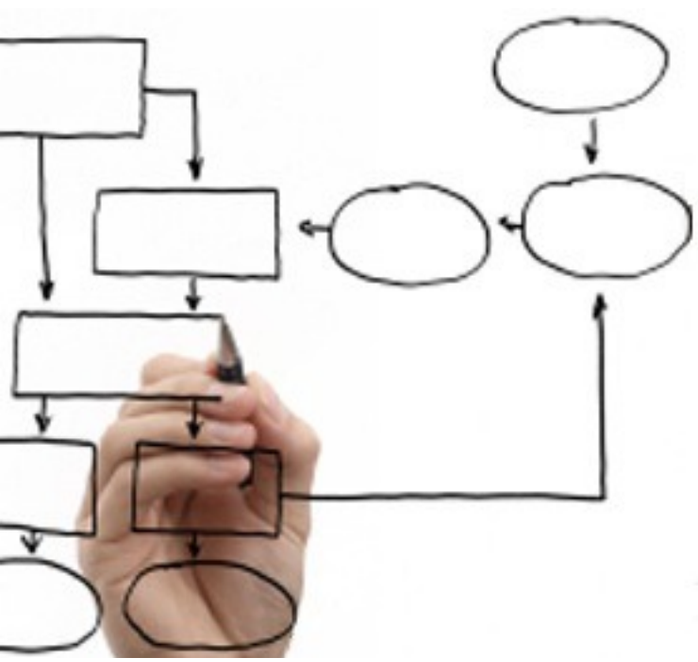
Methods for the specification and verification of business processes

MPB (6 cfu, 295AA)



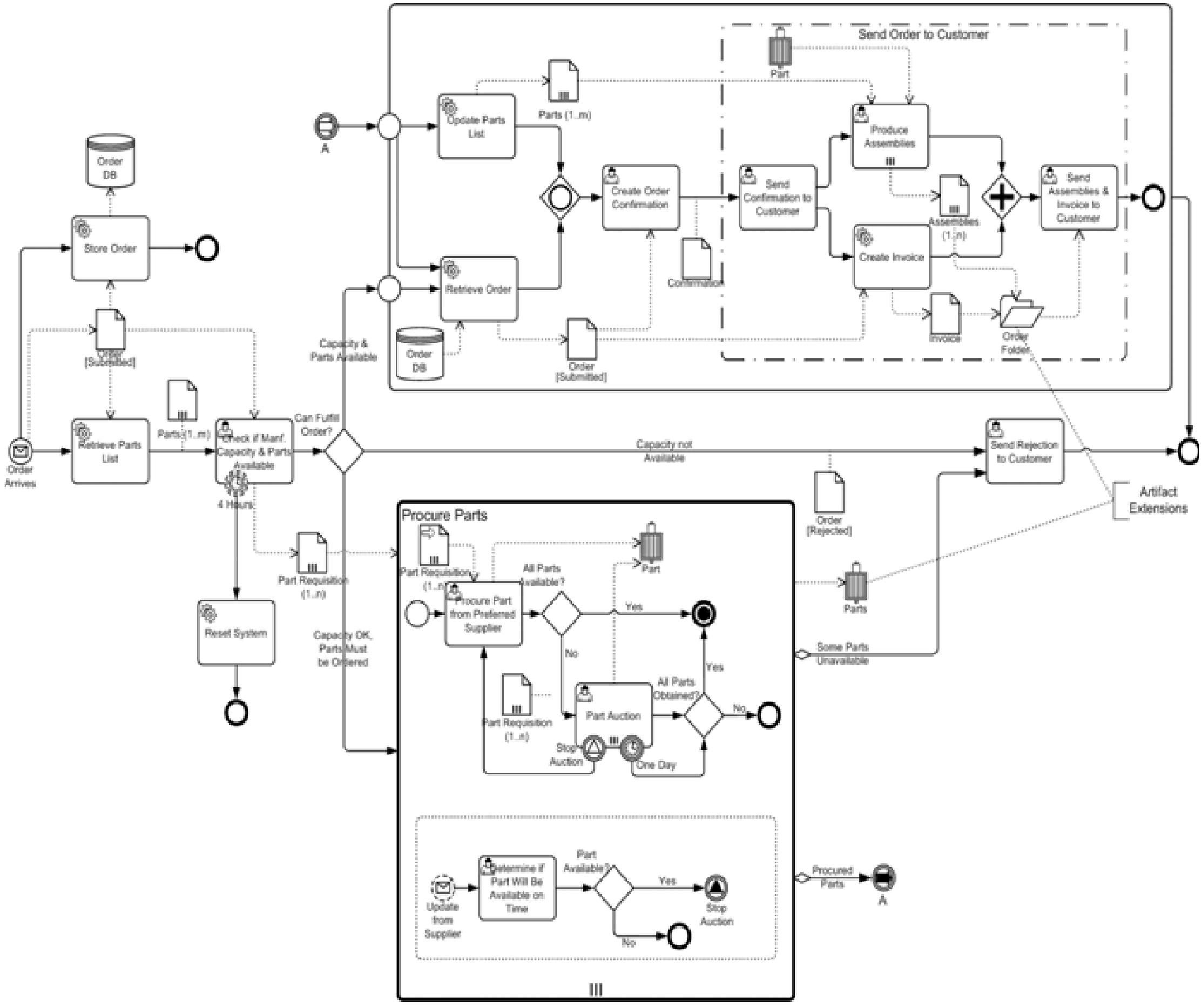
Roberto Bruni

http://www.di.unipi.it/~bruni

20 - Business process modelling notation

Object

We overview BPMN and their analysis based on Petri nets


Send Order to Customer
Part
Update Parts List
Parts (1..m)
A
Produce Assemblies
Create Order Confirmation
Send Confirmation to Customer
Send Assembles & Invoice to Customer
Assemblies (1..n)
Create Invoice
Confirmation
Retrieve Order
Order DB
Order [Submitted]
Capacity & Parts Available
Invoice
Order Folder
Store Order
Order DB
Order [Submitted]
Order Arrives
Retrieve Parts List
Parts (1..m)
Check if Manf. Capacity & Parts Available
4 Hours
Can Fulfill Order?
Capacity not Available
Send Rejection to Customer
Order [Rejected]
Artifact Extensions
Reset System
Part Requisition (1..n)
Capacity OK, Parts Must be Ordered
Procure Parts
Part Requisition (1..n)
Procure Part from Preferred Supplier
All Parts Available?
Yes
No
Part
Parts
Some Parts Unavailable
Part Requisition (1..n)
Part Auction
All Parts Obtained?
Yes
No
Stop Auction
One Day
Update from Supplier
Determine if Part Will Be Available on Time
Part Available?
Yes
No
Stop Auction
Procured Parts
A

Business Process Management Initiative

The **Business Process Management Initiative**

is an **independent organization** devoted to

the development of **open specifications**

for the management of **e-Business processes**
that span multiple applications, corporate departments, and business partners, behind the firewall and over the Internet

The membership of the BPMI Notation Working Group represents a large segment of the BP modelling community

BMI-DTF

June 2005

The Business Process Management Initiative (BPMI.org)
and the Object Management Group™ (OMG™)
decided to merge their
Business Process Management (**BPM**) activities
to provide thought leadership and industry standards for this vital and growing industry.

The combined group has named itself the
Business Modeling & Integration Domain Task Force
(**BMI -DTF**)

Standardisation

The development of BMPN is an important step in

reducing the fragmentation that exists
with myriad of process modelling tools and notation

exploiting expertise and experience with many divergent proposals to consolidate the best ideas

supporting the wide-spread adoption of inter-operable business process management systems

reducing the confusion among business and IT end-users

Disclaim

Formal rigour and conciseness:
not primary concerns for BPMN specifications
(shorthands and alternative constructs are often available)

The large number of object types
and their continuous evolution
makes it hard to define mappings
and to prove their consistency under all contexts

Inconsistencies and ambiguities in
BPMN standard are present but hard to detect

Business process diagram

BPMN defines a standard for
Business Process Diagrams (**BPD**)

based on **flowcharting technique**
tailored to graphical models of business process operations

Four basic categories of elements:
Artefacts
Swimlanes
Flow objects
Connecting objects

BPMN:
(some) key features

Key features of BPMN include:
sub-processes
exceptions
message flows

and also:
transactions
compensations
choreographies
...

Versioning

BPMN 1.0 approved 2006
BPMN 1.1 approved 2007
BPMN 1.2 approved 2009

BPMN 2.0 Beta 1 proposed 2009
BPMN 2.0 Beta 2 proposed 2010
BPMN 2.0 Final delivered 2011

BPMN 1.0 (2004/06)

Main goal:

provide a **notation** that is **readily understandable by all** business users

from the **business analysts** who create initial drafts of the processes

to the **technical developers** responsible for implementing the technology that will perform those processes

to the **business people** who will manage those processes

BPMN 2.0 (2009/11)
FAQ

What is BPMN?

BPMN is a graphical notation that depicts the steps (end to end flow) in a business process.

The notation has been specifically designed to coordinate the sequence of processes and the messages that flow between different process participants in a related set of activities.

BPMN 2.0 (2009/11)

FAQ

Why is BPMN important?

The world of business processes has changed dramatically over the past few years. Processes can be coordinated from behind, within and over organizations natural boundaries. A business process now spans multiple participants and coordination can be complex.

Until BPMN, there has not been a standard modelling technique developed that addresses these issues.

BPMN has been developed to provide users with a **royalty free notation**.

This will benefit users in a similar manner in which UML standardised the world of software engineering. There will be training courses, books and a body of knowledge that users can access in order to better implement a business process.

BPMN 2.0 (2009/11)

FAQ

Who is BPMN targeted at?

BPMN is targeted at a **high level for business users** and at a l**ower level for process implementers**.

The business users should be able to easily read and understand a BPMN business process diagram.
The process implementer should be able to adorn a business process diagram with further detail in order to represent the process in a physical implementation.

BPMN is targeted at users, vendors and service providers that need to communicate business processes in a standard manner.

BPMN 2.0 (2009/11)

FAQ

What does this mean for UML users?

The unified modelling language (UML) takes an object-oriented approach to the modeling of applications, while BPMN takes a **process-oriented approach** to modelling of systems.

The BPMN and the UML are compatible with each other. Where BPMN has a focus on business processes, the UML has a focus on software design and therefore the two are not competing notations but are different views on systems.
Further white papers will follow on the mapping between these techniques.

BPMN 2.0 (2009/11)
FAQ

Will there be a major rewrite?

Not for 2 or 3 years…

BPMN 2.0 vs 1.0

Updated (new markers):

Tasks/SubProcesses

Events

Gateways

Artefacts

Added:

Choreographies

Full metamodel

XML Serialization

Diagram Interchange

BPMN Execution Semantics (verbal)

Weaknesses of BPMN

ambiguity and confusion in sharing BPMN models

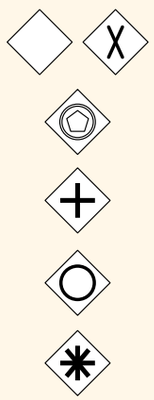
lack of support for routine work

lack of support for knowledge work

how to convert BPMN models to executable environments?

BPMN - Business Process Modeling Notation

Gateways



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

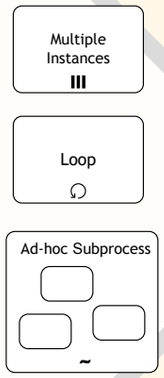
Event-based Exclusive Gateway
Is always followed by catching events or receive tasks. Sequence flow is routed to the subsequent event/task which happens first.

Parallel Gateway
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
When splitting, one or more branches are activated based on branching conditions. When merging, it awaits all active incoming branches to complete.

Complex Gateway
It triggers one or more branches based on complex conditions or verbal descriptions. Use it sparingly as the semantics might not be clear.

Activities



Multiple Instances of the same activity are started in parallel or sequentially, e.g. for each line item in an order.

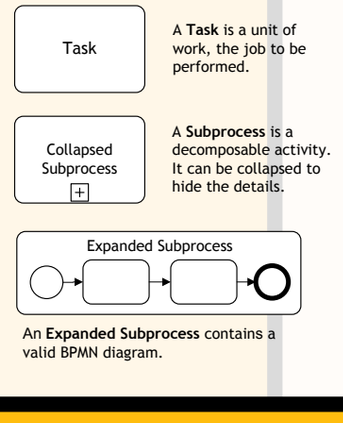
Loop Activity is iterated if a loop condition is true. The condition is either tested before or after the activity execution.

Ad-hoc Subprocesses contain tasks only. Each task can be executed arbitrarily often until a completion condition is fulfilled.

Sequence Flow defines the execution order of activities.

Conditional Flow has a condition assigned that defines whether or not the flow is used.

Default Flow is the default branch to be chosen if all other conditions evaluate to false.



A **Task** is a unit of work, the job to be performed.

A **Subprocess** is a decomposable activity. It can be collapsed to hide the details.

An **Expanded Subprocess** contains a valid BPMN diagram.

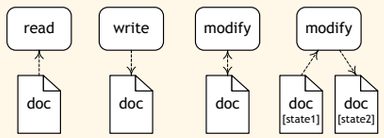
Data

A **Data Object** represents information flowing through the process, such as business documents, e-mails or letters.

Attaching a data object with an **Undirected Association** to a sequence flow indicates hand-over of information between the activities involved.

A **Directed Association** indicates information flow. A data object can be read at the start of an activity or written upon completion.

A **Bidirected Association** indicates that the data object is modified, i.e. read and written during the execution of an actvity.



Events

	Start		Intermediate		End	
	Catching		*Throwing*			
Plain	○	○			●	Untyped events, typically showing where the process starts or ends.
Message	✉	✉	✉		✉	Receiving and sending messages.
Timer	🕒	🕒				Cyclic timer events, points in time, time spans or timeouts.
Error		⚡			⚡	Catching or throwing named errors.
Cancel		✕			✕	Reacting to cancelled transactions or triggering cancellation.
Compen-sation		◀◀	◀◀		◀◀	Compensation handling or triggering compensation.
Conditional	☰	☰				Reacting to changed business conditions or integrating business rules.
Signal	△	△	▲		▲	Signalling across different processes. One signal thrown can be caught multiple times.
Multiple	⬠	⬠	⬟		⬟	Catching or throwing one out of a set of events.
Link		⇨	➡			Off-page connectors. Two corresponding link events equal a sequence flow.
Terminate					●	Triggering the immediate termination of a process.

Catching

Start Event: Catching an event starts a new process instance.

Intermediate Event (catching): The process can only continue once an event has been caught.

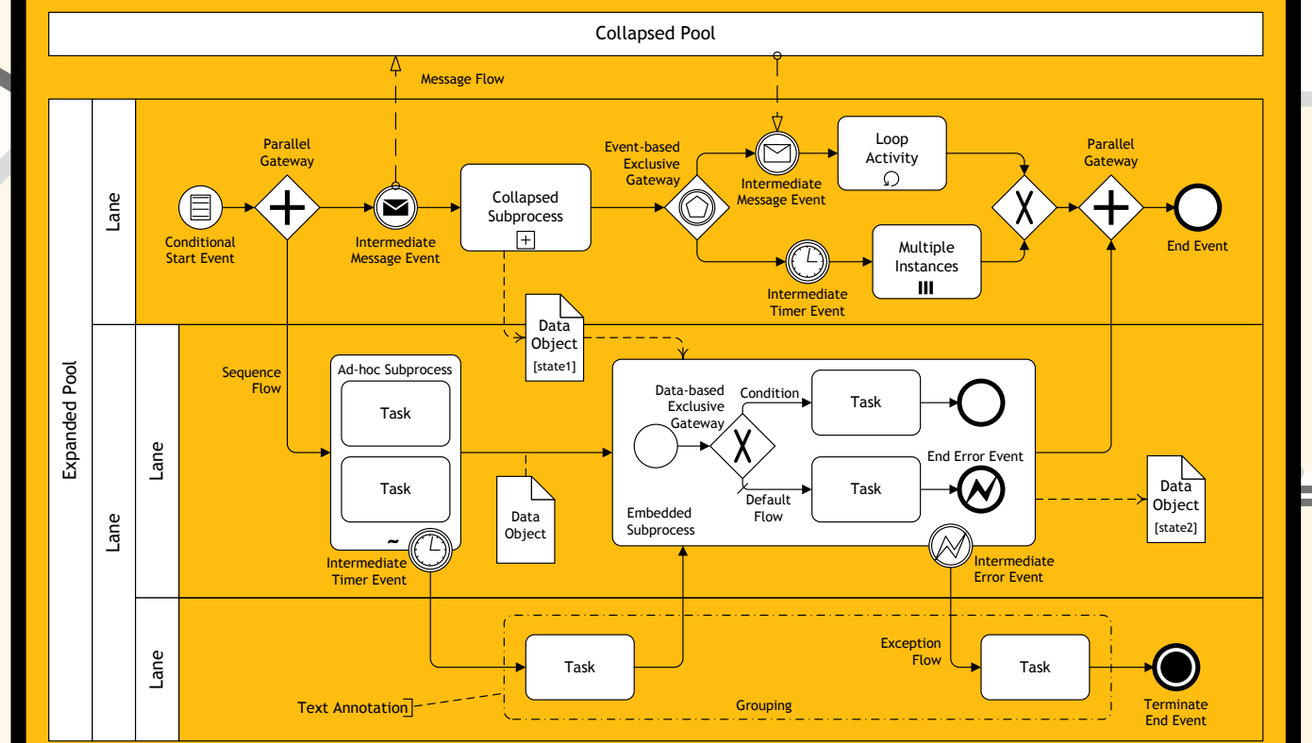
activity

Attached Intermediate Event: The activity is aborted once an event is caught.

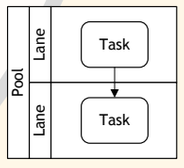
Throwing

End Event: An event is thrown when the end of the process is reached.

Intermediate Event (throwing): An event is thrown and the process continues.

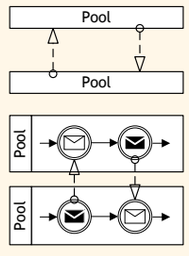


Swimlanes



Pools and **Lanes** represent responsibilities for activities in a process. A pool or a lane can be an organization, a role, or a system. Lanes sub-divide pools or other lanes hierarchically.

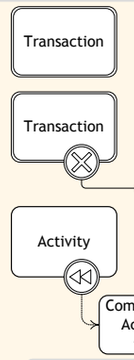
Collapsed Pools hide all internals of the contained processes.



Message Flow symbolizes information flow across organizational boundaries. Message flow can be attached to pools, activities, or message events.

The order of message exchanges can be specified by combining message flow and sequence flow.

Transactions

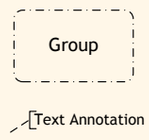


A **Transaction** is a set of activities that logically belong together; it might follow a specified transaction protocol.

Attached **Intermediate Cancel Events** indicate reactions to the cancellation of a transaction. Activities inside the transaction are compensated upon cancellation.

Completed activities can be compensated. An activity and the corresponding **Compensate Activity** are related using an attached **Intermediate Compensation Event**.

Documentation



An arbitrary set of objects can be defined as a **Group** to show that they logically belong together.

Any object can be associated with a **Text Annotation** to provide additional documentation.

Business Process Technology
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Oryx: oryx-project.org
Blog: bpmn.info
BPMN Version 1.2

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ORYX

Business Process Diagram Graphical Objects

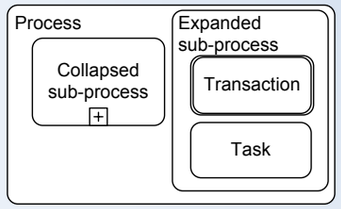
Events

An event is something that »happens« during the process. These events affect the flow of the process and usually have a cause (trigger) or an impact (result).
Examples: 'Email received', '3 o'clock', 'Warehouse empty', 'Critical error',...

Event type \ Event flow	Start	Intermediate	End	Description
General	○	◎	◎	The Start Event indicates where a particular process will start. Intermediate Events occur between a Start Event and an End Event. It will affect the flow of the process, but will not start or (directly) terminate the process. The End Event indicates where a process will end.
Message	✉	✉	✉	A message arrives from a participant and triggers the Event. This causes process to {start, continue, end} if it was waiting for a message, or changes the flow if exception happens. End type of message event indicates that a message is sent to a participant at the conclusion of the process.
Timer	🕒	🕒		A specific time or cycle can be set that will trigger the start of the Process or continue the process. Intermediate timer can be used to model the time-based delays.
Error		Ⓝ	Ⓝ	This type of End indicates that a named Error should be generated. This Error will be caught by an Intermediate Event within the Event Context.
Cancel		⊗	⊗	This type of Event is used within a Transaction Sub-Process. This type of Event MUST be attached to the boundary of a Sub-Process. It SHALL be triggered if a Cancel End Event is reached within the Transaction Sub-Process.
Compensation		◀◀	◀◀	This is used for compensation handling--both setting and performing compensation. It calls for compensation if the Event is part of a Normal Flow. It reacts to a named compensation call when attached to the boundary of an activity. Very useful for modelling roll-back actions within the transaction.
Rule	📋	📋		This type of event is triggered when the conditions for a rule become true. Rules can be very useful to interrupt the loop process, for example: 'The number of repeats = N'. Intermediate rule is used only for exception handling.
Link	→	→	→	A Link is a mechanism for connecting the end (Result) of one Process to the start (Trigger) of another. Typically, these are two Sub-Processes within the same parent Process. It can be used, for example, when the working area (page) is too small – go to another page.
Multiple	⬟	⬟	⬟	This type of event indicates that there are multiple ways of triggering the Process. Only one of them will be required to {start, continue, end} the Process.
Terminate			●	This type of End indicates that all activities in the Process should be immediately terminated. This includes all instances of Multi-Instances. The Process is terminated without compensation or event handling.

Activities

An activity is a generic type of work that a company performs. An activity can be atomic (task) or compound (process, sub-process).
Examples: 'Send a letter', 'Write a report', 'Calculate the interests',...



A task is used to represent the activity on the lowest abstraction level.

More information about the transaction and compensation attribute can be found under »Compensation Association«.

Task/Subprocess special attributes		
Looping	↻	The task or sub-process is repeated.
Ad Hoc	~	The tasks in the sub-process can not be connected with sequence flows at design time.
Multiple instances	‖	Multiple instances of task or sub-process will be created.
Compensation	◀◀	The symbol represents a compensation task or sub-process.

Artefacts

Artefacts are used to provide additional information about the process. If required, modellers and modelling tools are free to add new artefacts.
Examples of data objects: 'A letter', 'Email message', 'XML document', 'Confirmation',...

Set of standardized artefacts		
Data object	[state]	Data objects provide information about what activities are required to be triggered and/or what they produce. They are considered as Artefacts because they do not have any direct effect on the Sequence Flow or Message Flow of the Process. The state of the data object should also be set.
Group		Grouping can be used for documentation or analysis purposes. Groups can also be used to identify the activities of a distributed transaction that is shown across Pools. Grouping of activities does not affect the Sequence or Message Flow.
Annotation	Description	Text Annotations are a mechanism for a modeller to provide additional information for the reader of a BPMN Diagram.

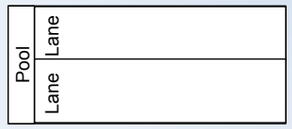
Gateways

A gateway is used to split or merge multiple process flows. Thus it will determine branching, forking, merging and joining of paths. Examples: 'Condition true? – yes/no', 'Choose colour? – red/green/blue',...

Gateway control types		
XOR (DATA)	◇ ✕	Data based exclusive decision or merging. Both symbols have equal meaning. See also Conditional flow.
XOR (EVENT)	⬠	Event based exclusive decision only.
OR	○	Data based inclusive decision or merging.
COM-PLEX	✱	Complex condition (a combination of basic conditions)
AND	+	Parallel forking and joining (synchronization).

Swimlanes

Pools and lanes are used to represent organizations, roles, systems and responsibilities. Examples: 'University', 'Sales division', 'Warehouse', 'ERP system',...



A Pool MUST contain 0 or 1 business process.

A Pool can contain 0 or more lanes.

Two pools can only be connected with message flows.

A **Pool** represents a participant in a process. It contains a business process and is used in B2B situations.

A **Lane** is a sub-partition within a pool used to organize and categorize activities.

From BPMN 1.2 poster

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Business Process Diagram Connecting Objects

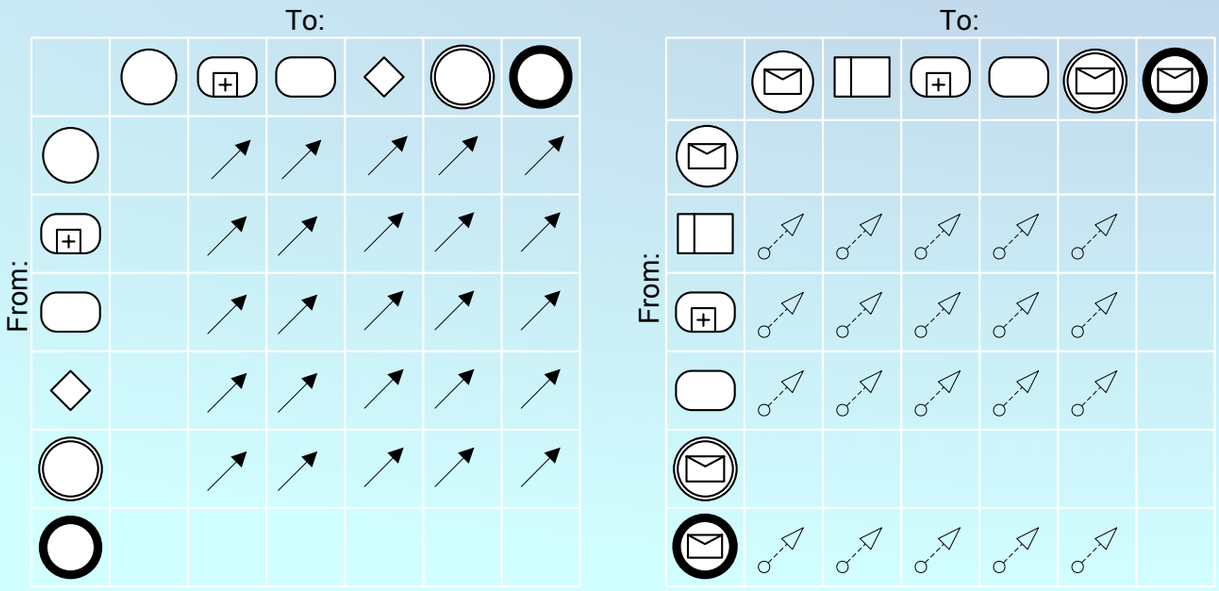
Graphical connecting objects

There are three ways of connecting **Flow objects (Events, Activities, Gateways)** with each other or with other information – using sequence flows, message flows or associations.

Graphical connecting objects		
Normal sequence flow		A Sequence Flow is used to show the order In which the activities in a process will be performed.
Conditional sequence flow		A Sequence Flow can have condition expressions which are evaluated at runtime to determine whether or not the flow will be used.
Default sequence flow		For Data-Based Exclusive Decisions or Inclusive Decisions, one type of flow is the Default condition flow. This flow will be used only if all other outgoing conditional flows are NOT true at runtime.
Message flow		A Message Flow is used to show the flow of messages between two participants that are prepared to send and receive them. In BPMN, two separate Pools in a Diagram can represent the two participants.
Association		An Association (directed, non-directed) is used to associate information with Flow Objects. Text and graphical non-Flow Objects can be associated with Flow objects.

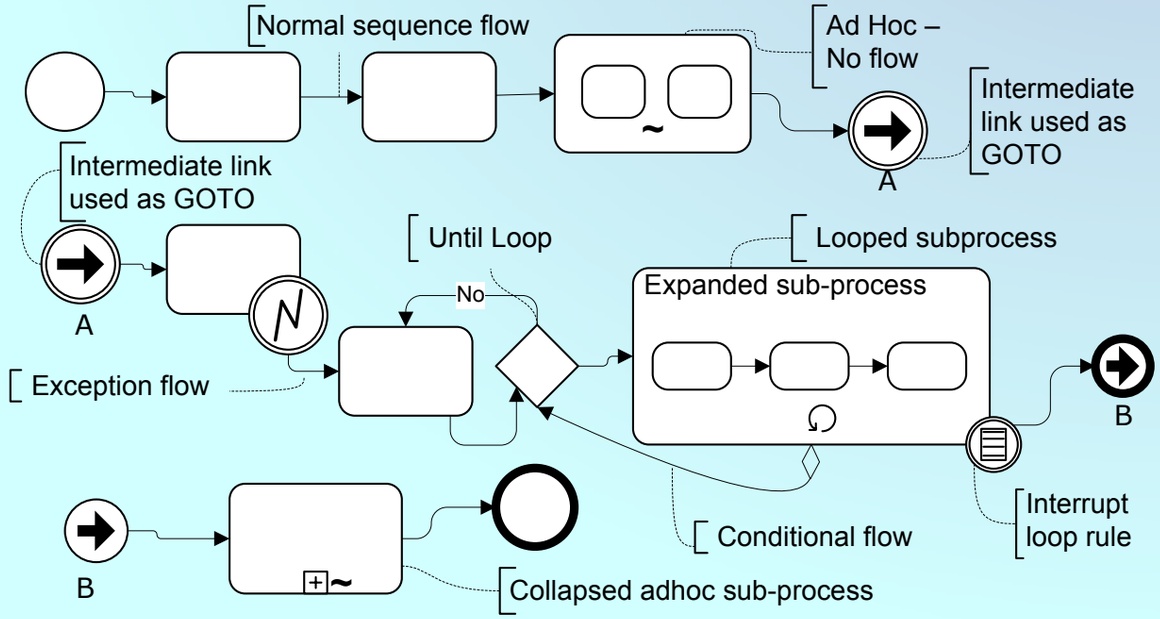
Sequence Flow and Message Flow rules

Only objects that can have an incoming and/or outgoing Sequence Flow / Message Flow are shown in the Tables Below.



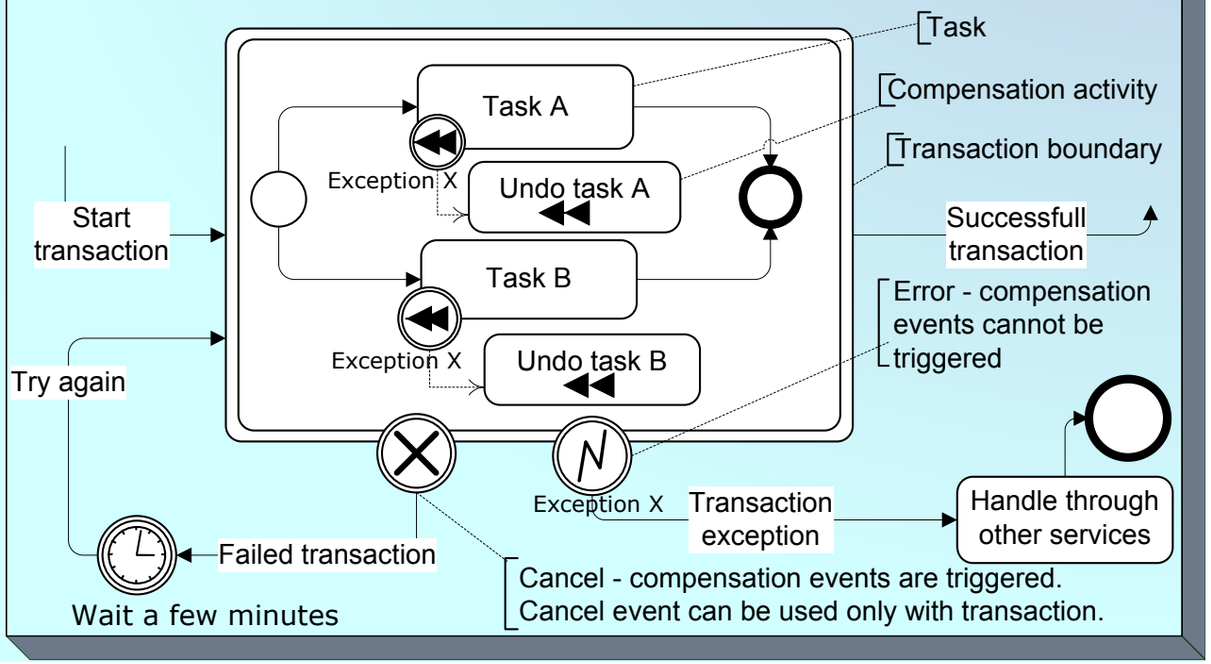
Sequence flow mechanism

The Sequence Flow mechanisms is divided into types: Normal flow, Exception flow, Conditional flow, Link Events and Ad Hoc (no flow). Refer also to specific »Workflow Patterns«.



Compensation Association

In case of transactions it is desired that all activities which constitute a transaction are finished successfully. Otherwise the transaction fails and rollback (compensation) activities occur which undo done activities.



From BPMN 1.2 poster

BPMN 2.0 - Business Process Model and Notation

http://bpmb.de/poster

Activities

Task

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.

Transaction

A **Transaction** is a set of activities that logically belong together; it might follow a specified transaction protocol.

Event Sub-Process

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.

Call Activity

A **Call Activity** is a wrapper for a globally defined Sub-Process or Task that is reused in the current process.

Activity Markers

Markers indicate execution behavior of activities:

- Sub-Process Marker
- Loop Marker
- Parallel MI Marker
- Sequential MI Marker
- Ad Hoc Marker
- Compensation Marker

Task Types

Types specify the nature of the action to be performed:

- Send Task
- Receive Task
- User Task
- Manual Task
- Business Rule Task
- Service Task
- Script Task

Sequence Flow

defines the execution order of activities.

Default Flow

is the default branch to be chosen if all other conditions evaluate to false.

Conditional Flow

has a condition assigned that defines whether or not the flow is used.

Gateways

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

Is always followed by catching events or receive tasks. Sequence flow is routed to the subsequent event/task which happens first.

Parallel Gateway

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

When splitting, one or more branches are activated. All active incoming branches must complete before merging.

Exclusive Event-based Gateway (instantiate)

Each occurrence of a subsequent event starts a new process instance.

Complex Gateway

Complex merging and branching behavior that is not captured by other gateways.

Parallel Event-based Gateway (instantiate)

The occurrence of all subsequent events starts a new process instance.

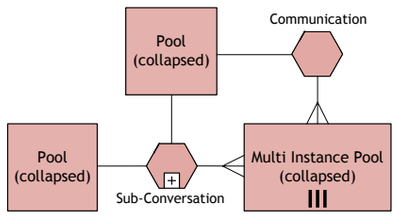
Conversations

A **Communication** defines a set of logically related message exchanges. When marked with a [+] symbol it indicates a Sub-Conversation, a compound conversation element.

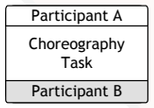
A **Conversation Link** connects Communications and Participants.

A **Forked Conversation Link** connects Communications and multiple Participants.

Conversation Diagram

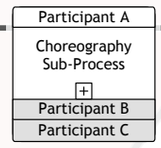


Choreographies



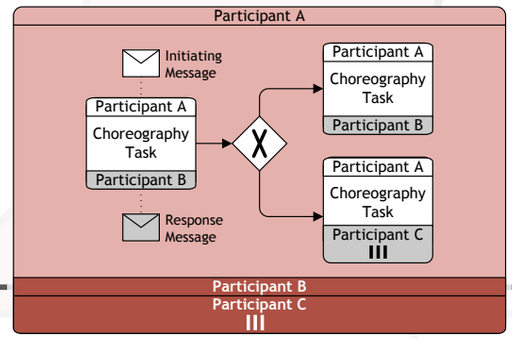
A **Choreography Task** represents an Interaction (Message Exchange) between two Participants.

Multiple Participants Marker denotes a set of Participants of the same kind.

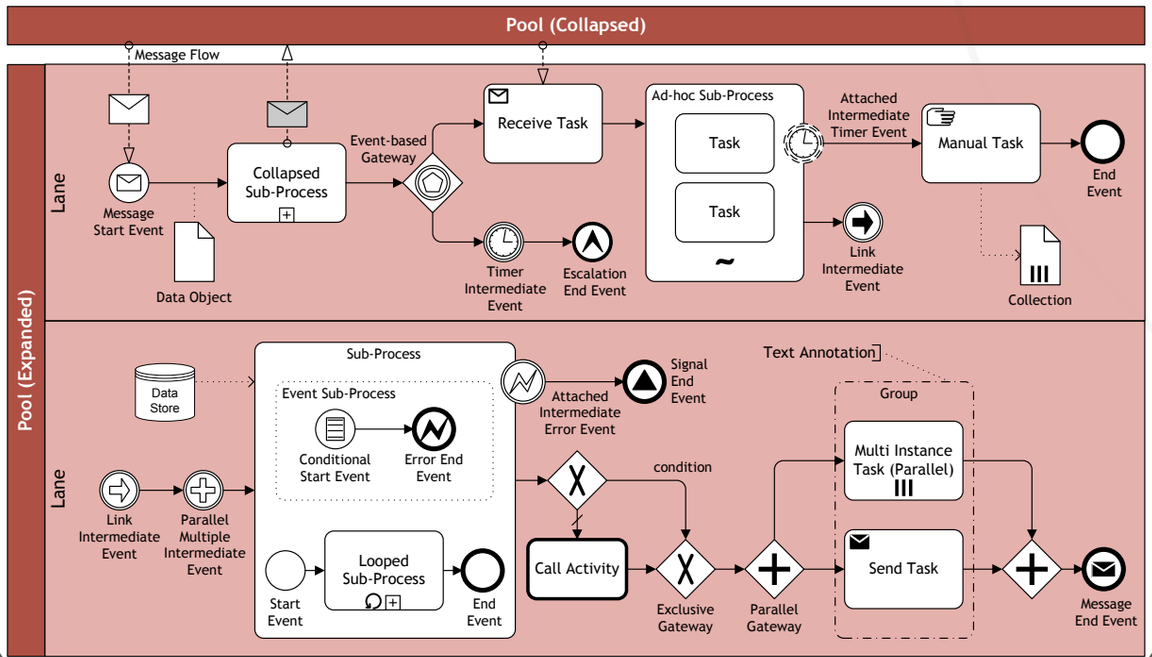


A **Choreography Sub-Process** contains a refined choreography with several Interactions.

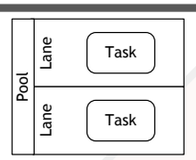
Choreography Diagram



Collaboration Diagram

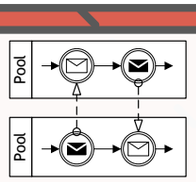


Swimlanes



Pools (Participants) and **Lanes** represent responsibilities for activities in a process. A pool or a lane can be an organization, a role, or a system. Lanes subdivide pools or other lanes hierarchically.

Message Flow symbolizes information flow across organizational boundaries. Message flow can be attached to pools, activities, or message events.



The order of message exchanges can be specified by combining message flow and sequence flow.

Events

	Start: Top-Level	Start: Event Sub-Process Interrupting	Start: Event Sub-Process Non-Interrupting	Intermediate: Catching	Intermediate: Boundary Interrupting	Intermediate: Boundary Non-Interrupting	Intermediate: Throwing	End
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.	🕒	🕒	🕒	🕒	🕒	🕒		
Escalation: Escalating to an higher level of responsibility.		⌃	⌃		⌃	⌃	⌃	⌃
Conditional: Reacting to changed business conditions or integrating business rules.	☰	☰	☰	☰	☰	☰		
Link: Off-page connectors. Two corresponding link events equal a sequence flow.				⇨			➡	
Error: Catching or throwing named errors.		⚡			⚡			⚡
Cancel: Reacting to cancelled transactions or triggering cancellation.					⊗			⊗
Compensation: Handling or triggering compensation.		◀◀			◀◀		◀◀	◀◀
Signal: Signalling across different processes. A signal thrown can be caught multiple times.	△	△	△	△	△	△	▲	▲
Multiple: Catching one out of a set of events. Throwing all events defined	⬠	⬠	⬠	⬠	⬠	⬠	⬟	⬟
Parallel Multiple: Catching all out of a set of parallel events.	✚	✚	✚	✚	✚	✚		
Terminate: Triggering the immediate termination of a process.								●

Data

A **Data Input** is an external input for the entire process. It can be read by an activity.

A **Data Output** is a variable available as result of the entire process.

A **Data Object** represents information flowing through the process, such as business documents, e-mails, or letters.

A **Collection Data Object** represents a collection of information, e.g., a list of order items.

A **Data Store** is a place where the process can read or write data, e.g., a database or a filing cabinet. It persists beyond the lifetime of the process instance.

A **Message** is used to depict the contents of a communication between two Participants.

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BPMN 2.0 - Business Process Model and Notation

http://bpmb.de/poster

Tradotto da: dexea

Attività

Task

Un ***task*** è un unità di lavoro, cioè il lavoro da svolgere. Quando si annota con il simbolo [+] indica un sottoprocesso, cioè un'attività che può essere perfezionata.

Transazione

Una **transazione** è un insieme di attività che si legano logicamente; essa potrebbe seguire uno specifico protocollo.

Sottoprocesso basato su eventi

Un **sottoprocesso basato su eventi** si trova all'interno di un processo o sottoprocesso. Si avvia quando il suo evento di inizio viene attivato e può interrompere il processo di livello superiore oppure eseguire in parallelo (senza interruzioni) in base all'evento di inizio.

Call Activity

Una ***call activity*** è un contenitore di un sottoprocesso definito globalmente o un task che può essere riusato nel processo attuale.

Simboli per attività

I seguenti simboli indicano il comportamento di esecuzione delle attività:

- Sottoprocesso
- Loop
- Esecuzione in parallelo
- Esecuzione sequenziale
- Ad hoc
- Compensazione

Tipologie di tasks

Le tipologie specificano la natura dell'azione da eseguire

- Task di invio
- Task di ricezione
- Utente
- Task manuale
- Regole di business
- Service
- Script

Flusso sequenziale

definisce l'ordine di esecuzione delle attività.

Flusso predefinito

è il ramo predefinito da scegliere se tutte le altre condizioni vengono valutate come false.

Flusso condizionale

ha una condizione assegnata che definisce se usare o meno il flusso.

Gateways

Esclusivo(xor)

In caso di *splitting*, il flusso sequenziale viene diretto esattamente verso uno dei rami in uscita. In caso di *merging*, il flusso aspetta che un ramo in entrata arrivi a termine prima di andare avanti.

Basato su eventi

Questo simbolo è sempre seguito da intercettazioni di eventi o *tasks* di ricezione. Il flusso sequenziale prosegue verso il sucessivo *task*/evento che accade per primo.

Parallelo

Quando viene usato per dividere il flusso sequenziale, tutti i rami in uscita sono attivati simultaneamente. Invece quando viene usato per unire rami paralleli, il flusso aspetta il completamento di tutti i rami in entrata prima di andare avanti.

Inclusivo
In caso di *splitting*, uno o più rami sono attivati. Il flusso va avanti solamente quando l'esecuzione di tutti i rami è terminata.

Esclusivo basato su eventi
All'attivazione di ogni evento successivo, viene avviata una nuova istanza di processo.

Complesso
Gestioni di *merging* e *branching* che non sono gestite da altri gateways.

Parallelo basato su eventi
All'attivazione di tutti gli eventi successivi, viene avviata una nuova istanza di processo.

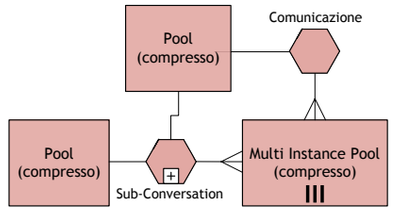
Conversazioni

Una **comunicazione** definisce un insieme di scambi di messaggi collegati logicamente. Se annotati con un simbolo [+] indicano una comunicazione interna ad un'altra conversazione.

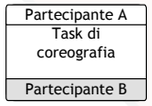
Un ***conversation link*** connette le comunicazioni ed i partecipanti.

Un ***forked conversation link*** connette le comunicazioni e molteplici partecipanti.

Diagramma di conversazione

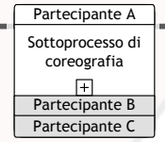


Coreografie



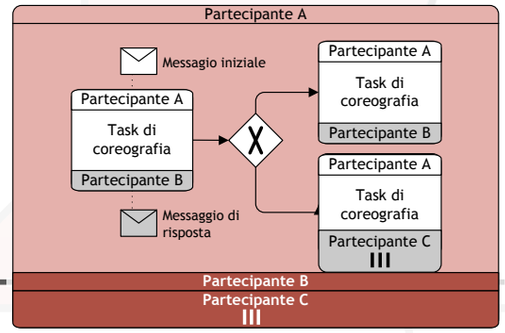
Un **Task di coreografia** rappresenta un'interazione(scambio di messaggi) tra due partecipanti.

Il simbolo ***Multiple Participants*** denota un insieme di partecipanti della stessa tipologia.

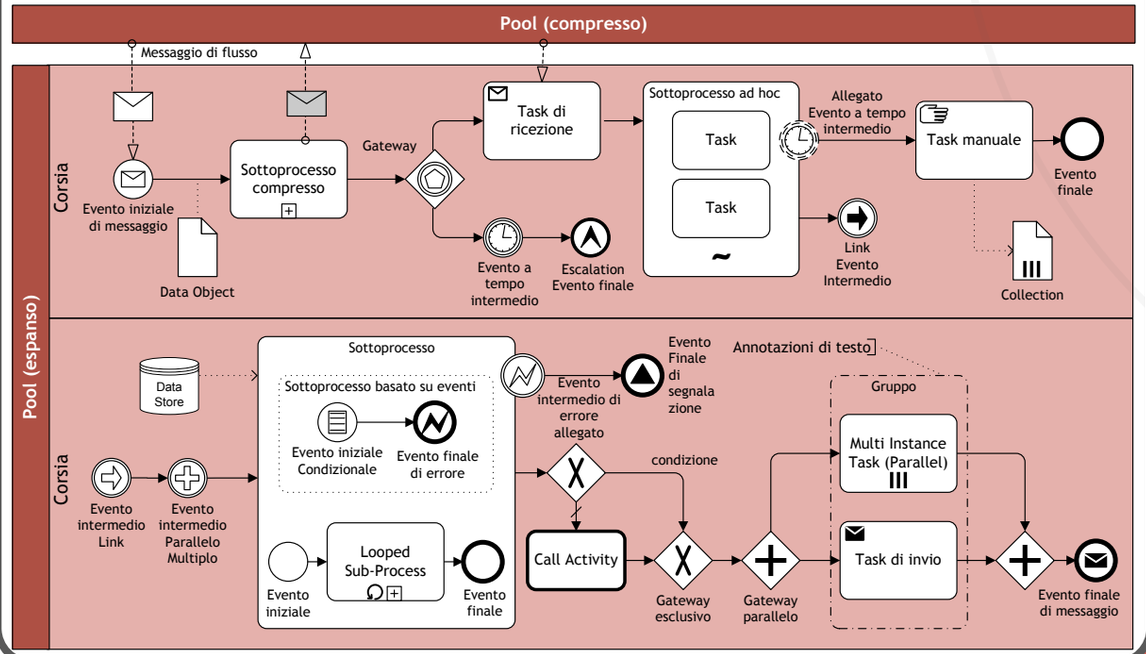


Un **Processo di coreografia** contiene una coreografia rifinita con molte interazioni.

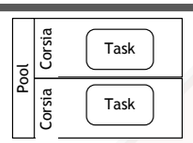
Diagramma di coreografia



Collaboration Diagram

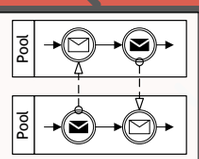


Swimlanes



Pools (Partecipanti) e **Lanes(corsie)** rappresentano le responsabilità per le attività in un processo. Esse possono essere un'organizzazione, un ruolo o un sistema. Le corsie suddividono le *pools* o altre *corsie* gerarchicamente.

Flusso di messaggi rappresenta il flusso di informazioni. Un flusso di messaggi può essere unito a pools, attività, o eventi di messaggi.



L' **ordine** degli **scambi di messaggi** può essere specificato associando il flusso di messaggi e il flusso sequenziale.

Eventi

	Inizio			Intermedio				Fine
	Alto livello	Interruzione di sottoprocessi	Non-interruzione di sottoprocessi	Catching	Boundary Interrupting	Boundary Non-Interrupting	Throwing	
Non definiti: punti di inizio, cambi di stato, o stati finali.	○						◎	◉
Messaggio: invio e ricezione di messaggi	✉	✉	✉	✉	✉	✉	✉	✉
Timer: eventi a tempo.	🕒	🕒	🕒	🕒	🕒	🕒		
Escalation: passa ad un livello più alto di responsabilità.		▲	▲		▲	▲	▲	▲
Condizionale: reagisce a condizioni di business cambiate o integra regole di business.	☰	☰	☰	☰	☰	☰		
Link: Due corrispondenti *link events* sono uguali ad un flusso sequenziale.				⇨			⇨	
Errore: attiva o si occupa di un errore.		⚡			⚡			⚡
Cancel: reagisce a delle transazioni cancellate o causa una cancellazione.					✕			✕
Compensazione: gestisce o innesca la compensazione.		◀◀			◀◀		◀◀	◀◀
Signal: comunica con più processi. Lo stesso segnale può essere intercettato più volte.	△	△	△	△	△	△	▲	▲
Multiplo: intercetta uno tra vari eventi. Gestisce tutti gli eventi definiti.	⬠	⬠	⬠	⬠	⬠	⬠	⬟	⬟
Parallelo Multiplo: intercetta tutti gli eventi.	✚	✚	✚	✚	✚	✚		
Terminate: causa la fine immediata di un processo.								●

Data

Un ***Data Input*** è un input esterno usato all'interno del processo. Può essere letto da un'attività.

Un ***Data Output*** è una variabile disponibile come risultato di un intero processo.

Un ***Data Object*** rappresenta le informazioni che attraversano l'intero processo, come ad esempio documenti di business, e-mails, o lettere.

Un ***Collection Data Object*** rappresenta una collezione di informazioni, come ad esempio una lista di elementi ordinati.

Un ***Data Store*** è un luogo dove il processo può leggere oppure scrivere dati, ad esempio un database. Esso si mantiene oltre la durata dell'istanza del processo.

Un **messaggio** è usato per rappresentare i contenuti di una comunicazione tra due partecipanti.

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BPMN basics

Artefacts

Artefacts

BPMN is designed to allow modellers and modelling tools some flexibility in extending the basic notation

Any number of artefacts can be added to a diagram as appropriate for the specific context of the business process being modelled

BPMN includes three pre-defined types of artefacts:

Data object

Group

Text annotation

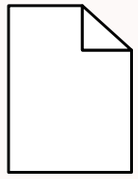
Data object

A **data object** specifies the data that are required or produced by an activity

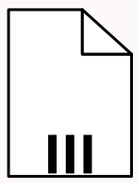
A data object is often represented by the usual file icon

A **Data Input** is an external input for the entire process. It can be read by an activity.

A **Data Output** is a variable available as result of the entire process.

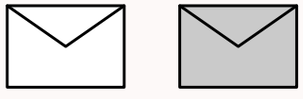


A **Data Object** represents information flowing through the process, such as business documents, e-mails, or letters.



A **Collection Data Object r**epresents a collection of information, e.g., a list of order items.

A **Data Store** is a place where the process can read or write data, e.g., a database or a filing cabinet. It persists beyond the lifetime of the process instance.



A **Message** is used to depict the contents of a communication between two Participants.

Group

An arbitrary set of objects can be defined as a **group** to show that they logically belong together

A group is represented by rounded corner rectangles with dashed lines

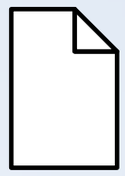
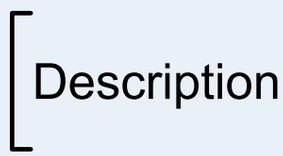
Annotation

Any object can be associated with a **text annotation** to provide any additional information and documentation that can be needed

A text annotation is represented as a dotted-line call-out

Artefacts

Artefacts are used to provide additional information about the process. If required, modellers and modelling tools are free to add new artefacts. Examples of data objects: 'A letter', 'Email message', 'XML document', 'Confirmation',...

Set of standardized artefacts		
Data object	 [state]	Data objects provide information about what activities are required to be triggered and/or what they produce. They are considered as Artefacts because they do not have any direct effect on the Sequence Flow or Message Flow of the Process. The state of the data object should also be set.
Group		Grouping can be used for documentation or analysis purposes. Groups can also be used to identify the activities of a distributed transaction that is shown across Pools. Grouping of activities does not affect the Sequence or Message Flow.
Annotation	 Description	Text Annotations are a mechanism for a modeller to provide additional information for the reader of a BPMN Diagram.

BPMN basics

Swimlanes

Swimlanes

Many process modelling methodologies utilise
the concept of a **swimlane** as a mechanism
to **organise activities into separate visual categories**
in order to illustrate different functional capabilities
or responsibilities

BPMN supports two main swimlane objects:

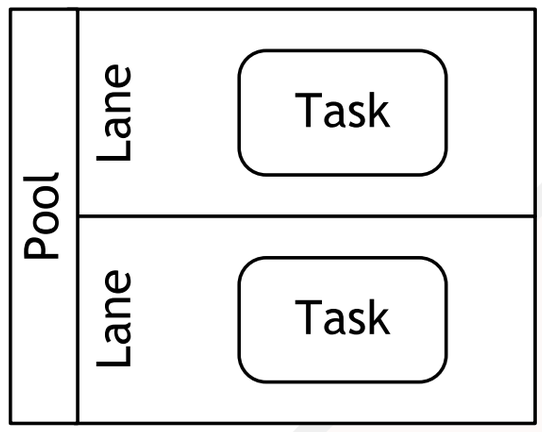
Pool

Lane

Pool and Lanes

A **pool** represents a participant (or role) in a process
A pool is represented as rectangle with a name

A **lane** is a hierarchical sub-partition within a pool
that is used to organise and categorise activities



A lane is an inner rectangle to the pool
that extends to the entire length of the pool

Swimlanes

Pools and lanes are used to represent organizations, roles, systems and responsibilities. Examples: 'University', 'Sales division', 'Warehouse', 'ERP system',...

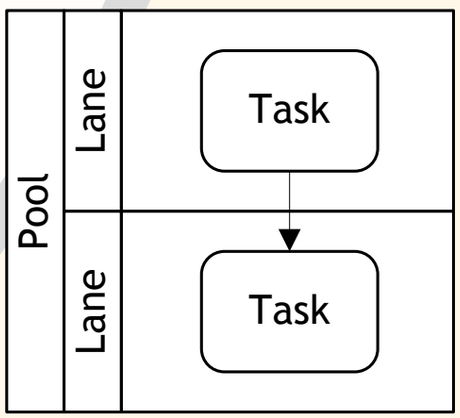
A Pool MUST contain 0 or 1 business process.

A Pool can contain 0 or more lanes.

Two pools can only be connected with message flows.

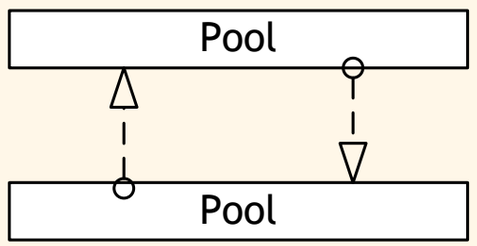
A **Pool** represents a participant in a process. It contains a business process and is used in B2B situations.

A **Lane** is a sub-partition within a pool used to organize and categorize activities.

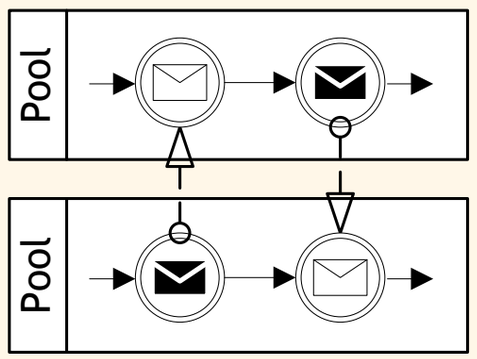


Pools and **Lanes** represent responsibilities for activities in a process. A pool or a lane can be an organization, a role, or a system. Lanes sub-divide pools or other lanes hierarchically.

Collapsed Pools hide all internals of the contained processes.



Message Flow symbolizes information flow across organizational boundaries. Message flow can be attached to pools, activities, or message events.



The order of message exchanges can be specified by combining message flow and sequence flow.

BPMN basics

Flow Objects

Flow objects

Theory:
fix a small set of core elements
so that modellers do not have to learn and recognise
a large number of different shapes:

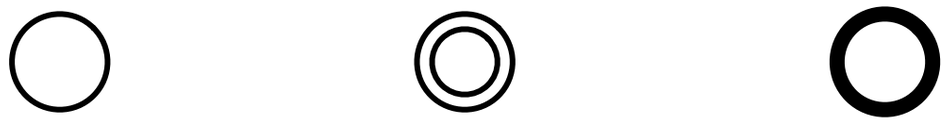
Events
Activities
Gateways

Practice:
use different border styles and internal markers
to add many more information
(this way the notation is more extensible)

Event

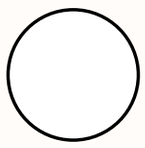
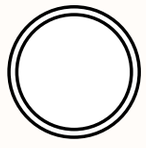
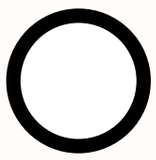
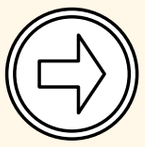
An **event** is something that “happens” during the course of a business process

The type of an event is one among:
start, **intermediate**, **end**

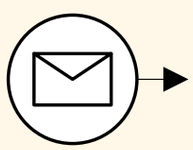


An event is represented as a circle
its type depends on the style of the border

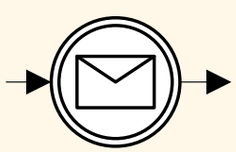
Usually an event has a cause (**trigger**)
or an impact (**result**)
Internal markers denote the trigger or result

	Start	Intermediate		End	
	Catching		*Throwing*		
Plain					Untyped events, typically showing where the process starts or ends.
Message					Receiving and sending messages.
Timer					Cyclic timer events, points in time, time spans or timeouts.
Error					Catching or throwing named errors.
Link					Off-page connectors. Two corresponding link events equal a sequence flow.
Terminate					Triggering the immediate termination of a process.

Catching

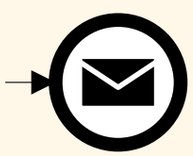


Start Event: Catching an event starts a new process instance.

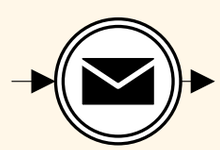


Intermediate Event (catching): The process can only continue once an event has been caught.

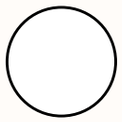
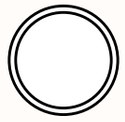
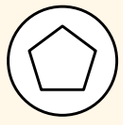
Throwing



End Event: An event is thrown when the end of the process is reached.

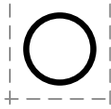
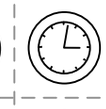
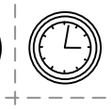


Intermediate Event (throwing): An event is thrown and the process continues.

	Start	Intermediate		End	
	Catching		*Throwing*		
Plain					Untyped events, typically showing where the process starts or ends.
Message					Receiving and sending messages.
Timer					Cyclic timer events, points in time, time spans or timeouts.
Error					Catching or throwing named errors.
Cancel					Reacting to cancelled transactions or triggering cancellation.
Compen-sation					Compensation handling or triggering compensation.
Conditional					Reacting to changed business conditions or integrating business rules.
Signal					Signalling across different processes. One signal thrown can be caught multiple times.
Multiple					Catching or throwing one out of a set of events.
Link					Off-page connectors. Two corresponding link events equal a sequence flow.
Terminate					Triggering the immediate termination of a process.

Events

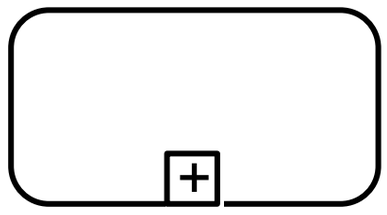
Event flow / Event type	Start	Intermediate	End	Description
General				The Start Event indicates where a particular process will start. Intermediate Events occur between a Start Event and an End Event. It will affect the flow of the process, but will not start or (directly) terminate the process. The End Event indicates where a process will end.
Message				A message arrives from a participant and triggers the Event. This causes process to {start, continue, end} if it was waiting for a message, or changes the flow if exception happens. End type of message event indicates that a message is sent to a participant at the conclusion of the process.
Timer				A specific time or cycle can be set that will trigger the start of the Process or continue the process. Intermediate timer can be used to model the time-based delays.
Error				This type of End indicates that a named Error should be generated. This Error will be caught by an Intermediate Event within the Event Context.
Cancel				This type of Event is used within a Transaction Sub-Process. This type of Event MUST be attached to the boundary of a Sub-Process. It SHALL be triggered if a Cancel End Event is reached within the Transaction Sub-Process.
Compensation				This is used for compensation handling--both setting and performing compensation. It calls for compensation if the Event is part of a Normal Flow. It reacts to a named compensation call when attached to the boundary of an activity. Very useful for modelling roll-back actions within the transaction.
Rule				This type of event is triggered when the conditions for a rule become true. Rules can be very useful to interrupt the loop process, for example: 'The number of repeats = N'. Intermediate rule is used only for exception handling.
Link				A Link is a mechanism for connecting the end (Result) of one Process to the start (Trigger) of another. Typically, these are two Sub-Processes within the same parent Process. It can be used, for example, when the working area (page) is too small – go to another page.
Multiple				This type of event indicates that there are multiple ways of triggering the Process. Only one of them will be required to {start, continue, end} the Process.
Terminate				This type of End indicates that all activities in the Process should be immediately terminated. This includes all instances of Multi-Instances. The Process is terminated without compensation or event handling.

	Start			Intermediate				End
	Top-Level	Event Sub-Process Interrupting	Event Sub-Process Non-Interrupting	Catching	Boundary Interrupting	Boundary Non-Interrupting	Throwing	
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.								
Escalation: Escalating to an higher level of responsibility.								
Conditional: Reacting to changed business conditions or integrating business rules.								
Link: Off-page connectors. Two corresponding link events equal a sequence flow.								
Error: Catching or throwing named errors.								
Cancel: Reacting to cancelled transactions or triggering cancellation.								
Compensation: Handling or triggering compensation.								
Signal: Signalling across different processes. A signal thrown can be caught multiple times.								
Multiple: Catching one out of a set of events. Throwing all events defined								
Parallel Multiple: Catching all out of a set of parallel events.								
Terminate: Triggering the immediate termination of a process.								

Activity

An **activity** is some “unit of work” (job) to be done during the course of a business process

An activity can be
atomic (**task**) or compound (**sub-process**)



An activity is represented as a rounded box,
Suitable markers are used to indicate
the nature of the action to be performed
and the execution behaviour

Task

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.

Transaction

A **Transaction** is a set of activities that logically belong together; it might follow a specified transaction protocol.

Event Sub-Process

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.

Call Activity

A **Call Activity** is a wrapper for a globally defined Sub-Process or Task that is reused in the current process.

Multiple Instances

Multiple Instances of the same activity are started in parallel or sequentially, e.g. for each line item in an order.

Loop

Loop Activity is iterated if a loop condition is true. The condition is either tested before or after the activity execution.

Ad-hoc Subprocess

Ad-hoc Subprocesses contain tasks only. Each task can be executed arbitrarily often until a completion condition is fulfilled.

activity

Attached Intermediate Event: The activity is aborted once an event is caught.

Task

A **Task** is a unit of work, the job to be performed.

Collapsed Subprocess

A **Subprocess** is a decomposable activity. It can be collapsed to hide the details.

Expanded Subprocess

An **Expanded Subprocess** contains a valid BPMN diagram.

Activity Markers

Markers indicate execution behavior of activities:

- Sub-Process Marker
- Loop Marker
- Parallel MI Marker
- Sequential MI Marker
- Ad Hoc Marker
- Compensation Marker

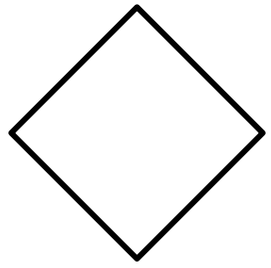
Task Types

Types specify the nature of the action to be performed:

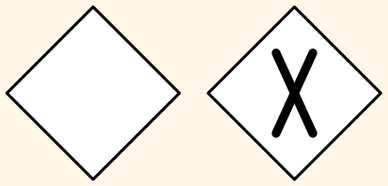
- Send Task
- Receive Task
- User Task
- Manual Task
- Business Rule Task
- Service Task
- Script Task

Gateway

A **gateway** is used to control the splitting and joining of paths in the sequence flow
(conditional, fork, wait)



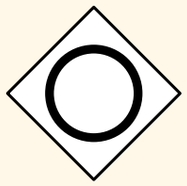
A gateway is represented as a diamond shape
Suitable markers are used to indicate
the nature of behaviour control



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

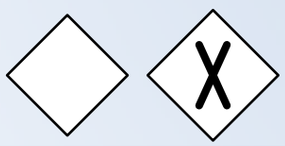
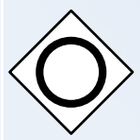
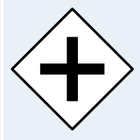
Event-based Exclusive Gateway
Is always followed by catching events or receive tasks. Sequence flow is routed to the subsequent event/task which happens first.

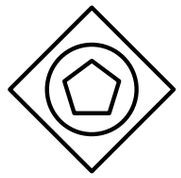
Parallel Gateway
When used to split the sequence flow, all outgoing branches are activated simultaneously. When merging parallel branches it waits for all incoming branches to complete before triggering the outgoing flow.



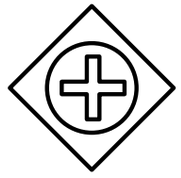
Inclusive Gateway
When splitting, one or more branches are activated based on branching conditions. When merging, it awaits all active incoming branches to complete.

Complex Gateway
It triggers one or more branches based on complex conditions or verbal descriptions. Use it sparingly as the semantics might not be clear.

Gateway control types		
XOR (DATA)		Data based exclusive decision or merging. Both symbols have equal meaning. See also Conditional flow.
XOR (EVENT)		Event based exclusive decision only.
OR		Data based inclusive decision or merging.
COM-PLEX		Complex condition (a combination of basic conditions)
AND		Parallel forking and joining (synchronization).



Exclusive Event-based Gateway (instantiate)
Each occurrence of a subsequent event starts a new process instance.



Parallel Event-based Gateway (instantiate)
The occurrence of all subsequent events starts a new process instance.

BPMN basics

Connecting objects

Connecting objects

The Flow objects are connected together in a diagram to create the basic skeletal structure of a business process

Three connecting objects can be used:

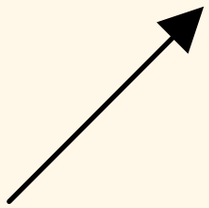
Sequence flow
Message flow
Association

Sequence flow

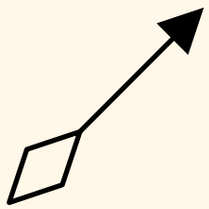
A **sequence flow** is used to show the order
in which activities are to be performed

Note: the term “control flow” is generally avoided in BPMN

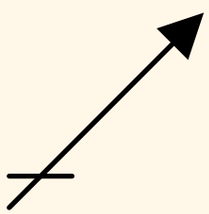
A sequence flow is represented by
a solid line with a solid arrowhead



Sequence Flow defines the execution order of activities.



Conditional Flow has a condition assigned that defines whether or not the flow is used.



Default Flow is the default branch to be chosen if all other conditions evaluate to false.

Message flow

A **message flow** is used to show the flow
of messages two separate process participants
(business entities or business roles)
that send and receive them

Note: in BPMN **the participants reside in separate pools**

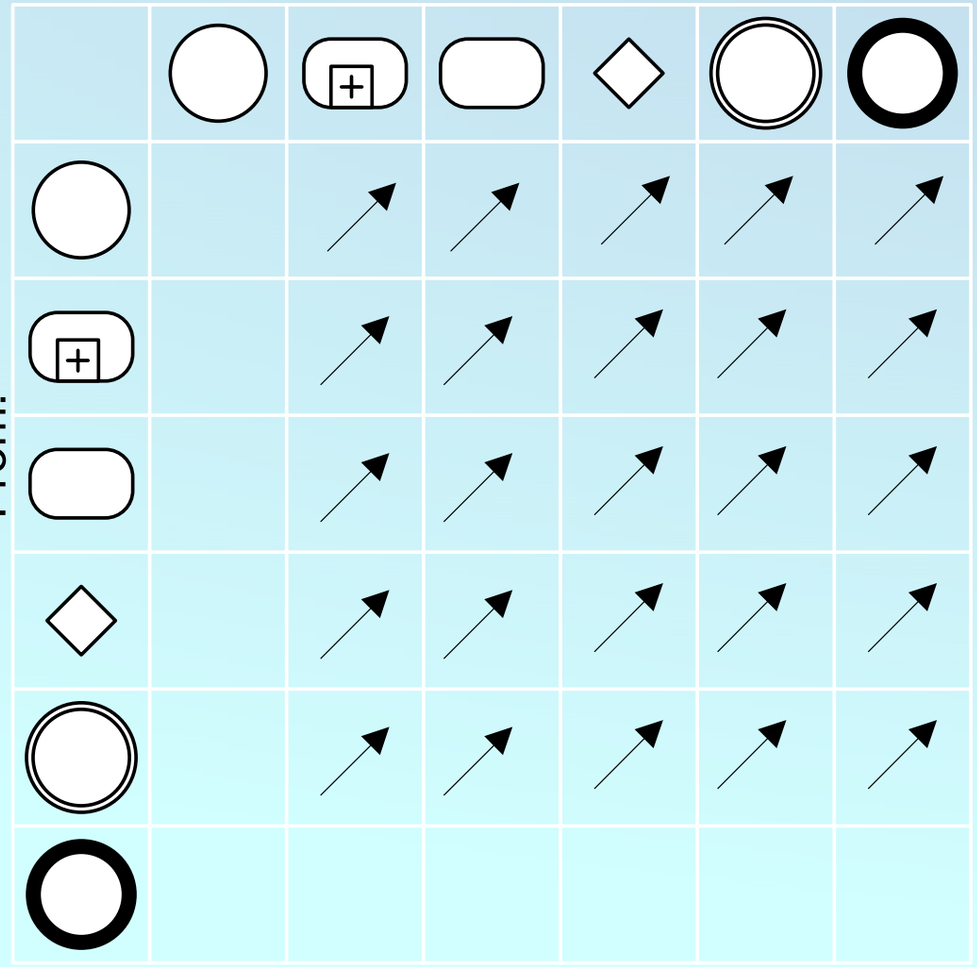
A message flow is represented by
a dashed line with a open arrowheads (see above)

Sequence Flow and Message Flow rules

Only objects that can have an incoming and/or outgoing Sequence Flow / Message Flow are shown in the Tables Below.

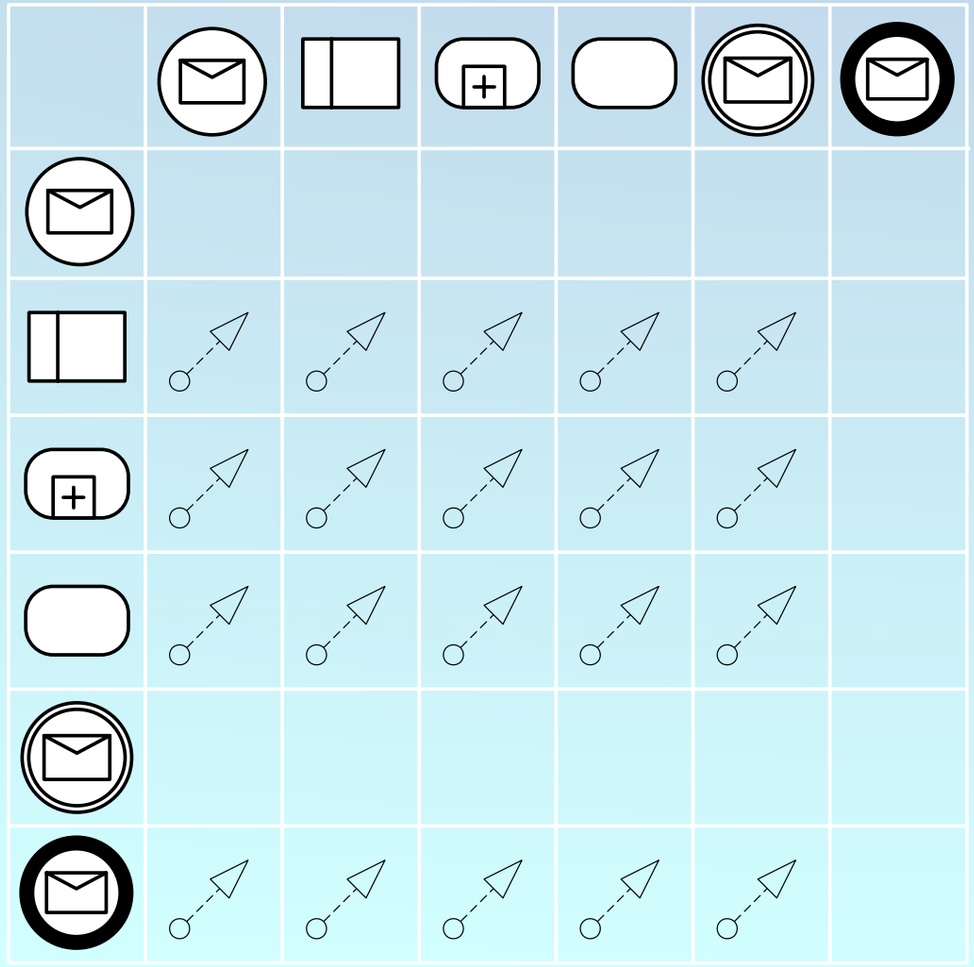
To:

From:



To:

From:

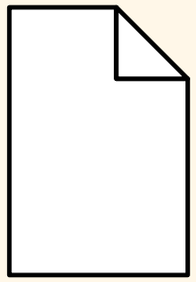


Association

An **association** is used to associate data, text, and other artefacts with flow objects

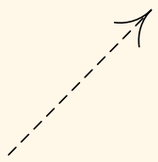
Note: in particular, input and output of activities

An association is represented by
a dotted line with a line arrowhead

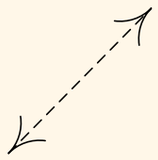


A **Data Object** represents information flowing through the process, such as business documents, e-mails or letters.

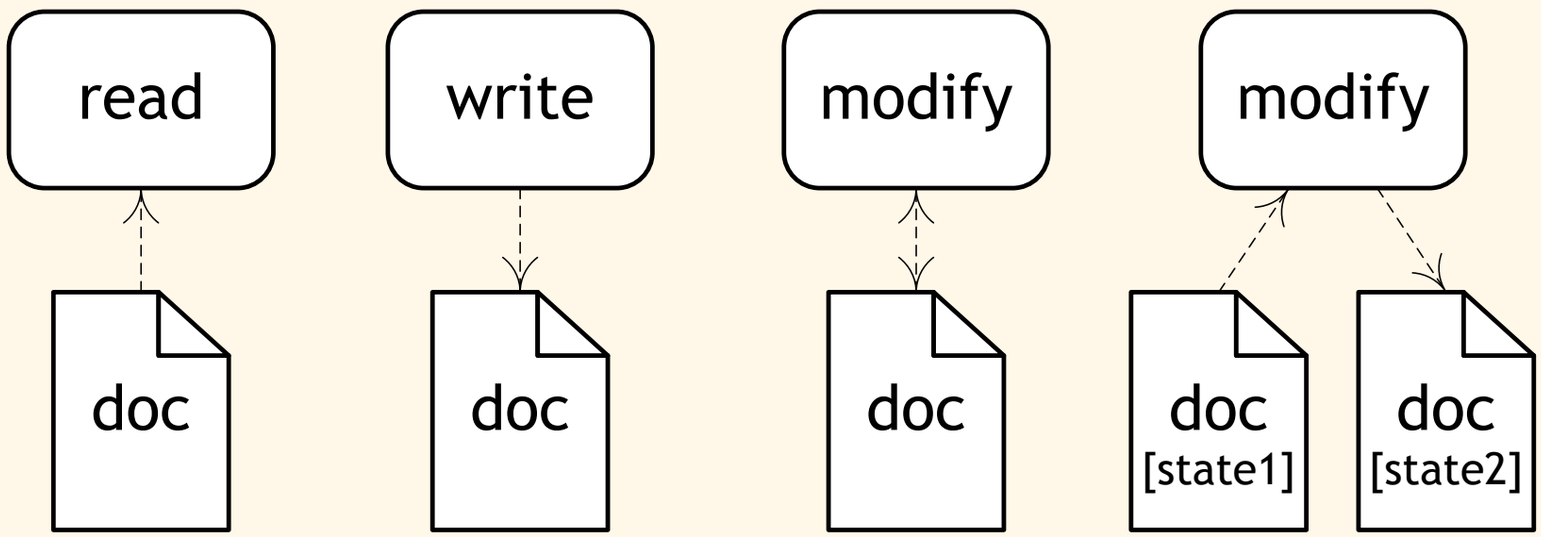
Attaching a data object with an **Undirected Association** to a sequence flow indicates hand-over of information between the activities involved.



A **Directed Association** indicates information flow. A data object can be read at the start of an activity or written upon completion.

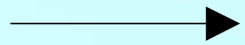
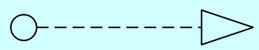
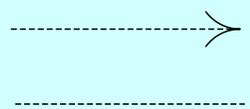


A **Bidirected Association** indicates that the data object is modified, i.e. read and written during the execution of an actvity.



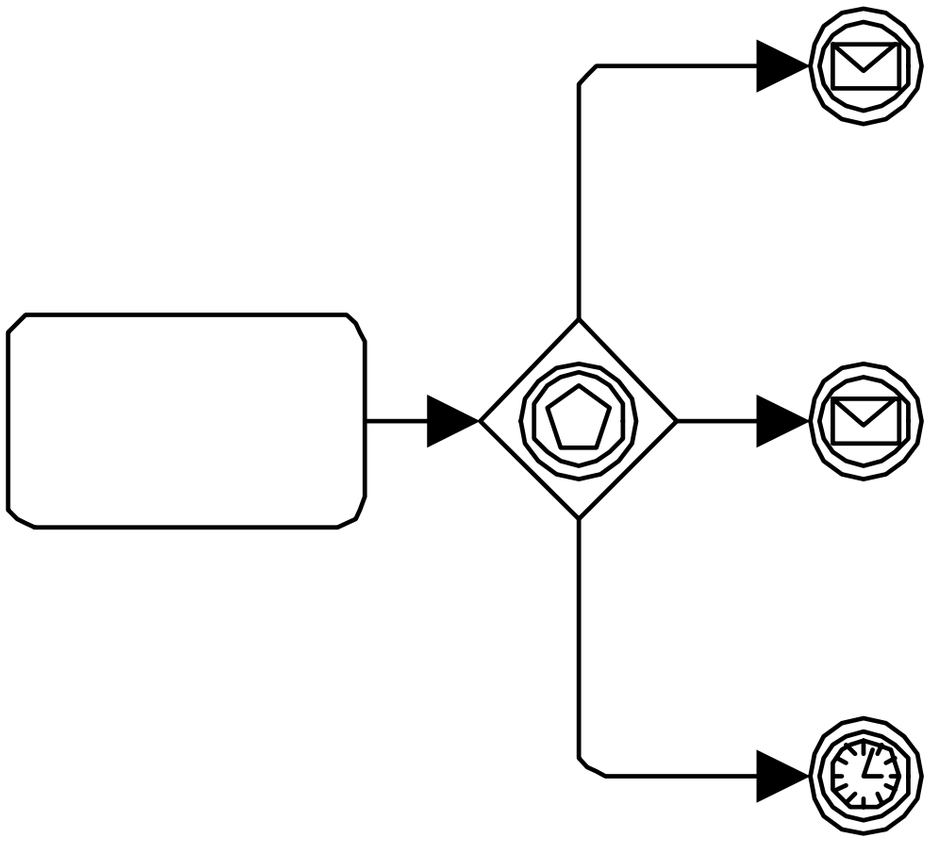
Graphical connecting objects

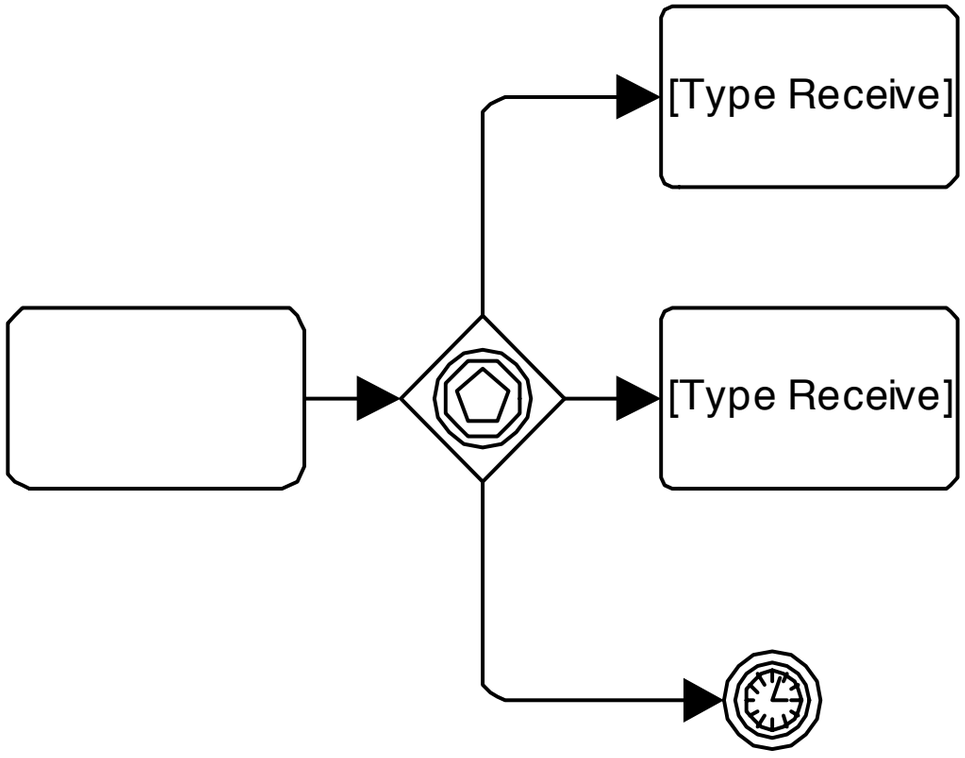
There are three ways of connecting **Flow objects (Events, Activities, Gateways)** with each other or with other information – using sequence flows, message flows or associations.

Graphical connecting objects		
Normal sequence flow		A Sequence Flow is used to show the order In which the activities in a process will be performed.
Conditional sequence flow		A Sequence Flow can have condition expressions which are evaluated at runtime to determine whether or not the flow will be used.
Default sequence flow		For Data-Based Exclusive Decisions or Inclusive Decisions, one type of flow is the Default condition flow. This flow will be used only if all other outgoing conditional flows are NOT true at runtime.
Message flow		A Message Flow is used to show the flow of messages between two participants that are prepared to send and receive them. In BPMN, two separate Pools in a Diagram can represent the two participants.
Association		An Association (directed, non-directed) is used to associate information with Flow Objects. Text and graphical non-Flow Objects can be associated with Flow objects.

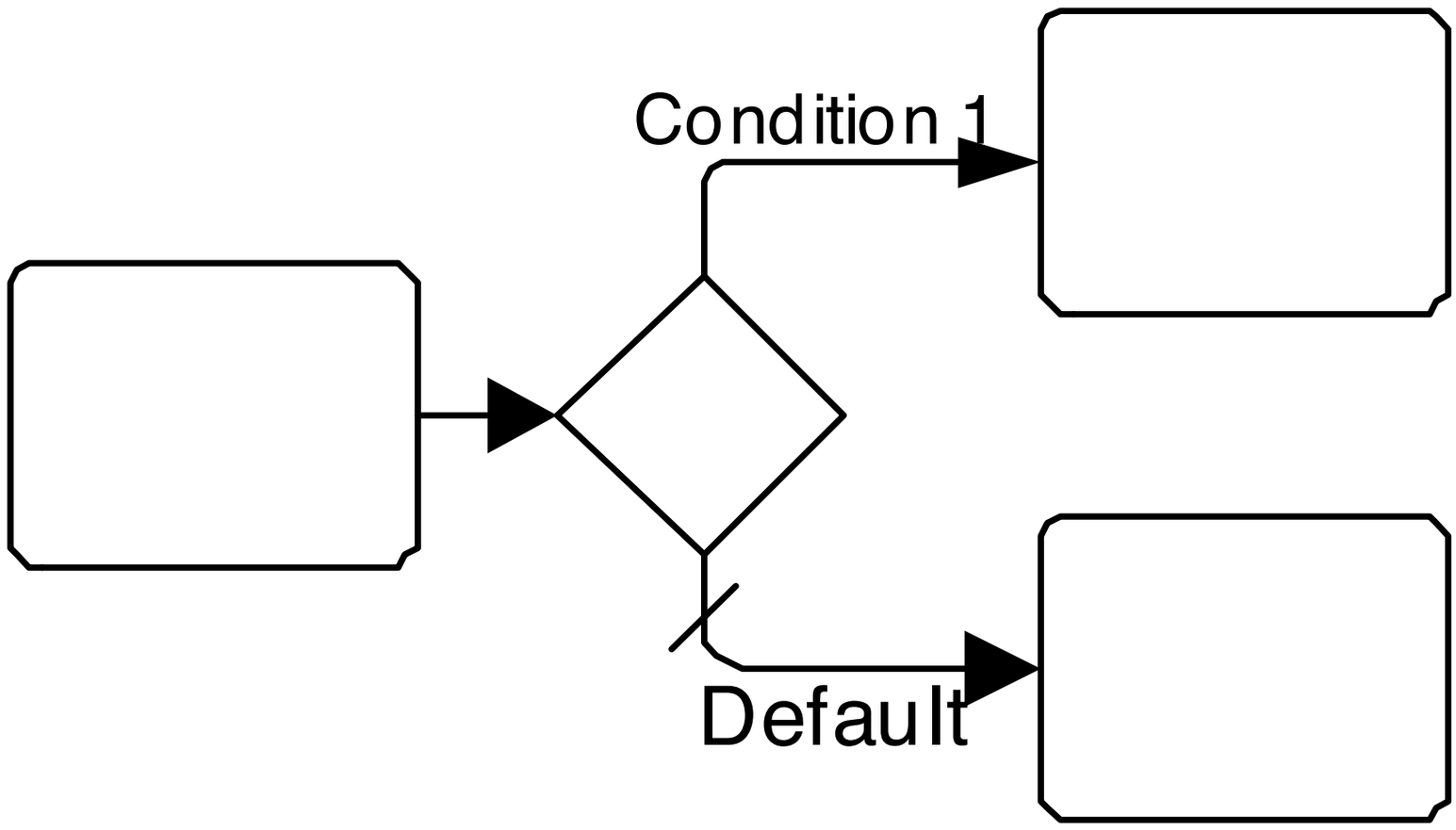
A few patterns

Event-based decisions

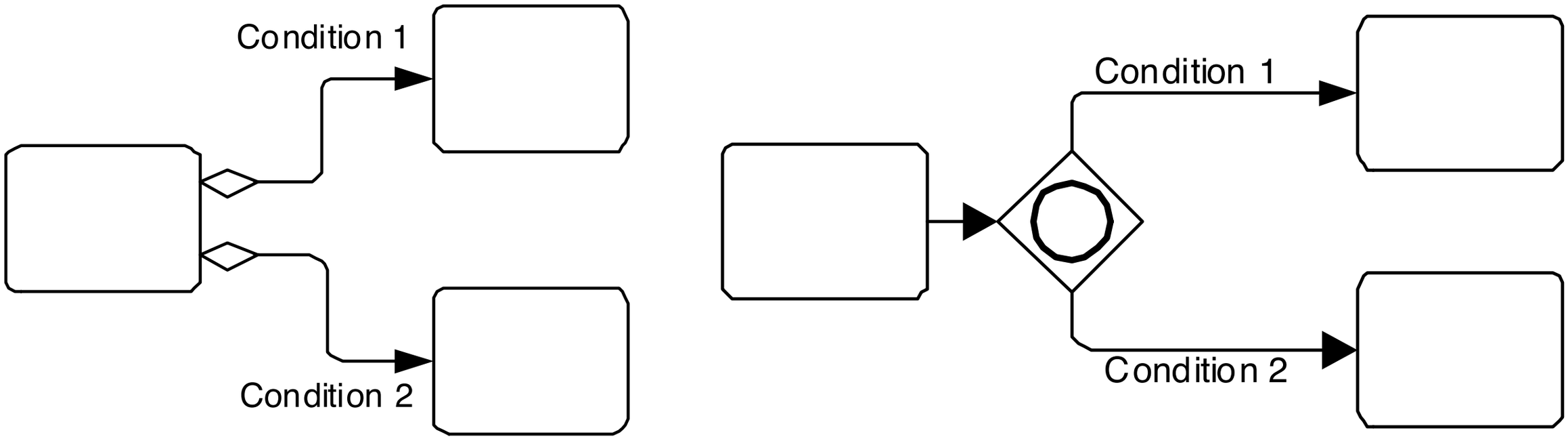




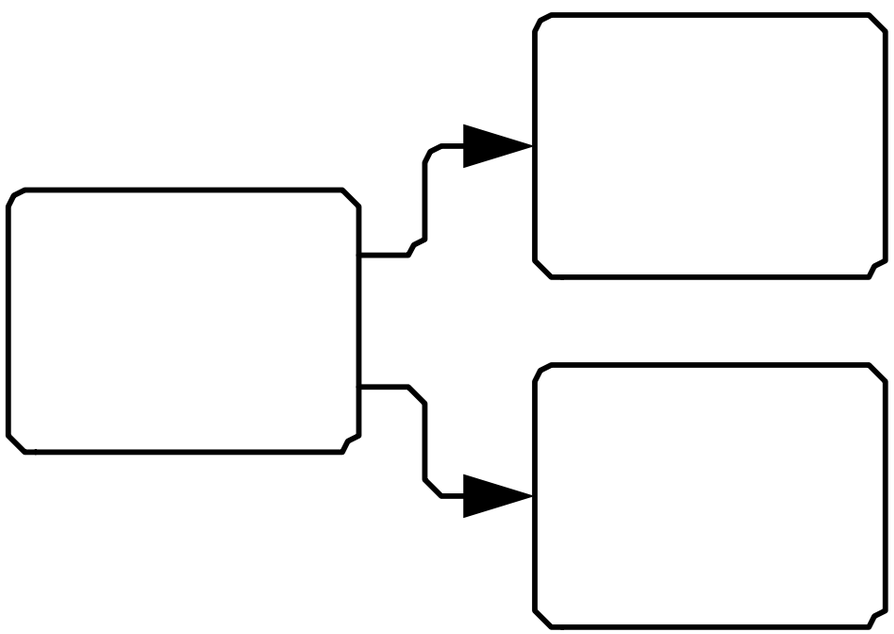
Exclusive decisions (exactly one)

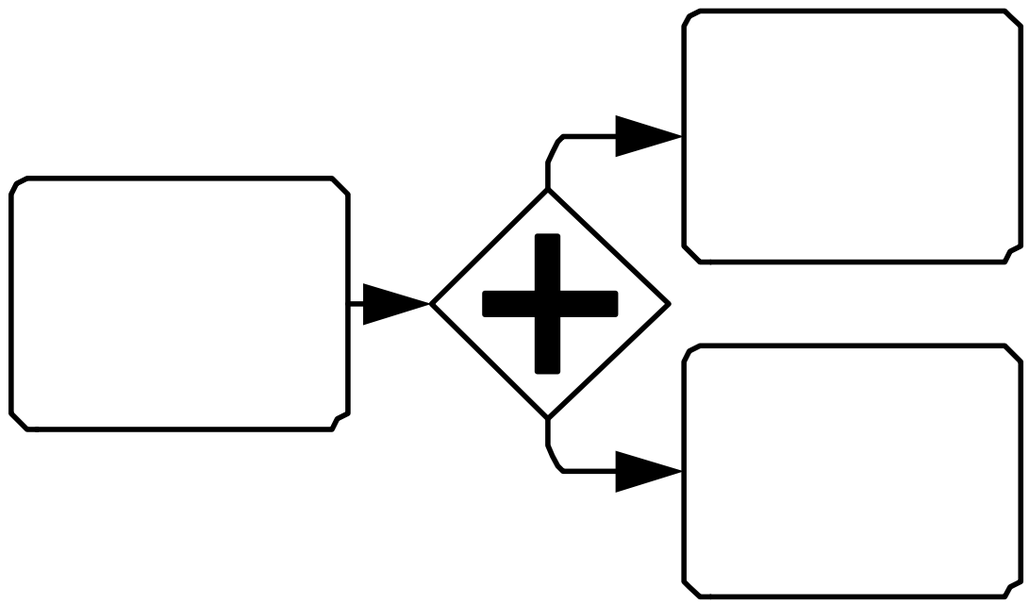


Inclusive decisions (none, one, many)

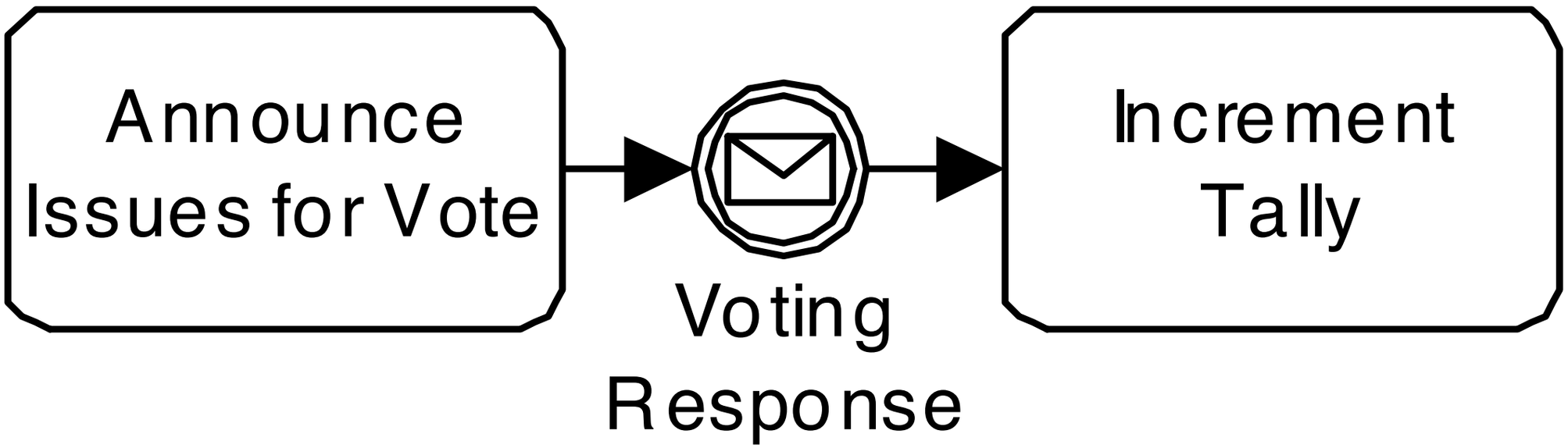


Fork

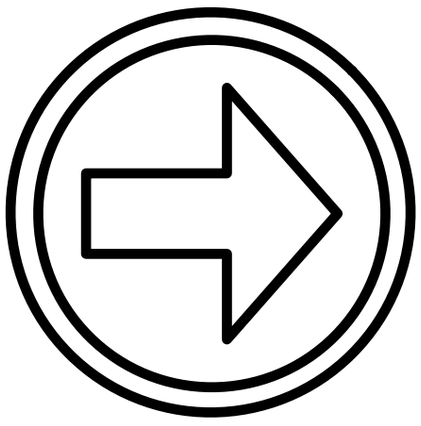




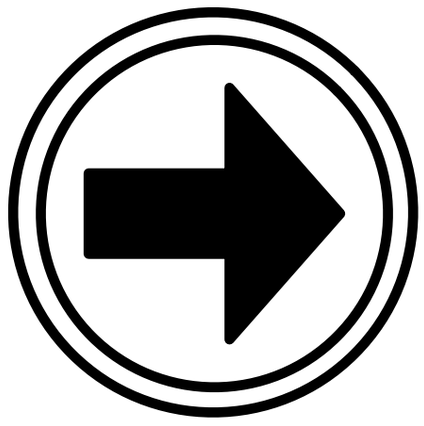
Process break (event waiting)



Off page connectors (printing / readability)

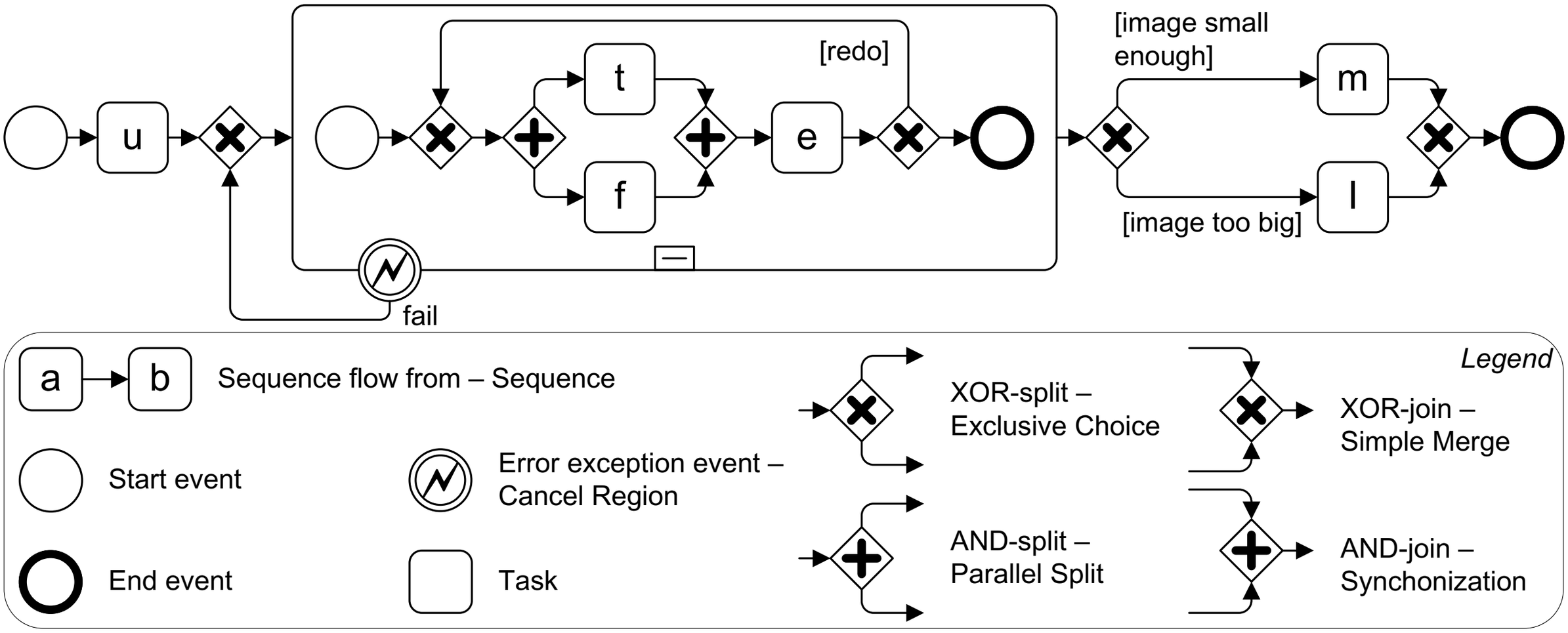


catch
(contd.)



throw
(to page)

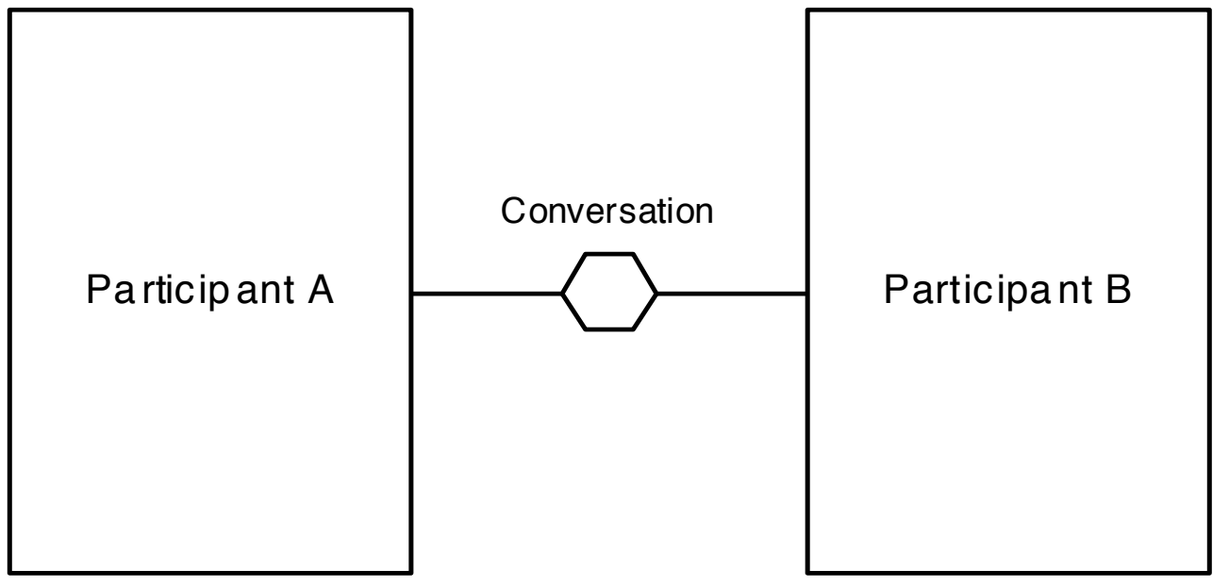
An example


u
t
f
e
[redo]
fail
[image small enough]
m
l
[image too big]
a
b
Sequence flow from – Sequence
Start event
End event
Error exception event – Cancel Region
Task
XOR-split – Exclusive Choice
AND-split – Parallel Split
Legend
XOR-join – Simple Merge
AND-join – Synchonization

Conversations, collaborations, and choreographies

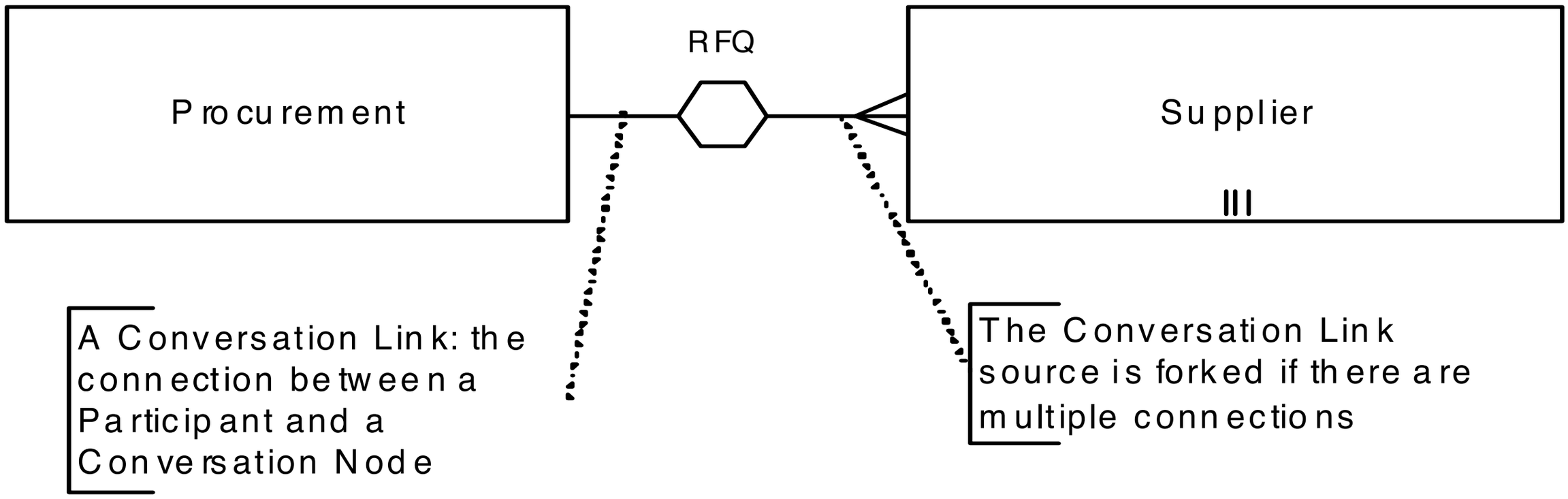
Conversation

A **Conversation** is the logical relation of (correlated) Message exchanges



communication element

Conversation links

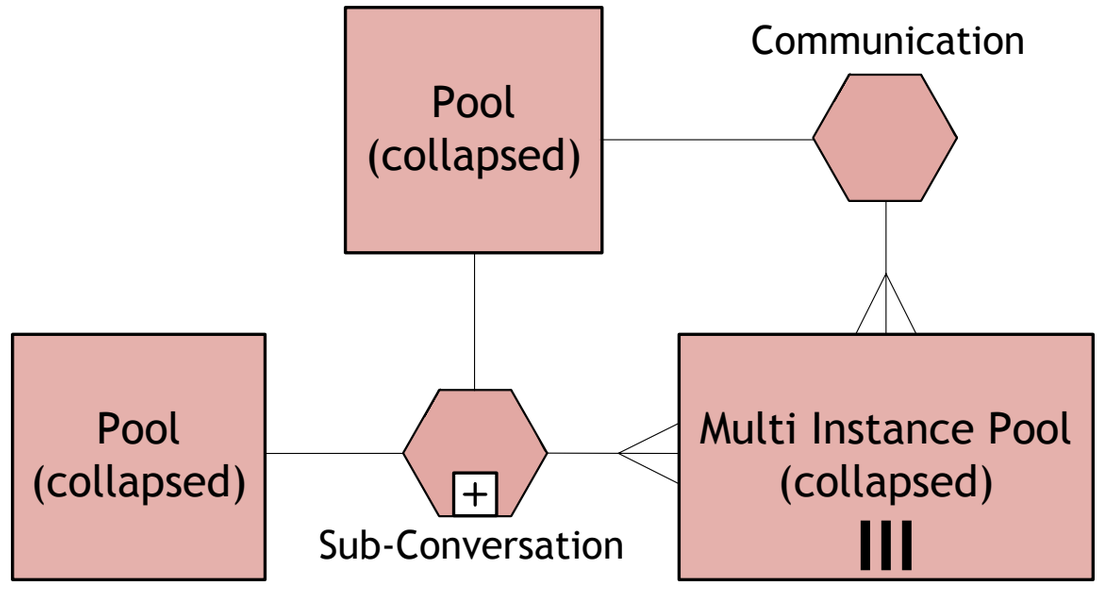


Conversation diagram

A **Communication** defines a set of logically related message exchanges. When marked with a [+] symbol it indicates a Sub-Conversation, a compound conversation element.

A **Conversation Link** connects Communications and Participants.

A **Forked Conversation Link** connect Communications and multiple Participants.



Choreography

The behaviour of different Conversations is modelled through separate Choreographies

A **Choreography** defines the sequence of interaction between participants

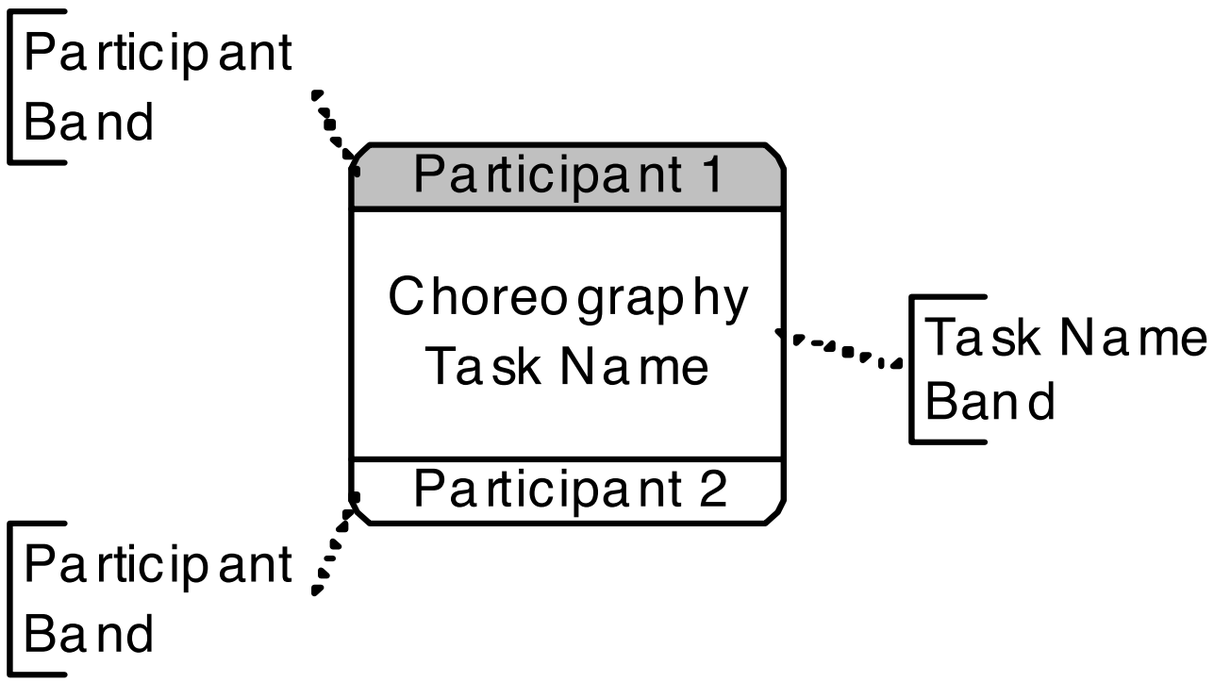
A choreography does not exists in a pool and it is not executable

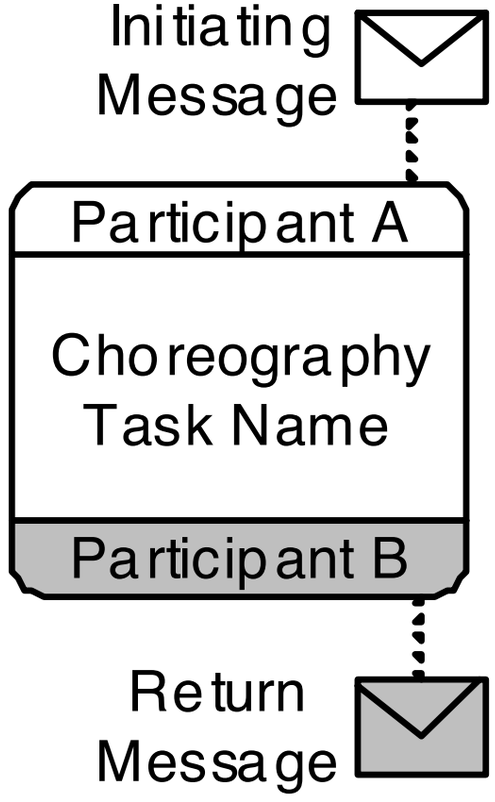
It describes how the participants are supposed to behave

Choreography task

A **Choreography task** is an activity in a choreography that consists of a set (one or more) Message exchanges

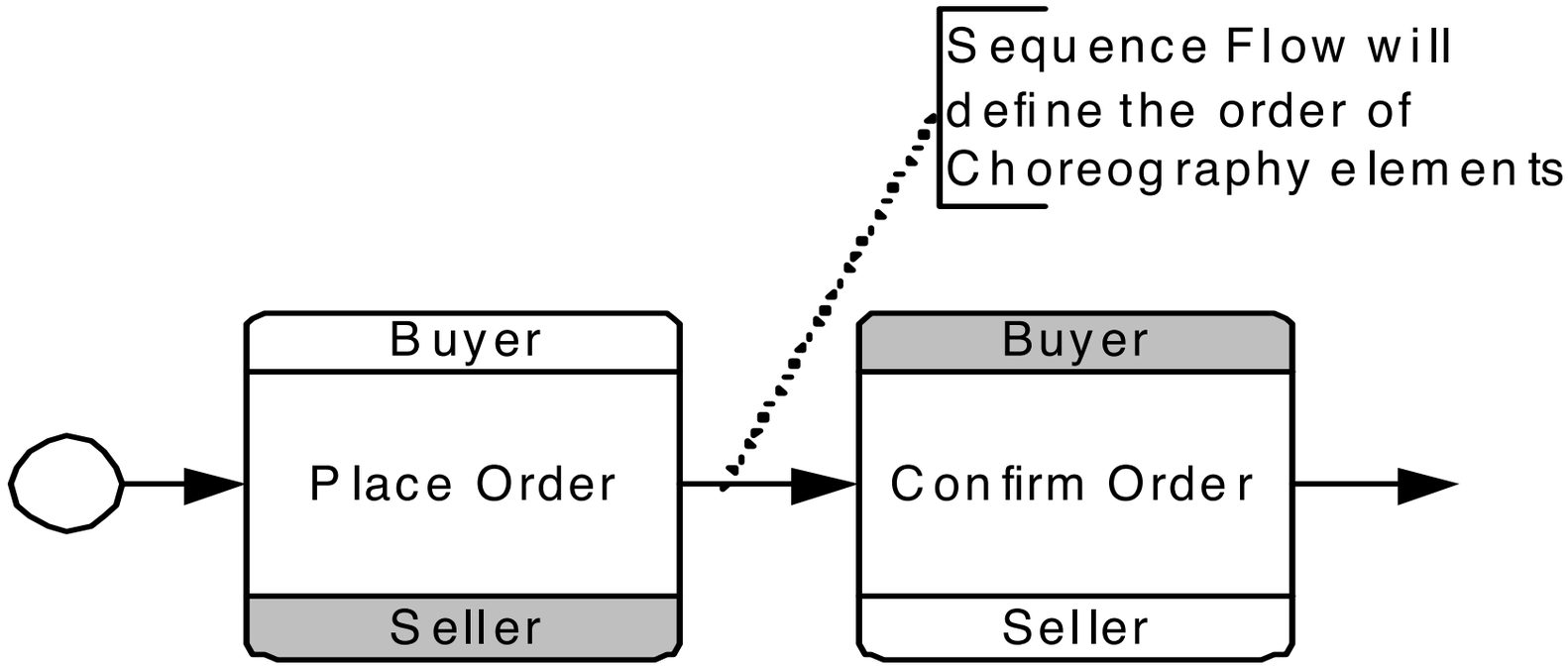
A choreography task involves two or more participants that are displayed in different bands



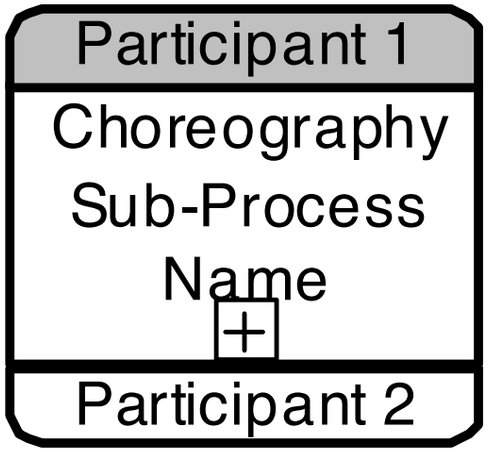


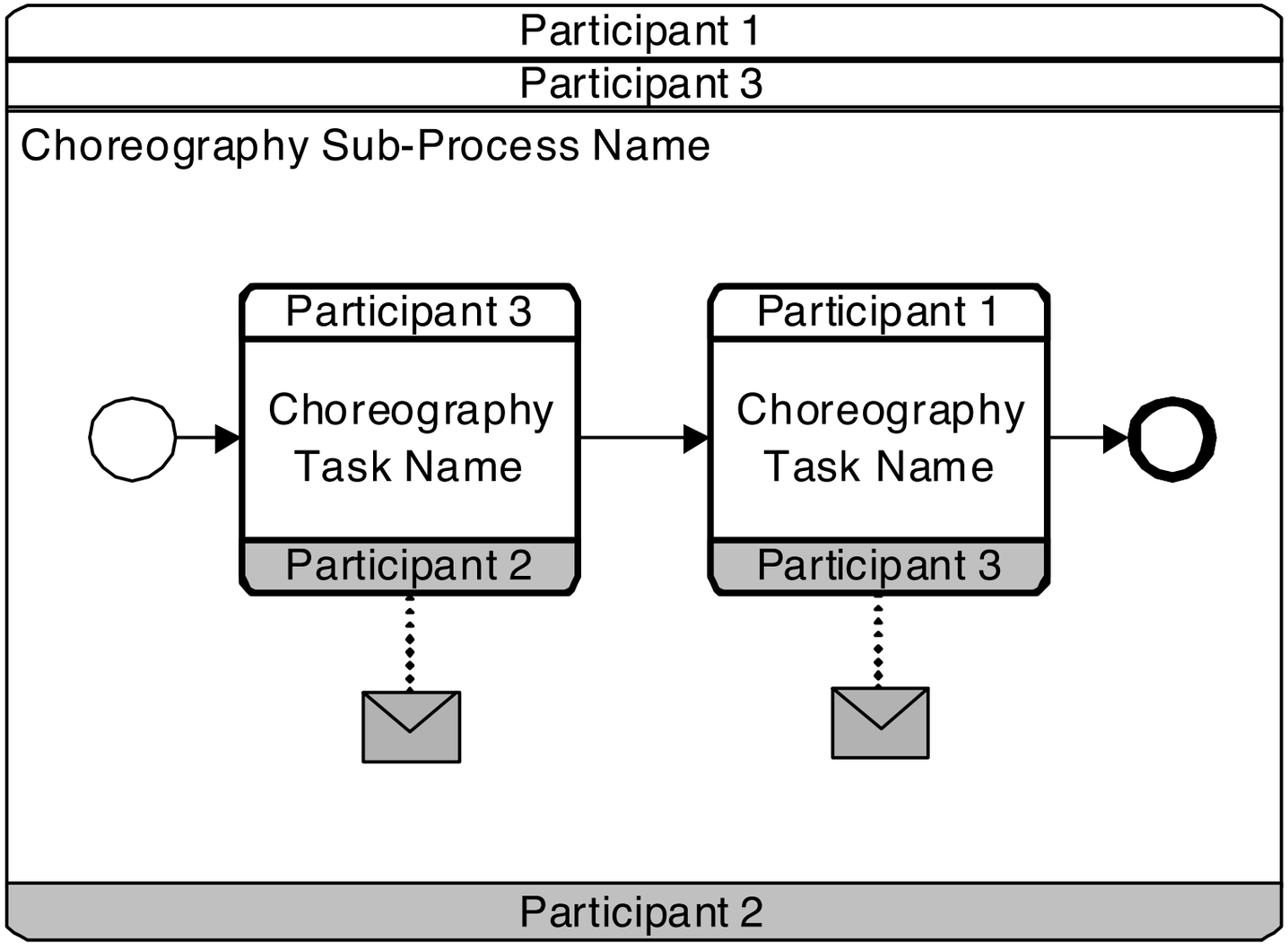
Sequence flow in a choreography

Sequence Flow are used within Choreographies to show the sequence of the Choreography Activities, Events, and Gateways



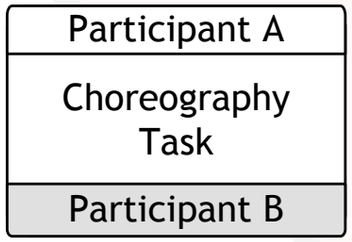
Choreography task collapsed / expanded





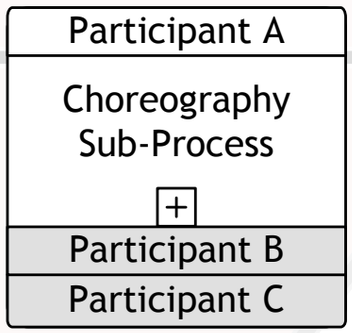
Choreography diagram

Choreographies

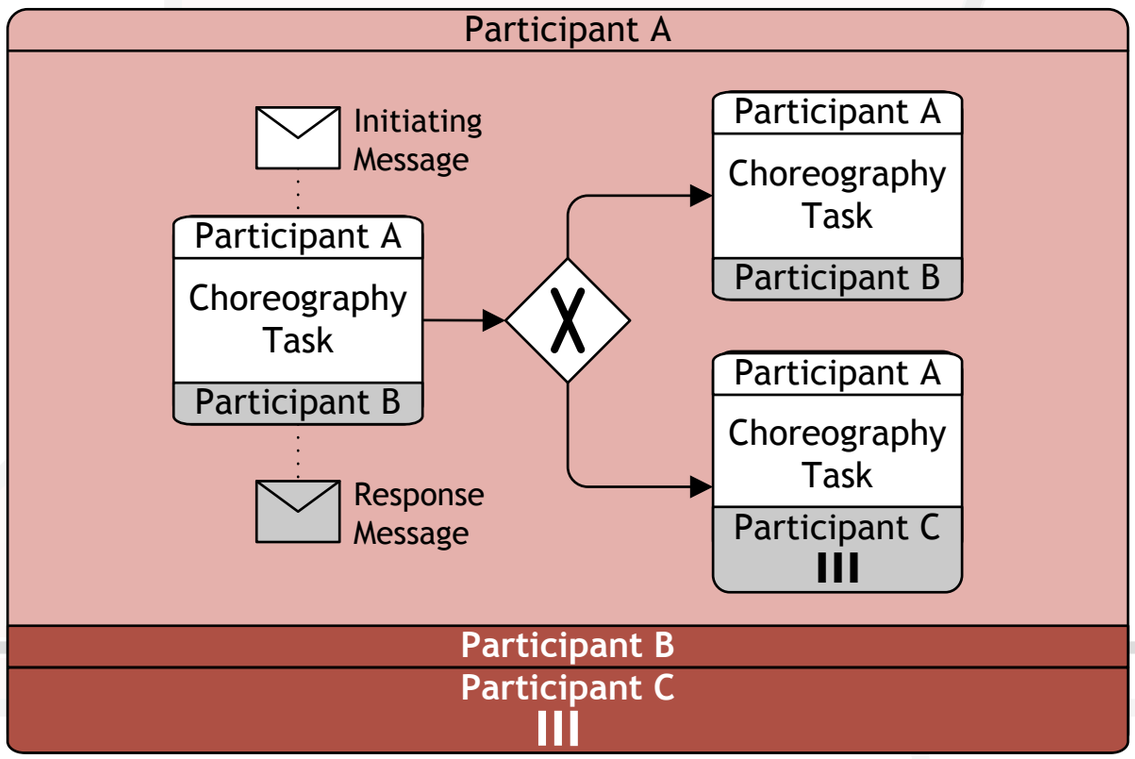


A **Choreography Task** represents an Interaction (Message Exchange) between two Participants.

Multiple Participants Marker denotes a set of Participants of the same kind.



A **Choreography Sub-Process** contains a refined choreography with several Interactions.



Collaboration

A **Collaboration** contains two or more Pools, representing the Participants in the Collaboration

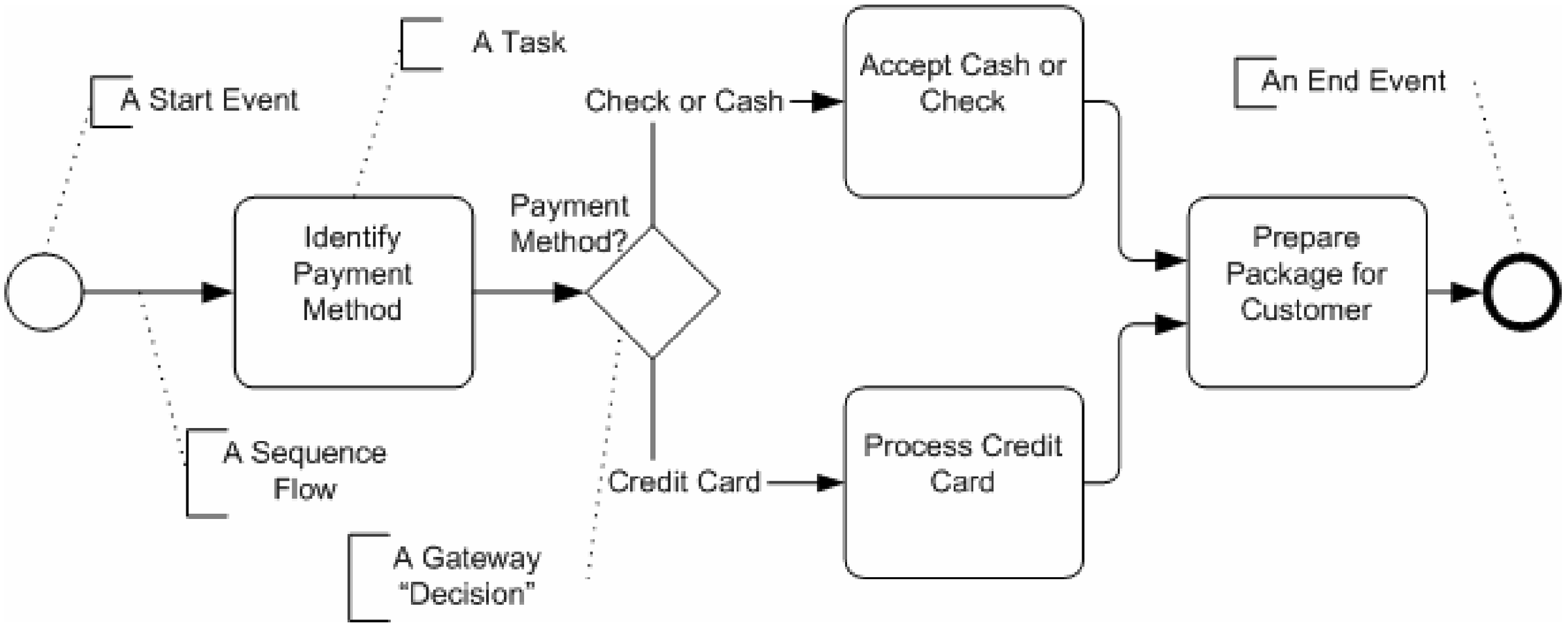
A Pool may be empty or show a Process within

The Message exchange is shown by a Message Flow that connects Pools or the objects within the Pools
The Messages associated with the Message Flow may also be shown

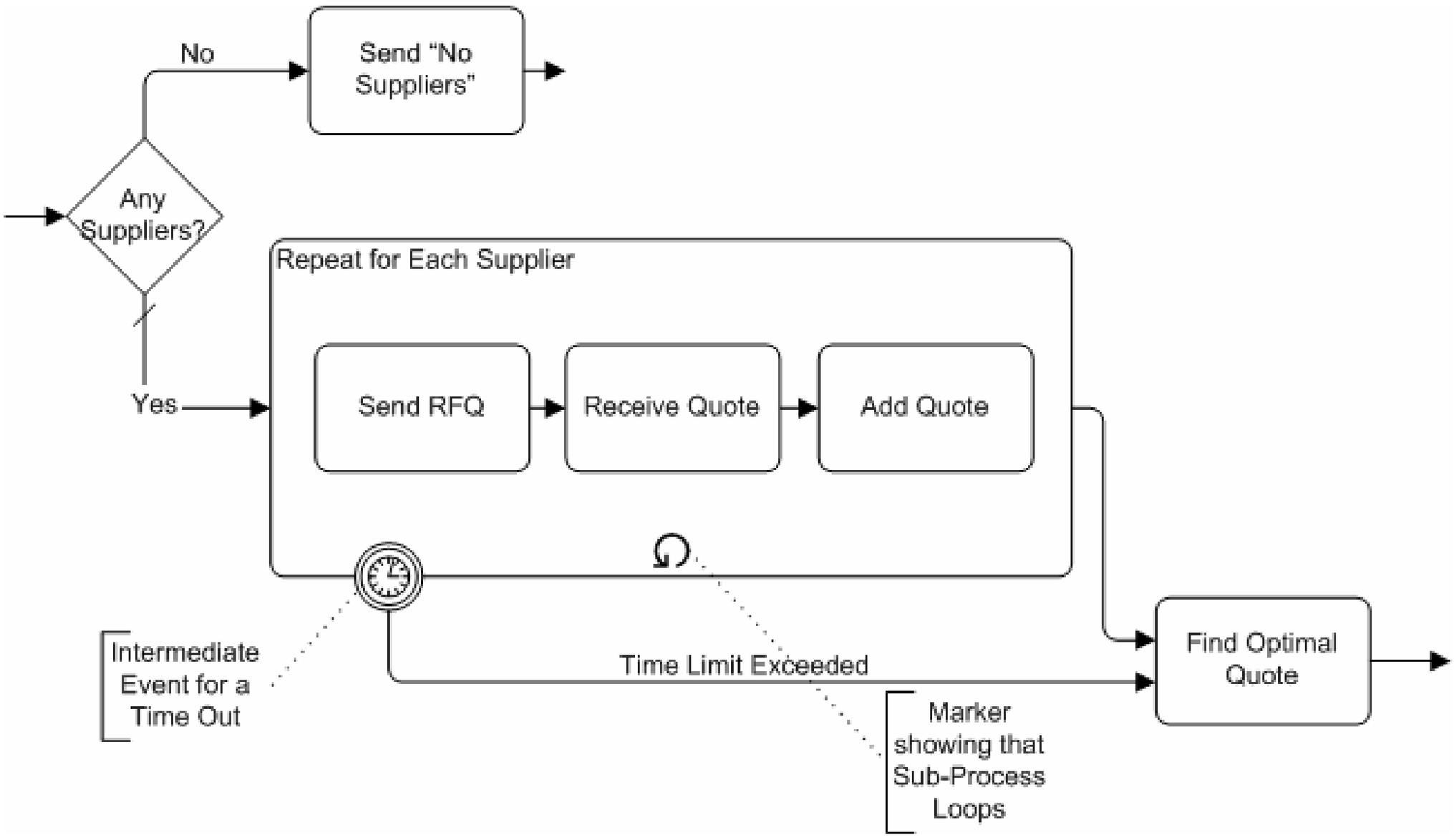
Choreographies may be shown “in between” the Pools as they bisect the Message Flow

Examples (a taste of BPMN)

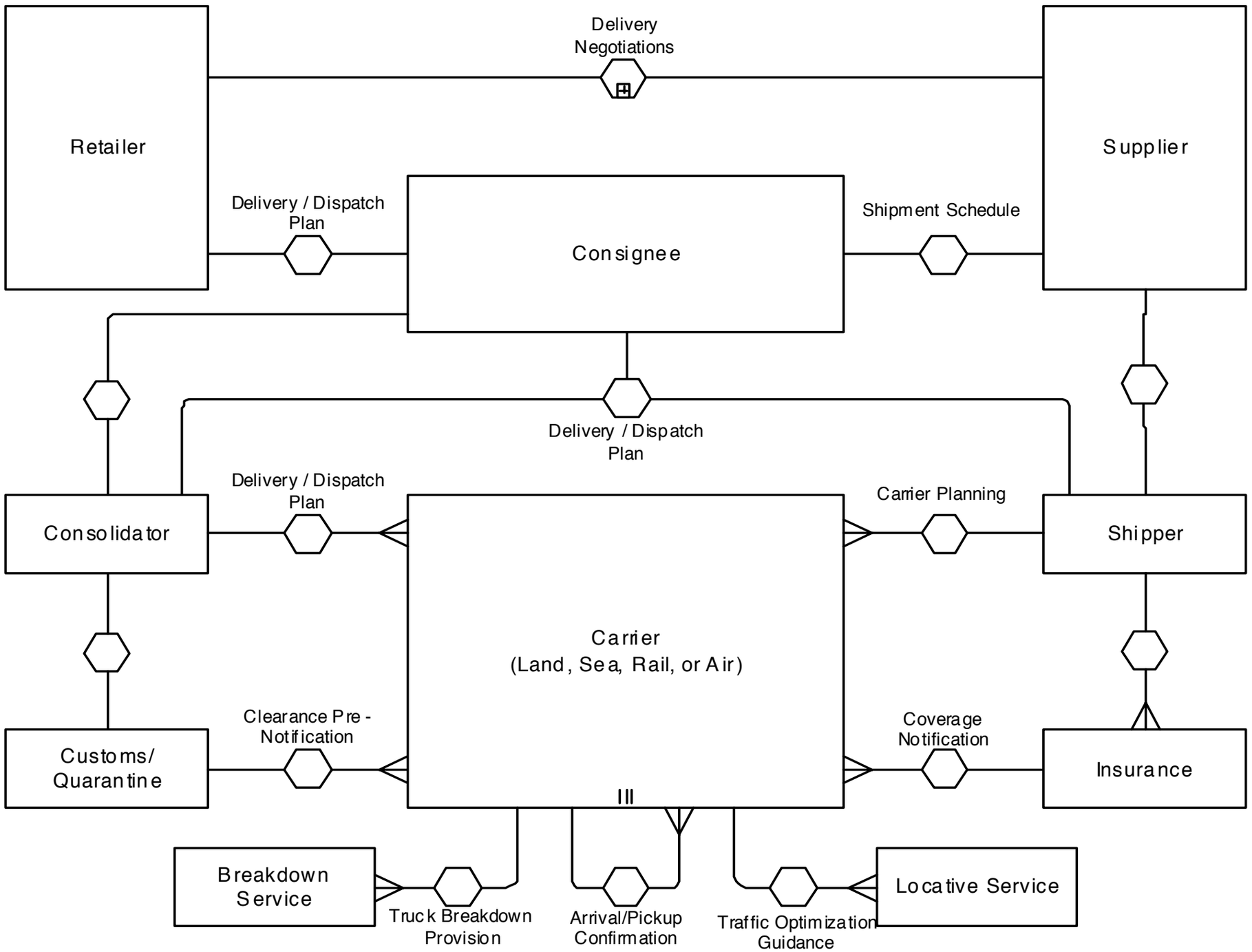
A low detailed orchestration



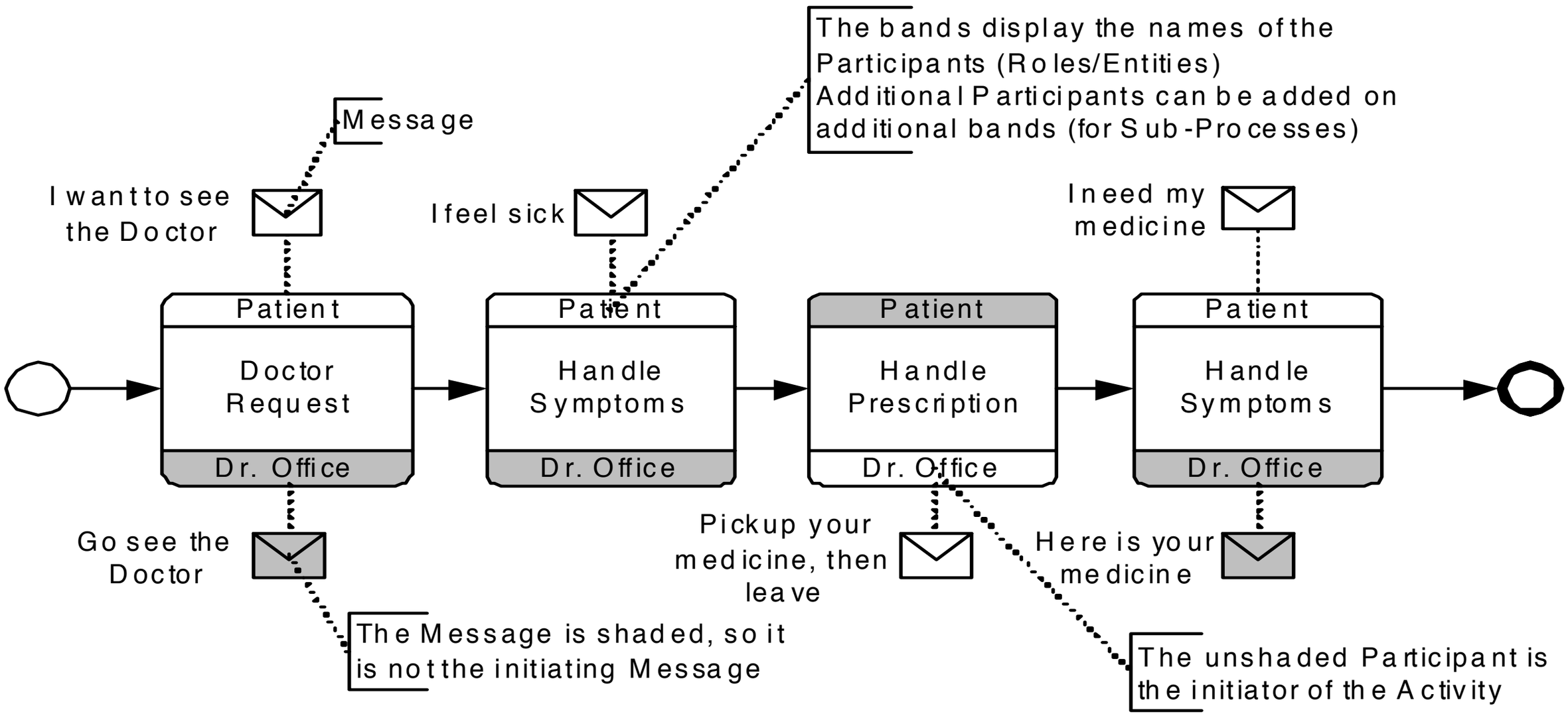
A fragment of a detailed orchestration



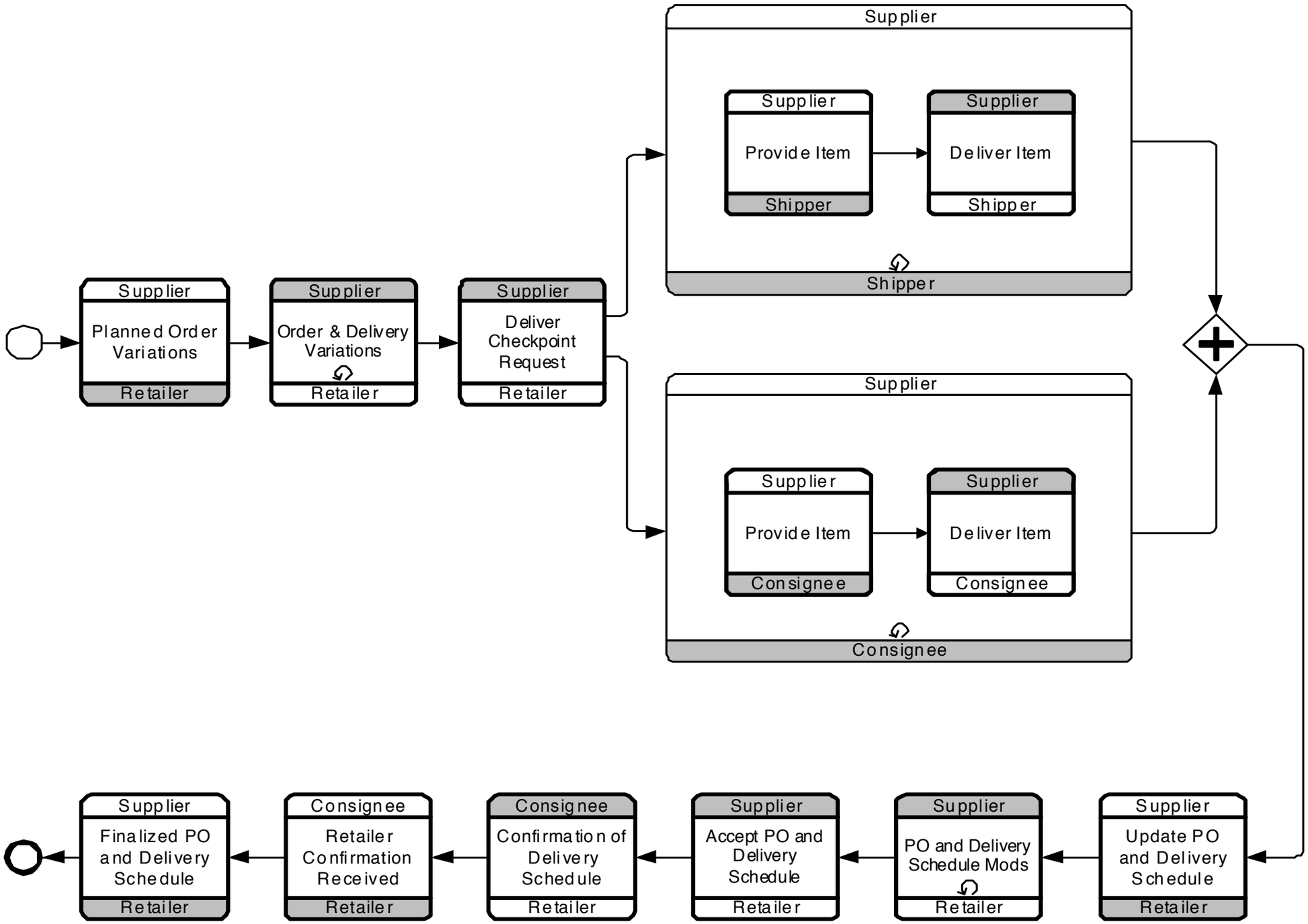
A conversation



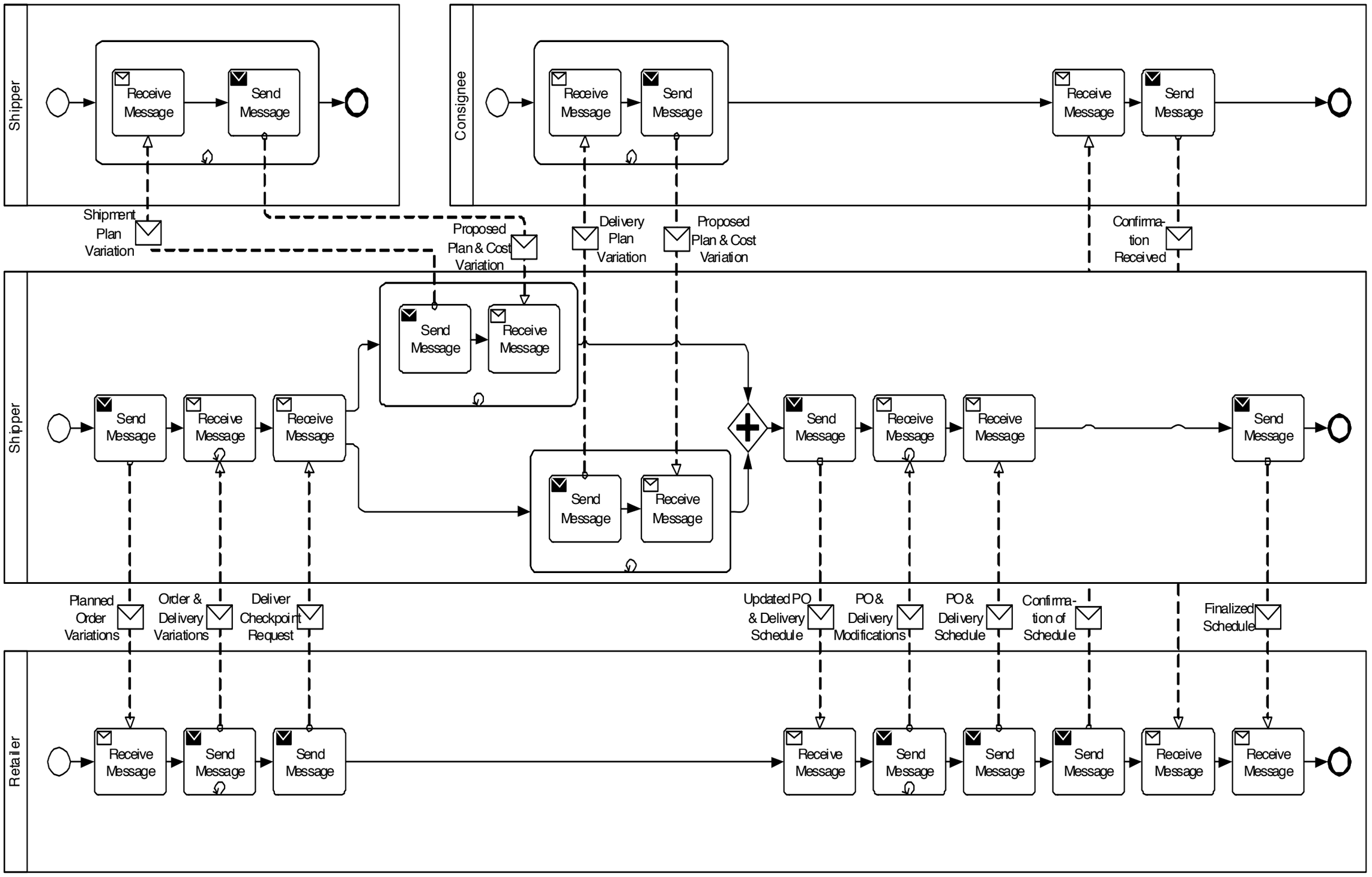
A choreography



Another choreography



A collaboration diagram



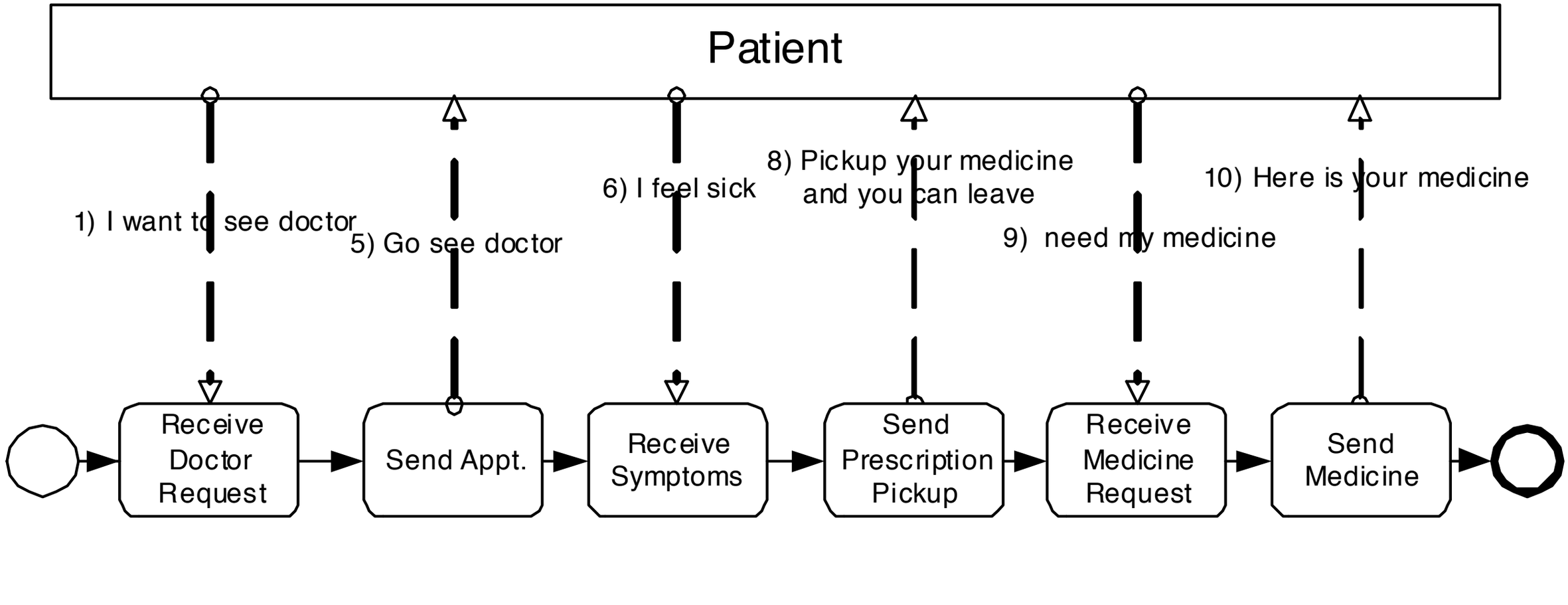
Public processes (collaborative B2B)

Public processes (also called **abstract** processes) depicts the interaction between two or more business entities

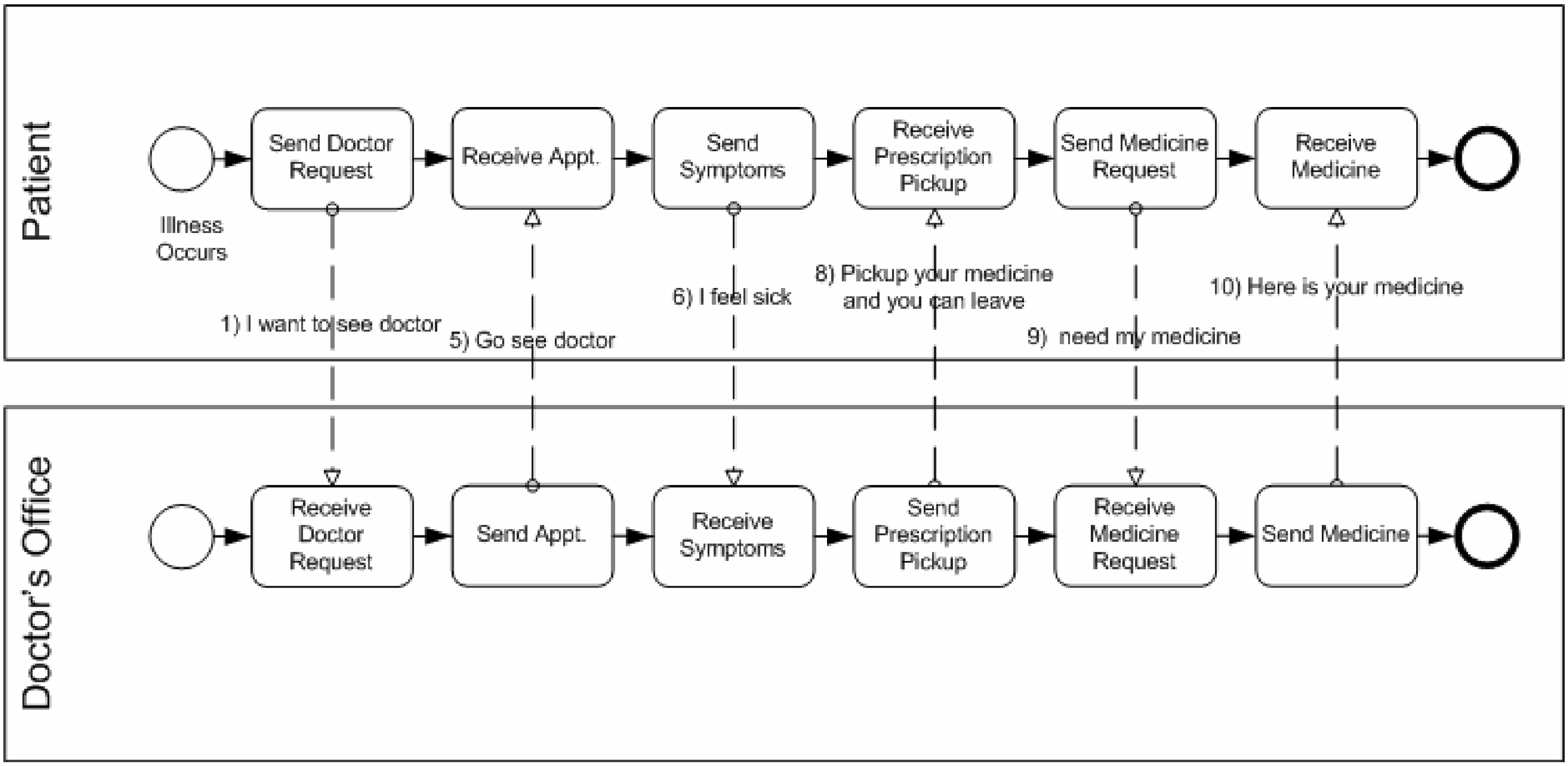
Typically designed as a global view:
Sequence of activities and
the message exchange patterns between participants

Activities of collaboration participants as “touch points”
(visible to the public)
Actual processes are likely to have more activities
(private or internal view)

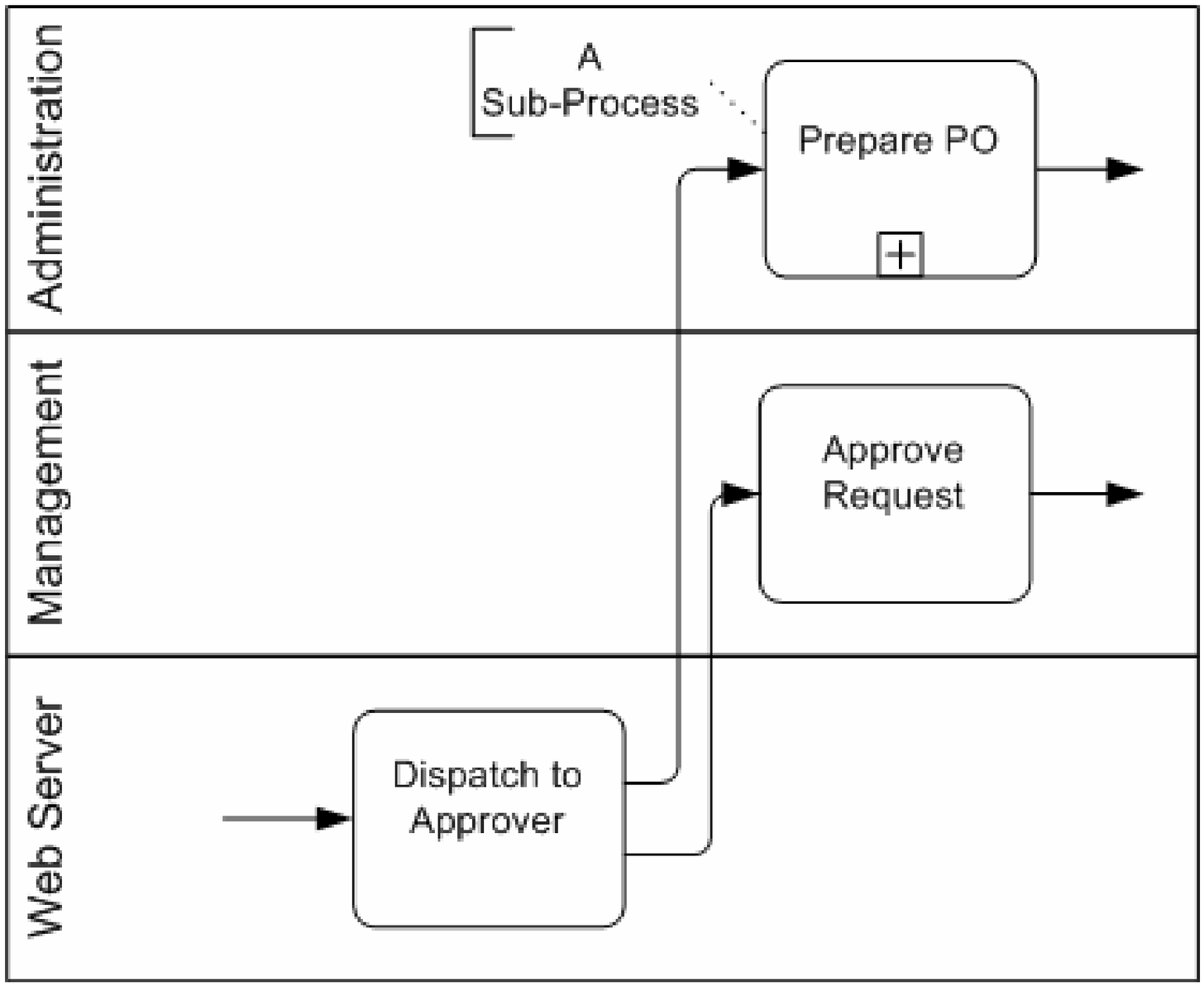
A public process



A collaboration with two pools



Three lanes


Administration
Management
Web Server
A
Sub-Process
Prepare PO
Approve
Request
Dispatch to
Approver

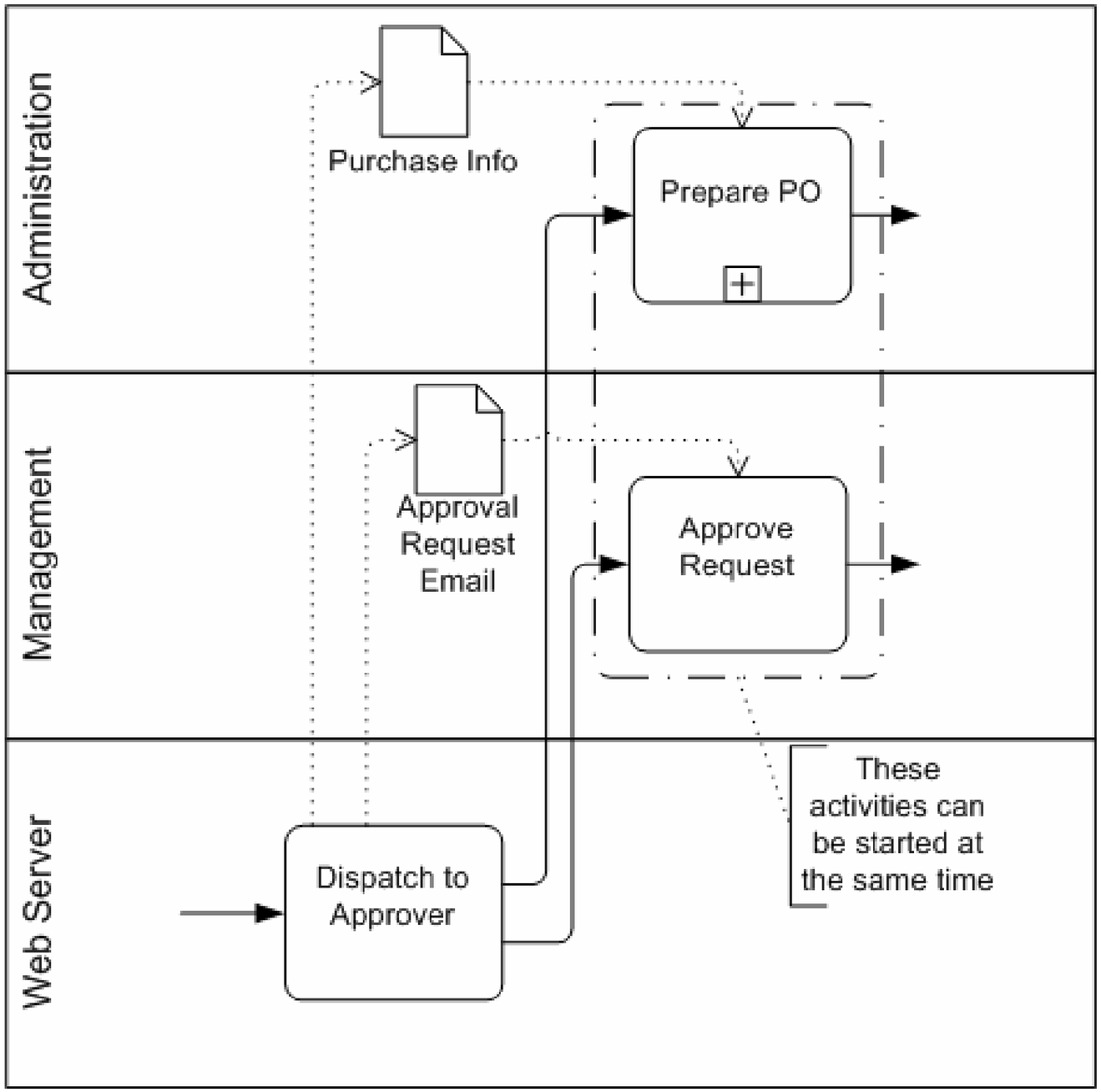
Some remarks

Lanes are often used to separate activities associated with a specific company function or role

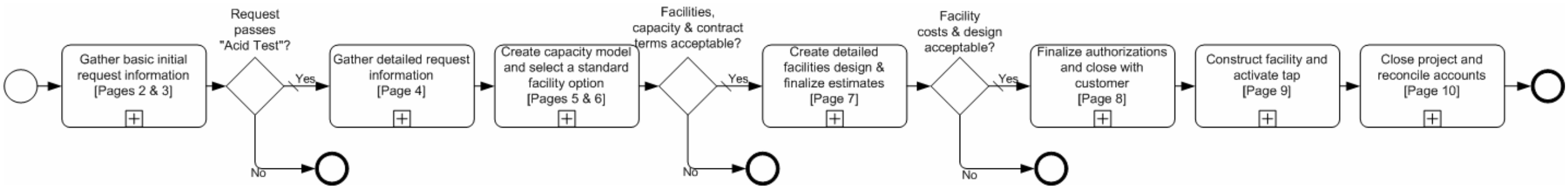
Sequence flow may cross the boundaries of Lanes within the same Pool

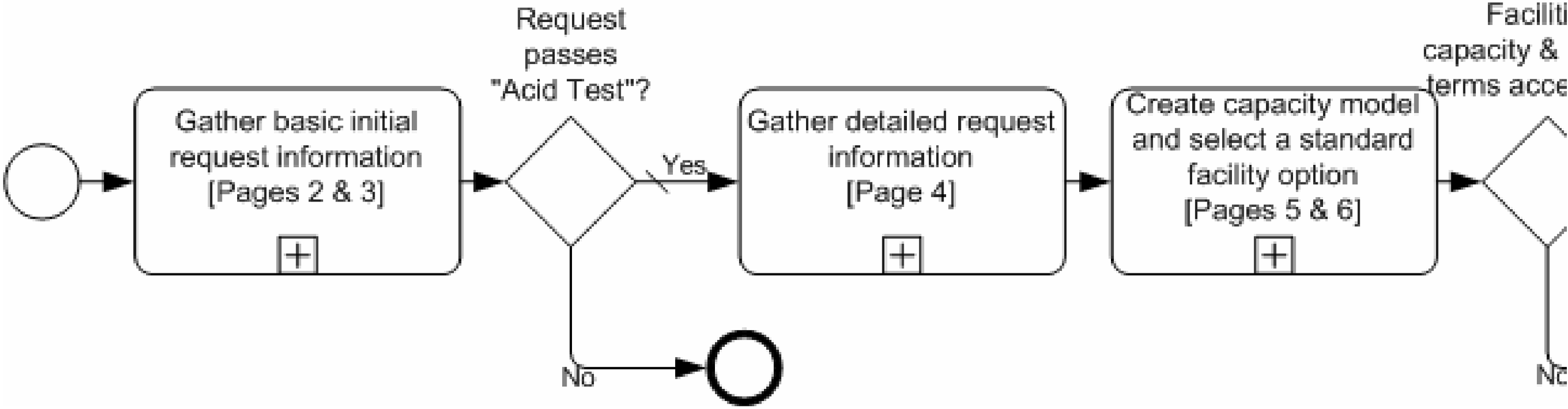
Message flow may not be used between Flow objects in Lanes of the same Pool

Three lanes, annotated

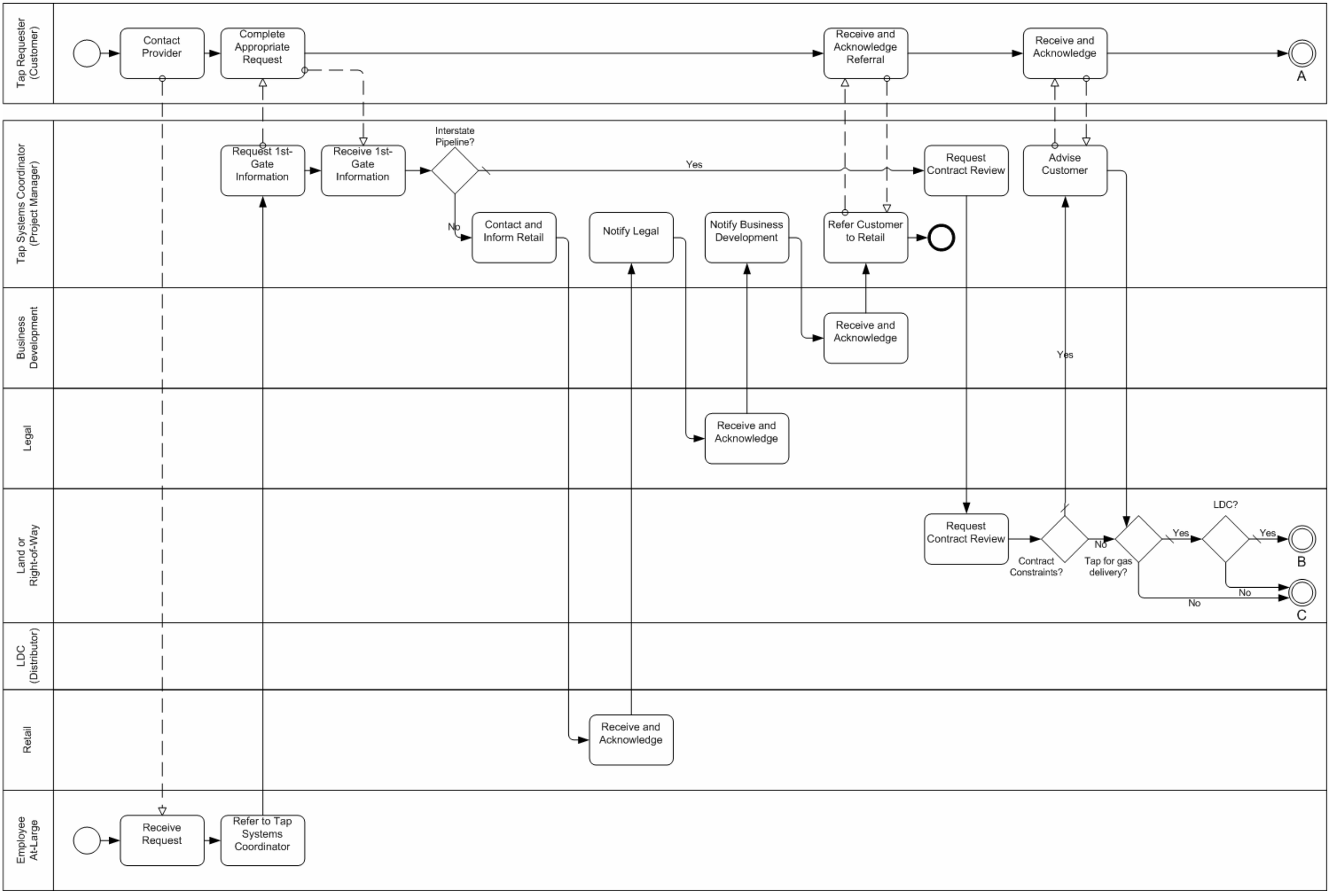


An abstract process





An internal, interactive process



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Semantics and analysis of business process models in BPMN

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From BPMN to Petri nets

Overview

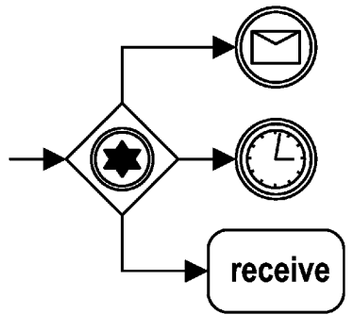
EVENT

start | start message | message | timer | error | end message | end

Start Event | Intermediate Event | End Event

ACTIVITY

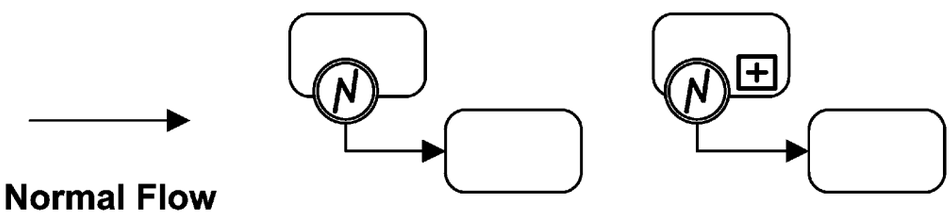
Task | Sub-process Invocation Activity | Activity Looping | Multiple Instance



GATEWAY

Parallel Fork Gateway | Parallel Join Gateway | Data-based XOR Decision Gateway | XOR Merge Gateway | Event-based XOR Decision Gateway | OR Decision Gateway

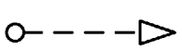
SEQUENCE FLOW



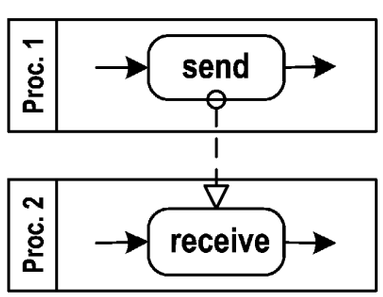
Normal Flow

Exception Flow

MESSAGE FLOW



Message Flow



Interacting processes

[Note]:

1. Apart from intermediate error events, intermediate message or timer events may also be the source of exception flows.
2. A message flow may link task to task, end event to task, task to start event, and end event to start event.

Simplified BPMN

a start / exception event has just one outgoing flow
and no incoming flow

an end event has just one incoming flow
and no outgoing flow

all activities and intermediate events have exactly
one incoming flow and one outgoing flow

all gateways have either
one incoming flow (and multiple outgoing)
or one outgoing flow (and multiple incoming)

Simplified BPMN

The previous constraints are no real limitation:

event or activities with multiple incoming flows
insert a preceding XOR-join gateway

event or activities with multiple outgoing flows
insert a following AND-split gateway

gateways with multiple incoming and outgoing flows
decompose in two gateways

insert start / end event if needed

Simplified BPMN

No link events
they are just a notational convenience
to spread a model into several pages
(no effect on the semantics)

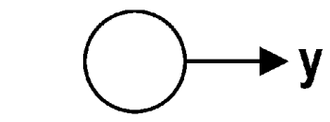
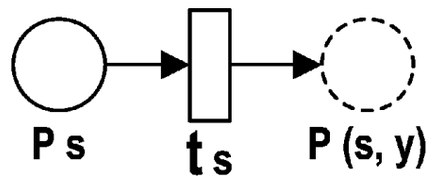
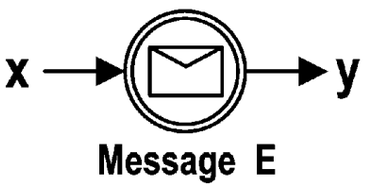
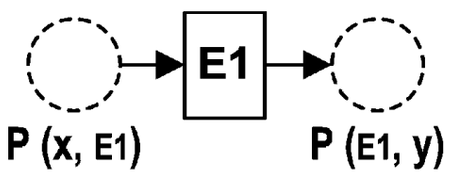
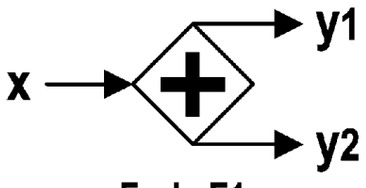
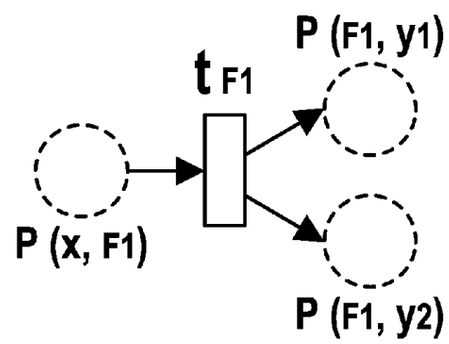
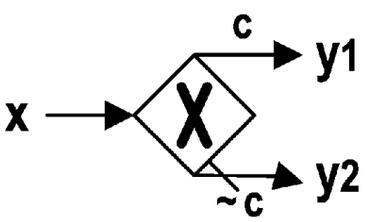
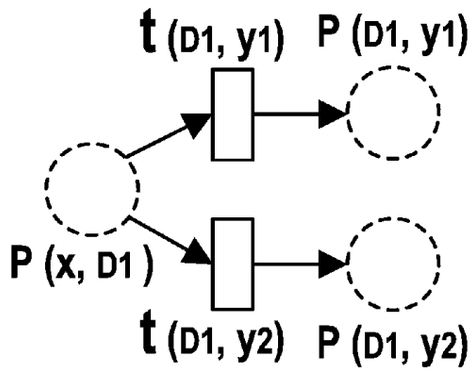
No transactions and compensations

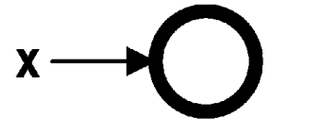
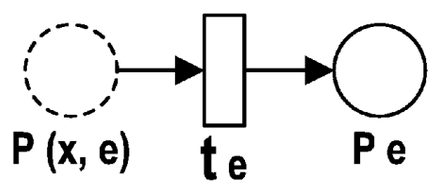
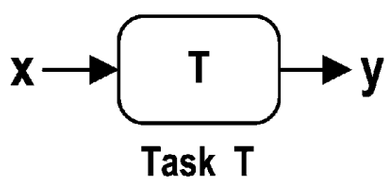
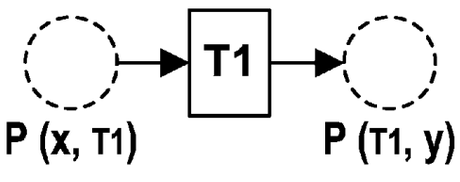
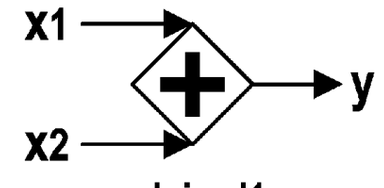
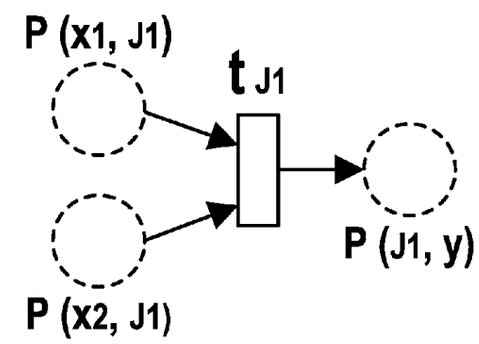
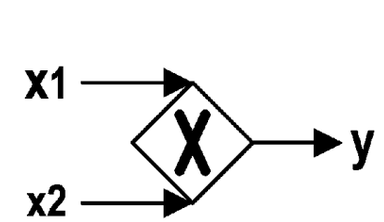
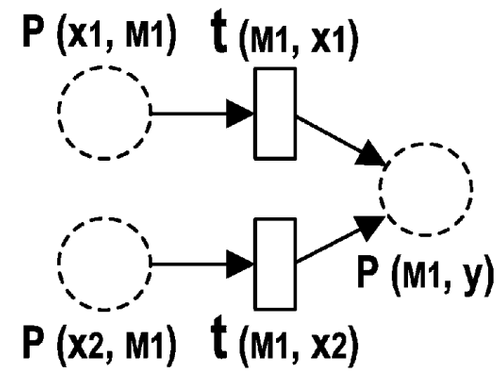
Limited form of sub-processing

no OR-split
(can be expressed in terms of AND-split and XOR-split)

no OR-join

Task, events and gateways as nets

BPMN Object	Petri-net Module
	
	
	
	

BPMN Object	Petri-net Module
	
	
	
	

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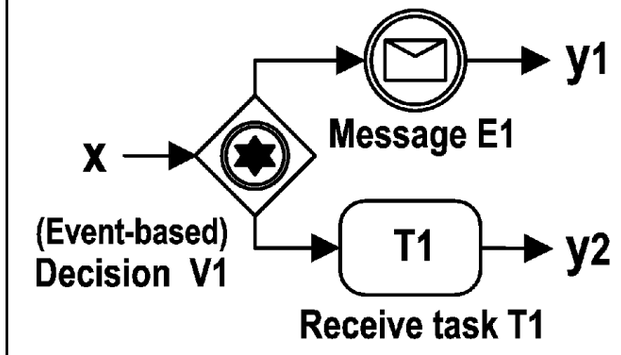
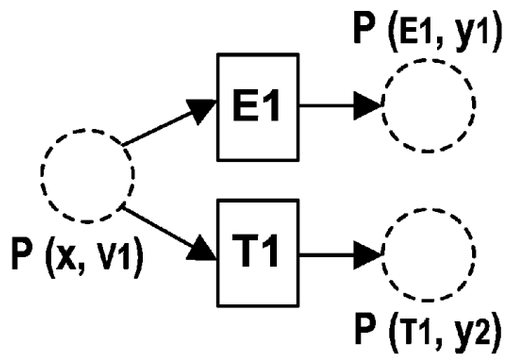
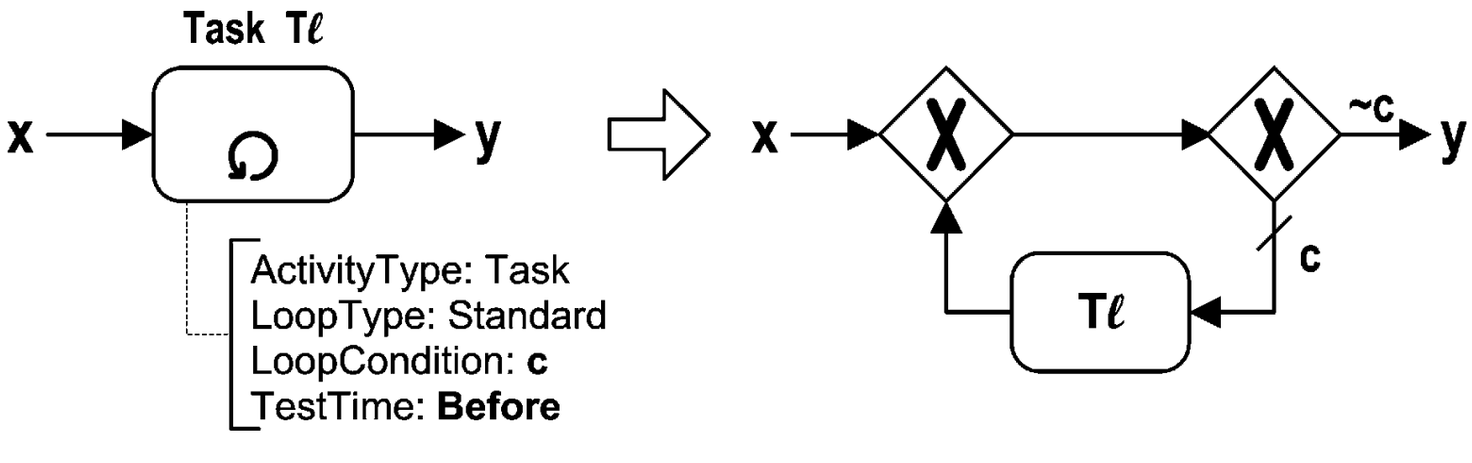

Petri-net Module


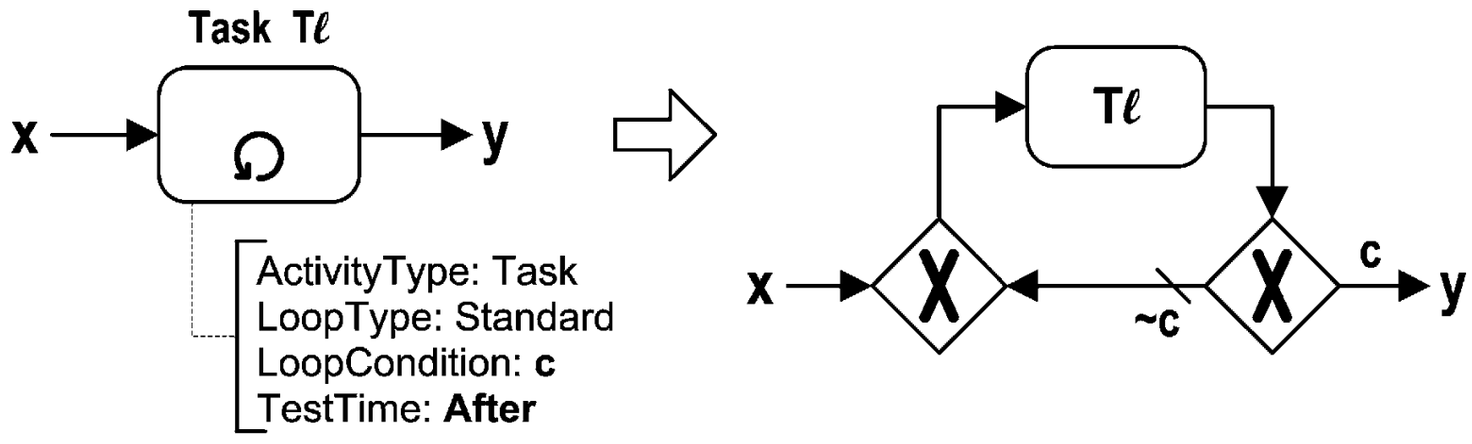
[Note]:

x, x1 or x2 represents an input object, and y, y1 or y2 represents an output object.

Activity looping

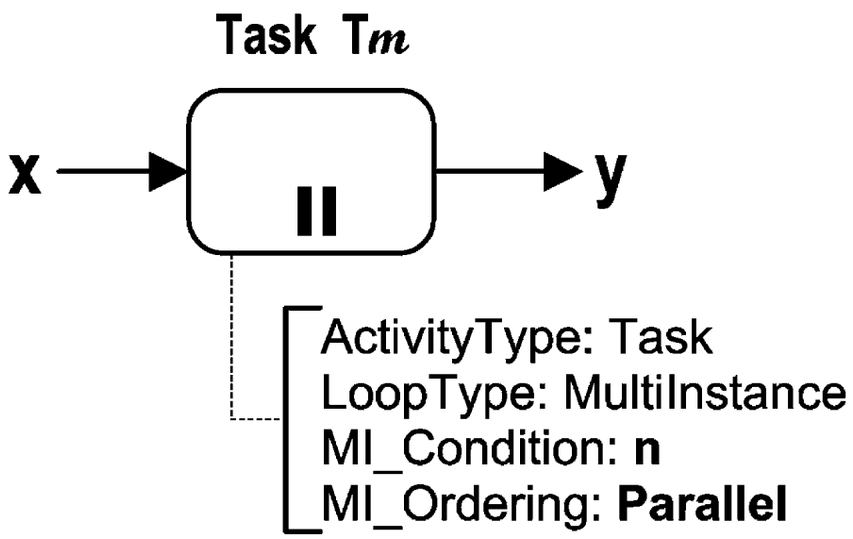


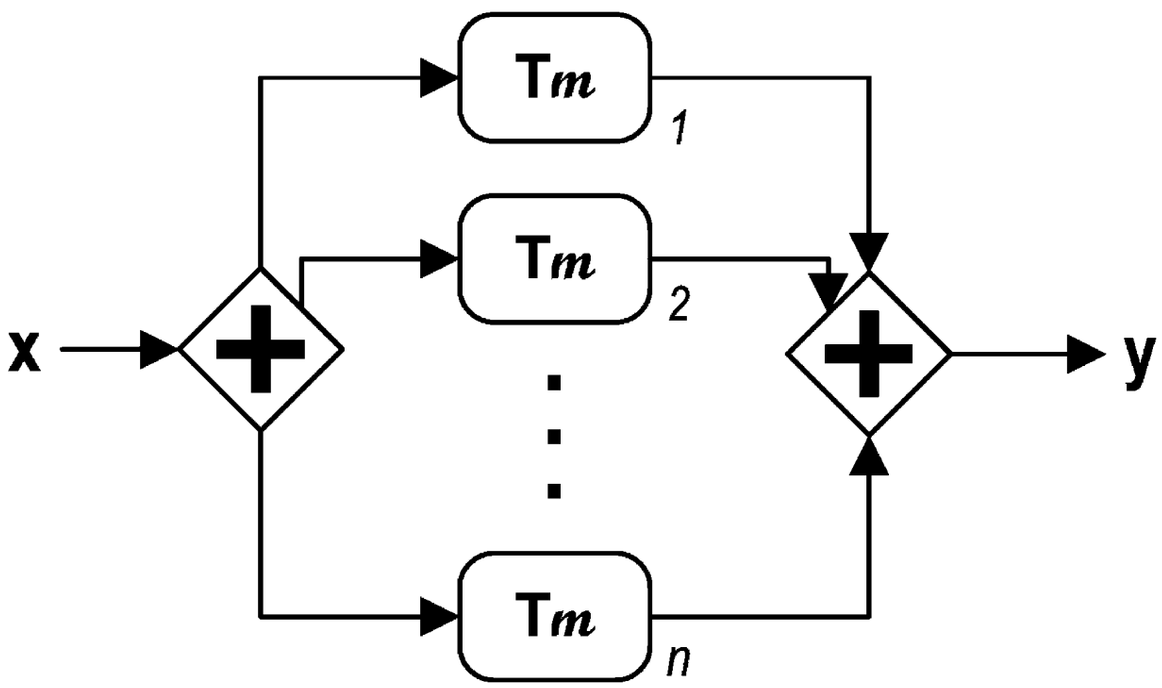
(a) “while-do” loop



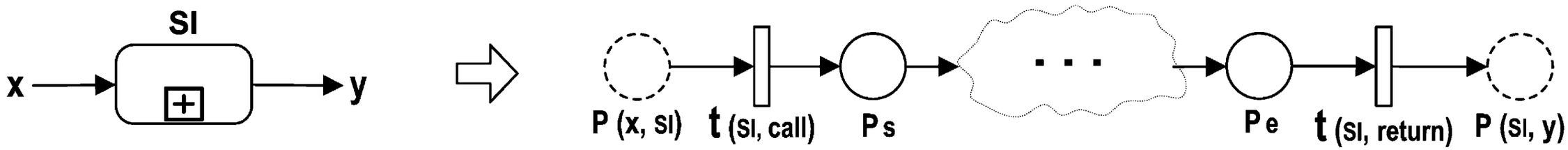
(b) “do-until” loop

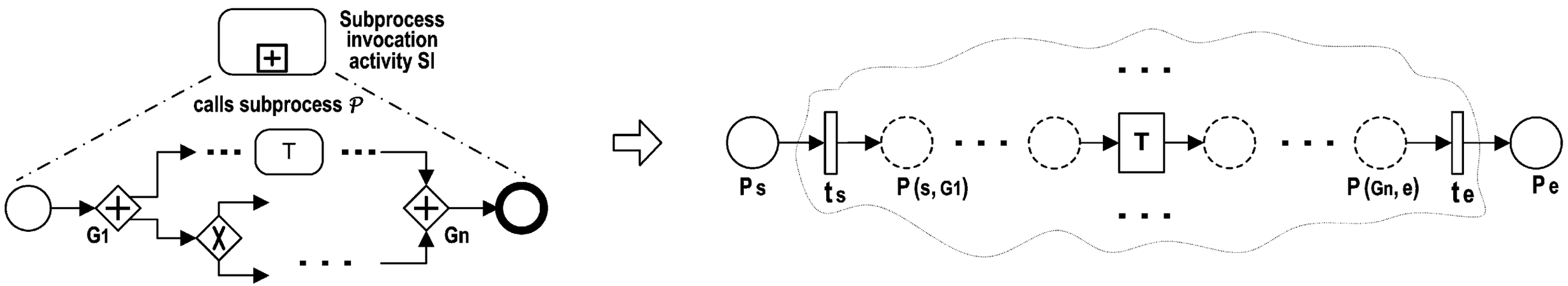
Multiple instances (design-time bounded)



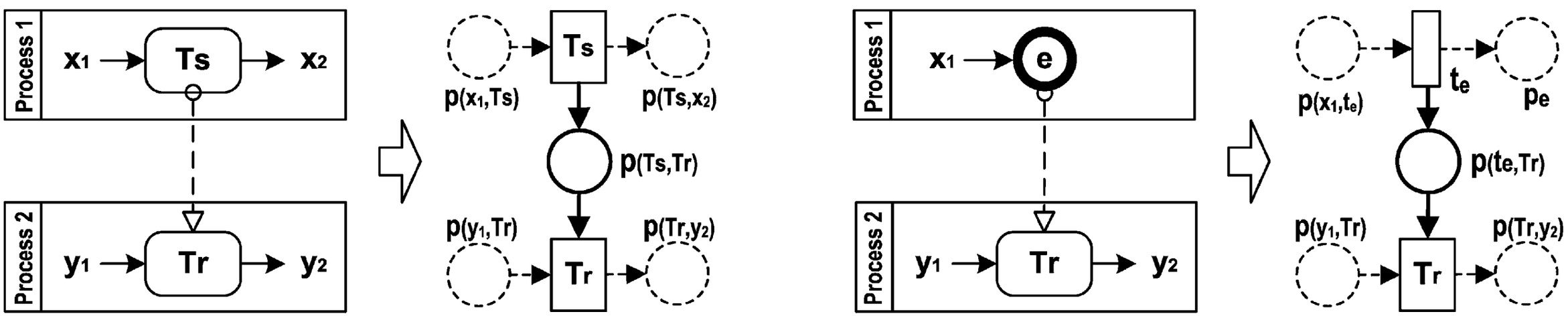


Sub-processes





Message flow



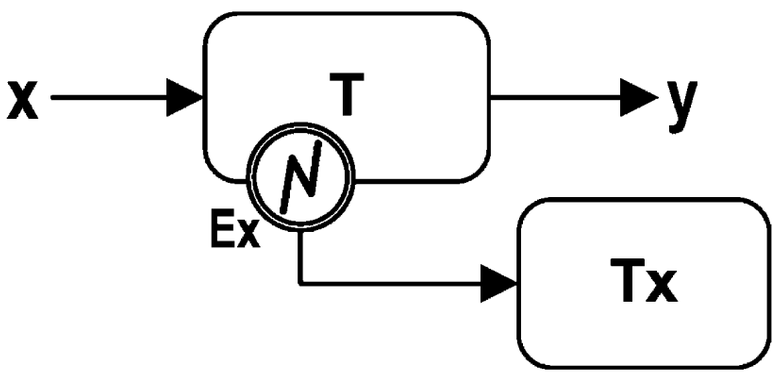
(a) task to task

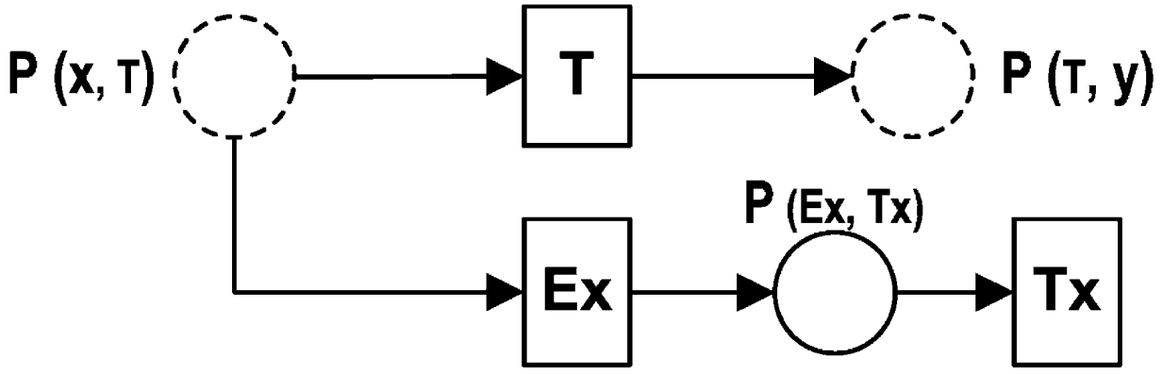
(b) end event to task

(c) task to start event

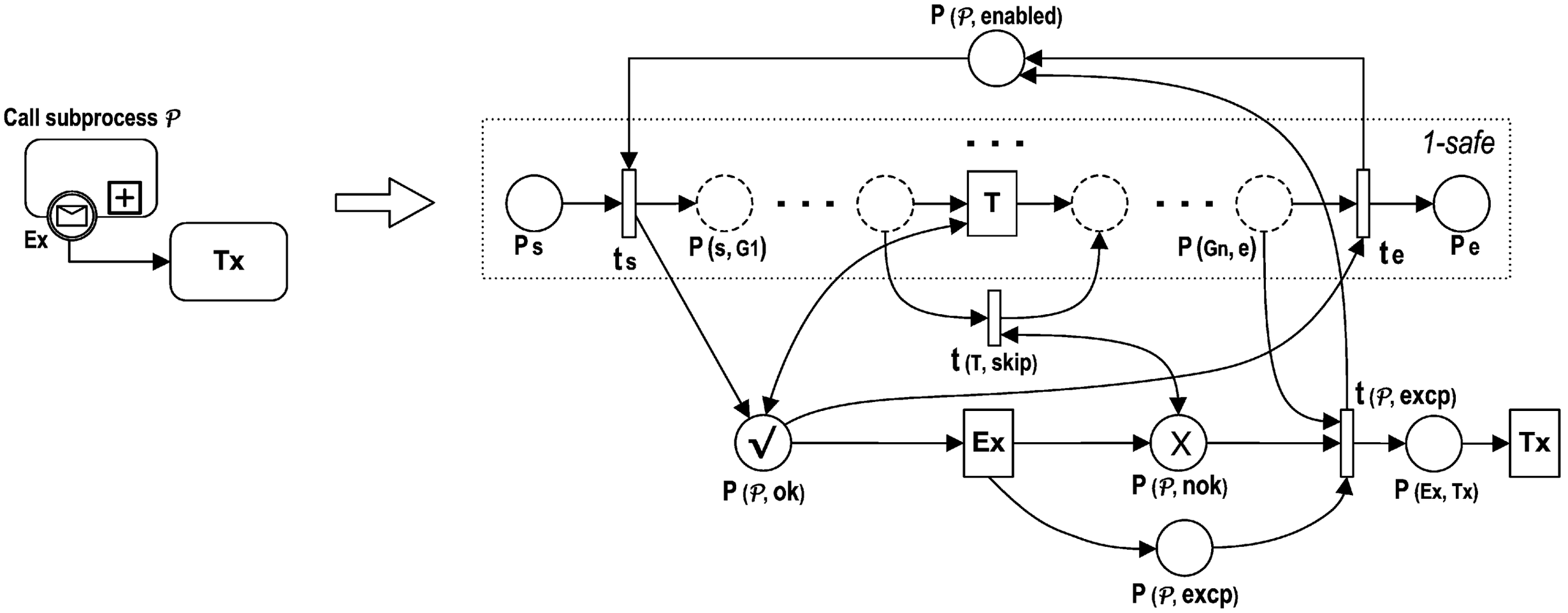
(d) end event to start event

Exception handling: single task

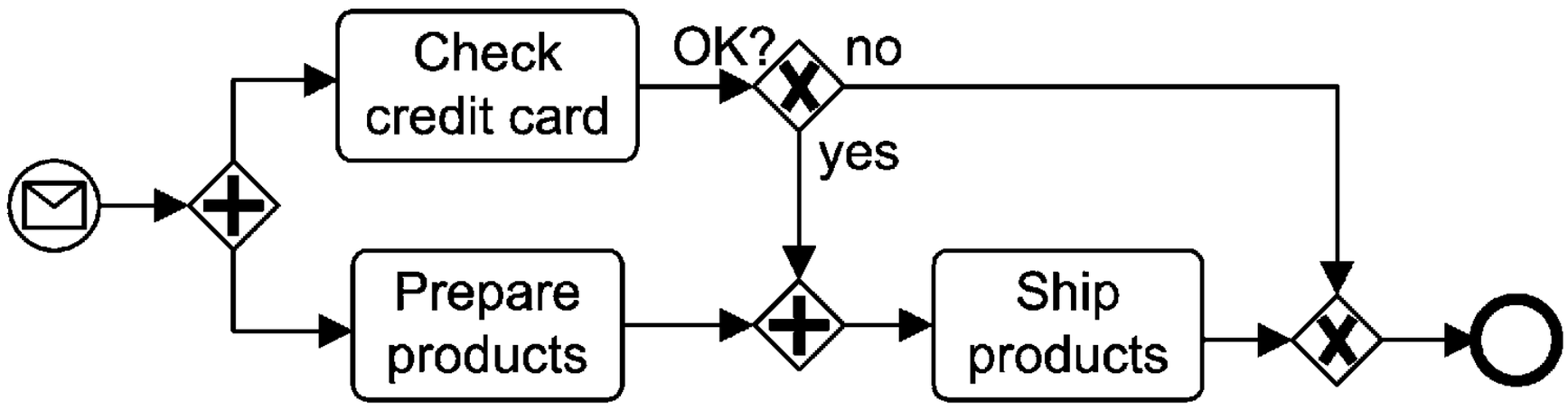


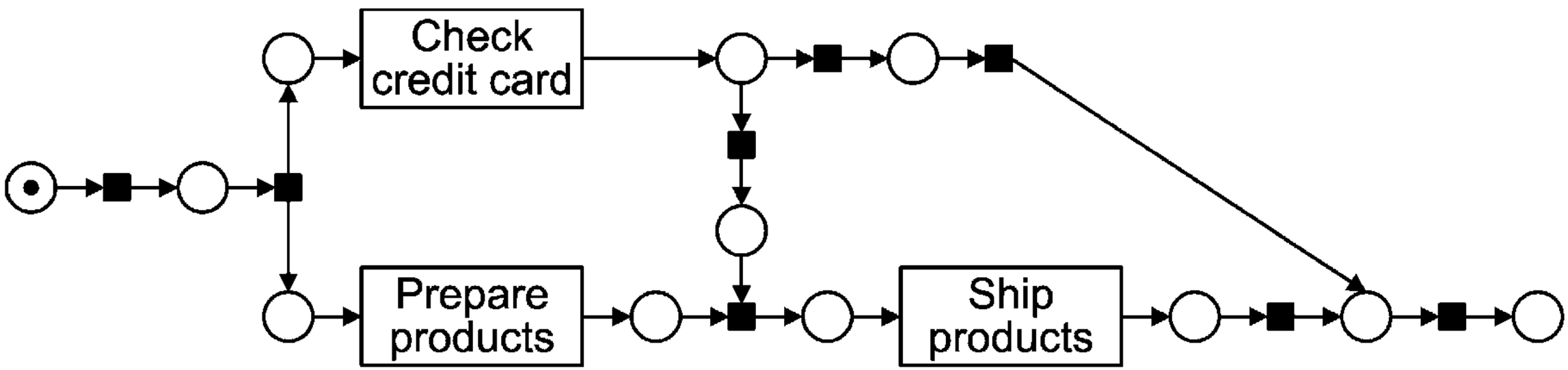


Exception handling: sub-processes

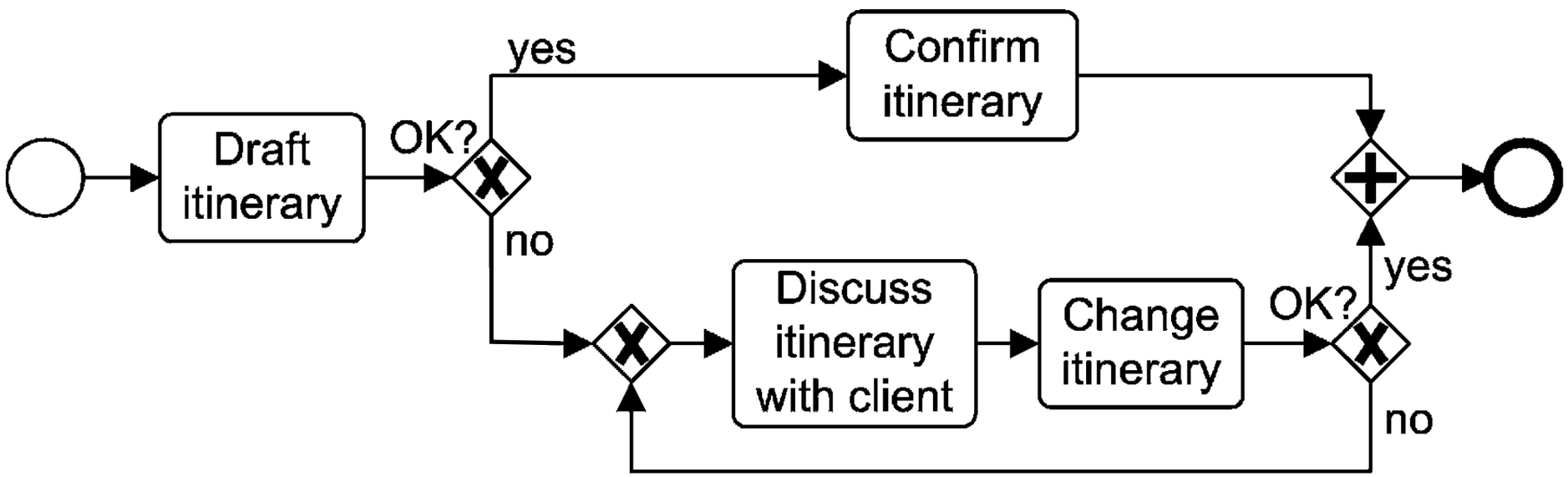


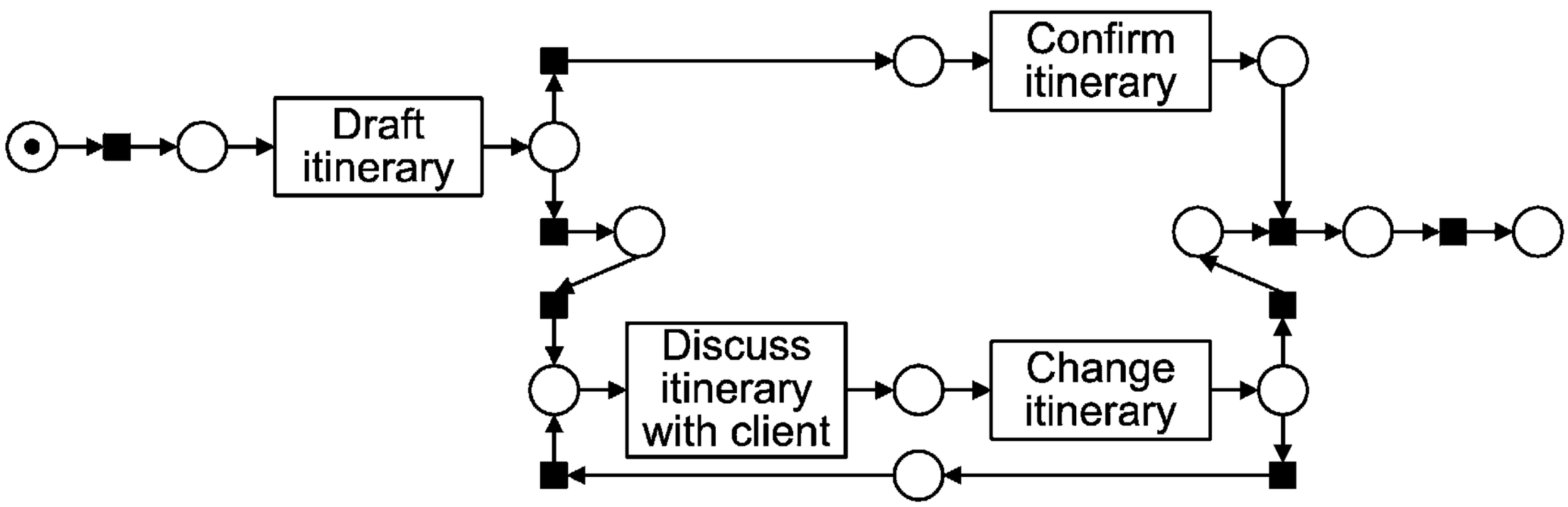
Example: Order process



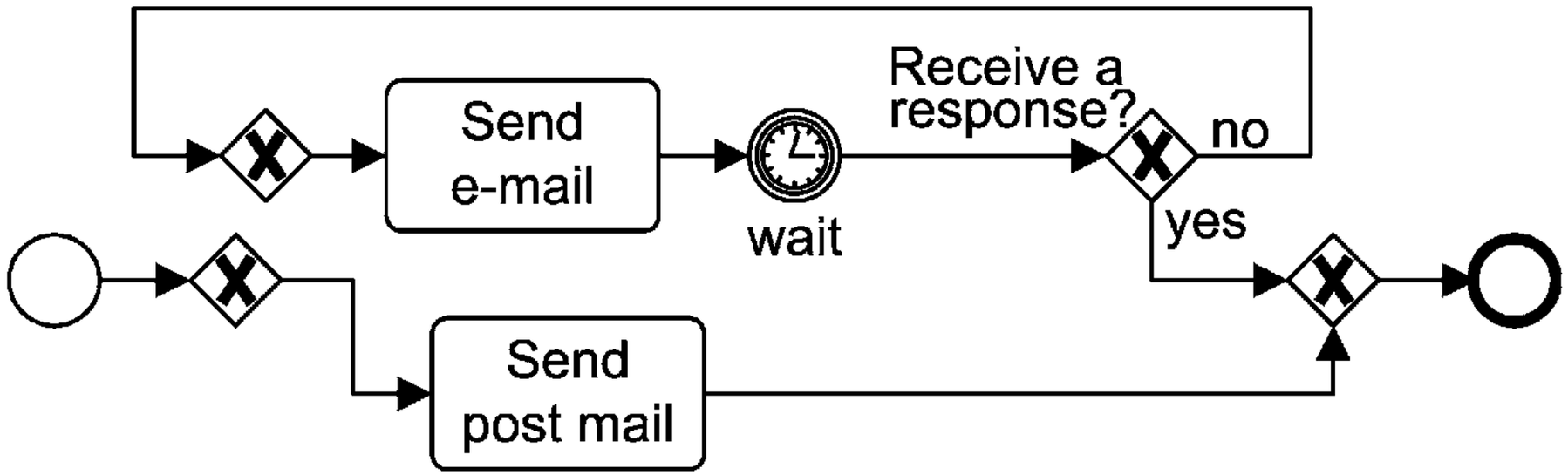


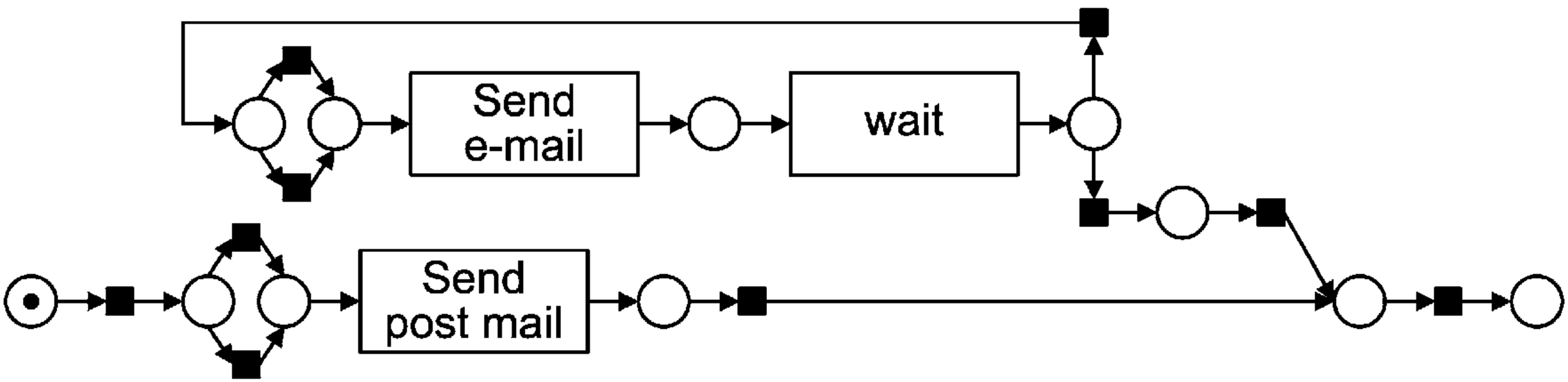
Example: Travel itinerary





Example: Answer process





Exercise

Translate the BPMN collaboration diagram to nets and discuss problematic issues