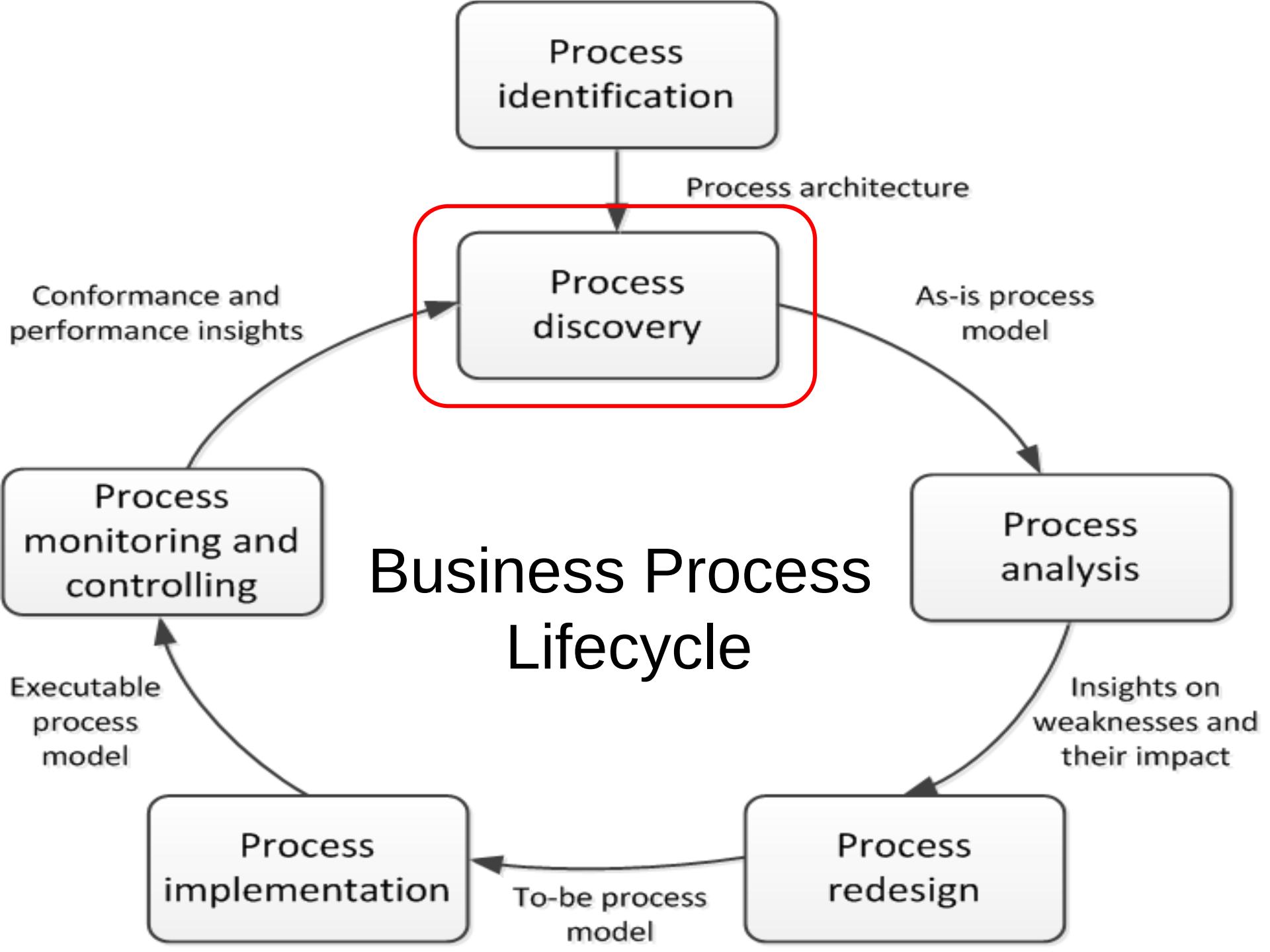

Process identification
Process architecture
Process discovery
Conformance and performance insights
As-is process model
Process monitoring and controlling
Process analysis
Business Process Lifecycle
Executable process model
Insights on weaknesses and their impact
Process implementation
To-be process model
Process redesign

Fundamentals of

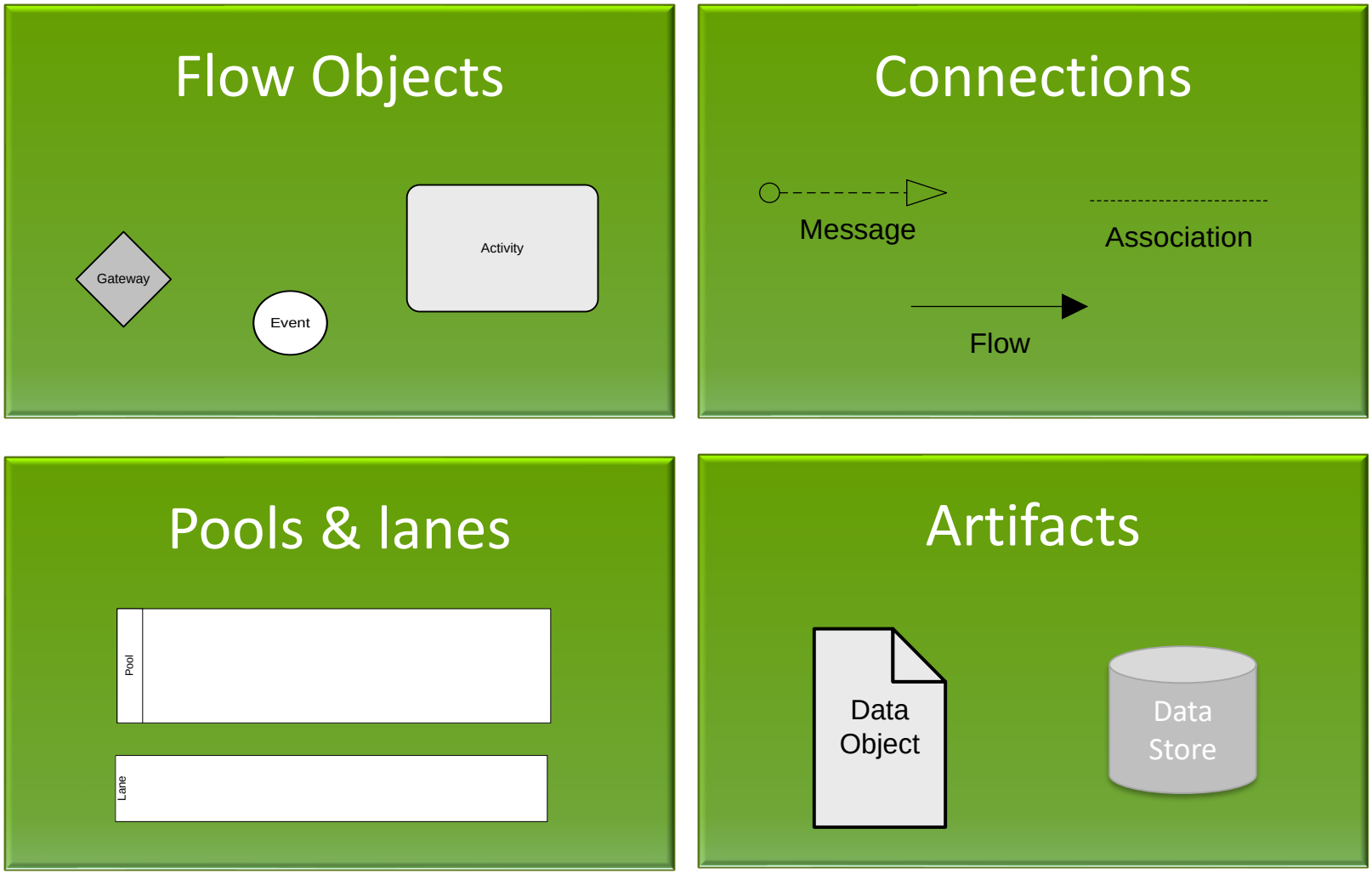
Business Process Management

Marlon Dumas
Marcello La Rosa
Jan Mendling
Hajo A. Reijers

Springer

1. Introduction
2. Process Identification
3. Essential Process Modeling
4. **Advanced Process Modeling**
5. Process Discovery
6. Qualitative Process Analysis
7. Quantitative Process Analysis
8. Process Redesign
9. Process Automation
10. Process Intelligence

BPMN Main Elements - Recap



BPMN Gateways

Exclusive (XOR)

- Exclusive decision
  take one branch
- Exclusive merge
  Proceed when one branch has completed

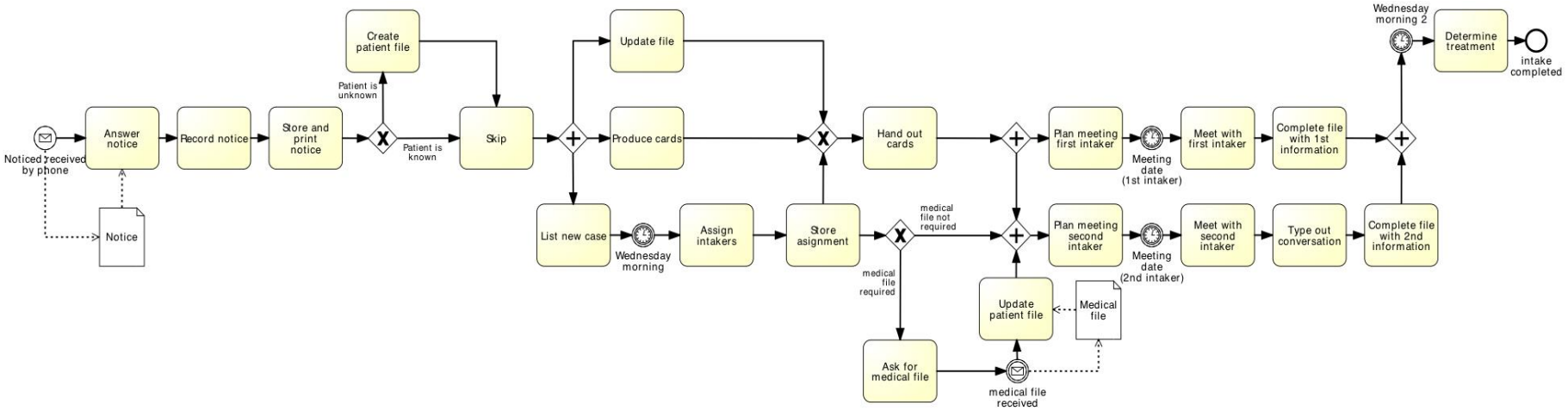
Parallel (AND)

- Parallel split
  take all branches
- Parallel join
  proceed when all incoming branches have completed

Inclusive (OR)

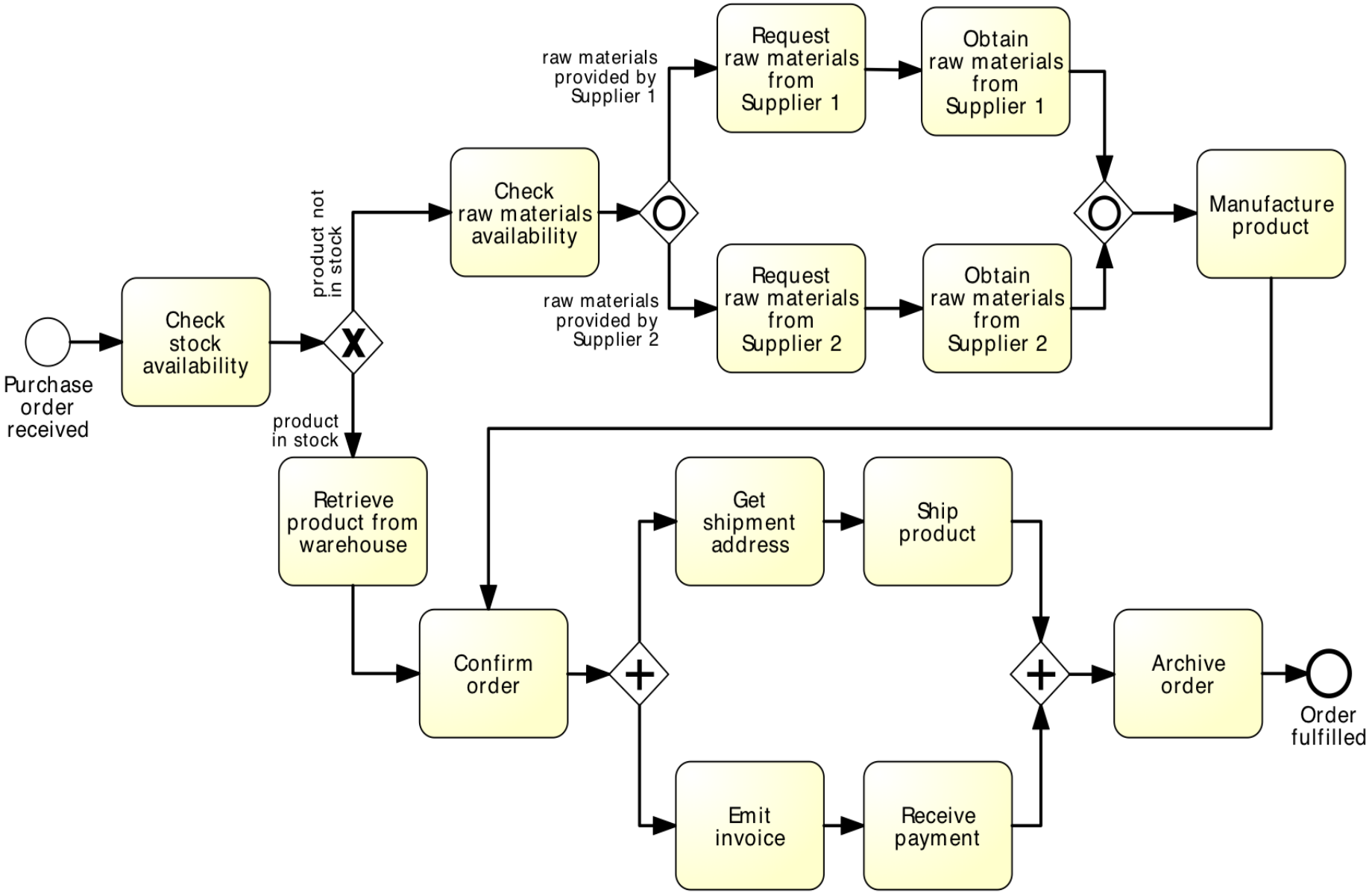
- Inclusive decision
  take one or several branches depending on conditions
- Inclusive merge
  proceed when all active incoming branches have completed

Exercise: critique the following model

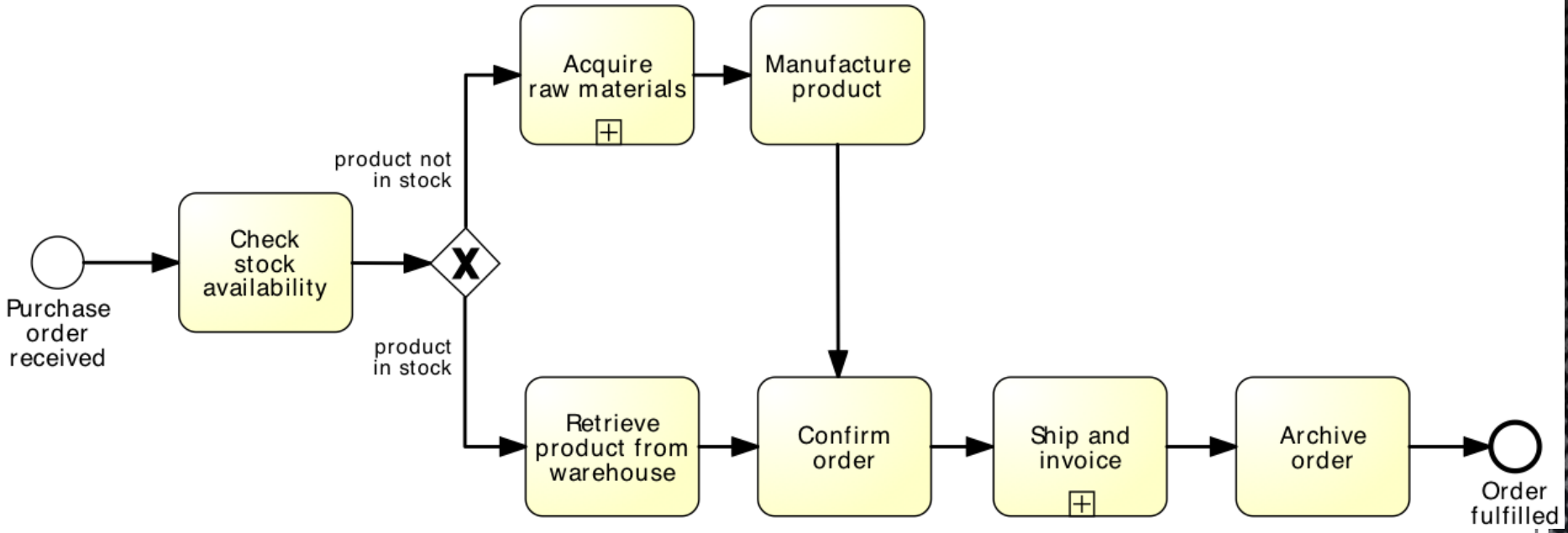


http://tinyurl.com/nnnfgd5

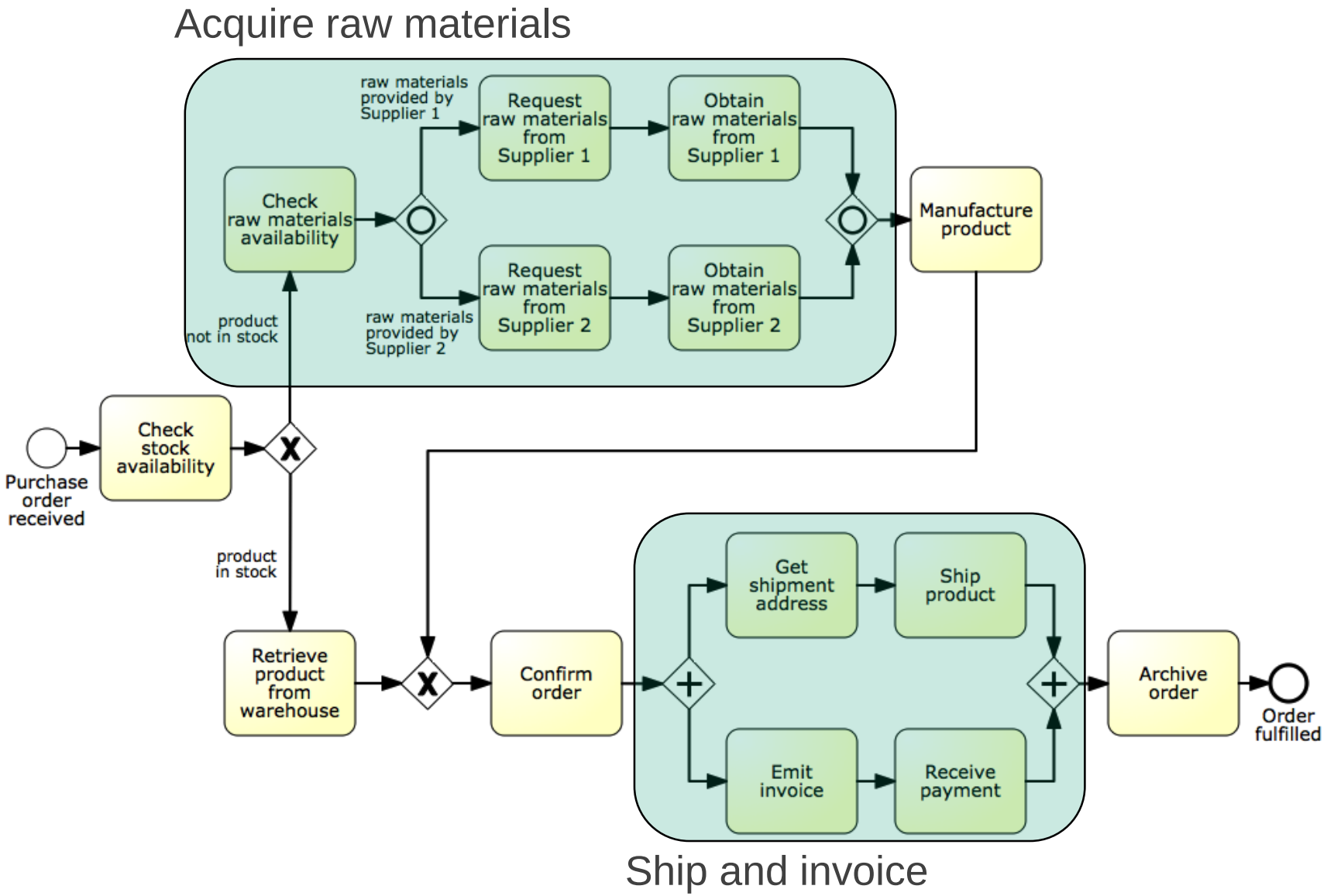
Anything wrong with this model?



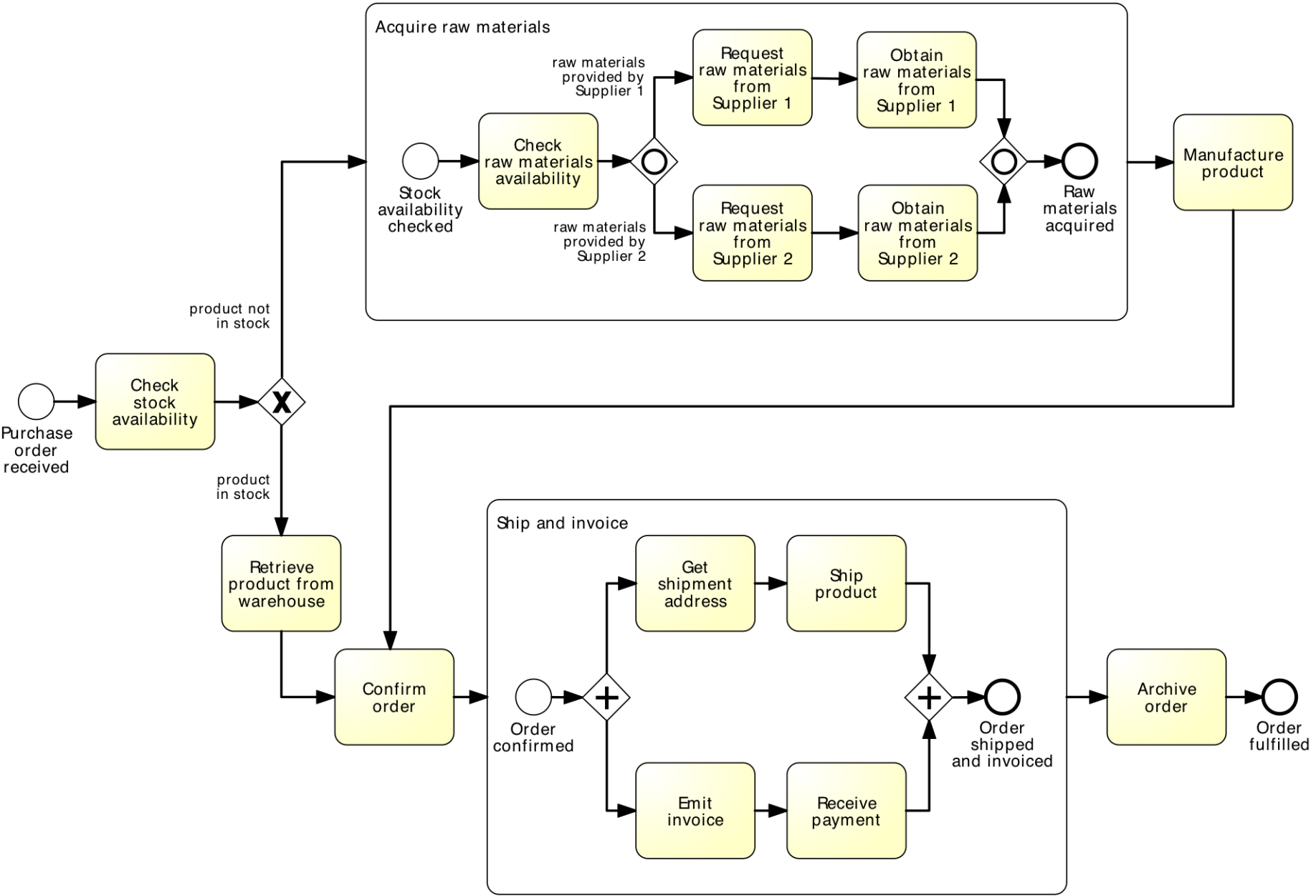
Is this better?



Identifying sub-processes



Using the Expanded Sub-Process Notation



Sub-processes

- An activity in a process can invoke a separate sub-process
- Use this feature to:
  1. Decompose large models into smaller ones, making them easier to understand and maintain

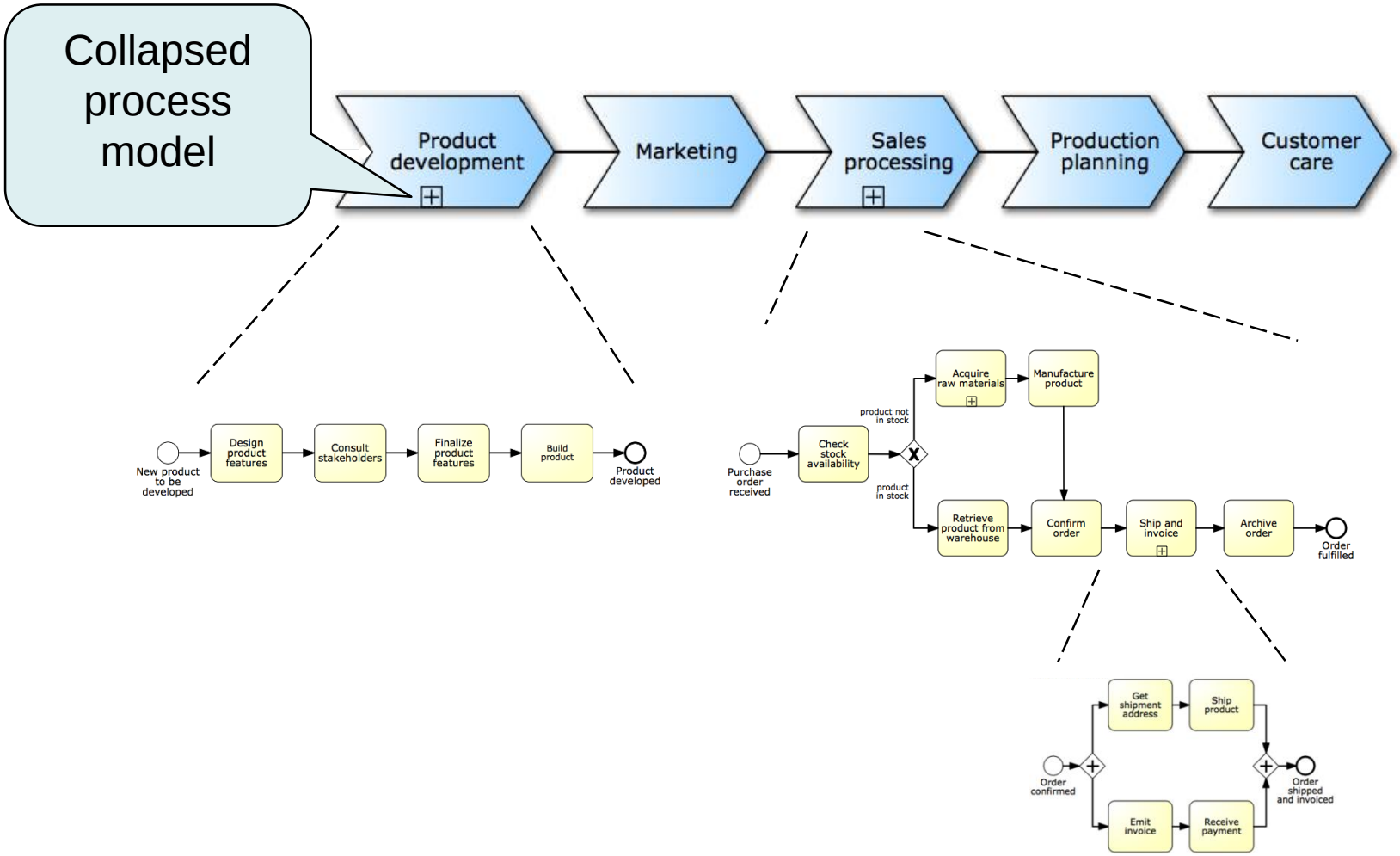
Guideline: Multi-level modeling

- Level 1: **value chain**
  - Simple linear description of the phases of the process
  - No gateways
  - Each activity chain is a sub-process
- Level 2+: expand each activity in the value chain, add incrementally the following:
  - Decisions, handoffs (lanes, pools)
  - Parallel gateways, different types of events
  - Data objects & data stores
  - And as much detail as you need, and no more

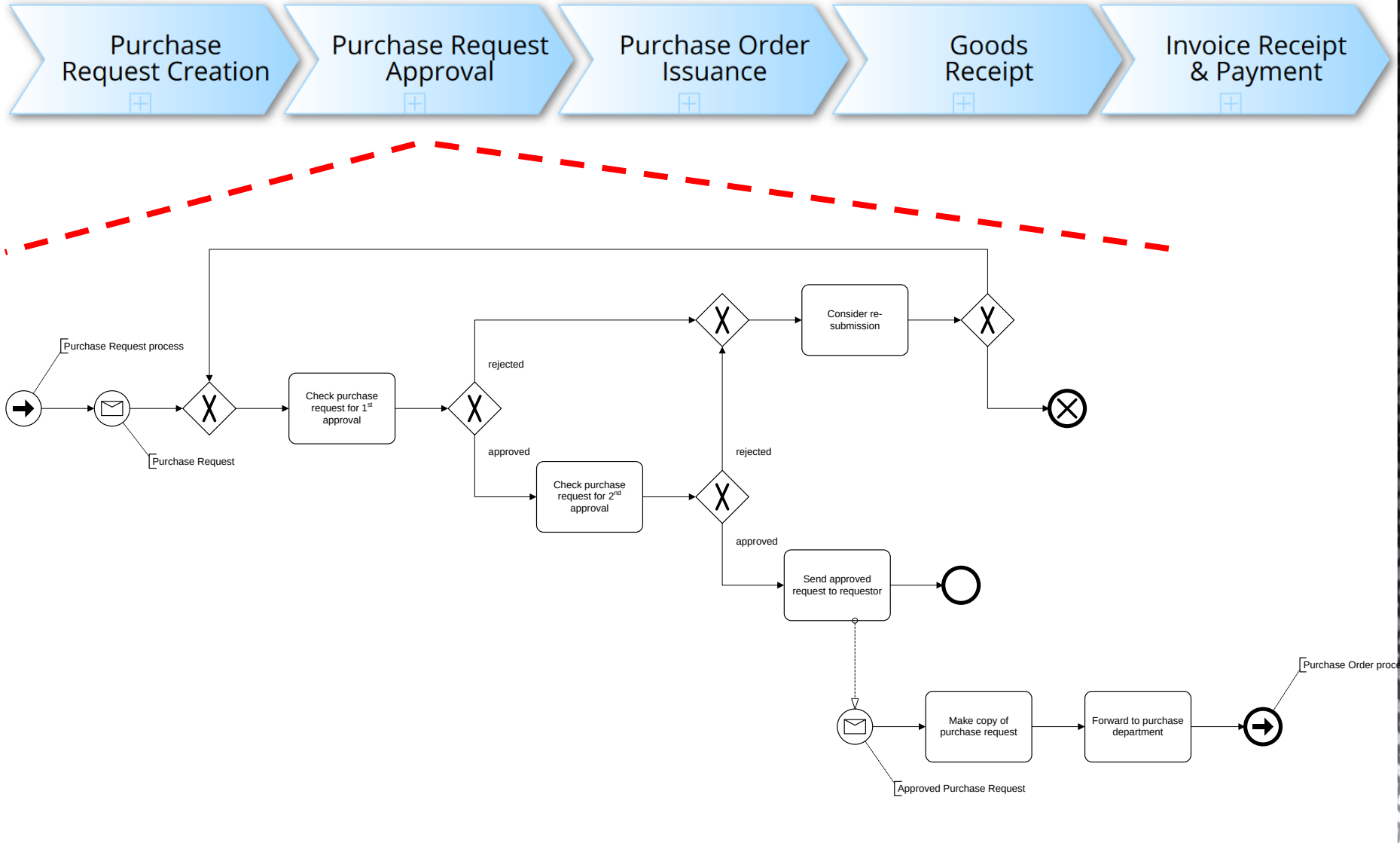
Guideline: Multi-level modeling (cont.)

- At each level, decompose according to:
  - Logical milestones towards achieving the outcome of the process
  - Major objects used in the process
- Decompose until processes are of “reasonable” size
  - e.g. up to 20 nodes (tasks+events+gateways) per model

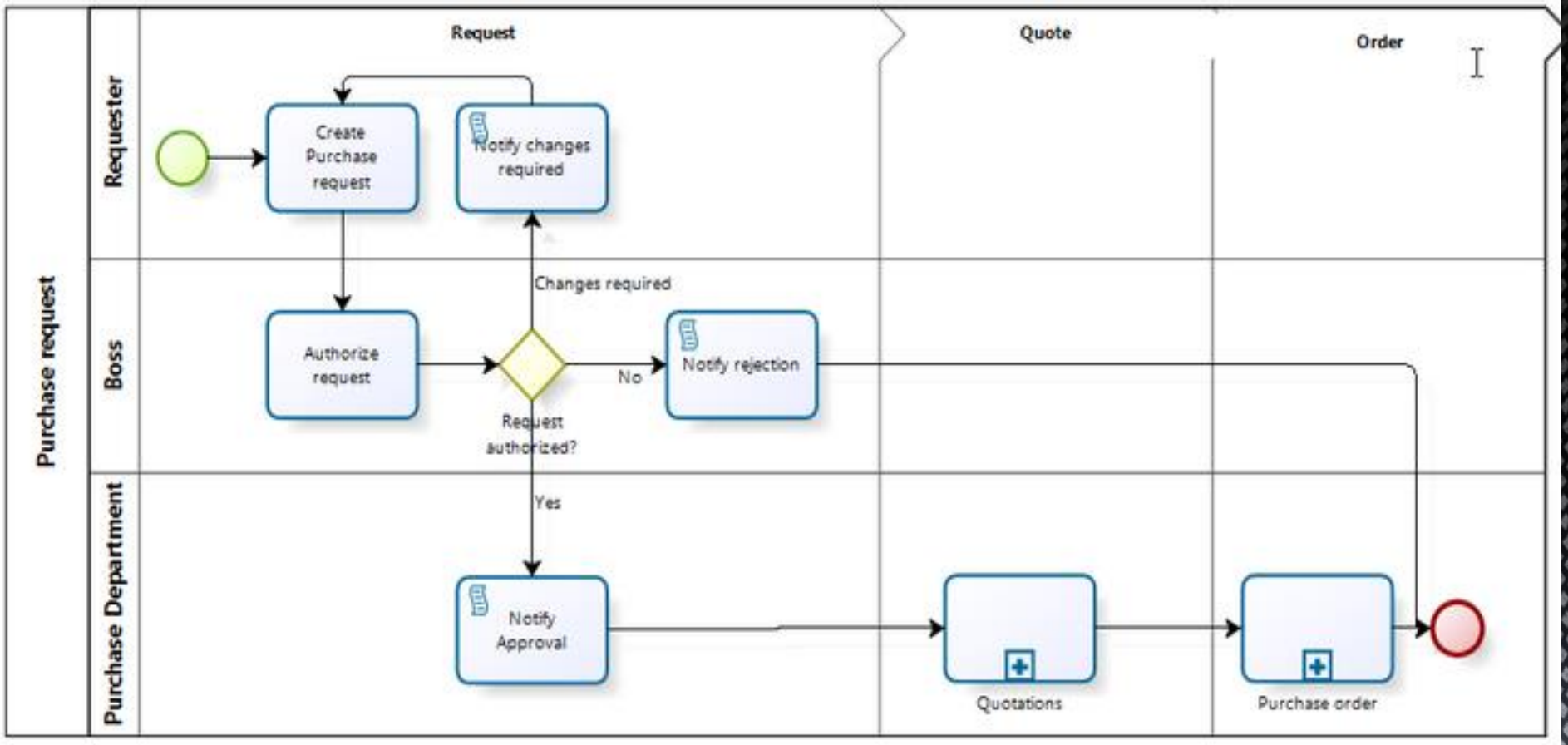
Non-BPMN value chain “chevron” notation (e.g. Signavio, ARIS)



Value chain with sub-processes



Side Note: Bizagi Milestones (non-standard BPMN)

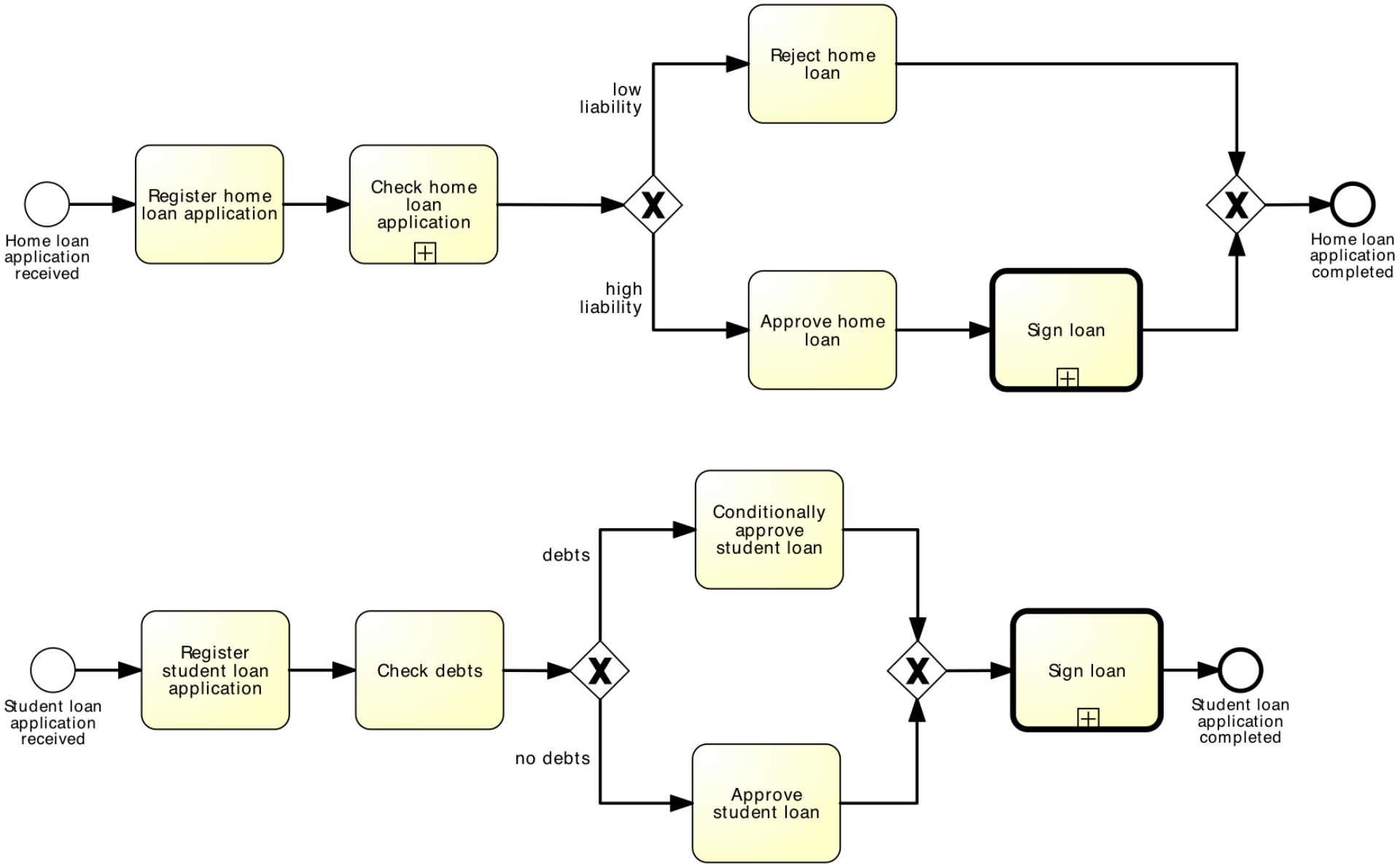


For details see: http://tinyurl.com/pp5reuo

Sub-processes

- An activity in a process can invoke a separate sub-process
- Use this feature to:
  1. Decompose large models into smaller ones, making them easier to understand and maintain
  2. Share common fragments across multiple processes

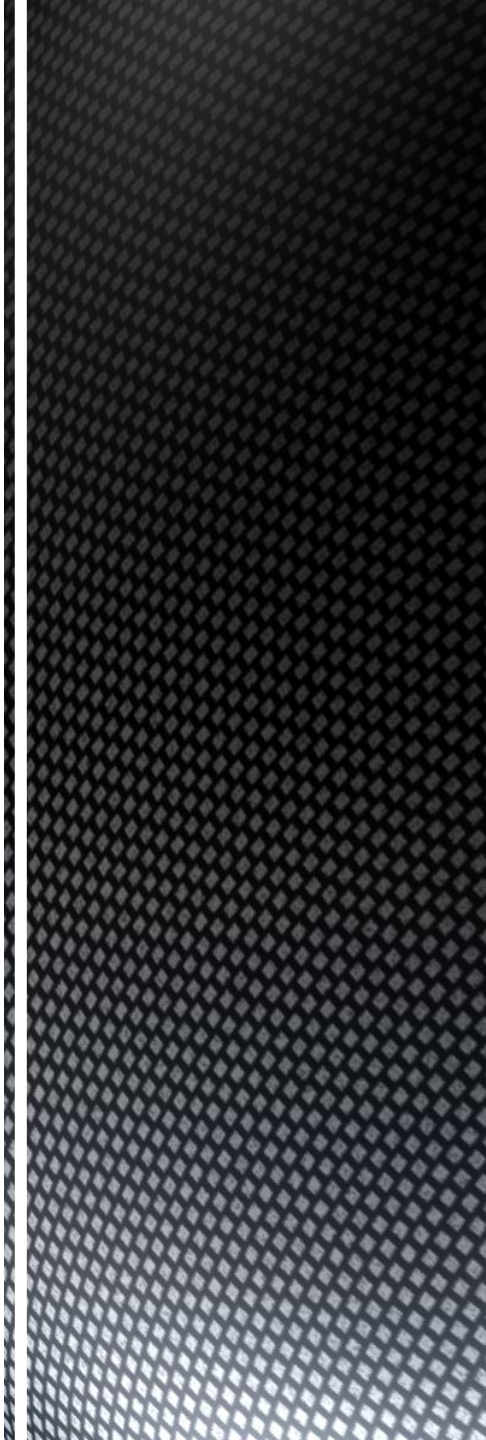
Shared sub-process



Sub-processes

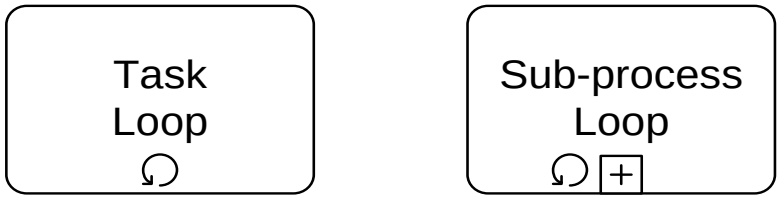
- An activity in a process can invoke a separate sub-process
- Use this feature to:
  1. Decompose large models into smaller ones, making them easier to understand and maintain
  2. Share common fragments across multiple processes
  3. Delimit parts of a process that can be:
     - Repeated
     - Interrupted

Structured repetition

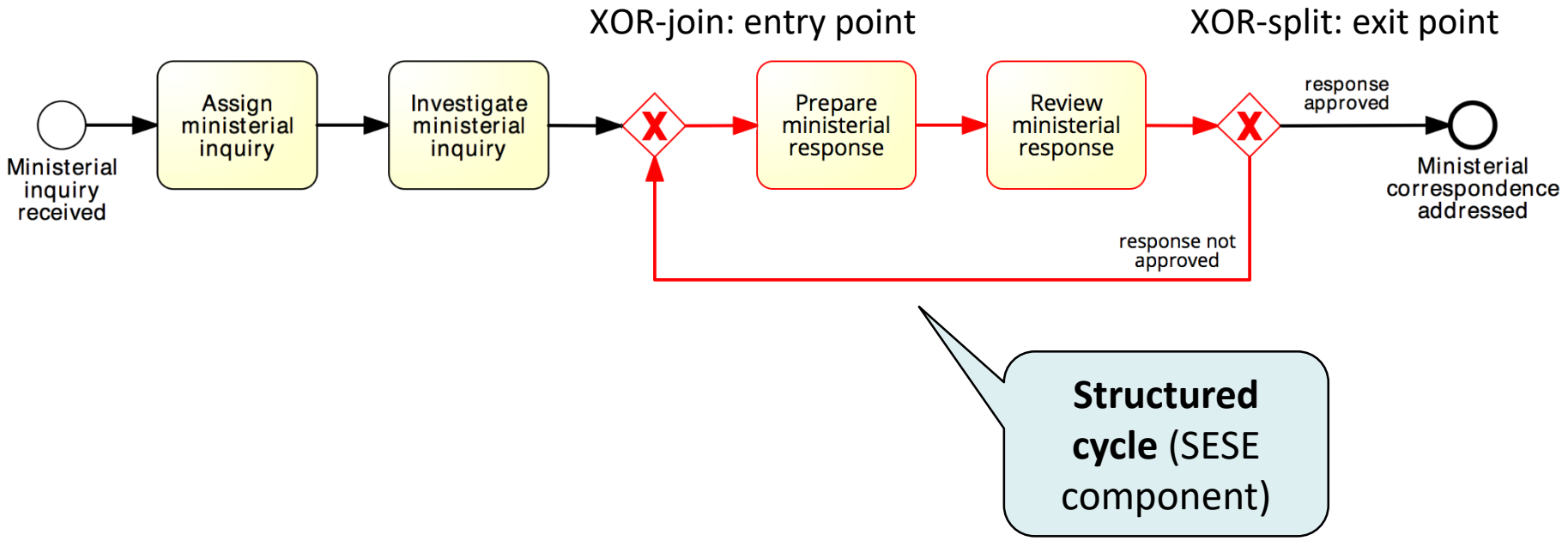


Block-structured repetition: Activity loop

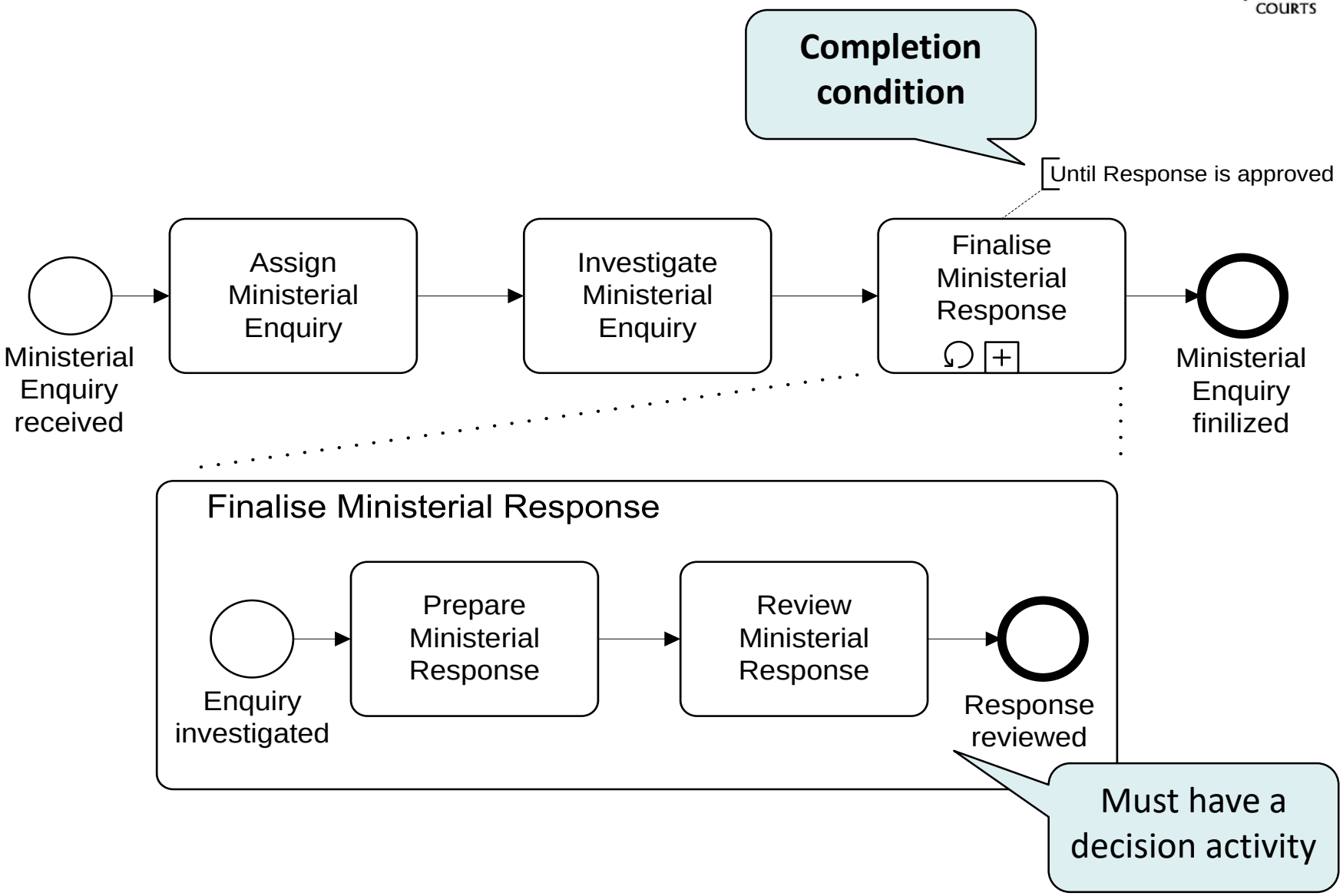
Activity loop markers allow us to state that a task or a sub-process may be repeated multiple times



More on rework and repetition



Example: block-structured repetition

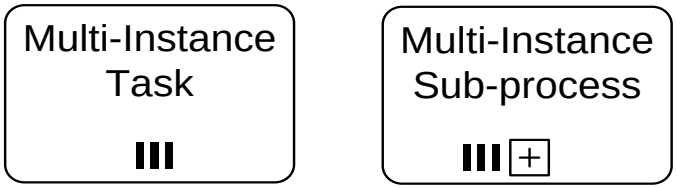


Exercise

After a claim is registered, it is examined by a claims officer. The claims officer writes a “settlement recommendation”. This recommendation is checked by a senior claims officer who may mark the claim as “OK” or “Not OK”. If the claim is marked as “Not OK”, it is sent back to the claims officer and the examination is repeated. If the claim is marked as “OK”, the claims officer notifies the settlement to the customer.

Parallel repetition: multi-instance activity

The multi-instance activity provides a mechanism to indicate that an activity is executed ***multiple times concurrently***



Useful when the same activity needs to be executed for multiple entities or data items, such as:

- Request quotes from multiple suppliers
- Check the availability for each line item in an order separately
- Send and gather questionnaires from multiple witnesses in the context of an insurance claim

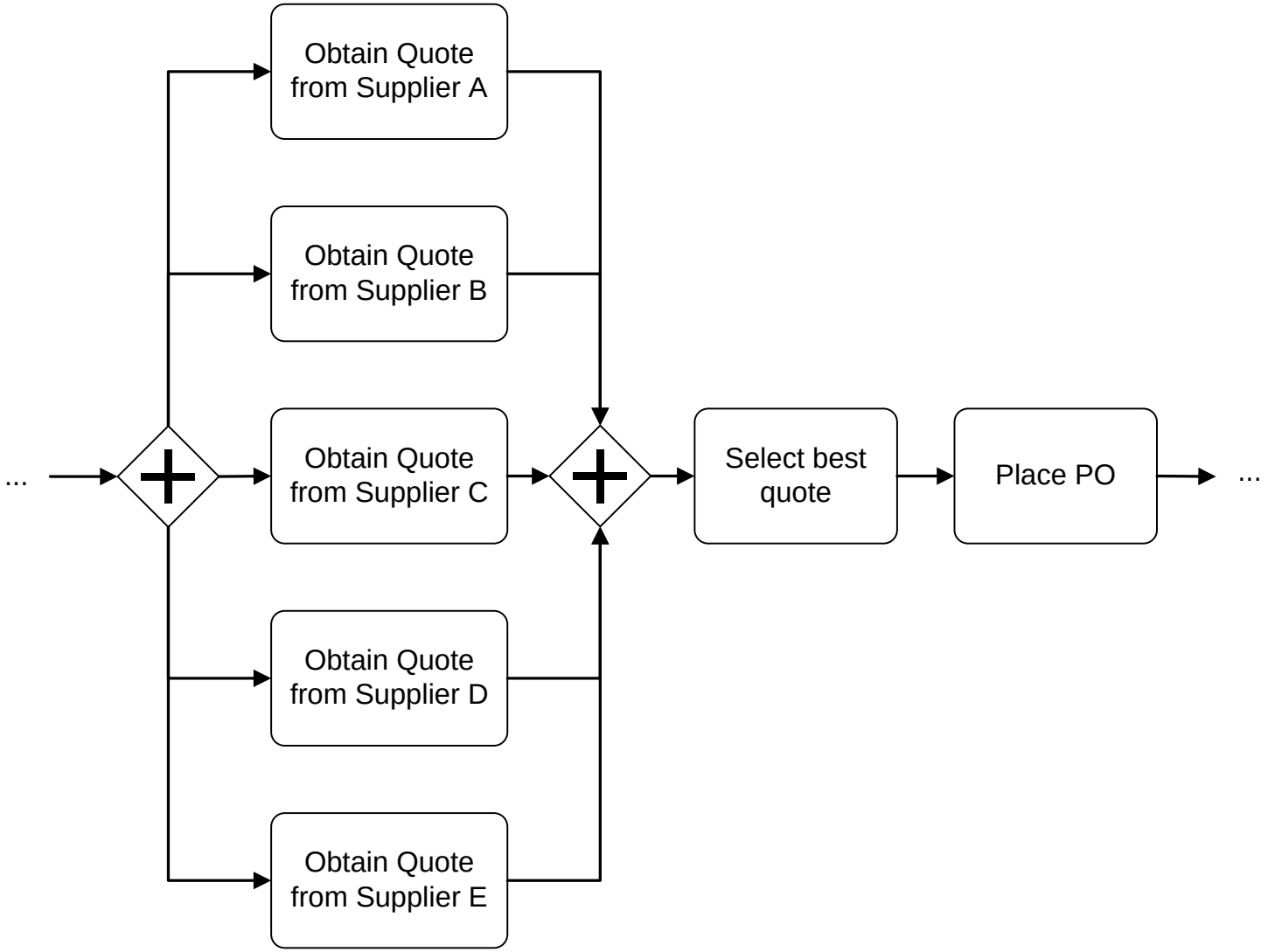
Example: multi-instance activity

Procurement

In procurement, typically a quote is to be obtained from all preferred suppliers (assumption: five preferred suppliers exist). After all quotes are received, they are evaluated and the best quote is selected. A corresponding purchase order is then placed.

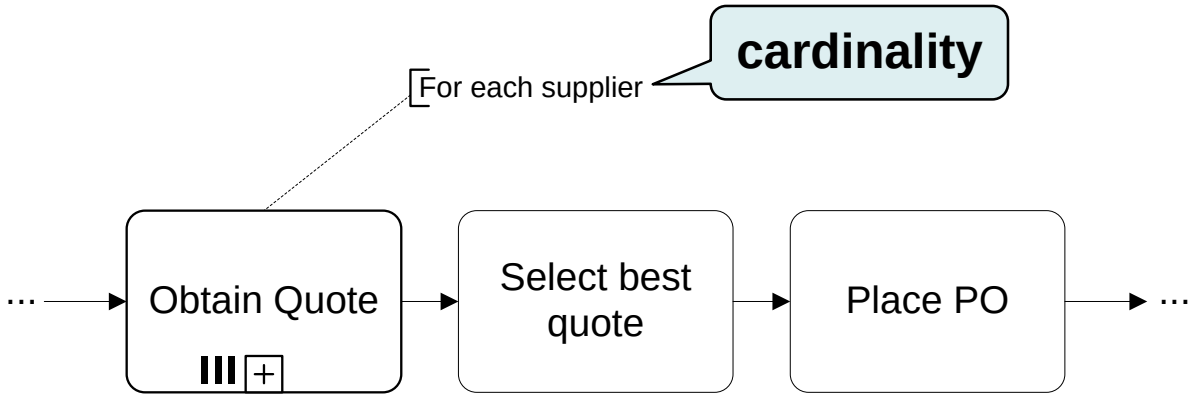
Solution: without multi-instance activity

Procurement



Solution: with multi-instance activity

Procurement

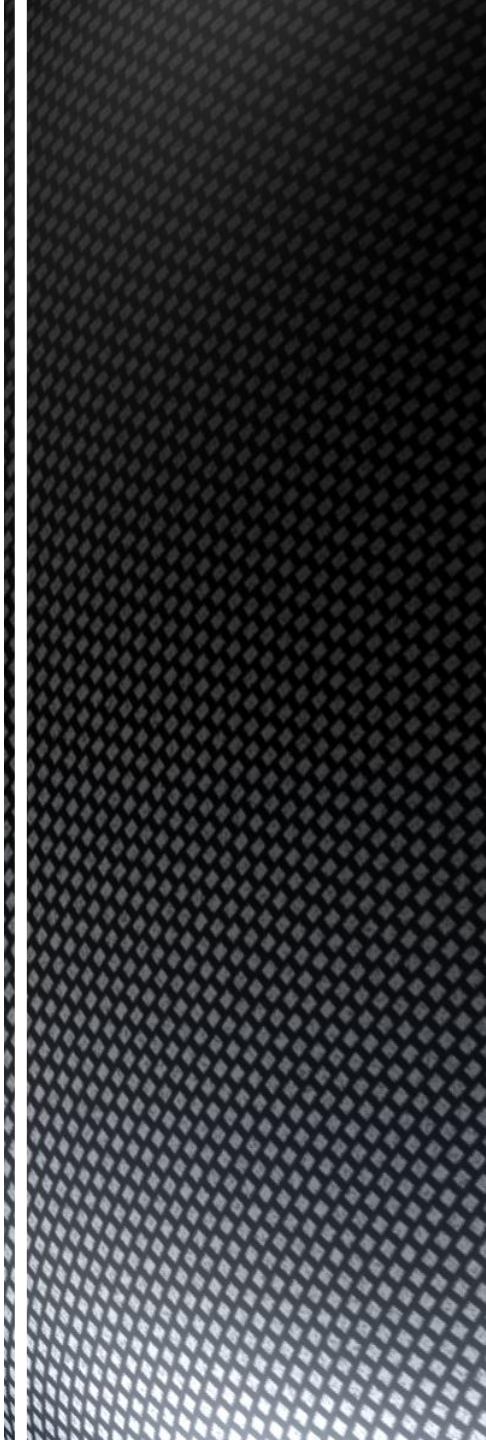


Exercise

Motor insurance claim lodgement

After a car accident, a statement is sought from the witnesses that were present, in order to lodge the insurance claim. As soon as the first two statements are received, the claim can be lodged to the insurance company without waiting for the other statements.

Events



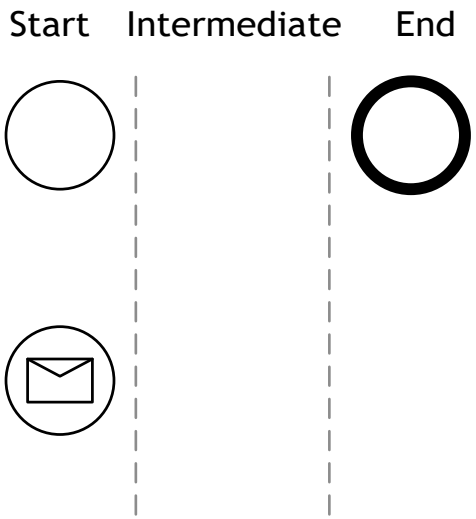
Events

In BPMN, events model something instantaneous happening during the execution of a process

Types of event:

- Start
- Intermediate
- End

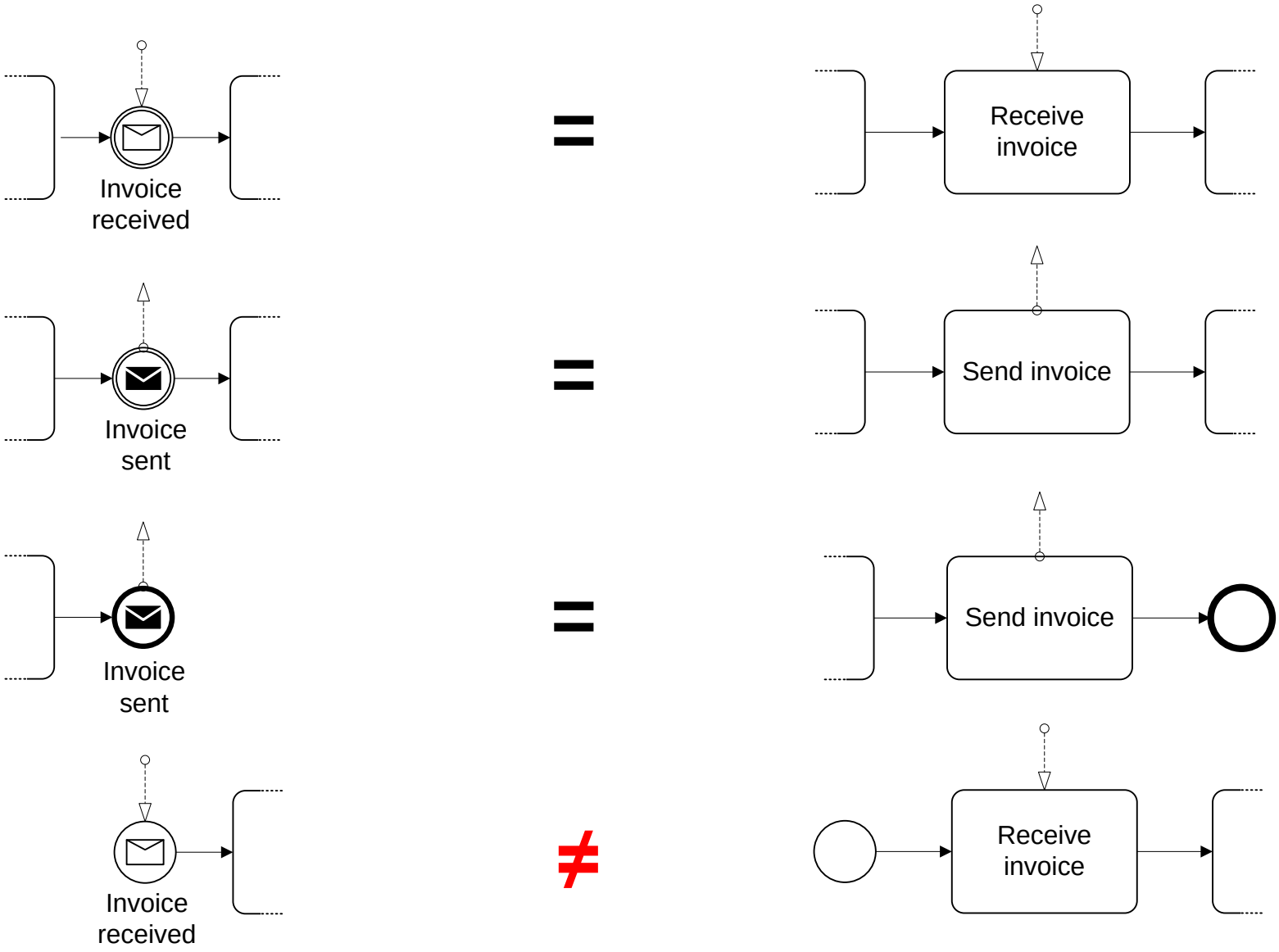
BPMN event types



Untyped Event – Indicates that an instance of the process is created (start) or completed (end), without specifying the cause for creation/completion

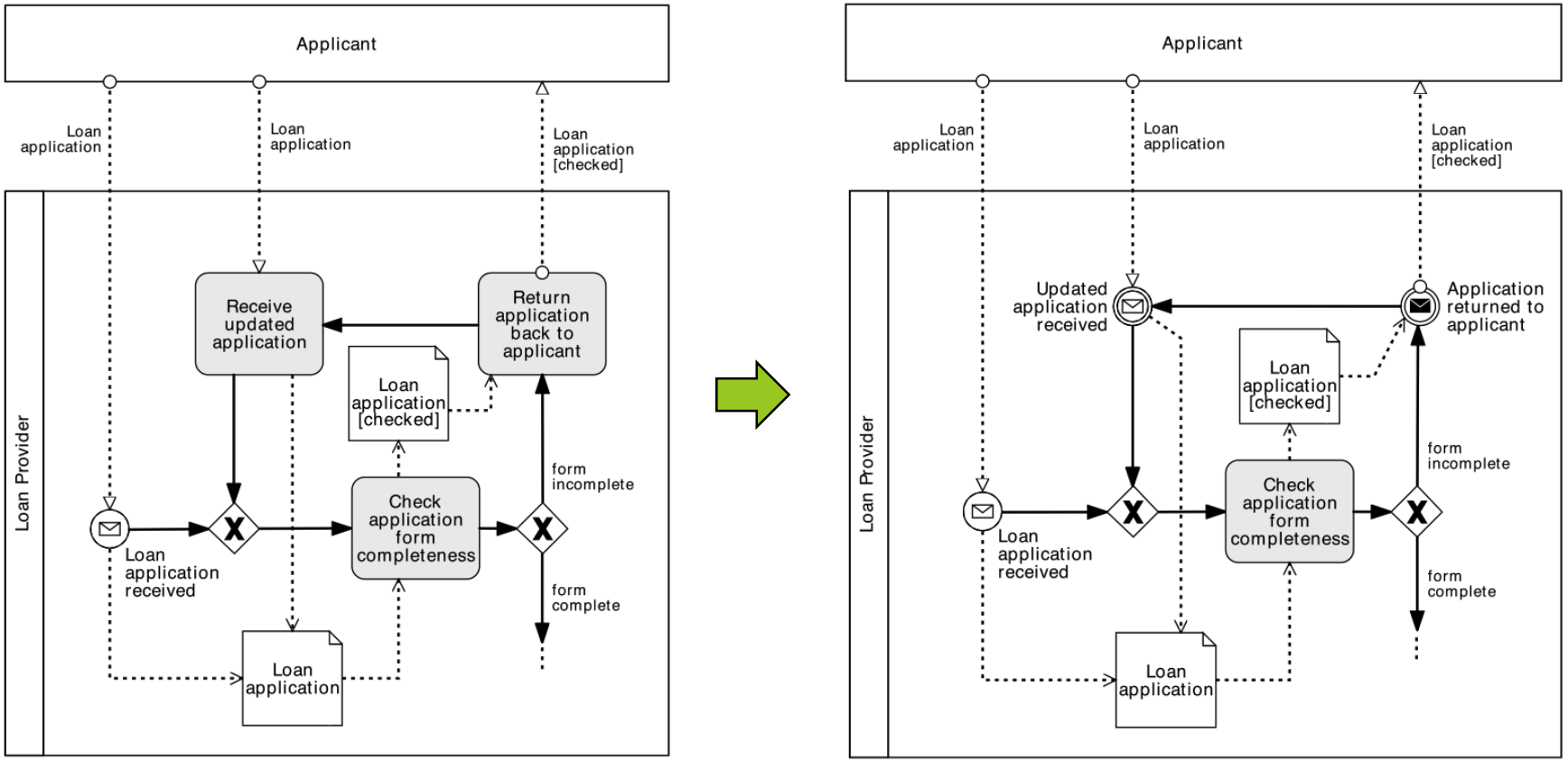
Start Message Event – Indicates that an instance of the process is created when a message is **received**

Comparison with sending/receiving tasks



So, when to use what?

Use message events only when the corresponding activity would simply send or receive a message and do nothing else



Temporal events

Start Intermediate End

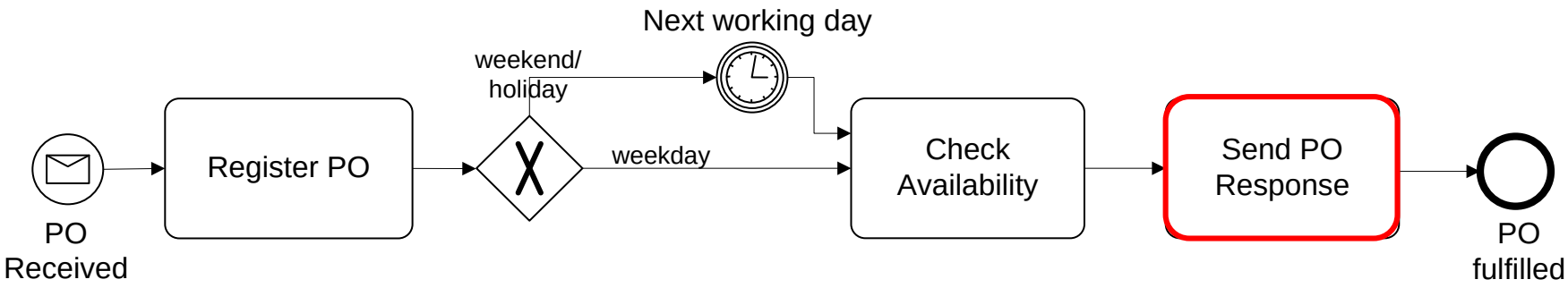
Start Timer Event – Indicates that an instance of the process is created at certain date(s)/time(s), e.g. start process at 6pm every Friday

Intermediate Timer Event – Triggered at certain date(s)/ time(s), or after a time interval has elapsed since the moment the event is “enabled” (delay)

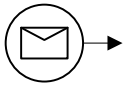
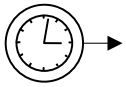
Example

PO handling

A Purchase Order (PO) handling process starts when a PO is received. The PO is first registered. If the current date is not a working day, the process waits until the following working day before proceeding. Otherwise, an availability check is performed and a PO response is sent back to the customer.



Recap: Message and Timer events

Start	Intermediate		End
Catching	**Catching**	**Throwing**	**Throwing**
 process starts upon message received	 message received during the process	 message sent during the process	 process ends upon message sent
 process starts when time event occurs	 time event occurred (to model delay)		

Data-based vs. event-based choices

- In an XOR-split gateway, one branch is chosen based on expressions evaluated over available data
  - →Choice is made immediately when the gateway is reached
- Sometimes, the choice must be delayed until something happens
  - →Choice is based on a "race between events"
- BPMN distinguishes between:
  - Exclusive decision gateway (XOR-split)
  - Event-based decision gateway

Choices outside our control…

Stock replenishment

A restaurant chain submits a purchase order (PO) to replenish its warehouses every Thursday. The restaurant chain's procurement system expects to receive either a "PO Response" or an error message. However, it may also happen that no response is received at all due to system errors or due to delays in handling the PO on the supplier's side. If no response is received by Friday afternoon or if an error message is received, a purchasing officer at the restaurant chain's headquarters should be notified. Otherwise, the PO Response is processed normally.

Event-based decision

With the XOR-split gateway, a branch is chosen based on conditions that evaluate over available data

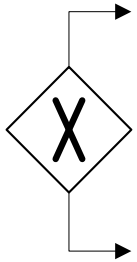
→ The choice can be made immediately after the token arrives from the incoming flow

Sometimes, the choice must be delayed until an event happens

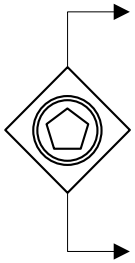
→ The choice is based on a “race” among events

Two types of XOR split:

data-driven XOR-split

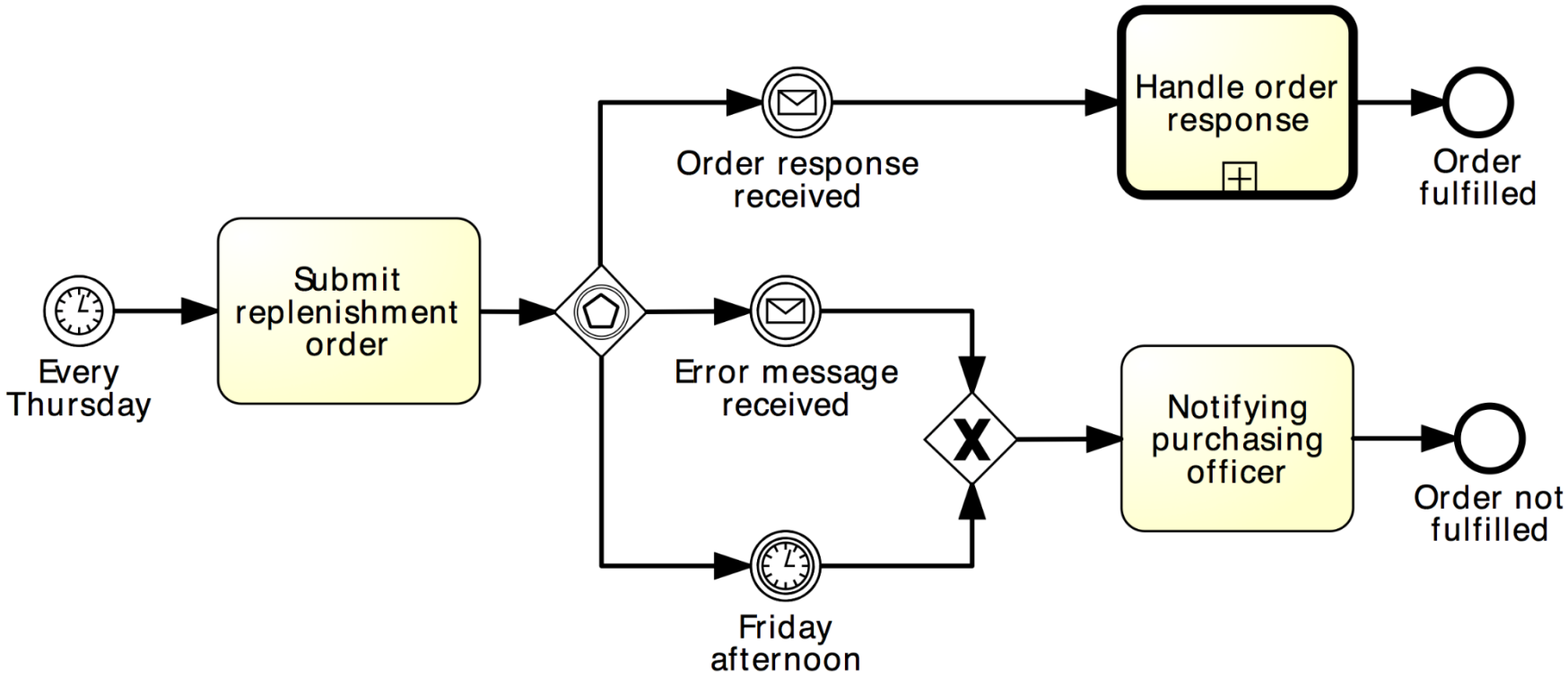


event-driven XOR split



Solution: event-driven XOR split

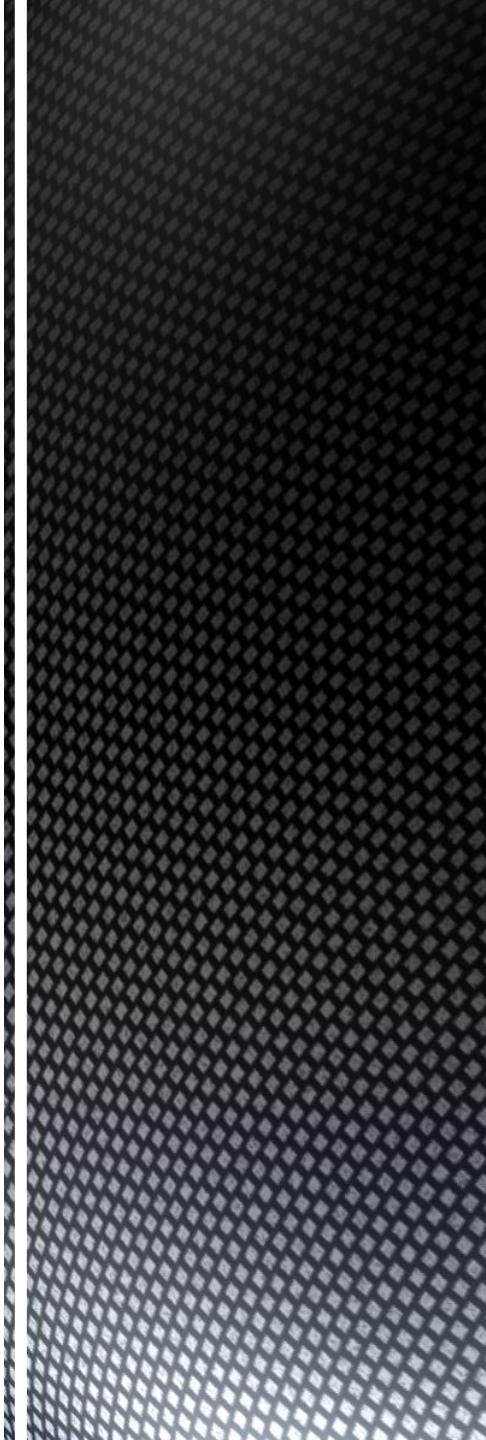
Stock replenishment



Exercise

In the context of a claim handling process, it is sometimes necessary to send a questionnaire to the claimant to gather additional information. The claimant is expected to return the questionnaire within five days. If no response is received after five days, a reminder is sent to the claimant. If after another five days there is still no response, another reminder is sent and so on until the completed questionnaire is received.

Exception handling

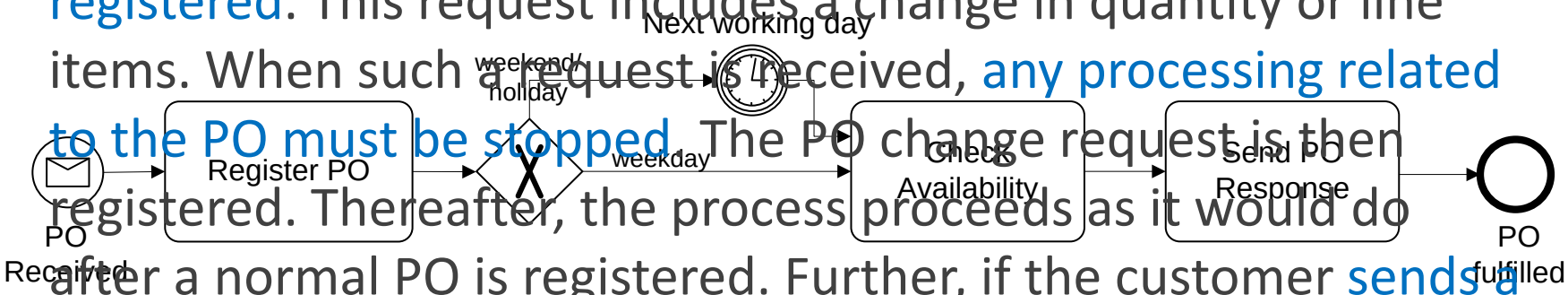


Let’s extend our PO handling process

PO handling

A PO handling process starts when a PO is received. The PO is first registered. If the current date is not a working day, the process waits until the following working day before proceeding. Otherwise, an availability check is performed and a PO response is sent back to the customer.

A PO change request may be received anytime after the PO is registered. This request includes a change in quantity or line items. When such a request is received, any processing related to the PO must be stopped. The PO change request is then registered. Thereafter, the process proceeds as it would do after a normal PO is registered. Further, if the customer sends a PO cancelation request after the PO registration, the PO processing must be stopped and the cancelation request must be handled.



Abortion (terminate event)

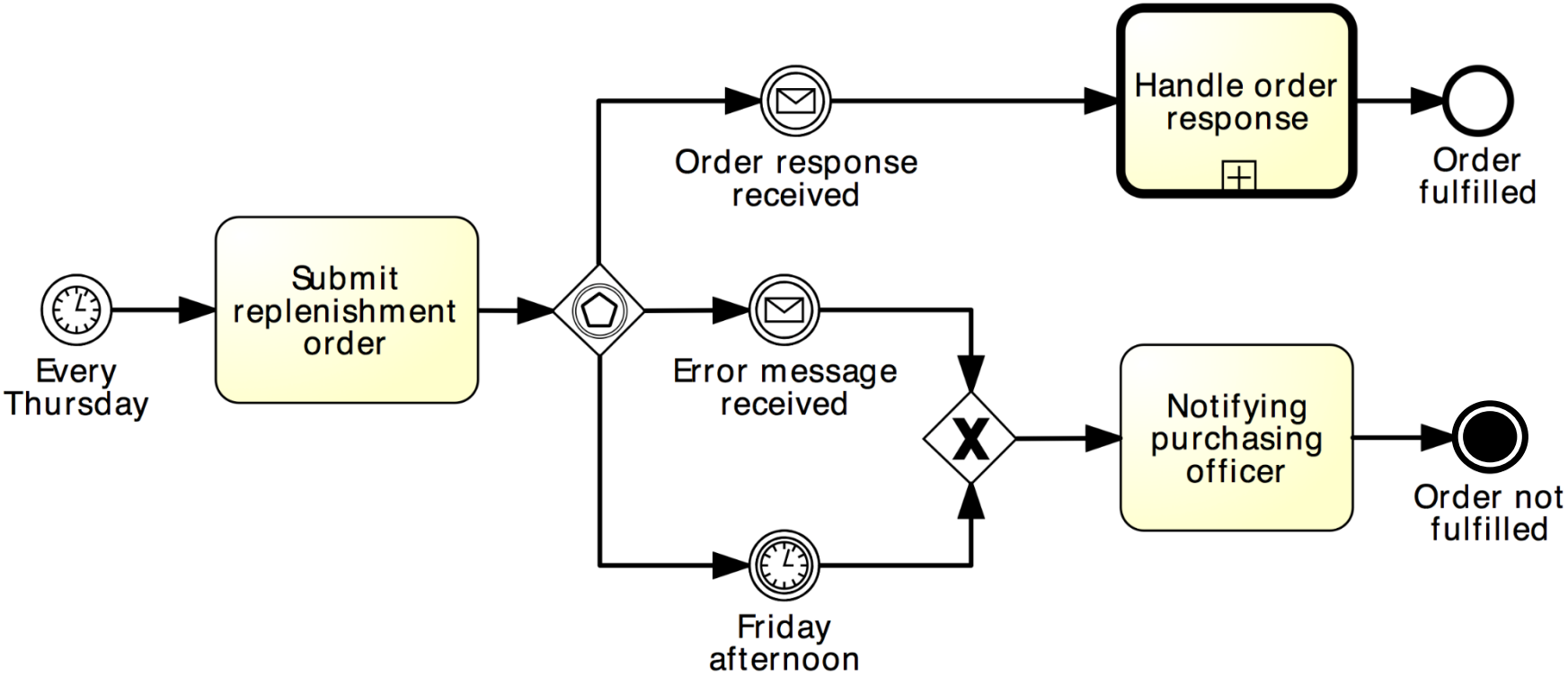
Exceptions are events that deviate a process from its “normal” course

The simplest form of exception is to notify that there is an exception (negative outcome)

This can be done via the Terminate end event: it forces the whole process to *abort* (“wipes off” all tokens left behind, if any)

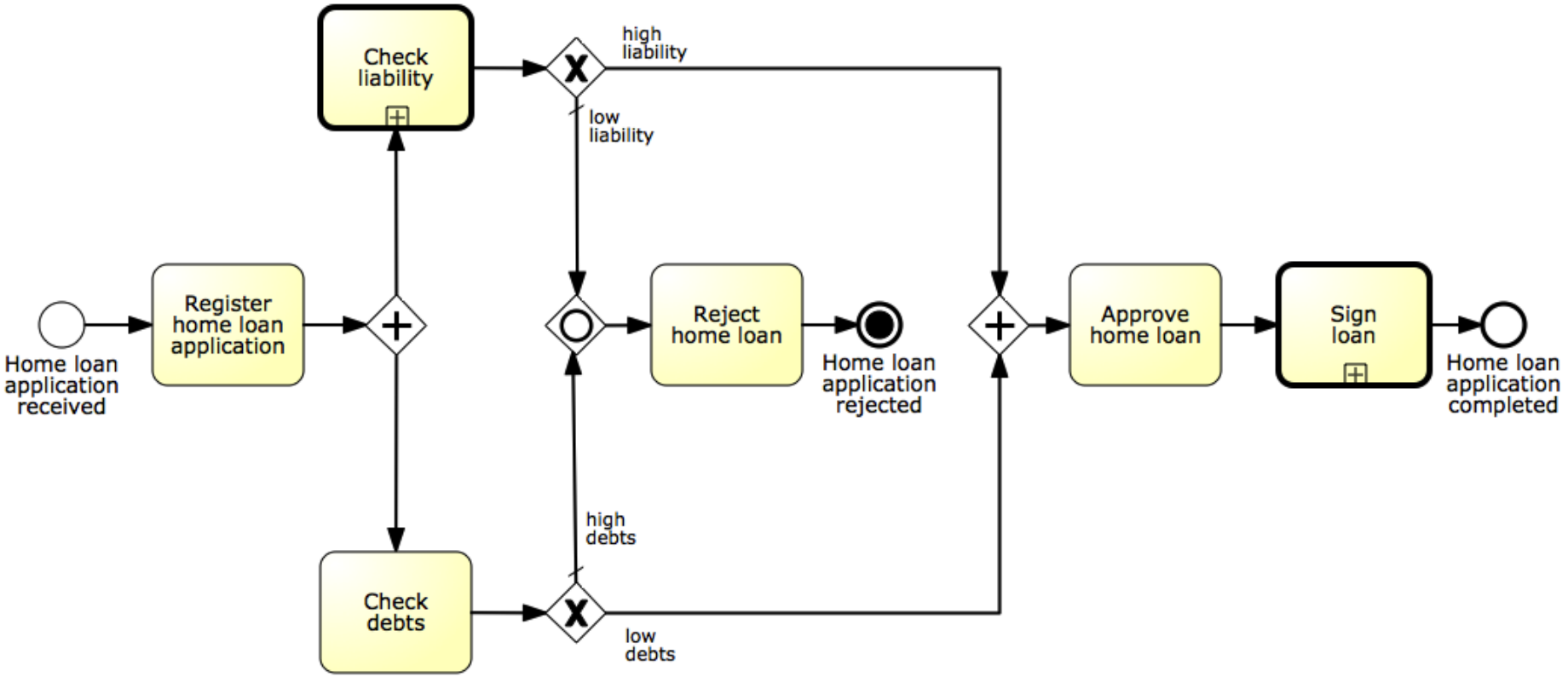
Example 1: terminate event

Signal the negative outcome…



Example 2: terminate event

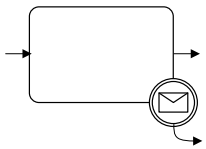
Abort the process by removing all tokens…



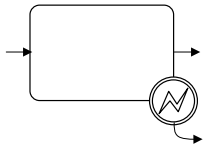
Exception handling

Handling exceptions often involves stopping a sub-process and performing a special activity

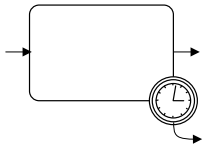
Types of exceptions for an activity (task/sub-process) in BPMN:



External: something goes wrong outside the process, and the execution of the current activity must be interrupted. Handled with the Message event



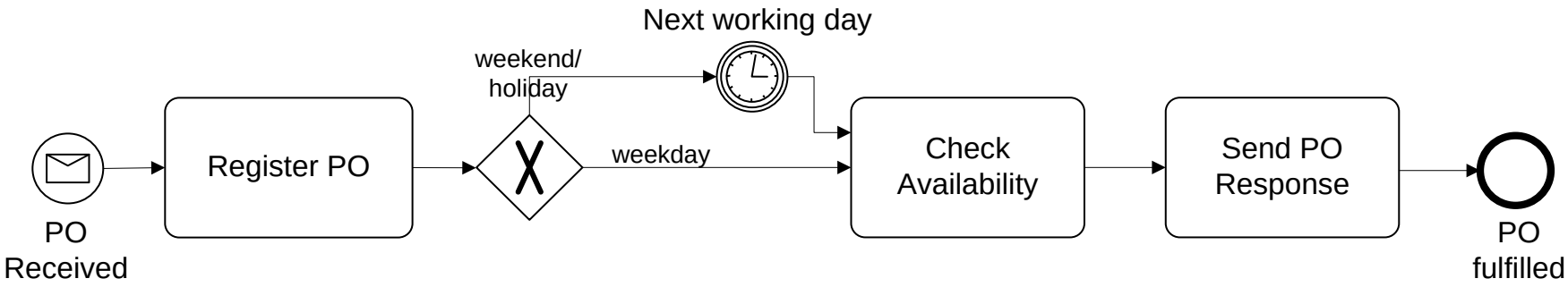
Internal: something goes wrong inside an activity, whose execution must thus be interrupted. Handled with the Error event



Timeout: an activity takes too long and must be interrupted. Handled with the Timer event

All these events are catching intermediate events. They stop the enclosing activity and start an exception handling routine.

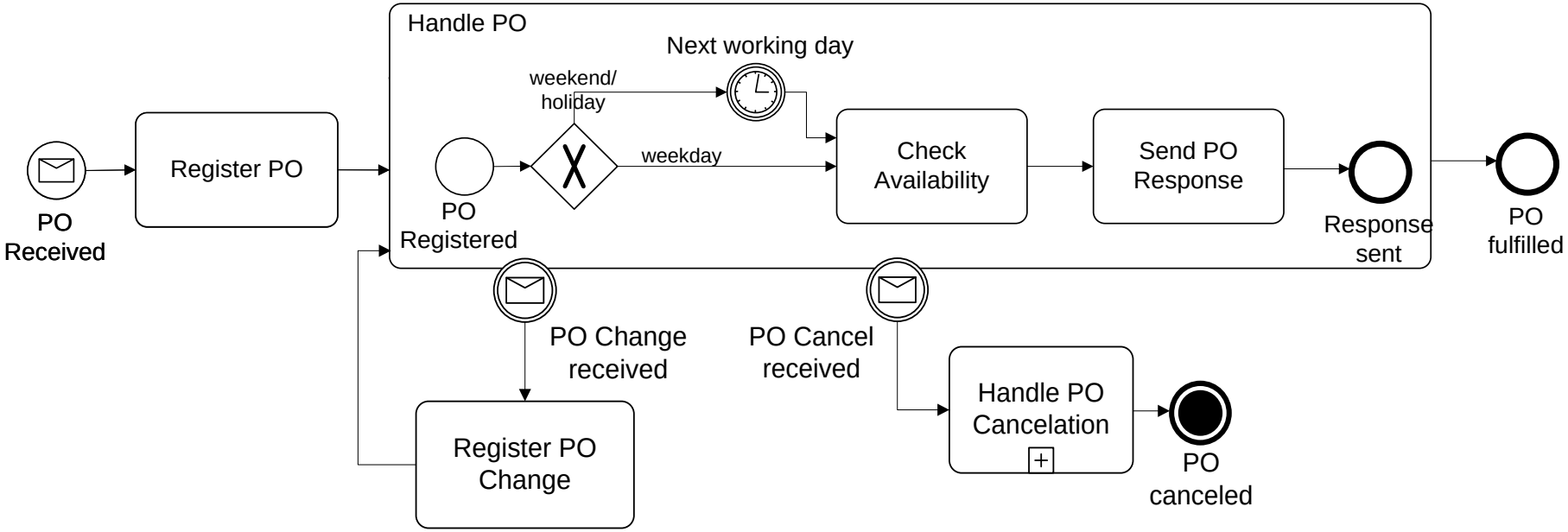
Let’s extend our PO handling process



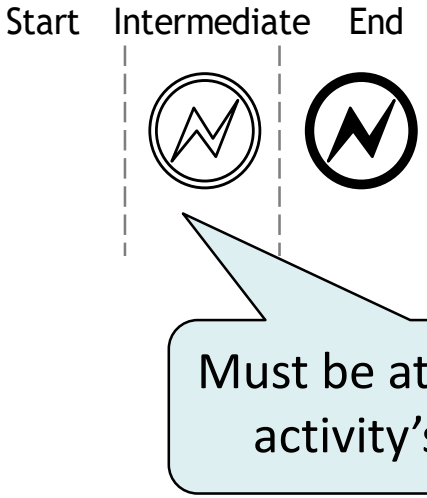
A PO change request may be received anytime after the PO is registered. This request includes a change in quantity or line items. When such a request is received, any processing related to the PO must be stopped. The PO change request is then registered. Thereafter, the process proceeds as it would do after a normal PO is registered. Further, if the customer sends a PO cancelation request after the PO registration, the PO processing must be stopped and the cancelation request must be handled.

Solution: exception handling

PO handling



Internal exception: error event

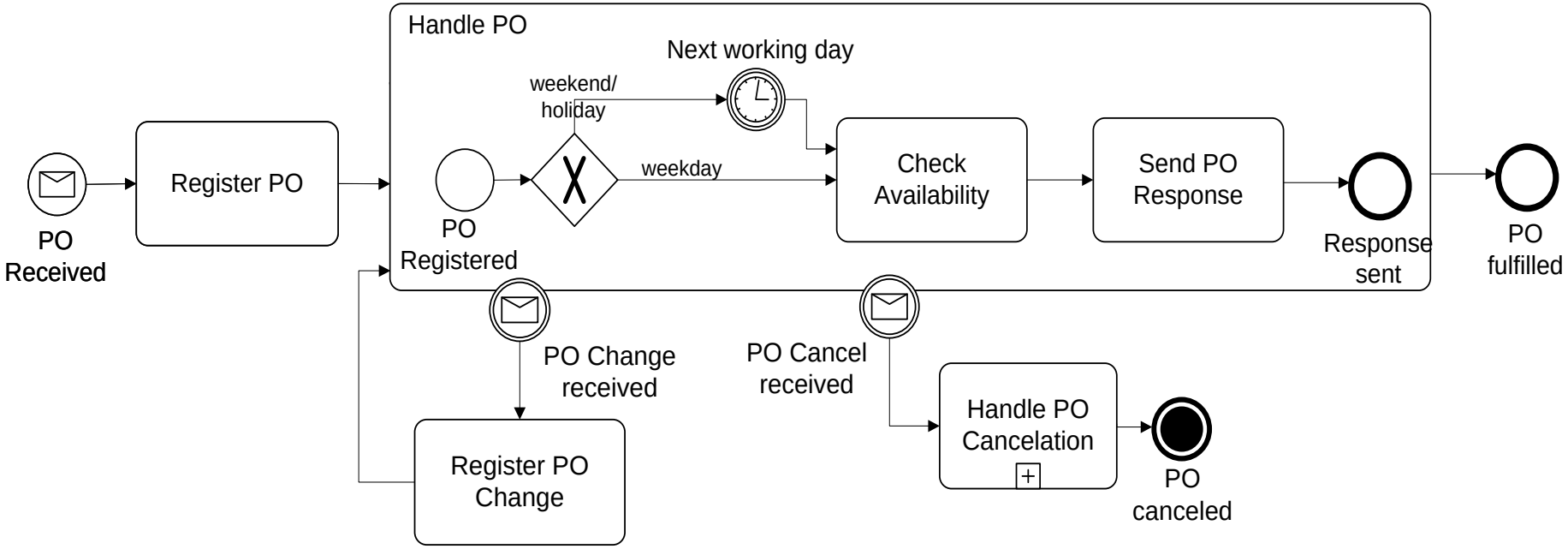


Error Event – Indicates an error: the "end" version generates an error event while the "catching intermediate" version consumes it when attached to the boundary of an activity

Example: internal exception

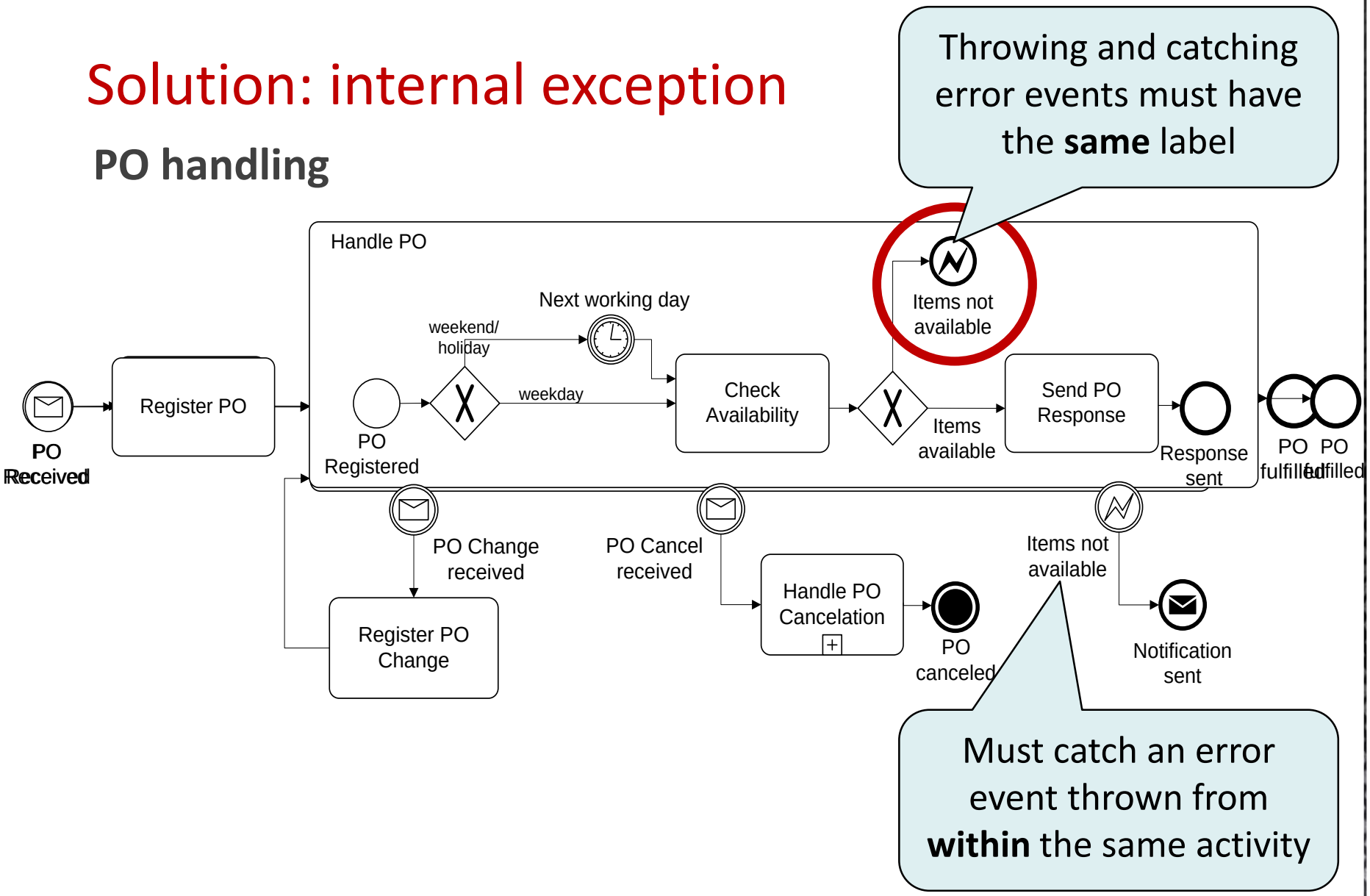
PO handling

Consider again our “PO Handling process” example with the following extension: if an item is not available, any processing related to the PO must be stopped. Thereafter, the client needs to be notified that the PO cannot be further processed.



Solution: internal exception

PO handling



Example: activity timeout

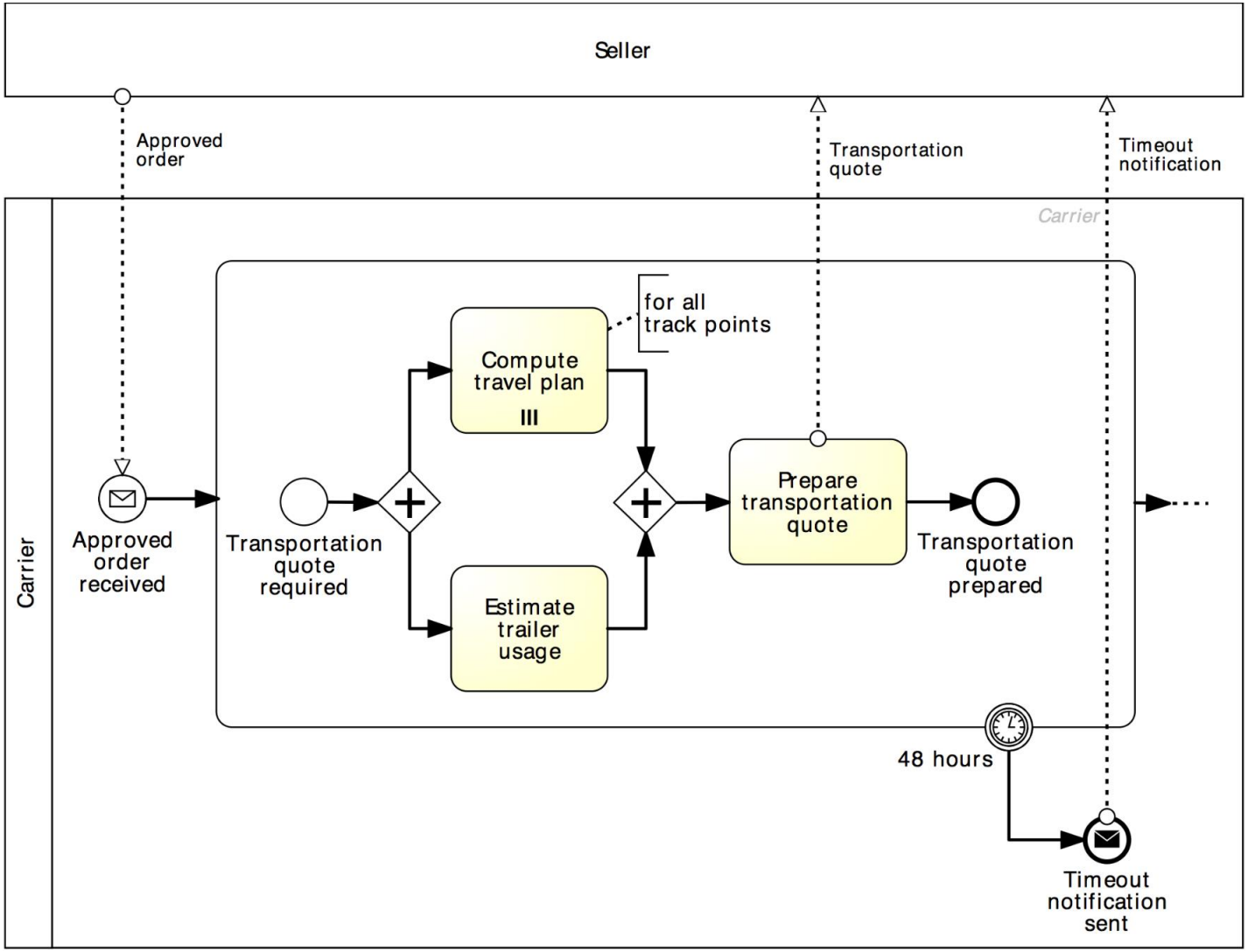
Order-to-transportation quote

Once a wholesale order has been confirmed, the supplier transmits this order to the carrier for the preparation of the transportation quote. In order to prepare the quote, the carrier needs to compute the route plan (including all track points that need to be traversed during the travel) and estimate the trailer usage.

By contract, wholesale orders have to be dispatched within four days from the receipt of the order. This implies that transportation quotes have to be prepared within 48 hours from the receipt of the order to remain within the terms of the contract.

Solution: activity timeout

Order-to-transportation quote



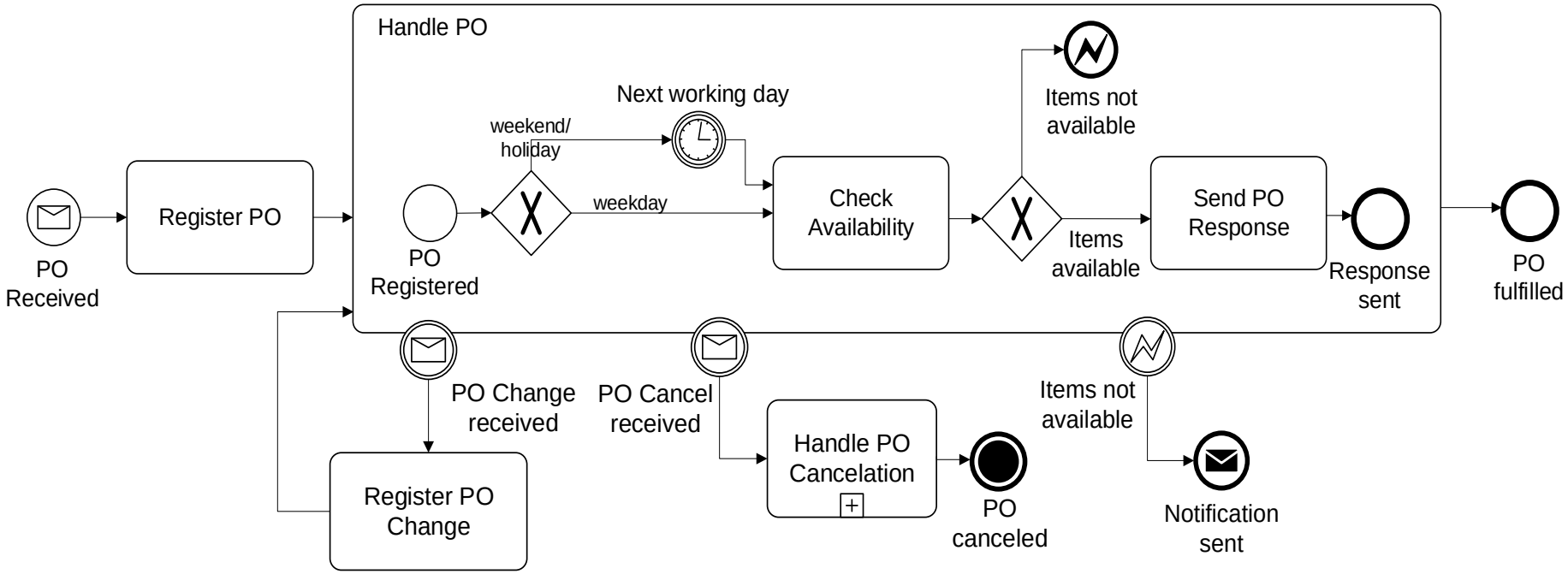
Exercise

When a claim is received, it is registered. After registration, the claim is classified leading to two possible outcomes: simple or complex. If the claim is simple, the policy is checked. For complex claims, both the policy and the damage are checked independently.

A possible outcome of the policy check is that the insurance is invalid. In this case, any processing is cancelled and a letter is sent to the customer. In the case of a complex claim, this implies that the damage checking is cancelled if it has not yet been completed.

More on the PO handling example…

PO handling

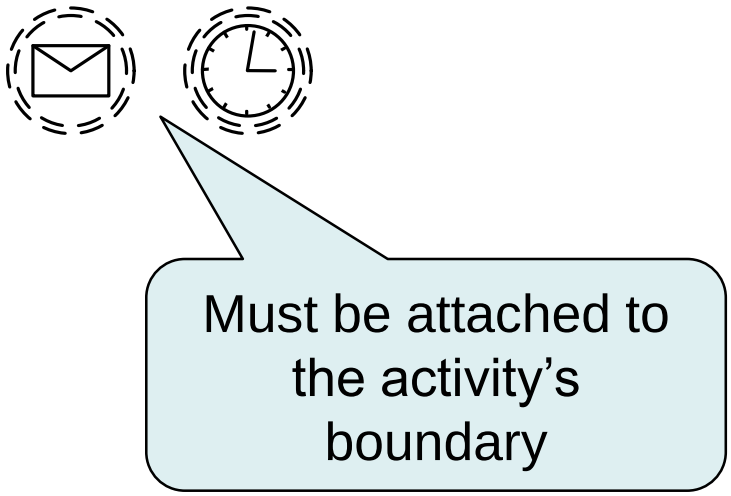


The customer may send a request for address change after the PO registration. When such a request is received, it is just registered, without further action.

Non-interrupting boundary events

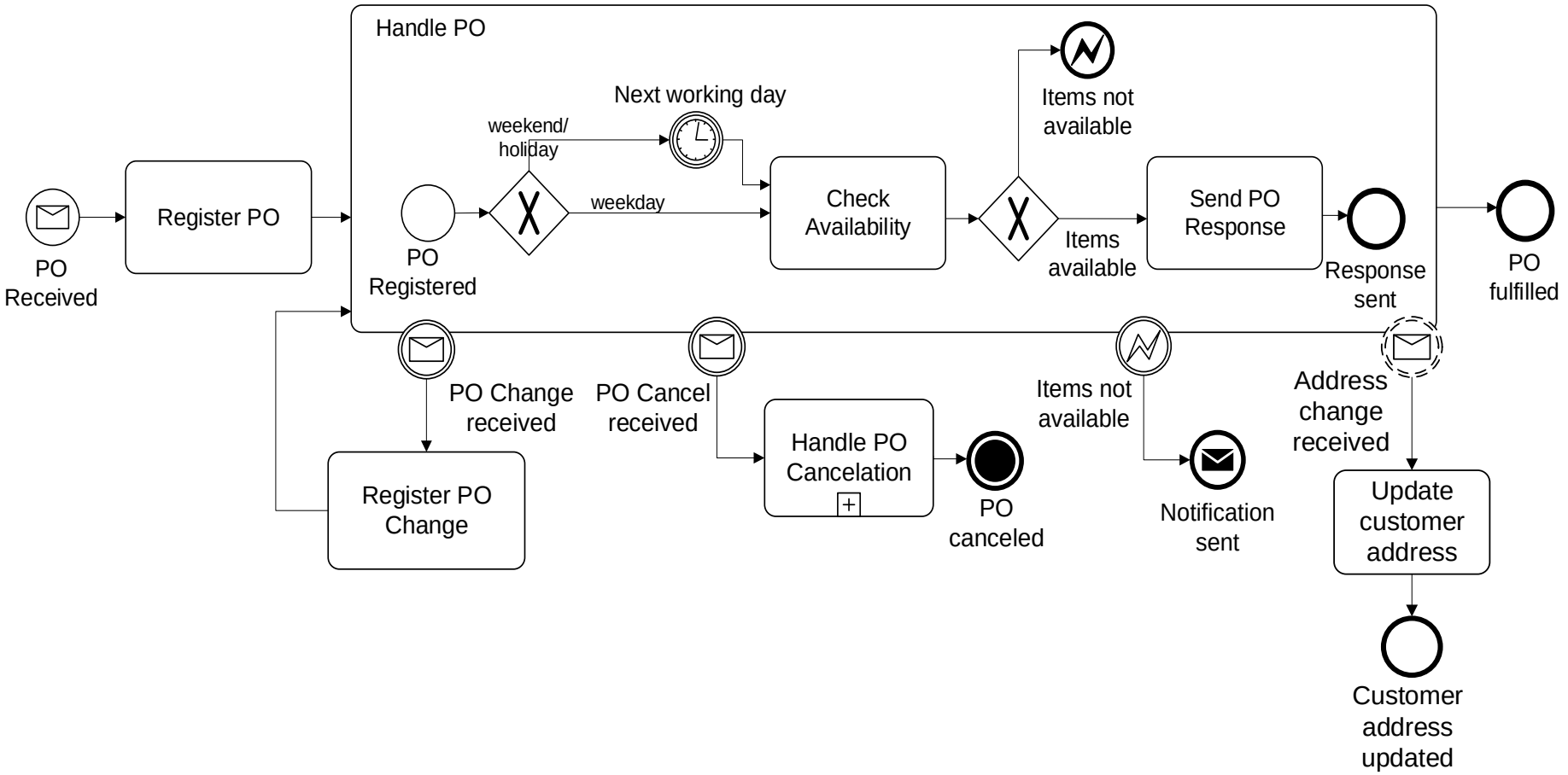
Sometimes we may need to trigger an activity **in parallel** to the normal flow, i.e. without interrupting the normal flow.

This can be achieved by using *non-interrupting* boundary events



Solution: non-interrupting boundary events

PO handling



Summary

- In this lecture we have learned about:
  - BPMN sub-processes
  - Repetition markers: loop marker and parallel multi-instance marker
  - Events: timer, message and error events
  - Event-based choice gateway
  - Boundary events: interrupting and non-interrupting
  - Error events (throw and catch)

And once I’ve got a model, what’s next?

Process analysis techniques:

- Added-value and waste analysis
- Root-cause analysis
- Flow Analysis
- Queuing Analysis
- Process Simulation