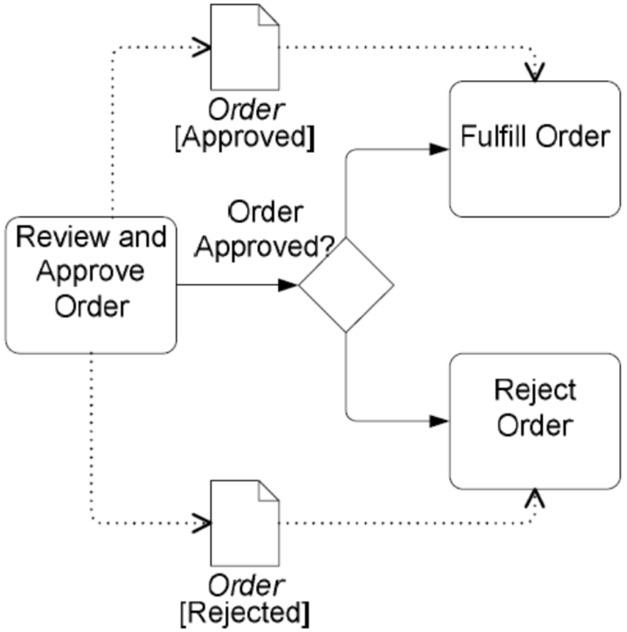
(Bridgeland & Zahavi 2009, p. 116)

Artifacts

- Artifacts provide the capability to show information beyond the basic flow-chart structure of the Process
- There are currently three standard Artifacts in BPMN:
    - Data Objects
    - Groups
    - Annotations
- A modeler or tool can extend BPMN by defining new Artifacts

Text Annotations and Data Objects



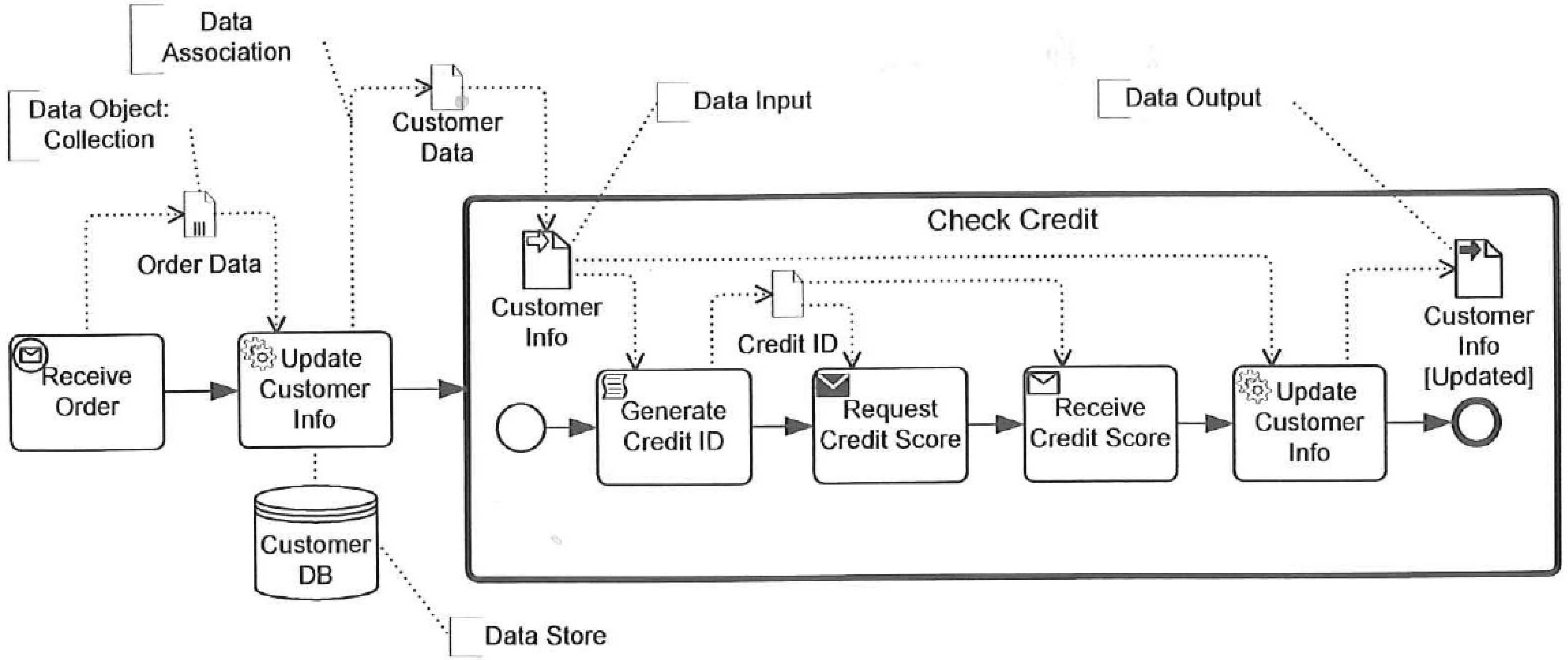


- Text Annotations are a mechanism for a modeler to provide additional information about a Process
- Text Annotations can be connected to a specific object on the Diagram with an Association

- Data Objects can be used to define inputs and outputs of activities
- Data Objects can be given a “state” that shows how a document may be changed or updated within the Process

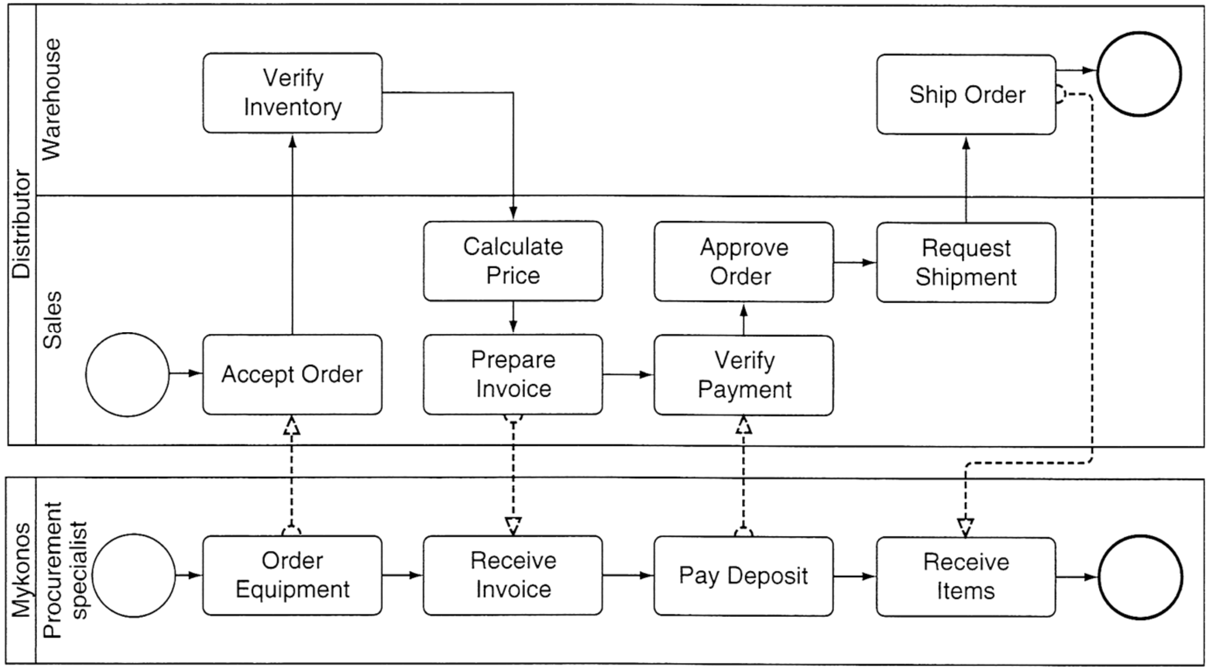
Data Elements in BPMN

- BPMN 2.0 contains new graphical elements to represent data
  - Data Associations: connecting Data Objects to Activities
  - Data Inputs and Outputs can be visualized
  - Data Stores represent repositories or databases
  - Collections, marked by [+], represent groups of Data Objects



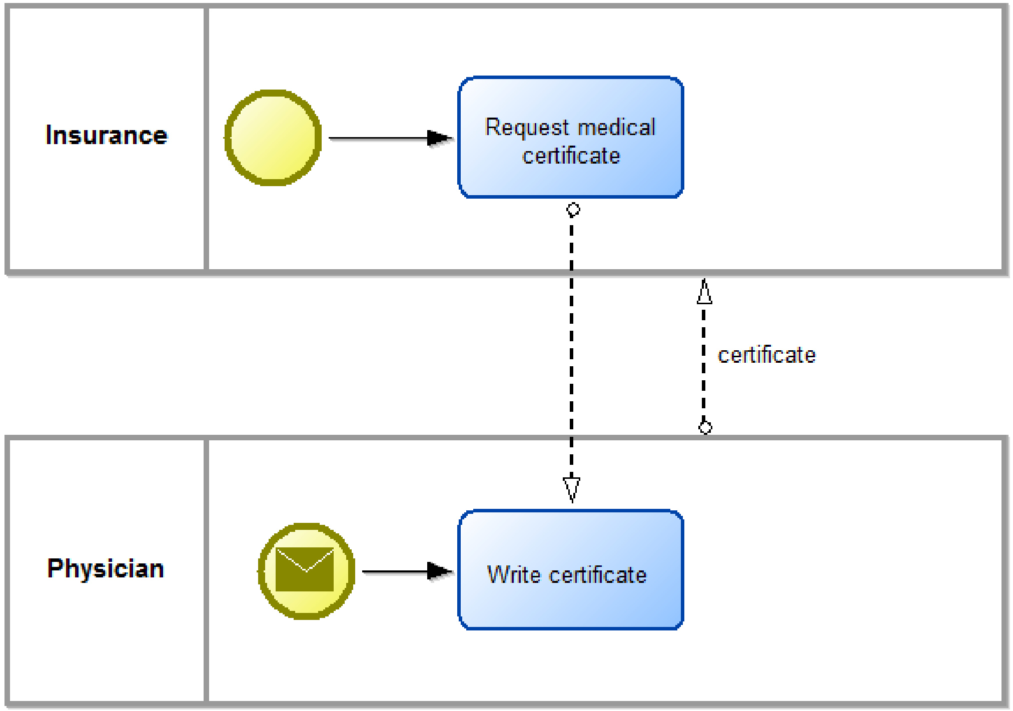
Swimlanes

- Swimlanes partition and organise activities
- There are two main types of swimlanes: Pool and Lane
  - Pools represent Participants in an interactive (B2B) Business Process Diagram
  - Lanes represent sub-partitions for the objects within a Pool – they represent participants of a process



(Bridgeland & Zahavi 2009, p. 123)

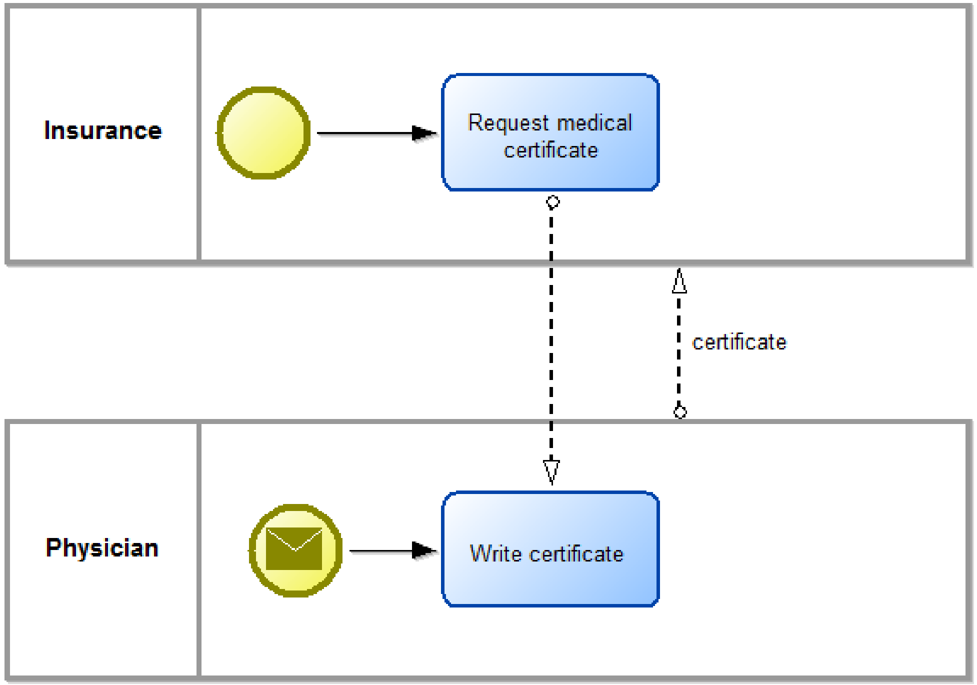
Message Flow



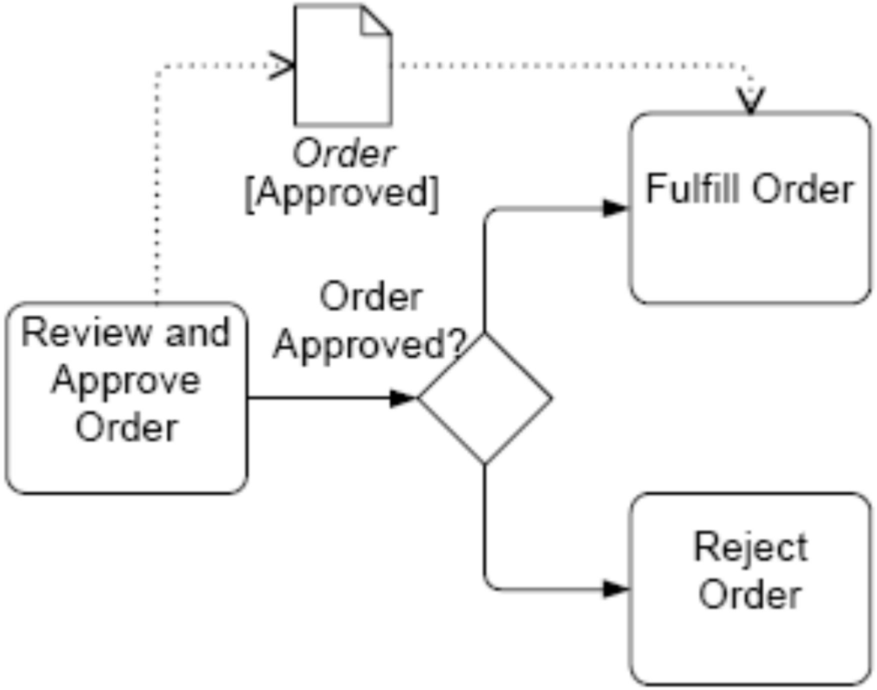
- A Pool may be a „black box“ or may contain a Process
- Interaction between Pools is handled through **Message Flow**
- A Message Flow can connect to the boundary of the Pool or to an object within the Pool
- Message Flows are not allowed between objects within a single Pool
- Sequence Flow must not cross the boundary of a Pool (i.e. a Process is fully contained within a Pool)

Data Transfer with Message Flow und Associations

Message Flow between pools:

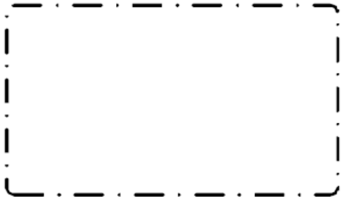


Data transfer inside a pool MUST NOT be modeled with Message Flow but with Associations :

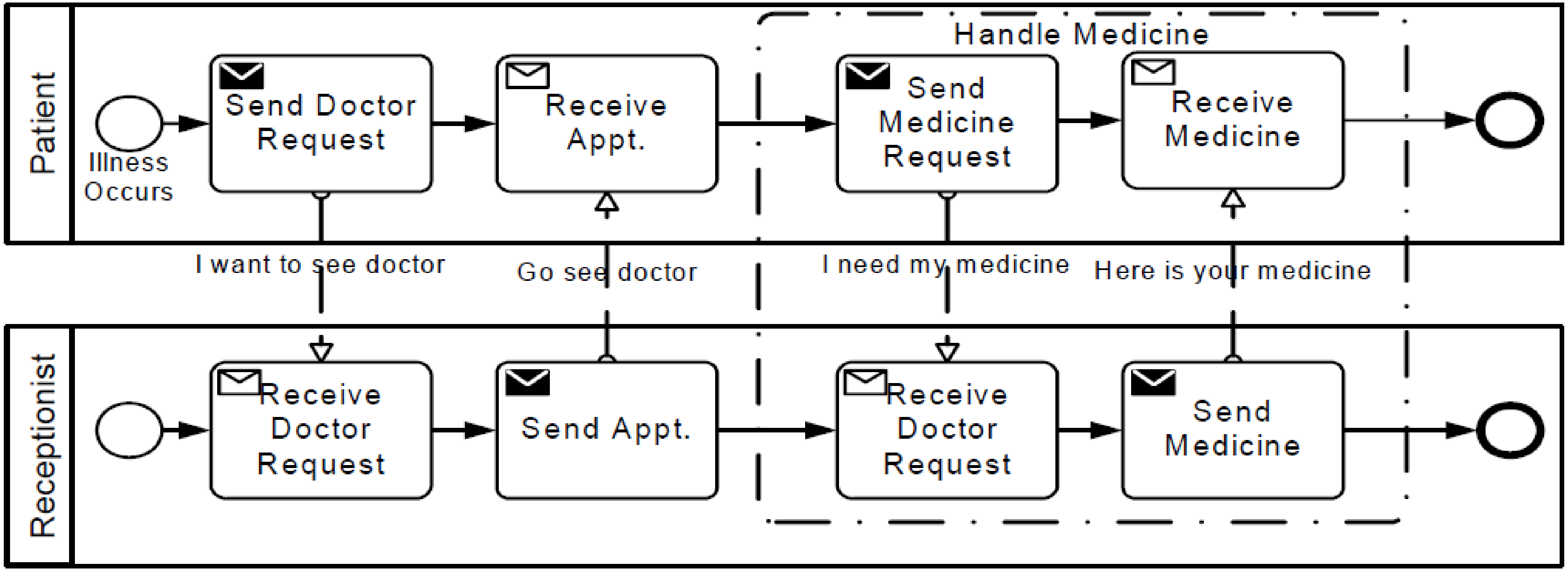


Groups

- The Group object is an Artifact that provides a visual mechanism to group elements of a diagram informally



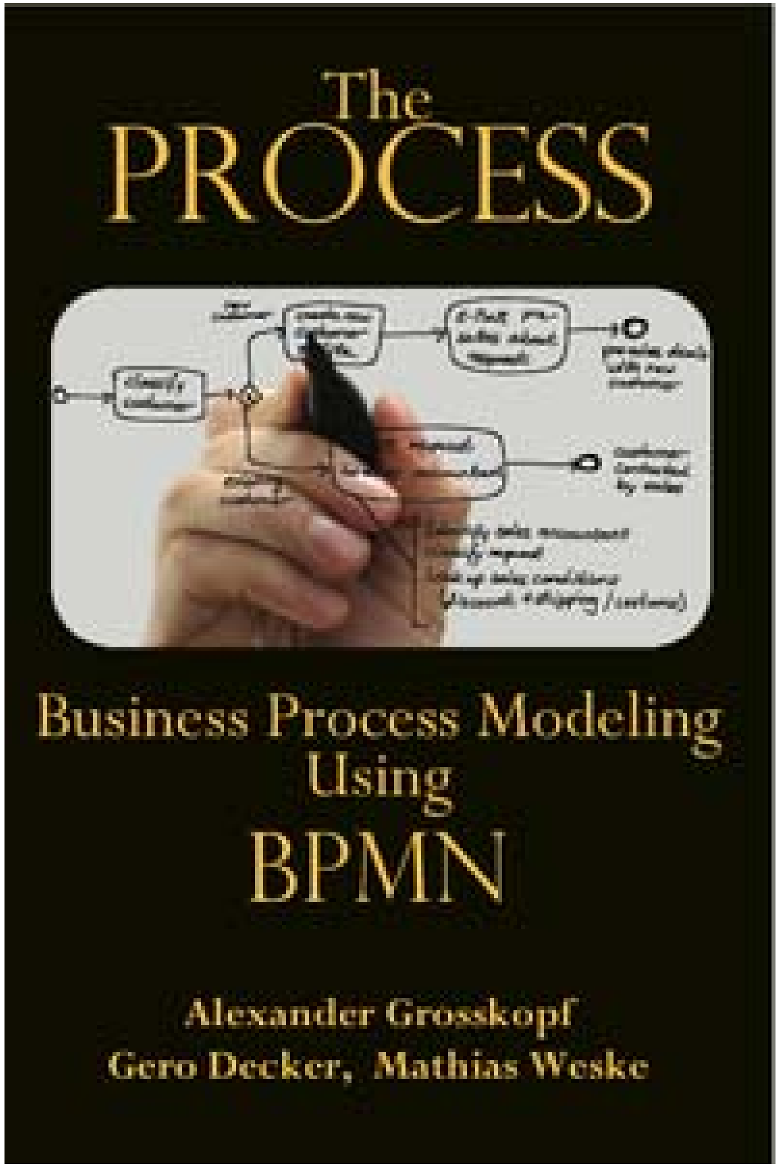
- A Group can stretch across the boundaries of a Pool, often to identify Activities that exist within a distributed business-to-business transaction.



BPMN Method (Silver 2010)

1. Agree on process scope, when it starts and ends, what the instance represents, and possible end states.
2. Enumerate major activities in a high-level map, ten or fewer, each aligned with the proces instance. Think about possible end states of each activity.
3. Create top-level BPMN diagram. Arrange high-level map activities as subprocesses in a BPMN process diagram, with one top-level end event per process end state. Use gateways to show conditional and concurrent paths.
4. Expand each top-level subprocess in a child-level diagram. If a subprocess at parent level is followed by a gateway, match subprocess end state and gateway (or gate) labels.
5. Add business context by drawing message flows between the process and external requester, service providers, and other internal processes, drawn as black-box pools. Message flows connecting to collapsed subprocess at parent level should be replicated with same name in the child-level diagram.
6. Repeat steps 4 and 5 with additional nested levels, if any.

Book Recommendation



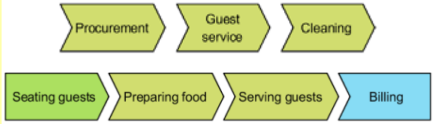
- A novel about BPMN
- "Entertaining with a high practical orientation" (from a review)

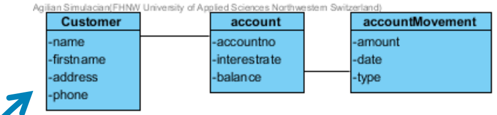
BUSINESS PROCESSES AND THEIR CONTEXT

References in BPMN

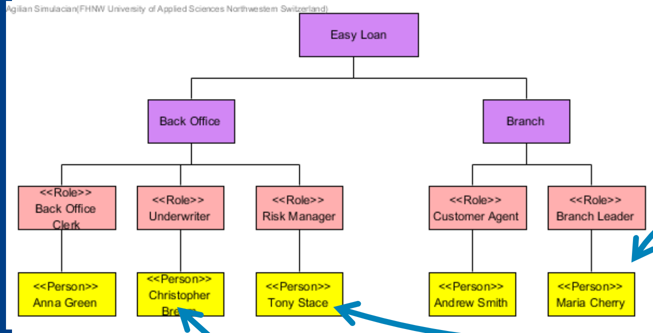
- Process models represent the flow of work.
- Processes are related to other aspects of business
- These are represented by references to other models.

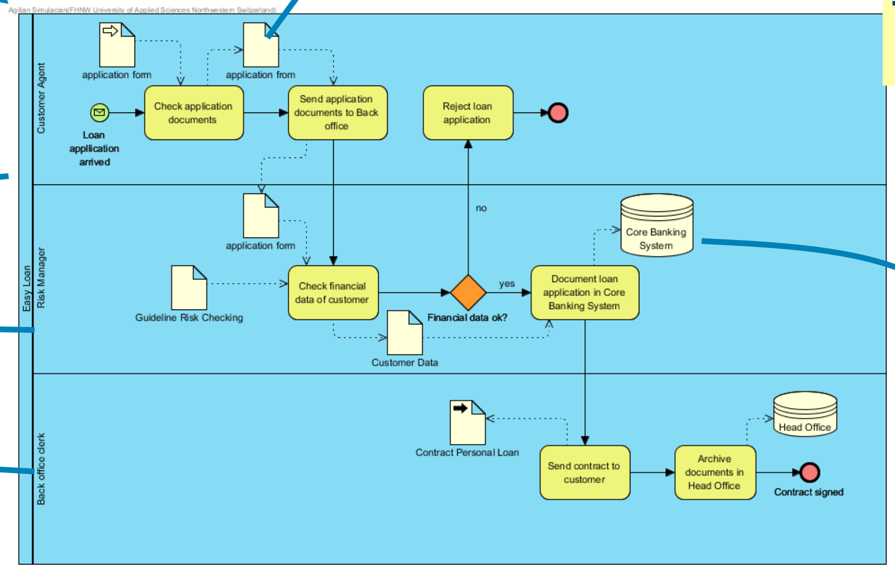
An element in a process map corresponds to a process diagramm



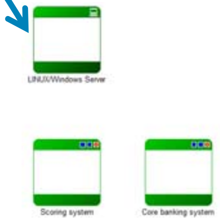


Data Objects can refer to
- *data models*
- *document models*




Agilian Simulacian(FHNW University of Applied Sciences Northwestern Switzerland)
Easy Loan
Customer Agent
Risk Manager
Back office clerk
application form
application from
Loan appllication arrived
Check application documents
Send application documents to Back office
Reject loan application
no
application form
Core Banking System
Guideline Risk Checking
Check financial data of customer
yes
Document loan application in Core Banking System
Financial data ok?
Customer Data
Contract Personal Loan
Head Office
Send contract to customer
Archive documents in Head Office
Contract signed

Data stores may refer to IT models



Lanes refer to elements in an organisation model

Relationships from and to Business Process Diagrams

There are two kinds of relations from/to BPMN

- Relations **to** process **models as a whole**
  - Process maps
  - Business motivations
- Relations **from** process model elements to **elements** in other models
  - data objects in document models and data models
  - organisation units in organisation models
  - applications and application services in IT models
  - business rules

References in BPMN

- Artifacts in BPMN stand for data objects
  - Data object in BPMN can represent different kinds of data
    - structured data
    - documents
  - Data store (applications)
- Lanes and pools represent organisational elements
  - organisation units
  - roles
  - people

Data and organisation are modeled in their own models; their elements can be referenced from BPMN