BPMN

BUSINESS PROCESS MODEL AND NOTATION

OVERVIEW OF BUSINESS PROCESS MODEL AND NOTATION (BPMN) LANGUAGE FOR MODELING BUSINESS PROCESSES

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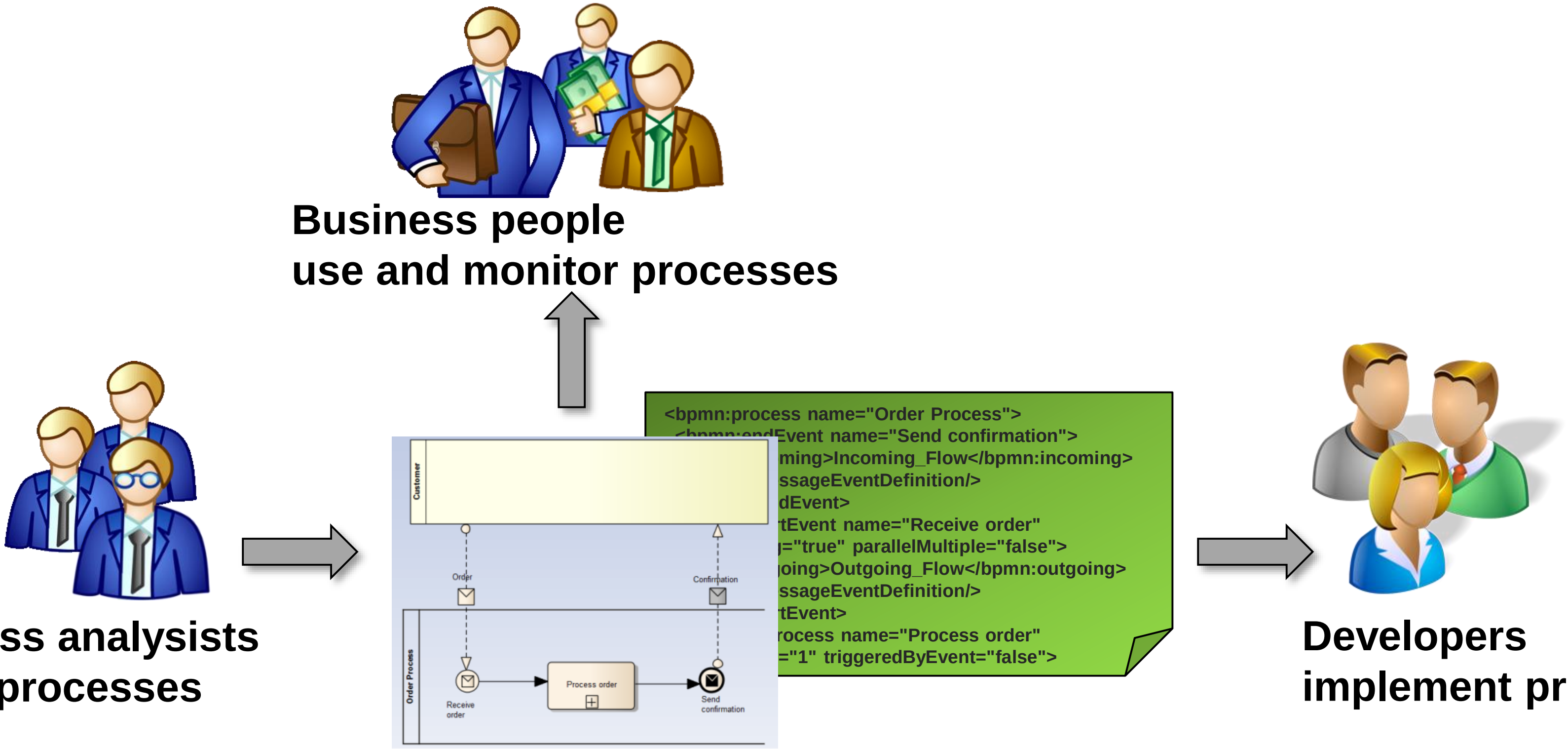
1. What is BPMN?

BMPN is a graphical modeling language and notation for business processes (=graphical DSL – Domain Specific Language) with the following goals:

1. Common language understandable for different stakeholders.
2. Visualization of execution languages like WSBPEL.
3. Interchange format between tools for process description and diagrams.



Business people use and monitor processes

Business analysists define processes

Developers implement processes

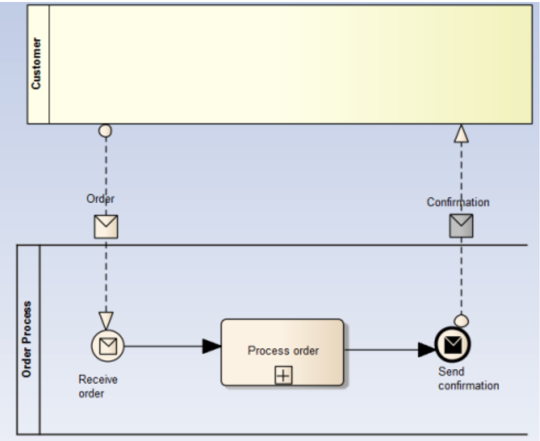
```
<bpmn:process name="Order Process">
  <bpmn:endEvent name="Send confirmation">
           ming>Incoming_Flow</bpmn:incoming>
           ssageEventDefinition/>
           dEvent>
           tEvent name="Receive order"
           ="true" parallelMultiple="false">
           oing>Outgoing_Flow</bpmn:outgoing>
           ssageEventDefinition/>
           tEvent>
           rocess name="Process order"
           ="1" triggeredByEvent="false">
```

BPMN = common language & notation

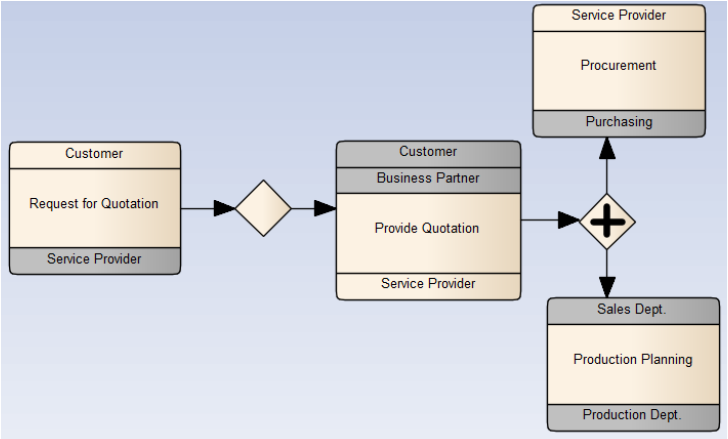
2. BPMN Main Parts (1/3)

A. Diagram types:

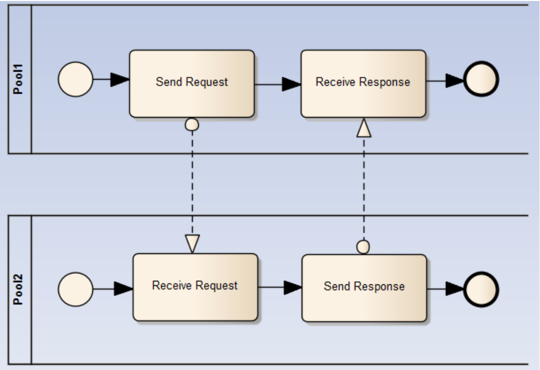
BPMN defines the following 4 diagram types.



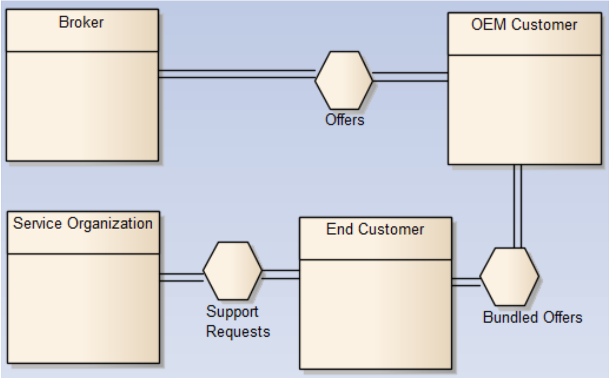
Orchestration/Process



Choreography



Collaboration

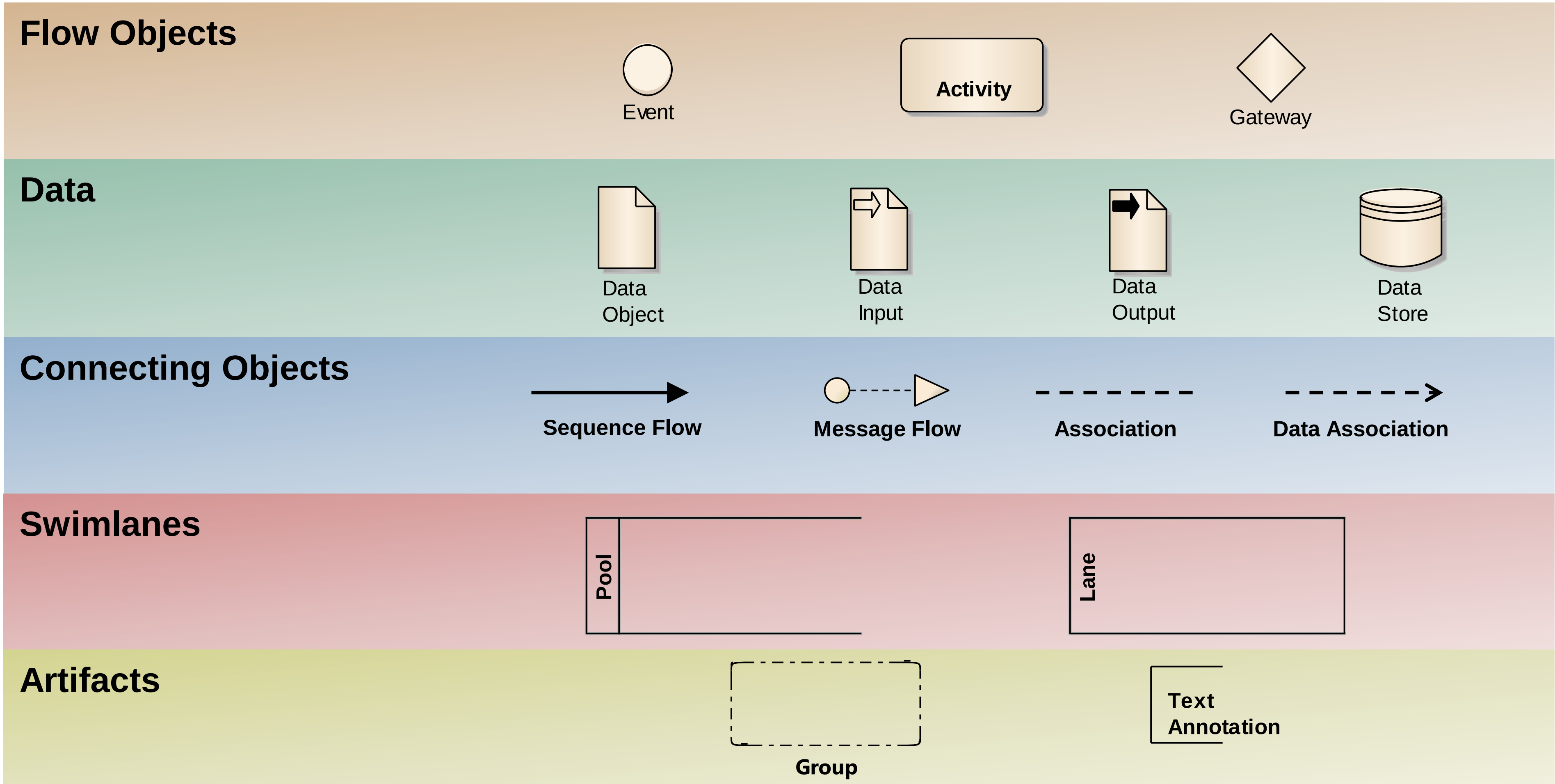


Conversation

2. BPMN Main Parts (2/3)

B. Business process notation:

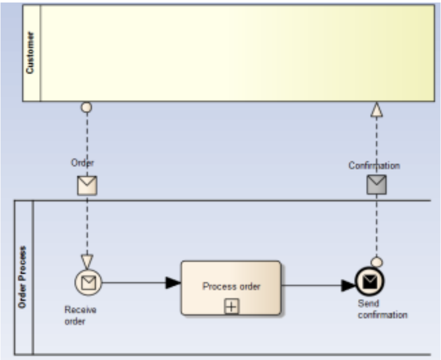
BPMN defines a common set of modeling elements to be used in BPMN diagrams.



2. BPMN Main Parts (3/3)

C. Mapping to execution language:

BPMN defines a mapping to the WSBPEL execution language.
BPMN roughly maps to WSBPEL, but could be mapped to another execution language as well.



BPMN
Business Process Model

Mapping to

```
…
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bpmn:id="_Oig9ANU5Edyqa7yB__NlQQ">
     <bpel:copy>

<bpel:from>$thisStartRequestMsg.body/tns:city</bpel:f
rom>

<bpel:to>$timeService1GetCityTimeRequestMsg.param
eters/TimeService1:city</bpel:to>
     </bpel:copy>
…
```
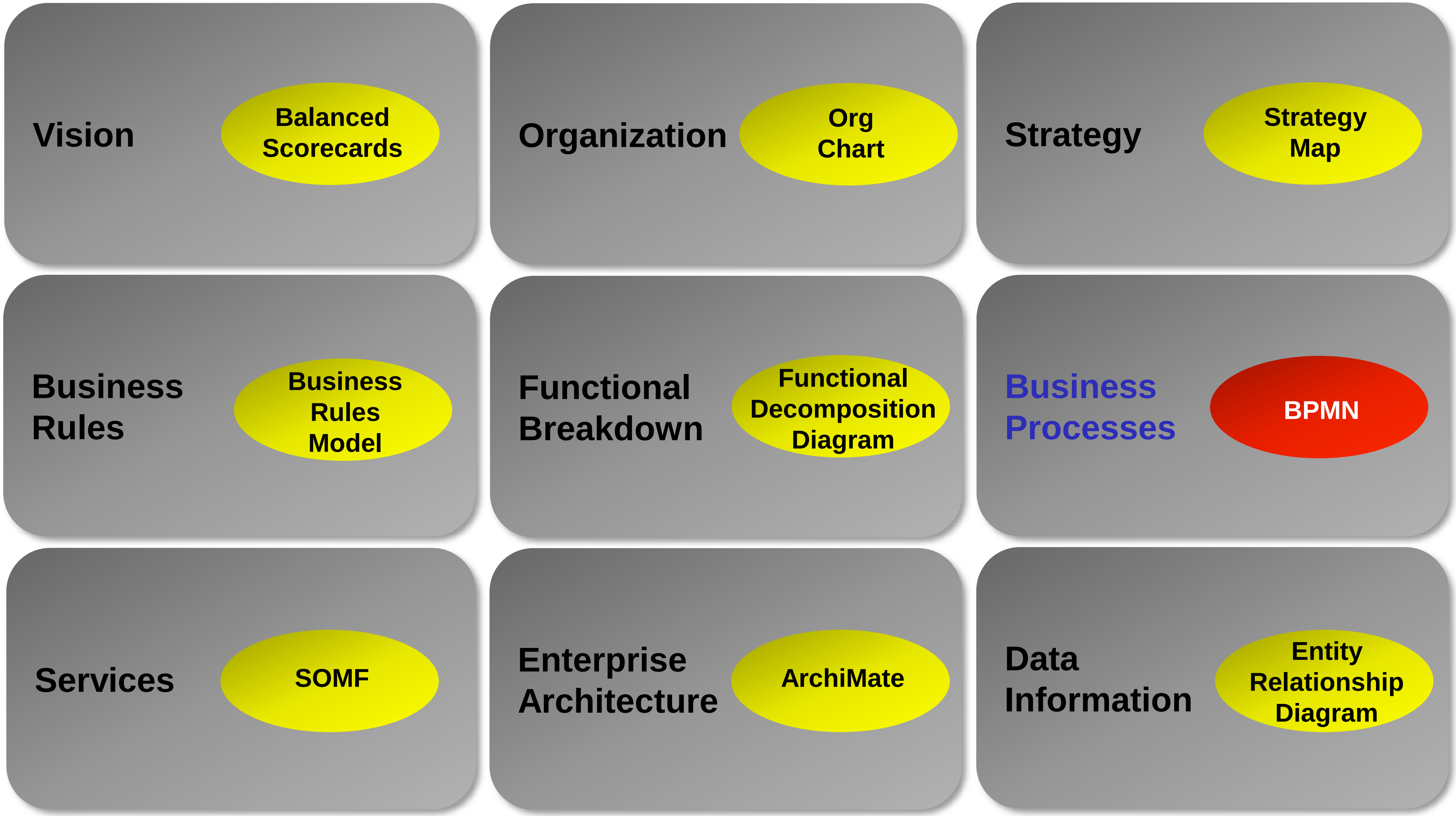

WSBPEL to run in BPEL-runtime

3. BPMN Scope

Different model notations and languages are used for modeling business aspects.
BPMN is a notation to model business processes.



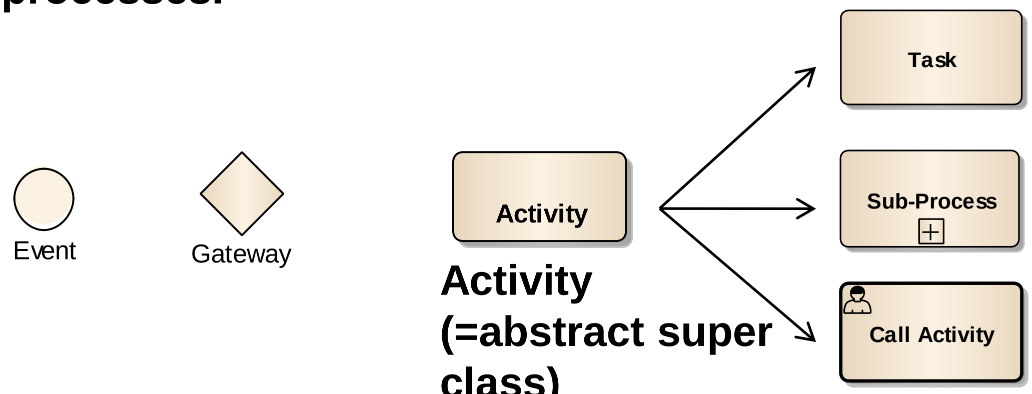
Vision	Balanced Scorecards
Organization	Org Chart
Strategy	Strategy Map
Business Rules	Business Rules Model
Functional Breakdown	Functional Decomposition Diagram
Business Processes	BPMN
Services	SOMF
Enterprise Architecture	ArchiMate
Data Information	Entity Relationship Diagram

4. BPMN Core Concepts (1/5)

A. Orchestration / processes (1/2):

A process describes a sequence or flow of activities as part of work to be carried out (=workflow).

Processes contain the BPMN flow elements (events, actitivies, gateways) and callable processes.



Activity (=abstract super class)

Concrete activity types

Process types:

a. Private non-executable process (process for documentary purposes only)

b. Private executable process (contains enough detail to be executable)

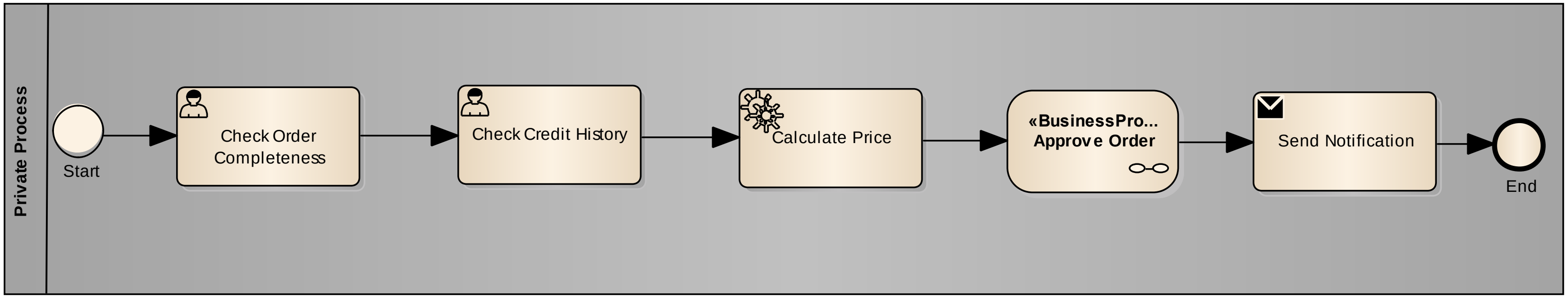
c. Public process

4. BPMN Core Concepts (2/5)

A. Orchestration / processes (2/2):

a. Private process:

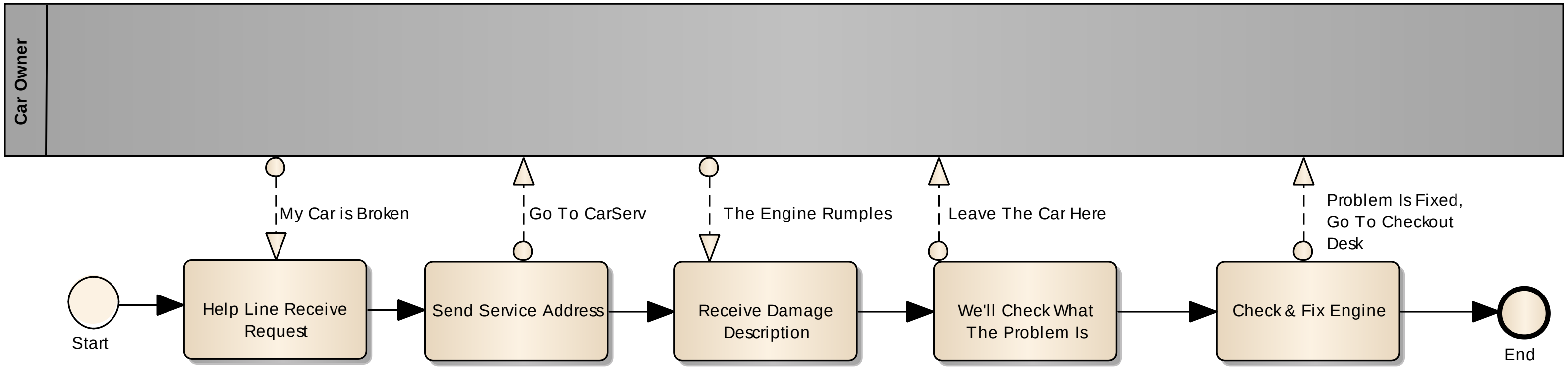
A private process is specific to an organization. There is no interaction with another swimlane (pool = participant).



b. Public process:

Public processes show interactions between a private process and another process or participant (pool).

Internals of public process are not shown, only the interactions with another process.

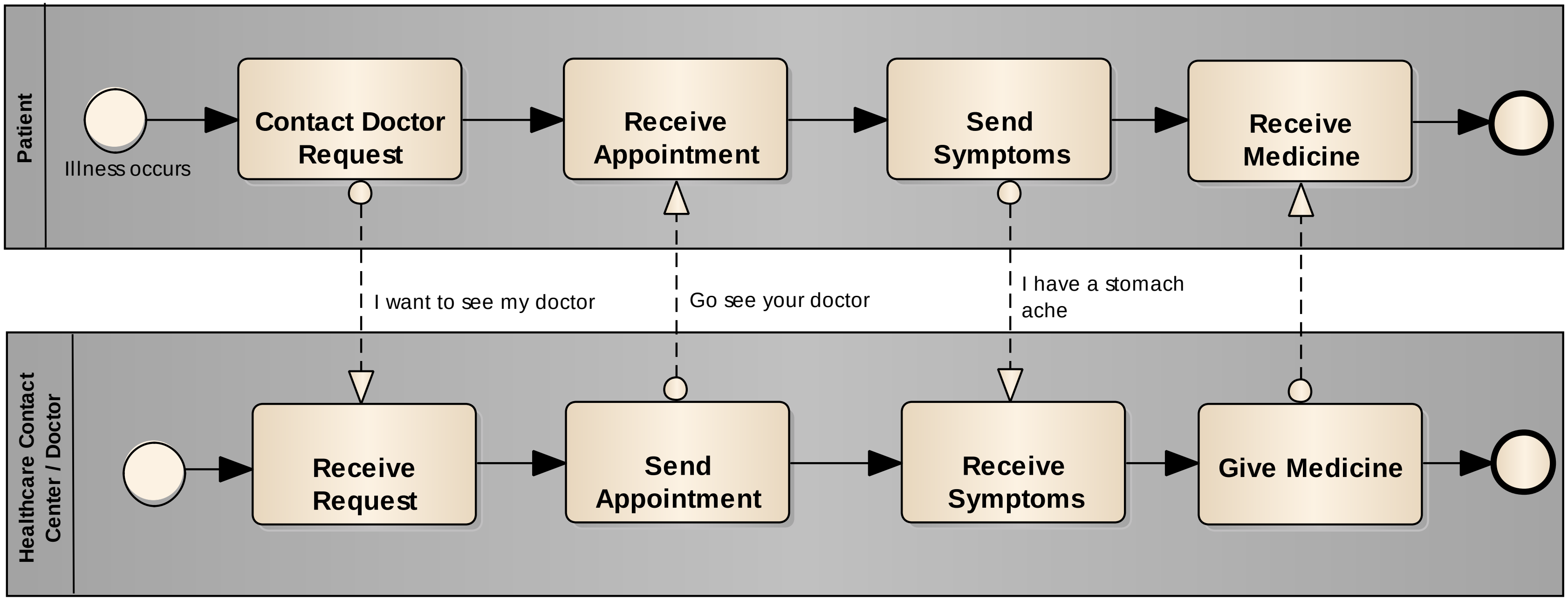


4. BPMN Core Concepts (3/5)

B. Collaboration:

A collaboration shows the interaction between participants modeled as swimlanes (pool, lane).
A collaboration diagram typically contains 2 or more pools / lanes.

Message flows cross the pool boundaries while sequence flows connect activities within pools.

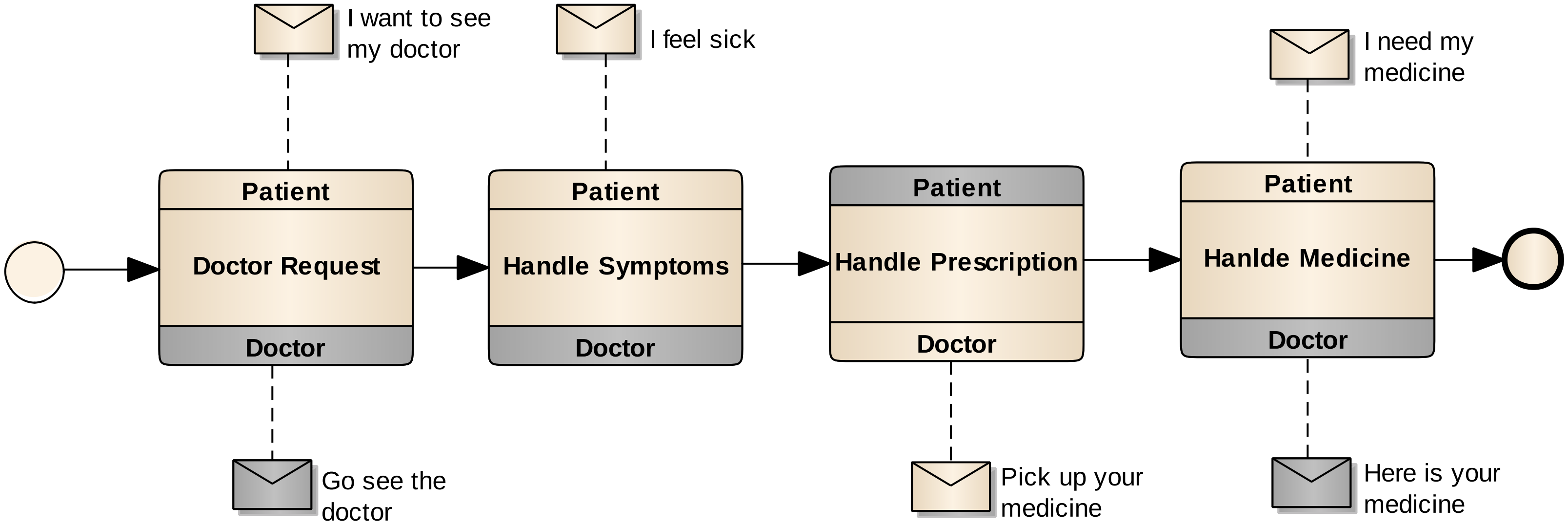


4. BPMN Core Concepts (4/5)

C. Choreography:

**Choreography shows the interactions between participants modeled as pools.
Choreographies are defined outside of pools and exist between pools.
The focus of choreographies is on the exchange of information between participants.**

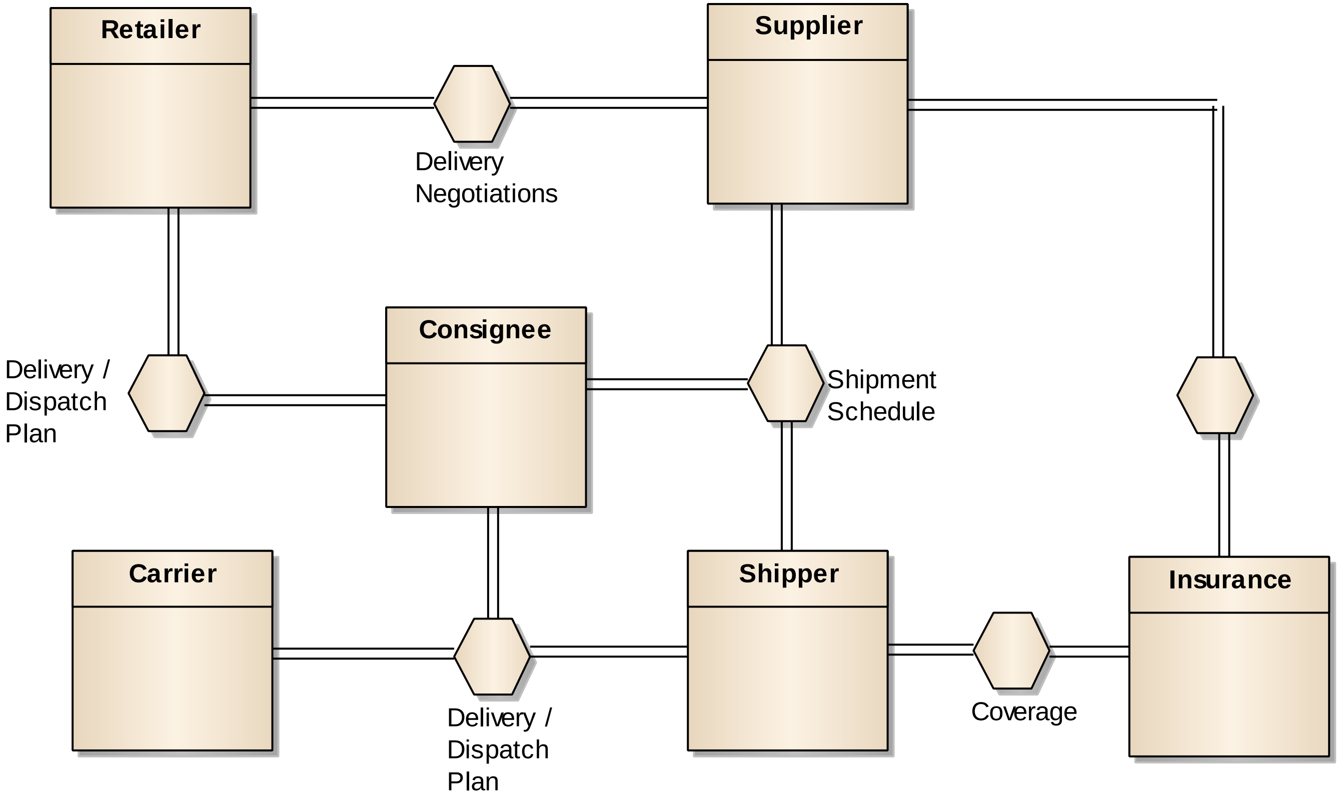
In choreographies, there is no central control, responsible entity or observer.



4. BPMN Core Concepts (5/5)

D. Conversation:

Conversation diagrams show the logical message exchanges between participants.
Unlike process, collaboration and choreography diagrams, conversation diagrams show a "birds eye view" of the different conversations (exchange of information) between participants.



5. BPMN versus BPEL

BPMN and BPEL share common concepts, but are not tools for the same purpose.

BPMN is mainly a notation that defines how business processes can be modeled graphically.

WS-BPEL defines a machine-processable and –executable format for business processes.

BPMN 1.2 is typically translated to BPEL 2.0 which in turn is executed on a BPMN runtime.

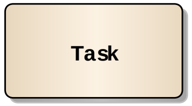
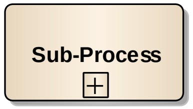
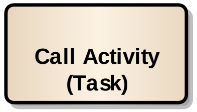
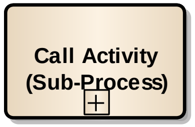
BPMN 2.0 can be directly executed on a BPMN runtime without translation to another format.

Description Language	Translator	Execution Language	Runtime
BPMN 1.2	BPMN Mapper	WS-BPEL (BPEL 2.0)	BPMN runtime like intalio
BPMN 2.0	-	BPMN 2.0	BPMN runtime
Java	Java compiler	Byte code	Java Virtual Machine
C / C++	Compiler	Machine code	CPU

6. BPMN notation elements (1/10)

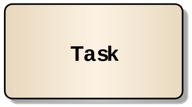
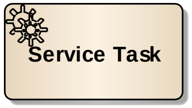
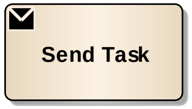
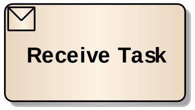
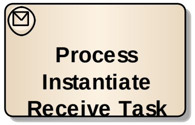
Activity:

Activities (tasks, sub-processes) are executable elements of a BPMN process.

Actity type	Symbol	Description
Task		Atomic activity within a process that cannot be broken down further. Typically a task is executed by an end-user or application.
Sub-process		Activity with an internal structure containing activities, gateways, events and sequence flows.
Call activity	 	Defines a point where a global task or process is called. A call activity differs from a sub-process in that it is a reference to a process while a sub-process is a process itself. This means that a call activity calls a reusable process or task. The called sub-process or task can be called multiple times by different call activities.

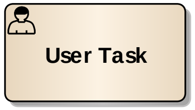
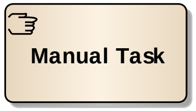
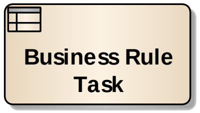
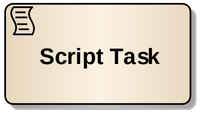
6. BPMN notation elements (2/10)

Task types (1/2):

Task type	Symbol	Description
Abstract task		Task without any specialization.
Service task		Task that uses some sort of service like a web service.
Send task		Task for sending a message to an external participant. After the message is sent, the task is completed.
Receive task		Task that waits for a message to arrive from an external participant. After the message is received, the task is completed.
Instantiating receive task		Same as receive task, but instantiates a process ("creates process token").

6. BPMN notation elements (3/10)

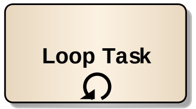
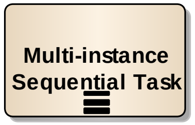
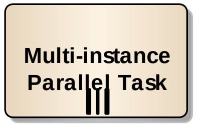
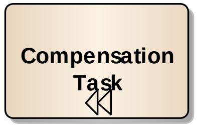
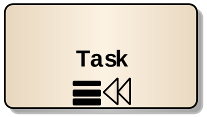
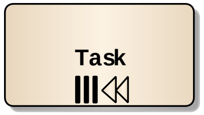
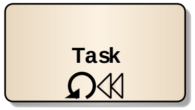
Task types (2/2):

Task type	Symbol	Description
User task		Task executed by a human with the assistance of a software application.
Manual task		Task executed by a human without the assistance of any process execution engine or application.
Business rule task		Provides input to a business rule engine. Receives output from a business rule engine. Business rule tasks connect a process or sub-process to a business rule engine.
Script task		A script task is executed by a business process engine. When the script is finished, the task is finished as well.

6. BPMN notation elements (4/10)

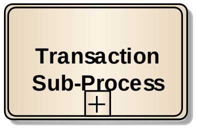
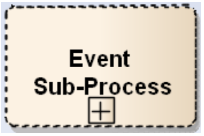
Task markers:

Additional markers add more semantics to tasks.

Task marker	Symbol	Description
Loop		A looping task repeats its action as long as a loop flag is set.
Multi-instance sequential		The task is executed in multiple instances in sequential order.
Multi-instance parallel		Multiple instances of the task are executed in parallel.
Compensation		Compensation is used in case of errors (exceptions) to undo steps that are already executed (call of compensation handler for a "rollback").
Allowed marker combinations		Multi-instance sequential & compensation
		Multi-instance parallel & compensation
		Loop & compensation

6. BPMN notation elements (5/10)

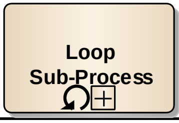
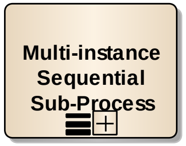
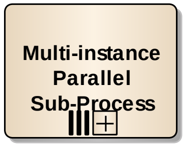
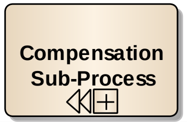
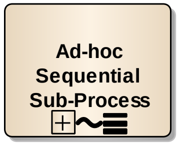
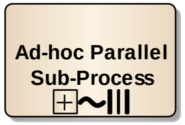
Sub-process types:

Sub-process type	Symbol	Description
Transaction sub-process		A transactional sub-process executes all internal activities either successfully or none (exception case). Typically, a transaction sub-process is combined with a cancel event to call a transaction cancel (rollback) handler.
Event sub-process		Execution of an event sub-process is triggered by an event. The execution is independent of the parent process flow, thus there are no incoming and outgoing sequence flows. However, an event sub-process is only executed when the parent process (or sub-process) is active.

6. BPMN notation elements (6/10)

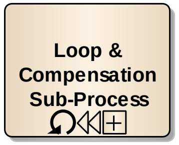
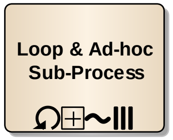
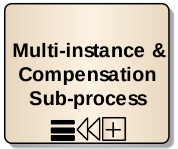
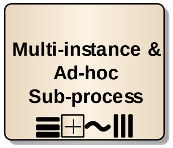
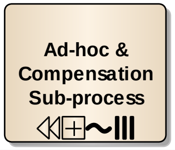
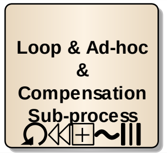
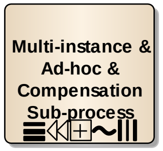
Sub-process markers (1/2):

Sub-processes may have the same markers as tasks. Additionally, the ad-hoc marker may be used on sub-processes to express a less strict execution ordering.

Sub-process marker	Symbol	Description
Loop		A looping sub-process repeats its internal activities as long as a loop flag is set.
Multi-instance sequential		The sub-process is executed in multiple instances in sequential order.
Multi-instance parallel		Multiple instances of the sub-process are executed in parallel.
Compensation		Compensation is used in case of errors (exceptions) to undo steps that are already executed (call of compensation handler to "rollback").
Ad-hoc sequential		Ad-hoc sub-processes have a less strict temporal ordering of activities. Internal activities may or may not have sequence flows. Ad-hoc sequential means that contained activities are executed sequentially.
Ad-hoc parallel		In a parallel ad-hoc sub-process, contained activities are executed in parallel.

6. BPMN notation elements (7/10)

Sub-process markers (2/2):

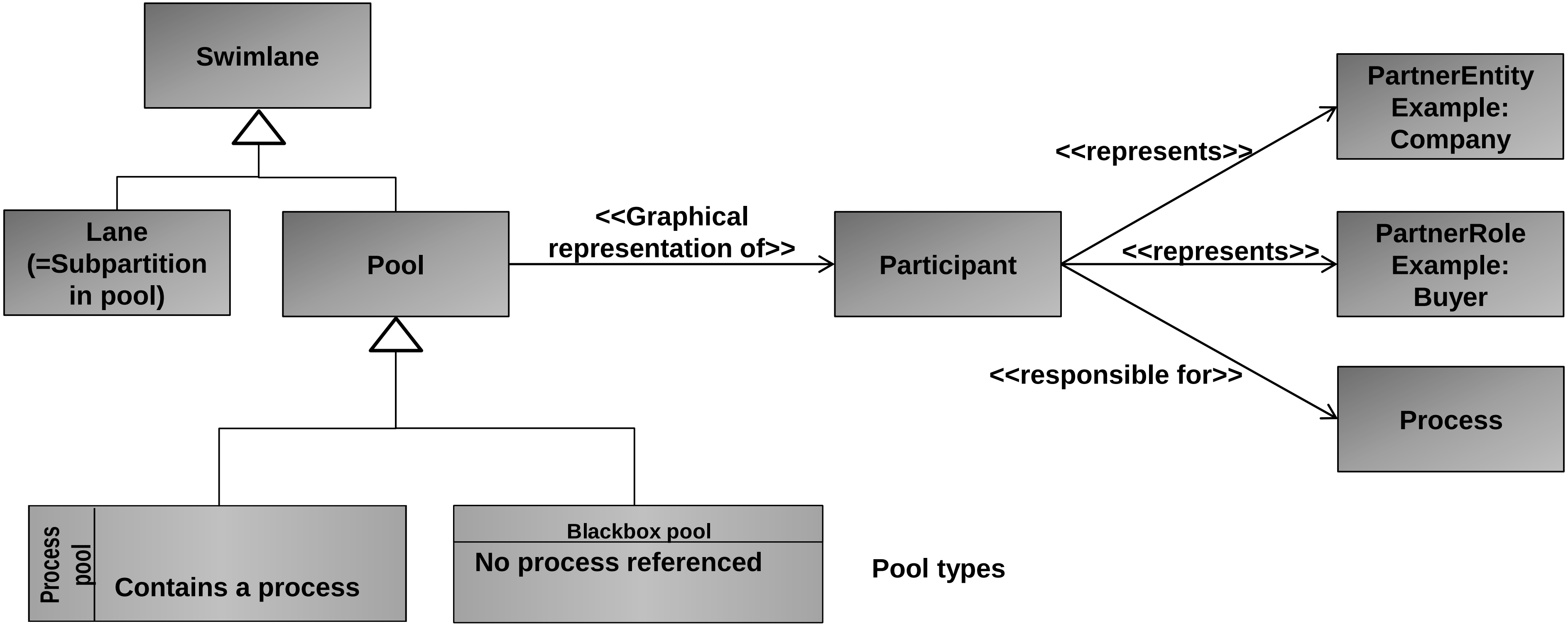
Task marker	Symbol & Description			
Allowed marker combinations		Loop & compensation		Loop & ad-hoc (parallel and sequential)
		Multi-instance & compensation (parallel and sequential)		Multi-instance & ad-hoc (parallel and sequential)
		Ad-hoc & compensation (parallel and sequential)		Loop & compensation & ad-hoc (parallel and sequential)
		Multi-instance & compensation & ad-hoc (parallel and sequential)		

6. BPMN notation elements (8/10)

Swimlanes (1/2):

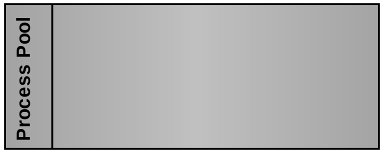
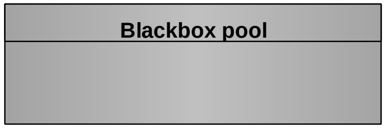
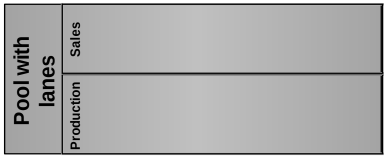
Swimlanes are either pools (white-box or black-box) or lanes (=partitions in pools).
Pools represent participants which are partner entities like a supplier.
Participants are often responsible for a process execution in a pool.

Simplified meta-model:

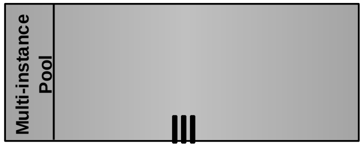


6. BPMN notation elements (9/10)

Swimlanes (2/2):

Swimlane type	Symbol	Description
Process ("White-box") pool		Pool that contains a process.
Black-box pool		Pool that does not contain a process.
Lane		Lanes are sub-partitions in a pool or process. Lanes can be nested. Lanes do not have semantics in BPMN, i.e. lanes are a simple grouping and partitioning concept.

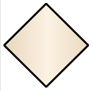
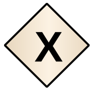
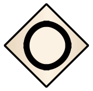
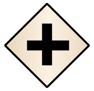
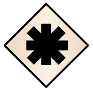
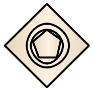
Swimlanes markers:

Swimlane marker	Symbol	Description
Multi-instance		Multi-instance pools represent multi-instance participants. Example: Multiple suppliers.

6. BPMN notation elements (10/10)

Gateways:

Gateways are used to produce and consume process tokens (process instances).

Gateway type	Symbol	Description
Exclusive gateway	 or 	Exclusive gateways are like decisions. The process flow takes either of the outgoing directions (only 1 or none).
Inclusive gateway		The inclusive gateway evaluates all outgoing conditions and creates a process token for each condition that evaluates to true.
Parallel gateway		Parallel gateways join and fork flows. Thus parallel gateways are used to create (fork) and synchronize (join) parallel flows. No condition checking is involved with parallel gateways.
Complex gateway		Complex gateways are used to model complex synchronization behavior. Example: 3 out of 5 incoming flow tokens must be present to create an outgoing process token (depending on the conditions of the outgoing flows). Outgoing and incoming token semantics are the same as in inclusive gateways.
Event gateway		Event gateways represent branching points based on events rather than conditions. Example: Reception of different messages is dispatched into different process paths to handle the messages.

7. BPMN 2.0 versus 1.2

BPMN 2.0 brought a number of changes :

- Formalization and clarification of the execution semantics of all BPMN elements
- Extensibility mechanism for graphical elements
- Refinement of event composition and correlation
- Definition of choreography model (choreography, choreography diagram)
- Redefinition and clarification of various BPMN elements (see table below)

BPMN 1.2 Feature	BPMN 2.0 Feature
Reusable sub-process	Call activity
Embedded sub-process	Sub-process
Abstract process	Public process
Directional association to show how data objects are inputs and outputs to activities	Data association connector to show inputs and outputs
Message is a BPMN element	Message is only a graphical decorator
None task	Abstract task
Directional associations to show data flows to and from activities	Data association connector to show inputs and outputs of activities
Performer role for describing people in activities	In addition to Performer role, HumanPerformer role allows to identify humans performing a task
Intermediate events possible without incoming sequence flows	Intermediate events must have an incoming sequence flow