Business Process Management

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Block 2: Introduction to BPM - BPMN

Essence of modelling

- A model is the result of *analysis* and *synthesis*
  - A mapping of an original
  - A reduction of the original
  - **Serving a specific purpose**

- Original
  - May be existing, fictitious, or planned
  - May be a model as well

Object models

Original

Abstraction

Model of
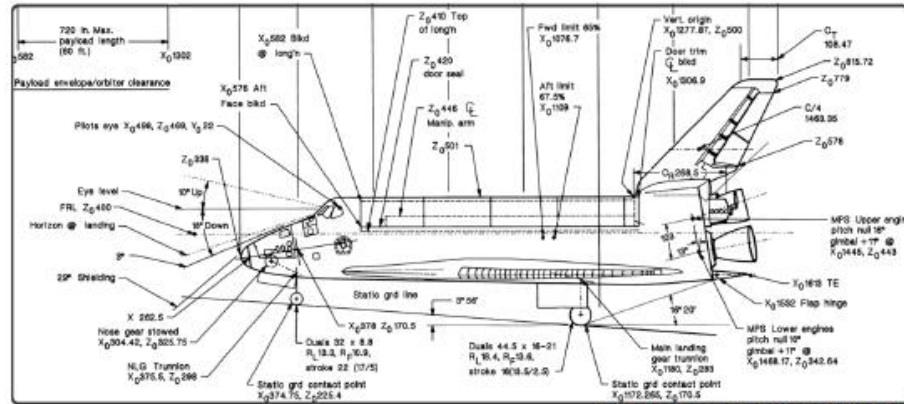
Abstraction

Model of

Model Level
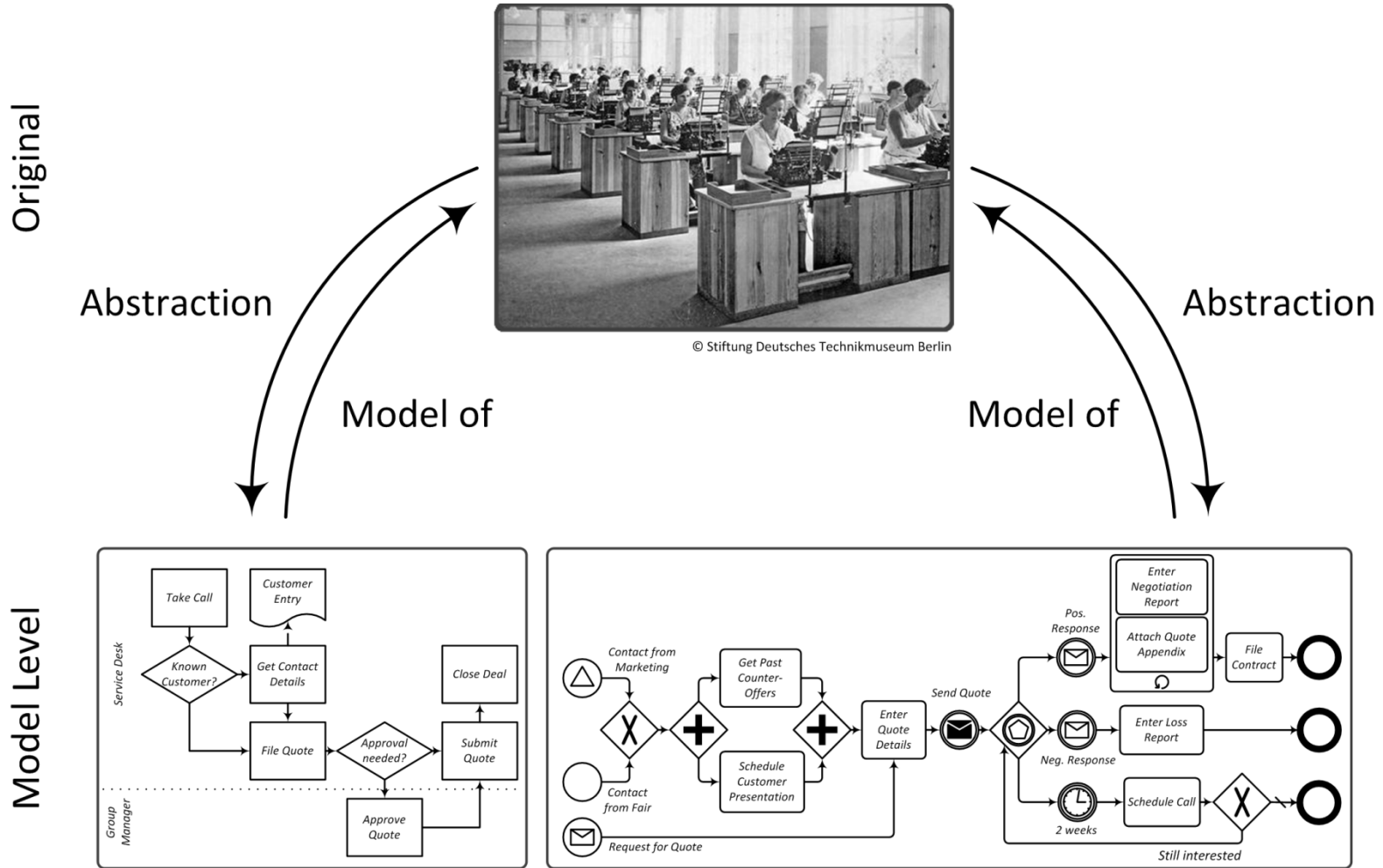
© National Aeronautics and Space Administration (NASA)

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© Historic Space Systems at www.space1.com

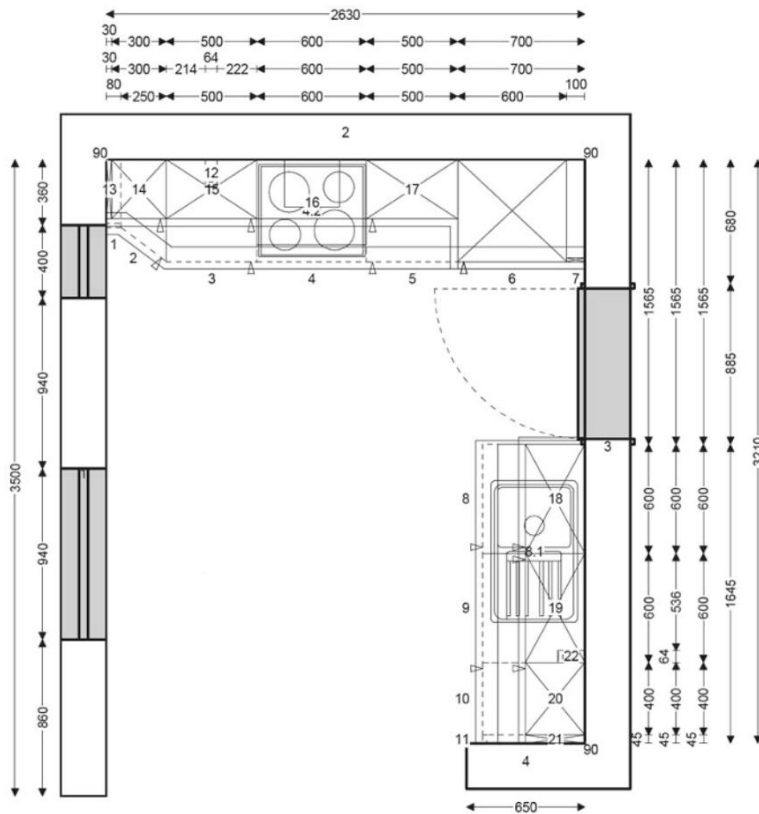# Process models

Models come in two flavours

Prescriptive (to be)

Descriptive (as is)

Essence of process modelling

Process modelling
- – Original is a business process
- – Process model is abstraction for a certain purpose
- – Again, original existing, fictitious, or planned

Process models answer questions
- – What is done?
- – Who is responsible?
- – What are the decisions taken?
- – How long does it take to finish the process?
- – Who is affected by a change in the process?

Mapping business processes

- What is mapped to a process model?
  - Activities
    - Building blocks that describe elementary pieces of work
  - Routing conditions
    - Describe temporal and logical constraints on the execution of activities
  - Inputs, Outputs
    - Informational or physical artefacts processed by activities
  - Events
    - How time, messages, exception influence the execution
  - Resources
    - Persons, organisational units, systems that execute activities

Simplifications

- Abstraction is information loss
  - Projection
    Remove information considered irrelevant

  - Classification
    Aggregate related information
    Different types of classification

Projection ➕ **Classification** ➖ **Abstraction**

Classification

From cases …

– Singular sequence of activities observed in time and space

– Instance level, also process instance

… to processes …

– A process model classifies related cases

– Type level, also process schema

– Types of activities / documents / persons (roles)

Business process versus case

Business process
Activity
Business process attributes

Case (process instance)
Activity instance (work item)
Case attributes

Car Assembly Process

Car body number

Buyer

Car color

Car Assembly Case
  3324-20181016

Car body number
  10203324

Buyer
  John Doe

Car color
  White

Classification cont.

- … and beyond
  - Classification of process model yields meta-model
  - Defines element types used to construct process model
  - Specification of a business process modelling language

- Granularity as an abstraction principle
  - Many detailed elements vs. few coarse-granular elements
  - Organisation of process models using process architectures
  - Typically, at least 3 levels of granularity
  - Orthogonal to classification

Abstraction Overview
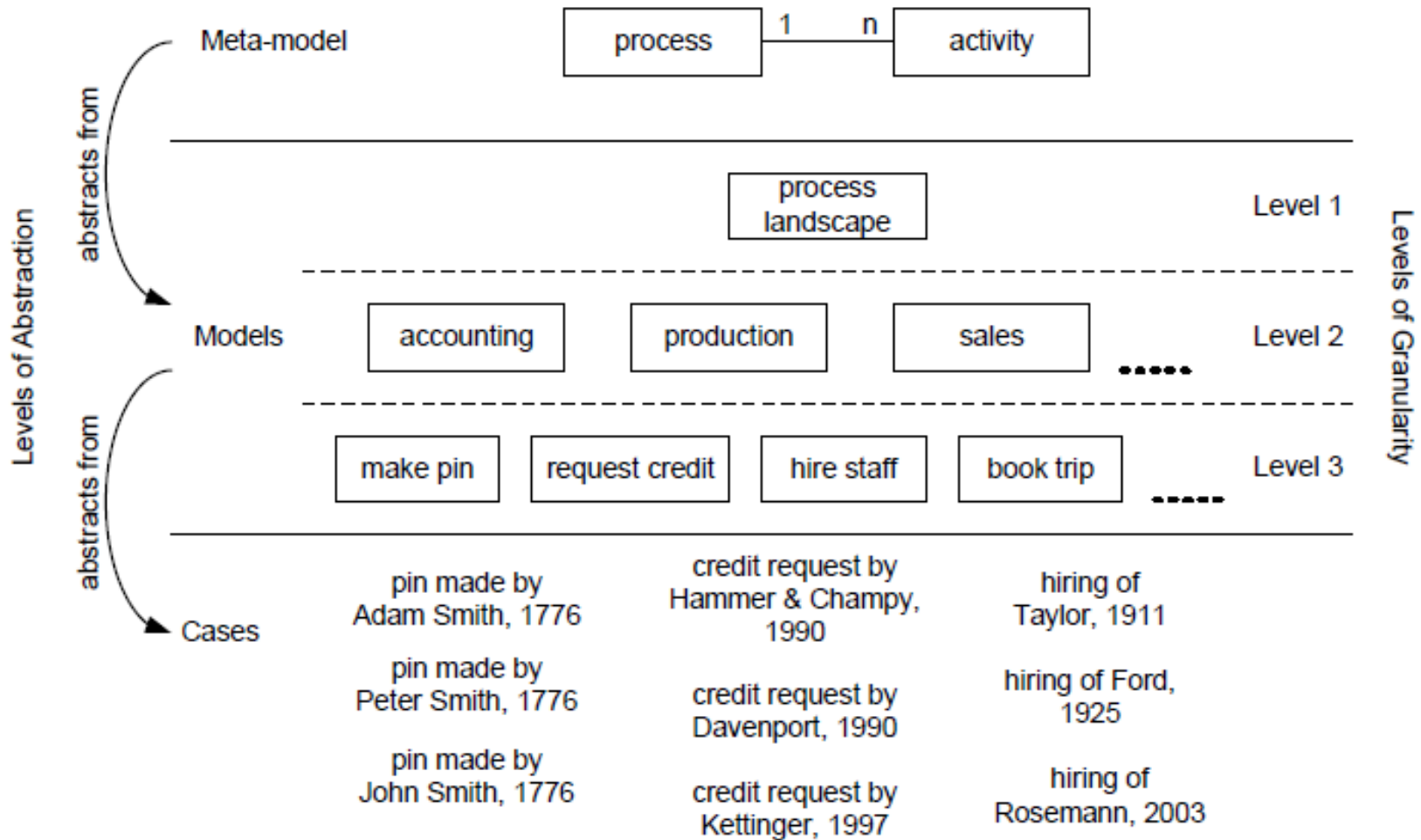
Purposes of Process Modeling

Organizational Analysis

"AS IS" Process Models

Process Analysis & Design

"TO BE" Process Models

Communication, simulation, activity-based costing…

Measures for Improvement

Target Values

Process Evaluation

Process Implementation

Detailed Models including

Data types, conditions, data mappings, fault handling…

Integration, testing, deployment…

Executable Process Models

Process Metrics

Process Enactment & Monitoring

Components of a modeling language
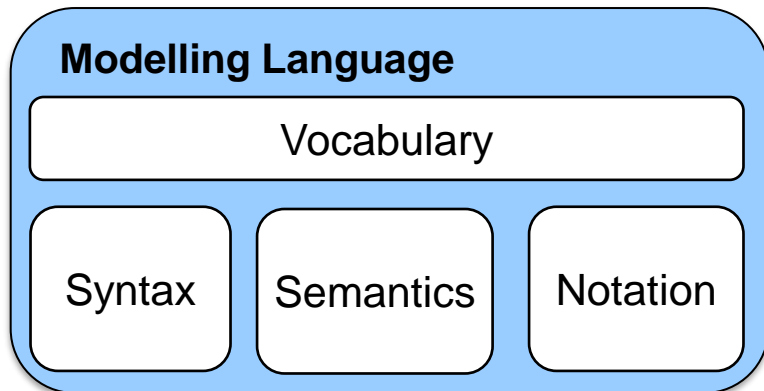
Vocabulary: set of modelling elements of the language
  – BPMN: activities, gateways, events…

Syntax: set of rules to govern how these elements can be combined
  – BPMN: start events only have outgoing sequence flows; end events only have incoming sequence flows

Semantics: bind these elements, including their textual descriptions, to a precise meaning
  – BPMN: activities model something actively performed during the business process; XOR gateways model exclusive decisions and merging points

Notation: set of graphical symbols for the visualization of the elements
  – BPMN: labelled rounded boxes to depict activities and circles with a thin border to depict start events

Modelling Language

Vocabulary

Syntax | Semantics | Notation

Business Process Modeling Notation (BPMN)

https://www.bpmn.org/

- OMG Standard, supported by many tools:
  - Bizagi Process Modeller
  - Signavio (http://www.signavio.com/)
  - TIBCO Business Studio (free download, quite large)
  - IBM Websphere Business Modeler
  - Business Process Visual Architect (Visual Paradigm)
  - OMNIA

BPMN 2.0

BPMN from 10,000 miles…

Based on popular graphical flowcharts:

- Core set of notation elements
- Each core element has various subtypes

A BPMN process model is a graph consisting of four types of **core elements**:

| activity | start end | gateway | sequence flow |
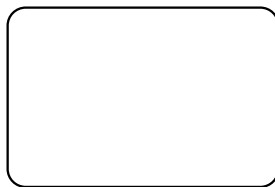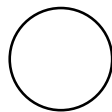
activity

start   end

event
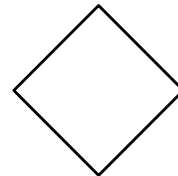
gateway

sequence flow

The overall metamodel
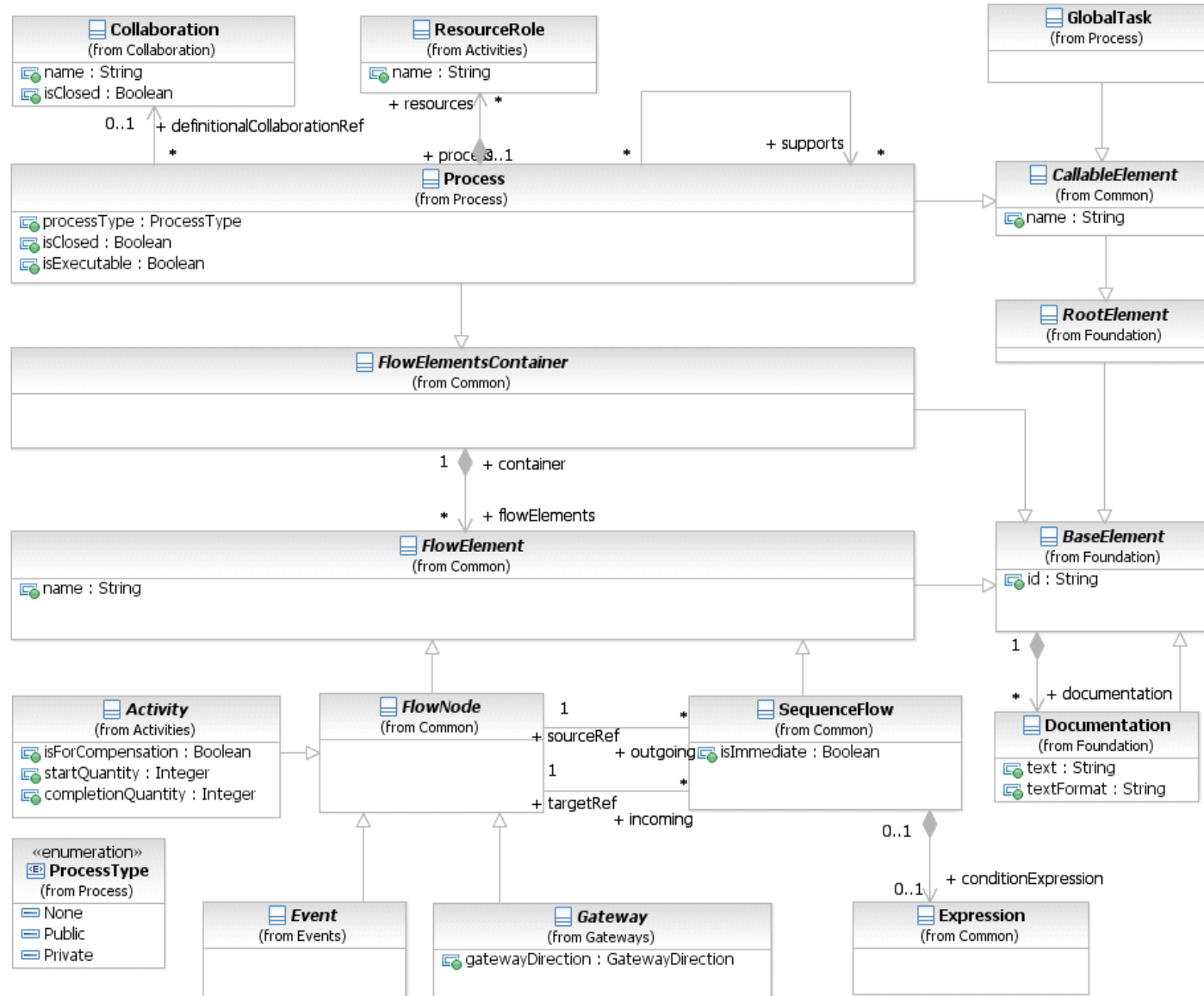
Activities in a process
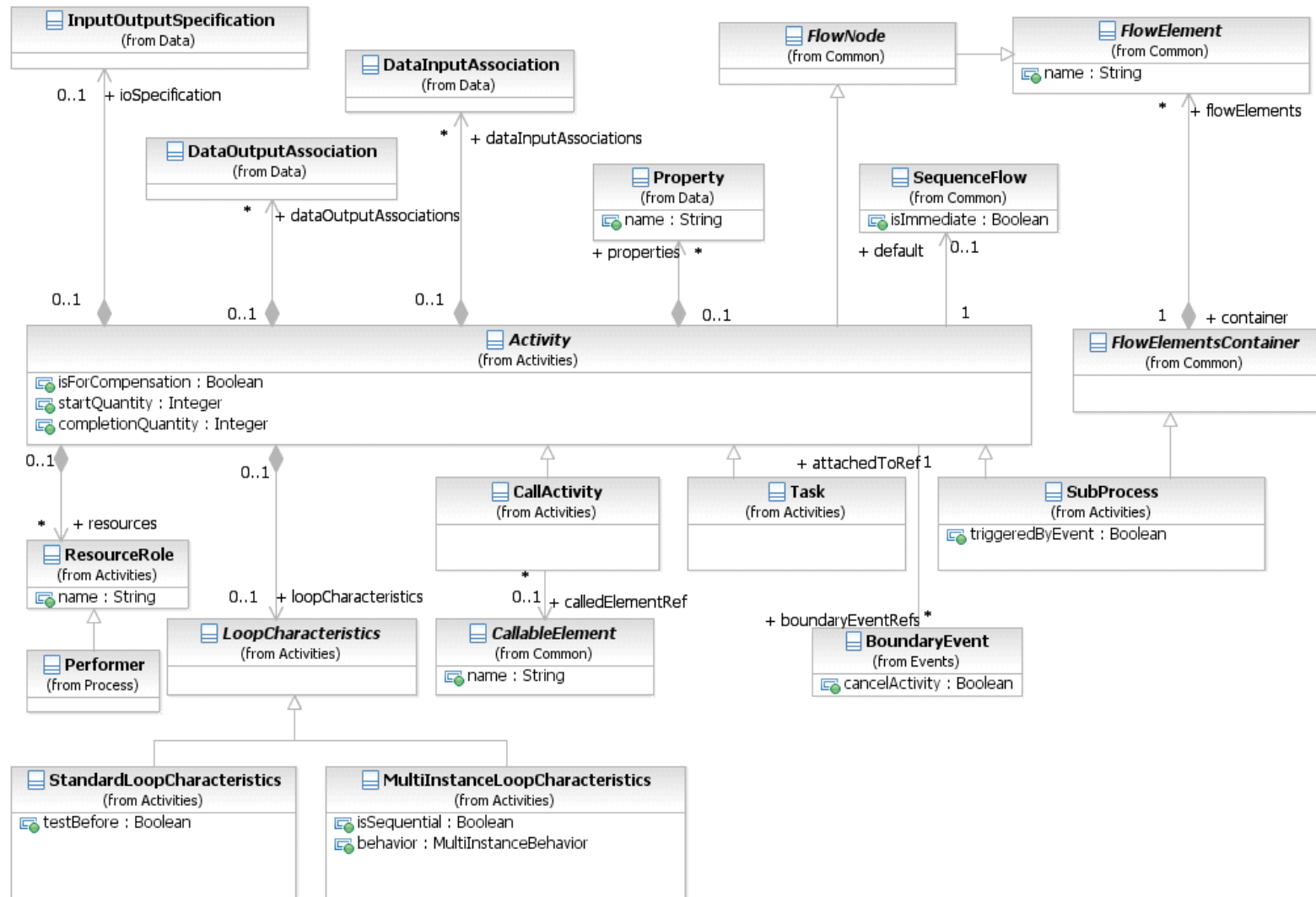
Tasks are atomic
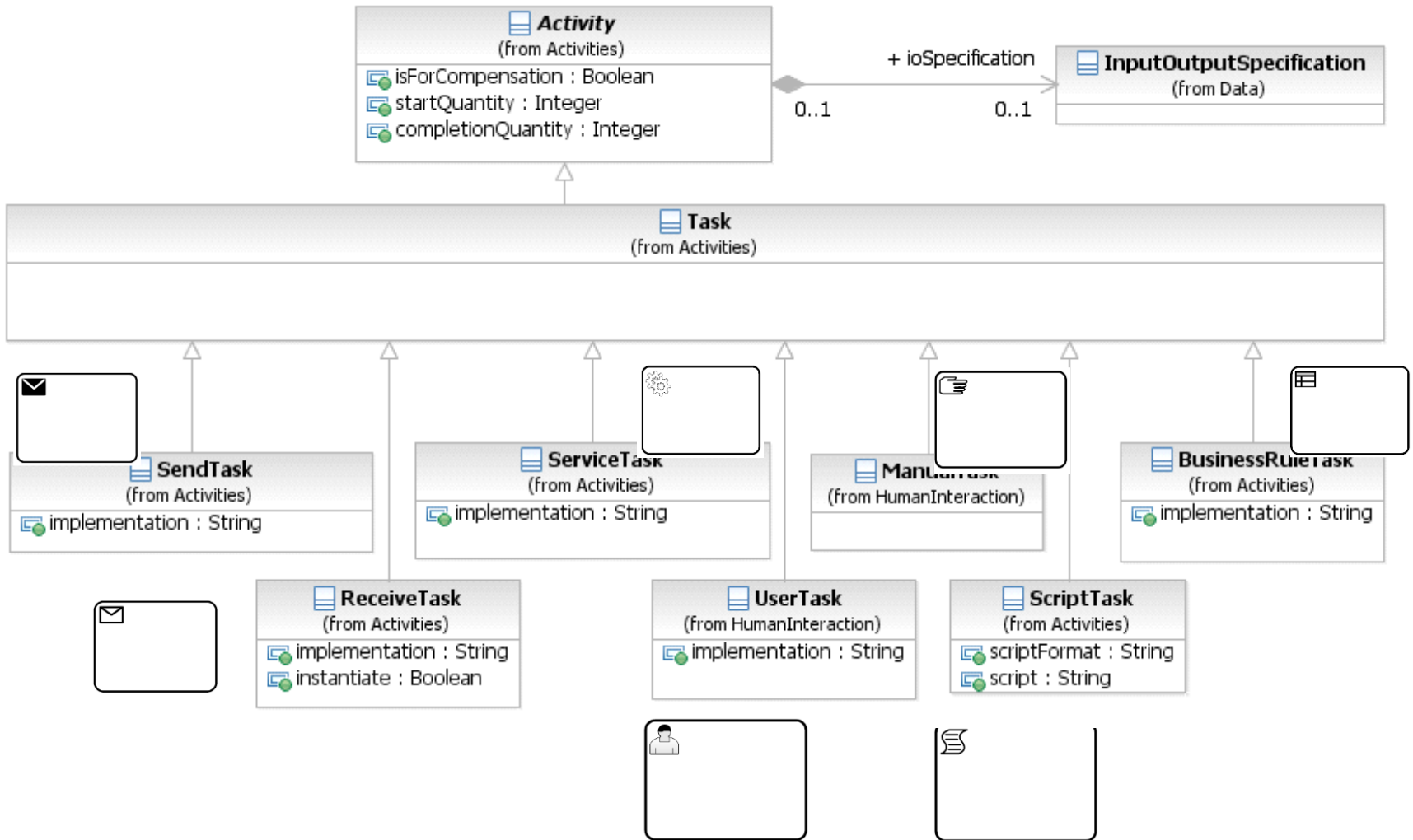
Order Management Process in BPMN First Try
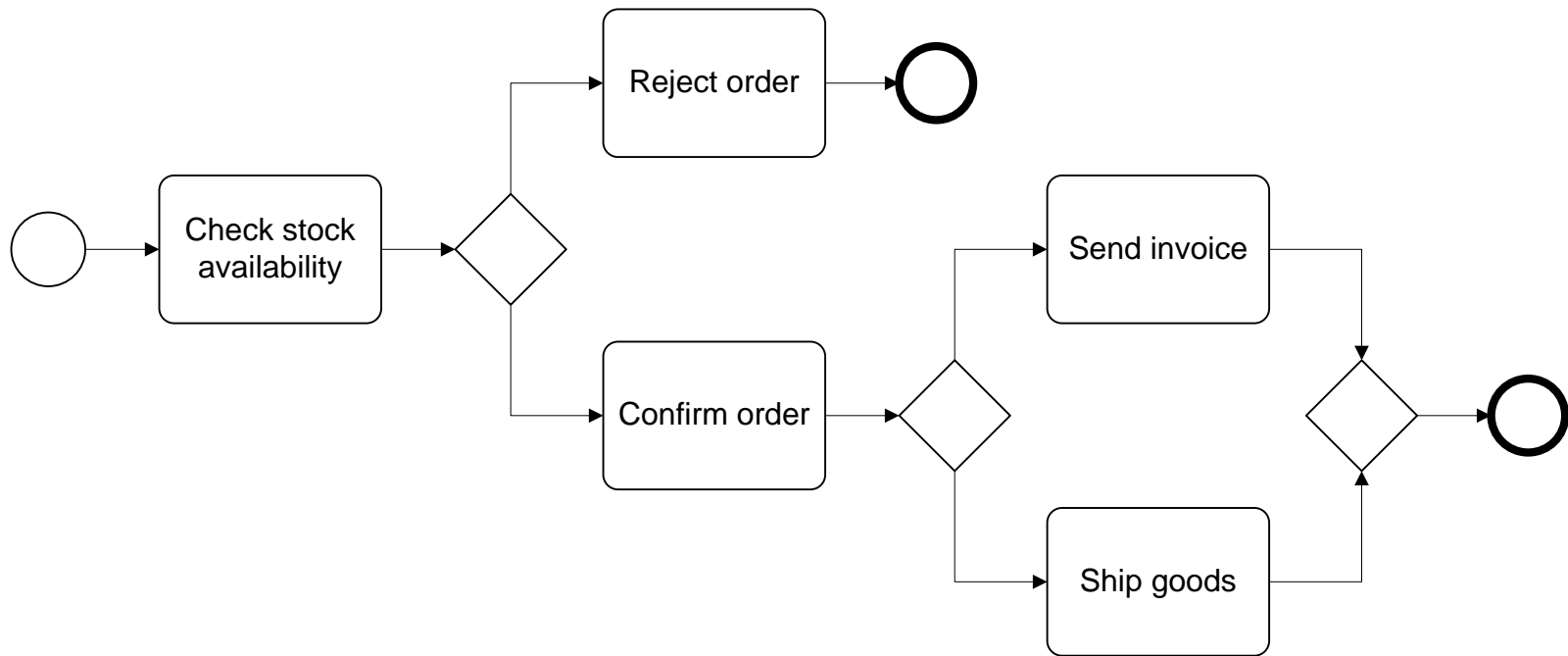
A little bit more on Gateways …

- Exclusive Decision / Merge
  - Indicates locations within a business process where the sequence flow can take two or more alternative paths.
  - **Only one** of the paths can be taken.
  - Depicted by a diamond shape that *may* contain a marker that is shaped like an "X".
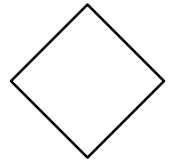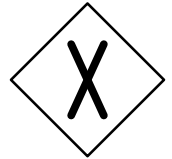
- Parallel Fork / Join
  - Provide a mechanism to synchronize parallel flow and to create parallel flow.
  - Depicted by a diamond shape that *must* contain a marker that is shaped like a plus sign.
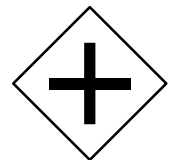
Revised Order Management Process
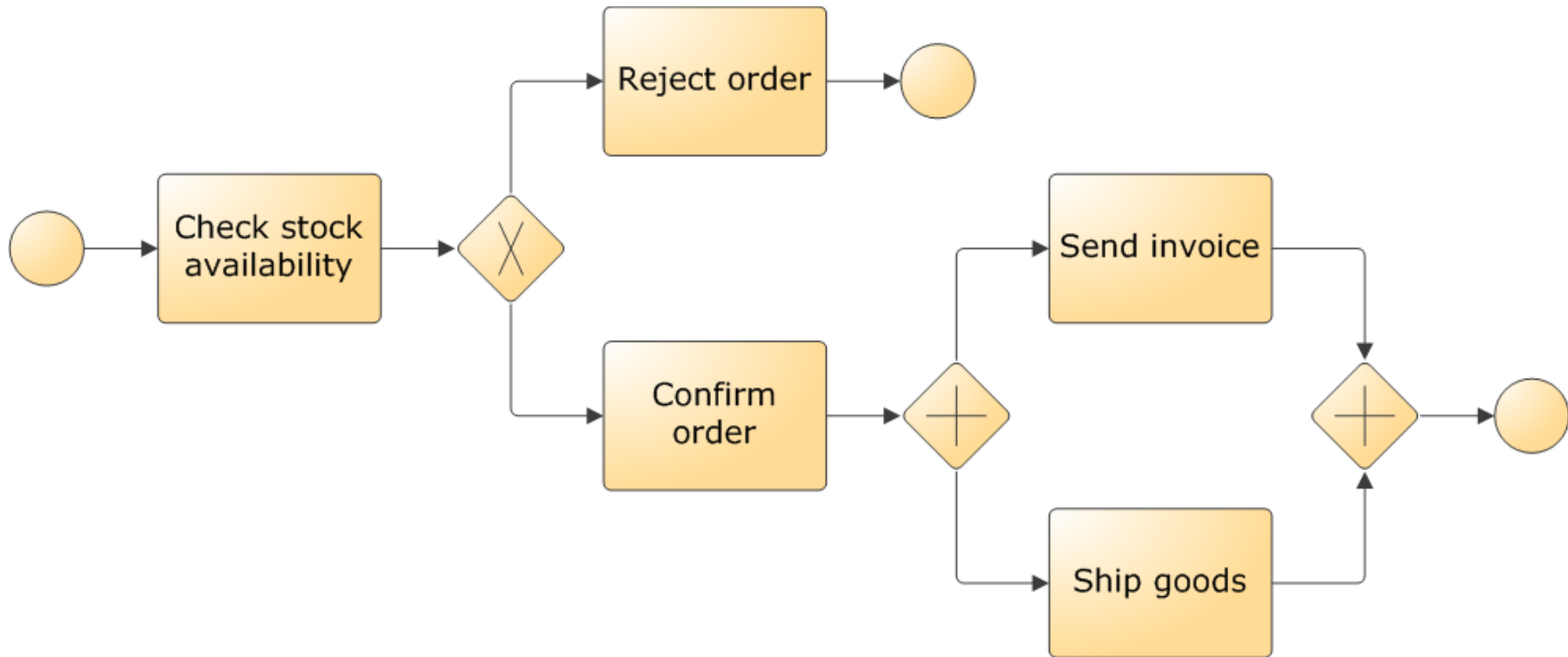
BPMN Exercise:
Simplified Insurance Claim Registration

When a claim is received, it is first checked whether the claimant has a valid insurance policy. If not, the claimant is informed that the claim is rejected due to an invalid policy.

Otherwise, the severity of the claim is evaluated. Based on the outcome (simple or complex claims), relevant forms are sent to the claimant. Once the forms are returned, they are checked for completeness.

If the forms are complete, the claim is registered in the Claims Management system and the evaluation of the claim may start. Otherwise, the claimant is asked to update the forms. Upon reception of the updated forms, they are checked again.

Process Modelling Viewpoints

Organization

Who?

What?

Function

When?

Process

Which?

Data / Service / Product
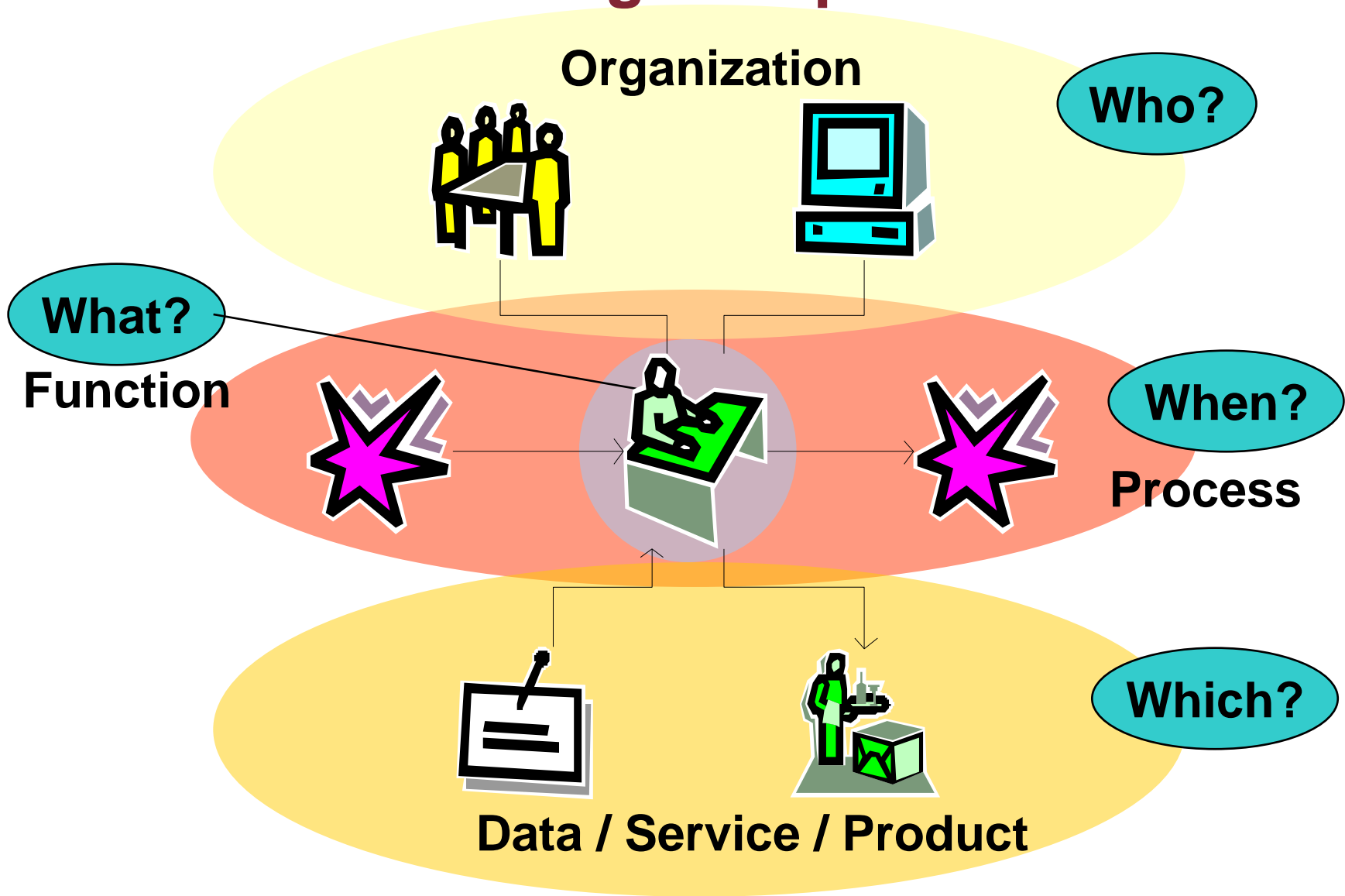
Organisational Elements in Process Models

Two basic abstractions:

- **Resource:** Human actor or equipment (e.g., printer) that is required to perform an activity

- **Resource class:** Set of resources with shared characteristics, e.g., *Clerk*, *Manager*, *Insurance Officer*

A *resource class* may be a:

- **Role** (skill, competence, qualification) Classification based on what a resource can do or is expected to do.

- **Group** (department, team, office, organizational unit) Classification based on the organization's structure.

Resource Modelling in BPMN

- In BPMN, resource classes are captured using:
  - Pools – <u>independent</u> organizational entities, e.g.
    - *Customer, Supplier, Sapienza University, Department of CS*
  - Lanes – resource classes in the same organizational space and sharing common systems
    - *Sales Department, Marketing Department*
    - *Clerk, Manager, Engineer*
    - *Department of CS*

Lanes and Pools – Notation
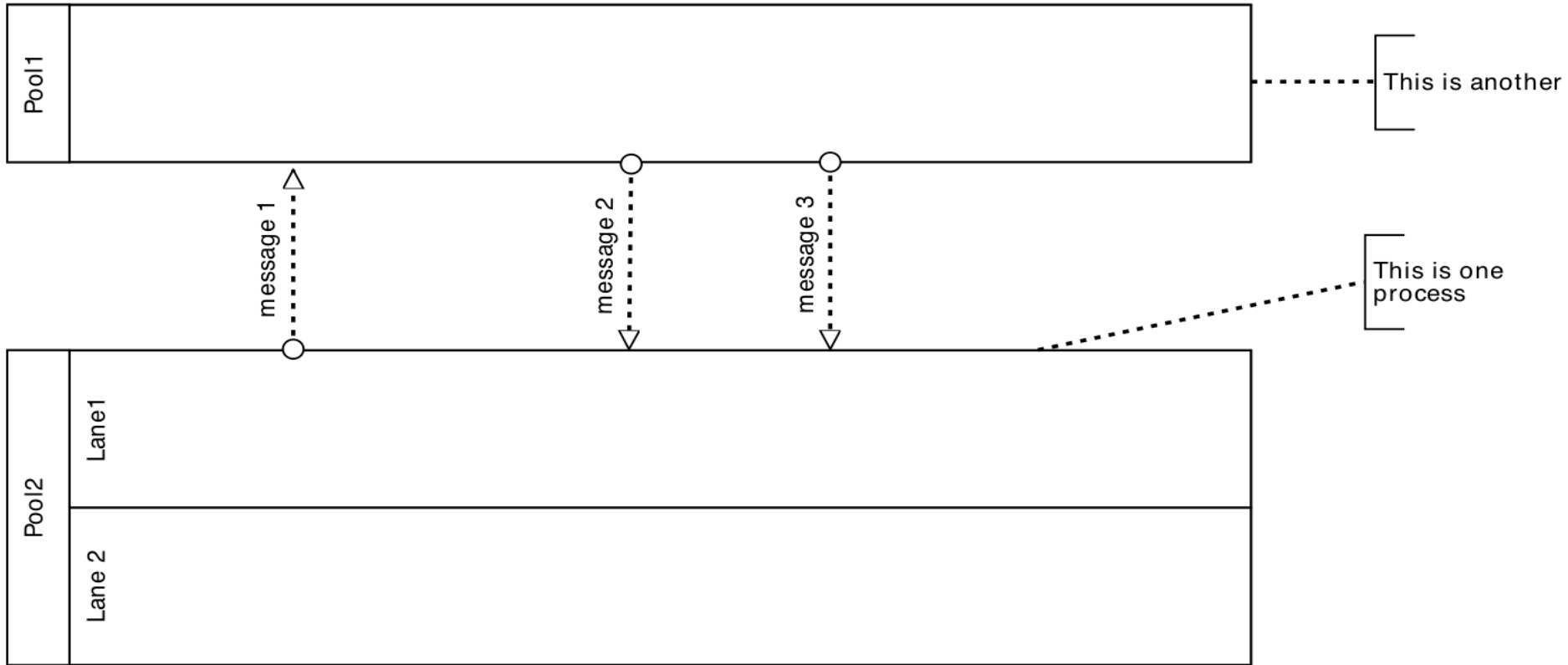
Order Management Process with Pools
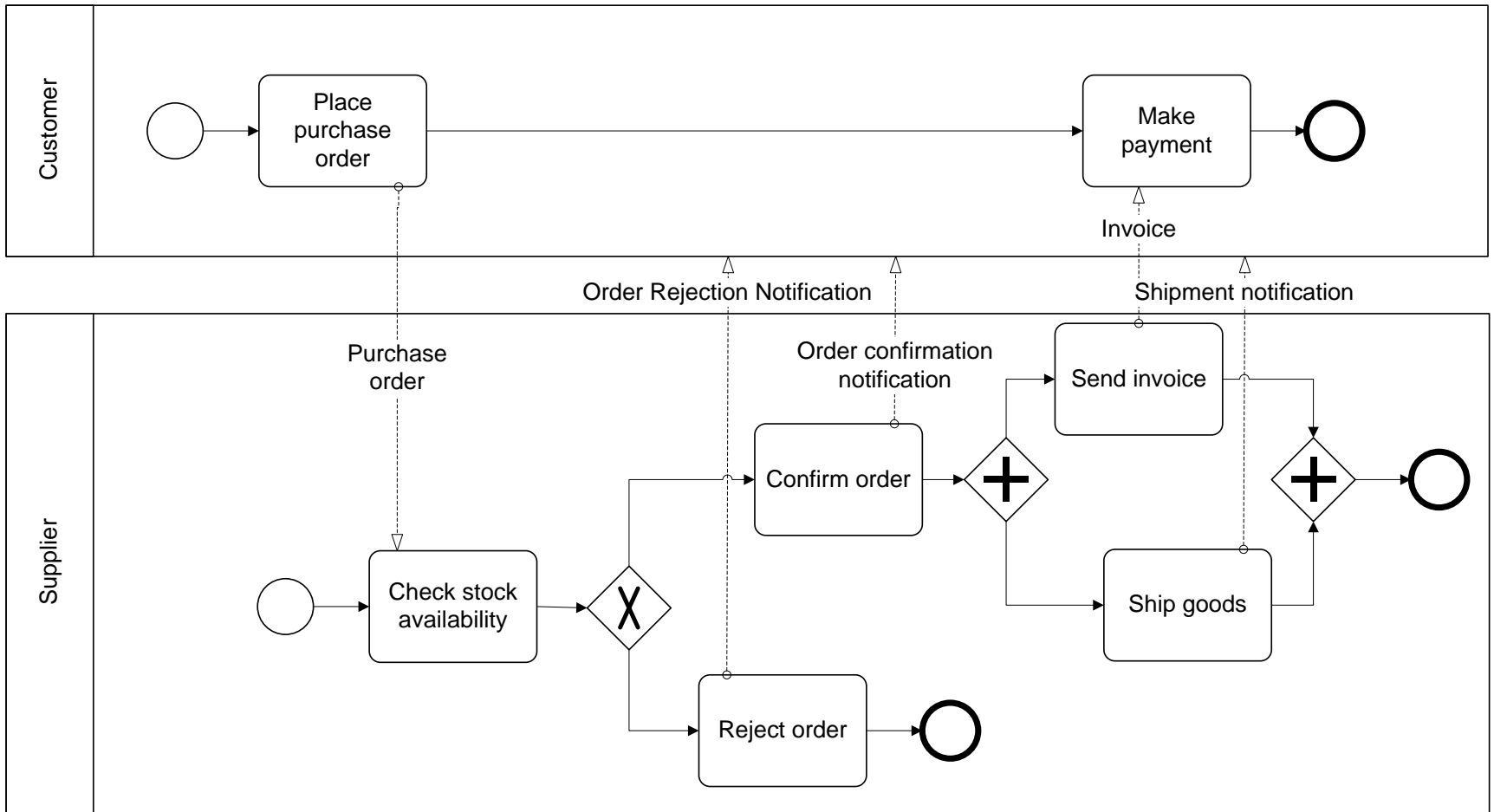
Order Management Process with Lanes
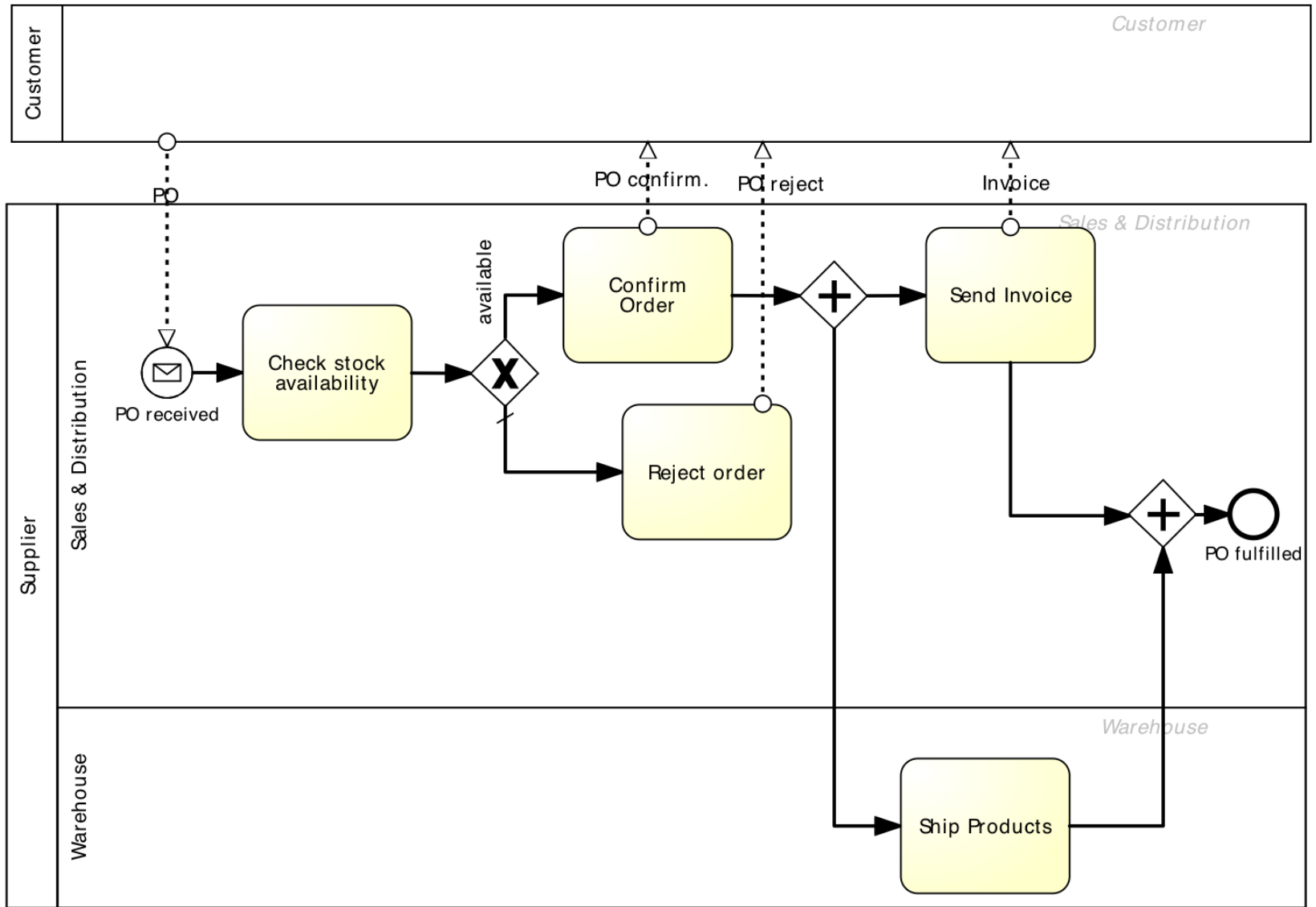
BPMN Exercise: Lanes, Pools

- Claims Handling process at a car insurer

    A customer submits a claim by sending in relevant documentation. The *Customer Service* department checks the documents for completeness and registers the claim. The *Claims Handling* department picks up the claim and first checks the insurance policy. Then, an assessment is performed. If the assessment is positive, a garage is phoned to authorise the repairs and the payment is scheduled (in this order). In any case (whether the outcome is positive or negative), an e-mail is sent to the customer to notify the outcome.

Identifying data, actions, gateways, pools

- Claims Handling process at a car insurer

    A customer submits a claim by sending in relevant documentation. The Customer Service department checks the documents for completeness and registers the claim. The Claims Handling department picks up the claim and first checks the insurance policy. Then, an assessment is performed. If the assessment is positive, a garage is phoned to authorise the repairs and the payment is scheduled (in this order). In any case (whether the outcome is positive or negative), an e-mail is sent to the customer to notify the outcome.

BPMN Information *Artifacts*

Data Object

- *Data Objects* are a mechanism to show how data is required or produced by activities.
  - Are depicted by a rectangle that has its upper-right corner folded over.
  - Represent input and output of a process activity.

Data Store

- Data stores are containers of data objects that need be persisted beyond the duration of a process instance
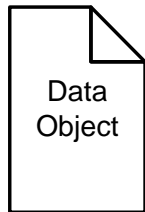
Directed association

Undirected association

- Associations are used to link artifacts such as data objects and data stores with flow objects (e.g., activities).

Order Processing Model with Artifacts
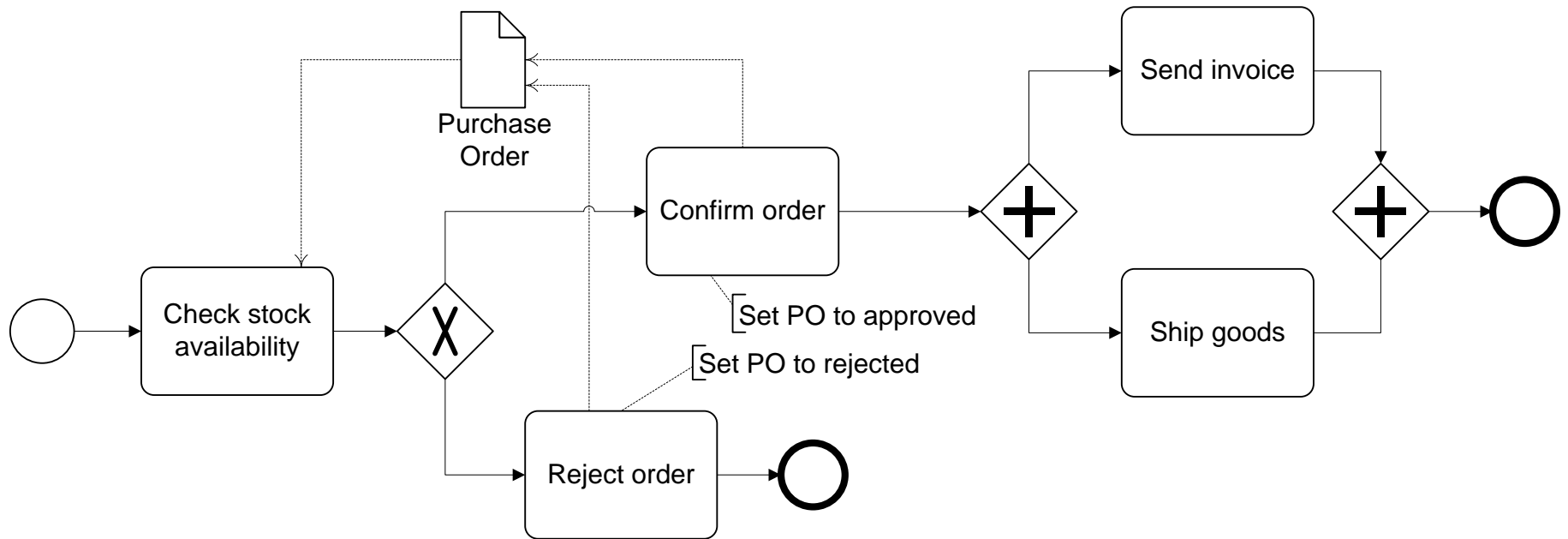
BPMN Exercise 3: Artifacts

When a claim related to a major car accident is evaluated, a clerk first retrieves the corresponding car accident report in the *Police Reports* database. If the report is retrieved, it is attached to the claim file. The claim file and the police report serve as input to a claims handler who calculates an initial claim estimate. Then, an "action plan" is created based on a "checklist". Based on the action plan and the initial claims estimate, a claims manager negotiates a settlement with the customer. After this negotiation, the claims manager makes a final decision, updates the claim file to record this decision, and sends a letter to the claimant to inform him/her of the decision.

Please depict all relevant documents in the model.

BPMN Main Elements - Recap

Connections

○-------▷ Message

---------------- Association

------▶ Flow

Swimlanes

Pool

Lane

Flow Objects

Gateway

Event

Activity

Artifacts

Text Annotation

Data Object

Data Store
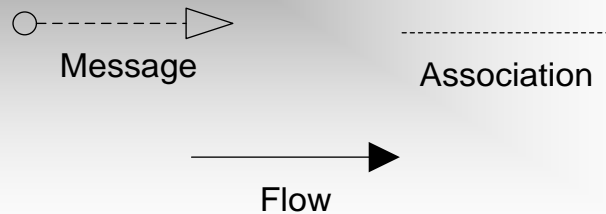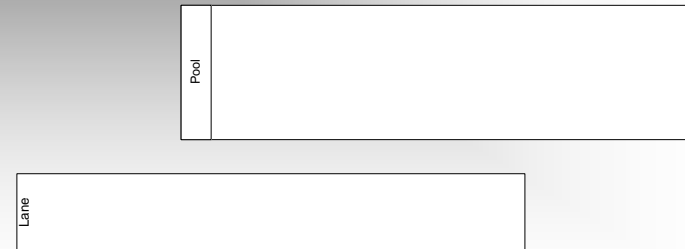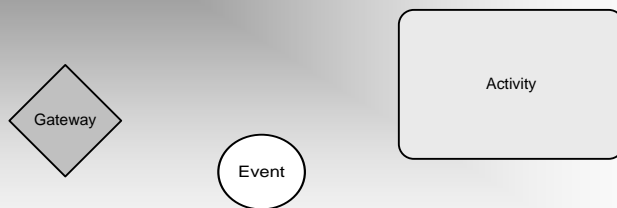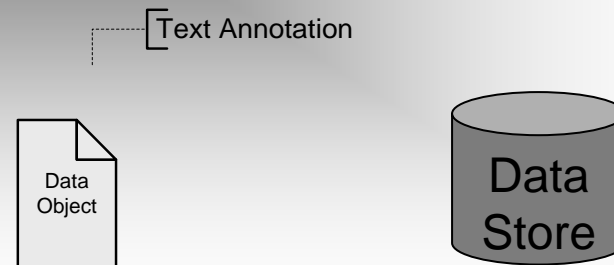
BPMN Flow Elements – Recap

Start Event

Task

End Event

Flow
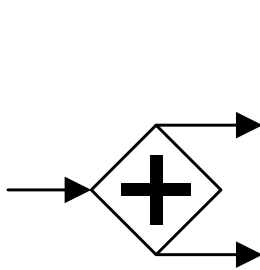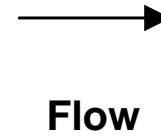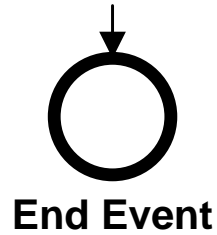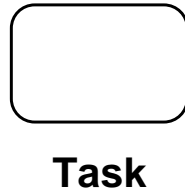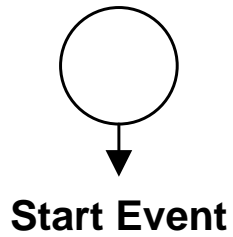
AND-Join

AND-Split
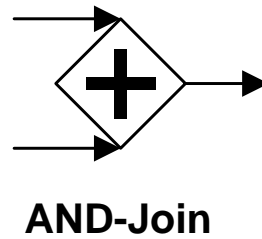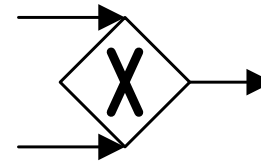
XOR-Decision

XOR Merge
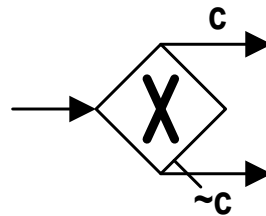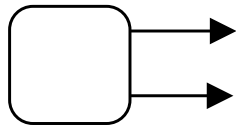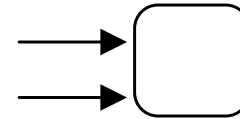
What's wrong with this model?
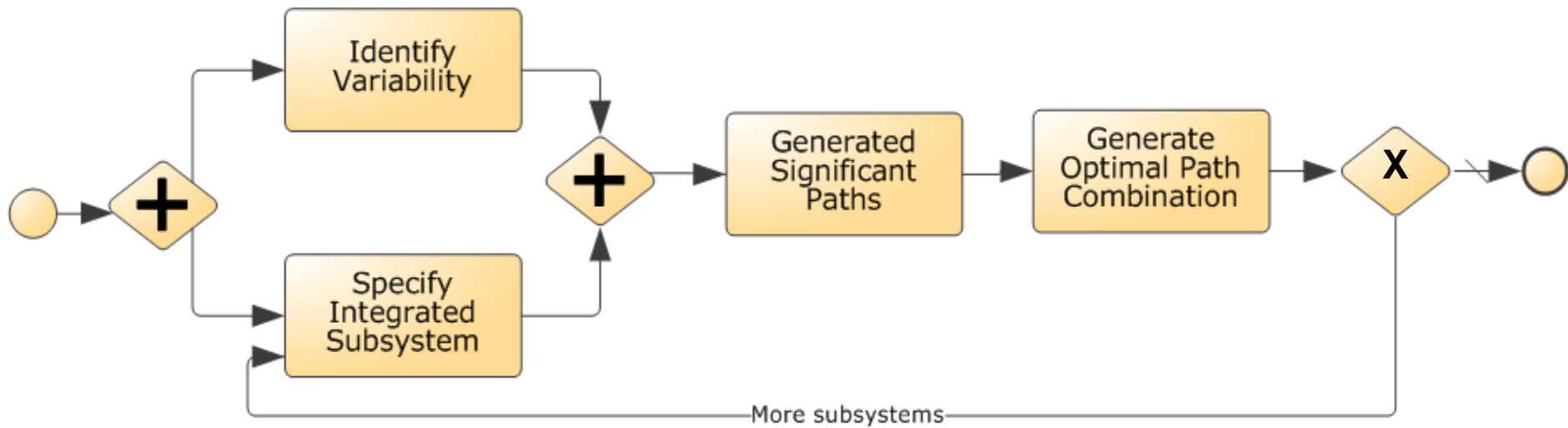
BPMN Gateways

Exclusive (XOR)	Parallel (AND)	Inclusive (OR)
• <u>Exclusive decision</u> take one branch • <u>Exclusive merge</u> Proceed when one branch has completed	• <u>Parallel split</u> take all branches • <u>Parallel join</u> proceed when all incoming branches have completed	• <u>Inclusive decision</u> take one or several branches depending on conditions • <u>Inclusive merge</u> proceed when all <u>active</u> incoming branches have completed

Example: OR gateways
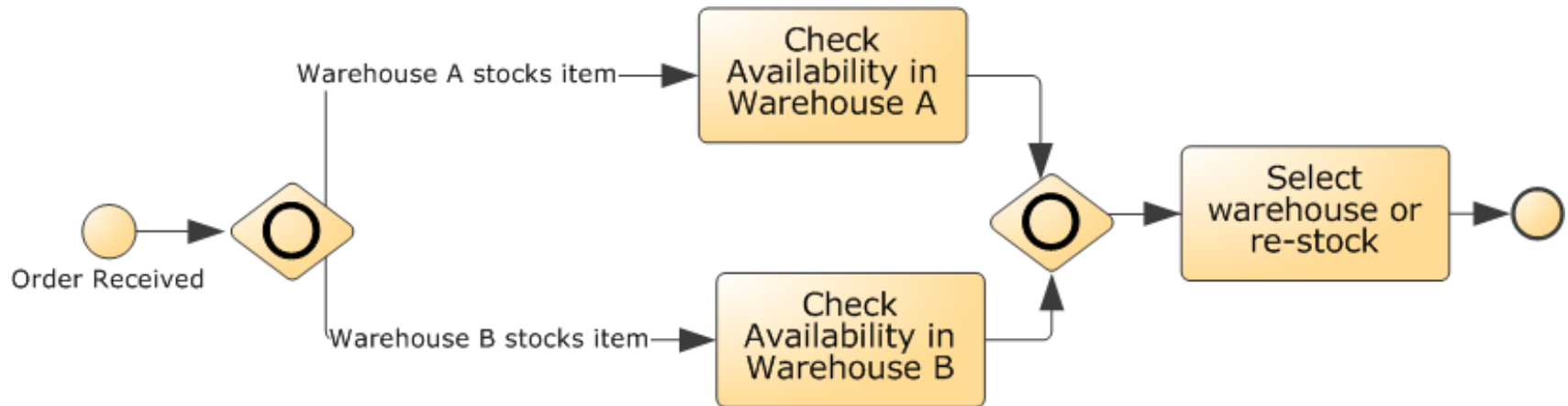
How can we fix this model?
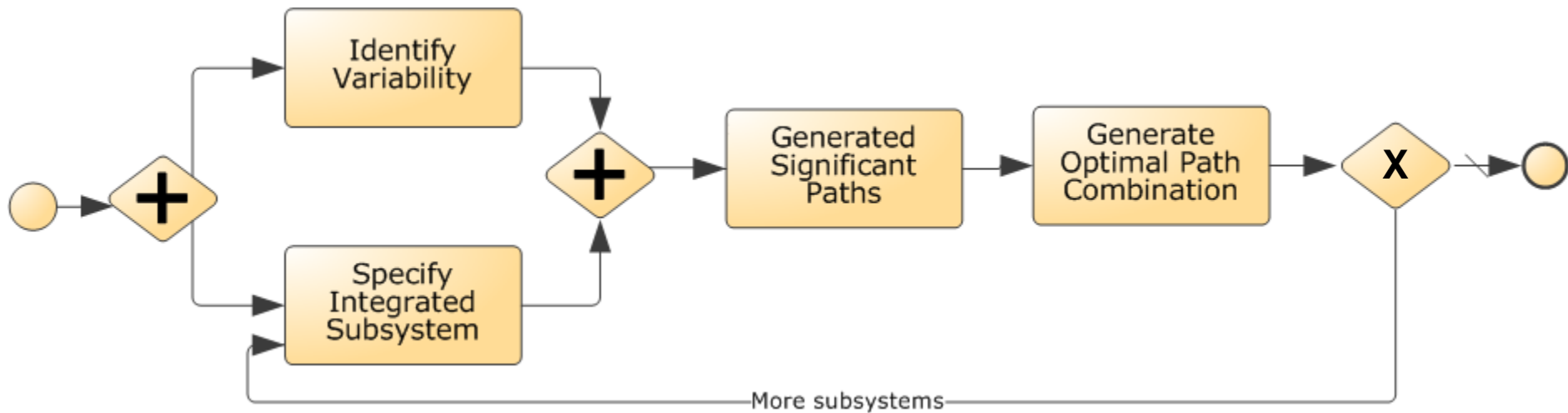
Exercise

Model the following fragment using OR gateways:

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.

Check also the self-test quiz available at: http://www.proprofs.com/quiz-school/story.php?title=essentials-of-process-modeling

About the control structures: XOR gateways
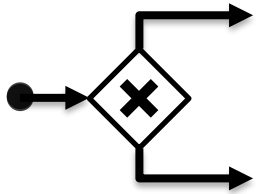
XOR split:
take **one** outgoing branch
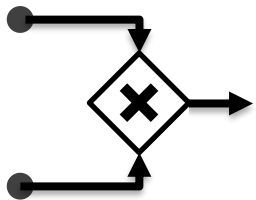
XOR join:
proceed when **one** incoming branch completes

About the control structures: AND gateways
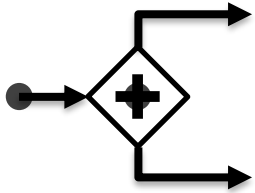
AND split:
take **all** outgoing branches
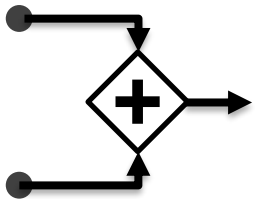
AND join:
proceed when **all** incoming branches complete

Process model vs process instances: The token game

● Order #1
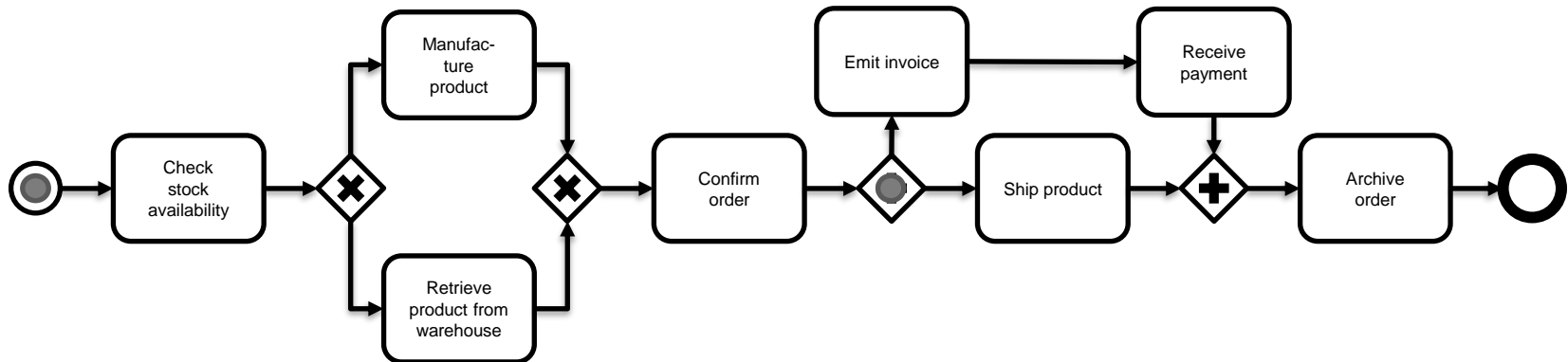
Process model vs process instances: The token game
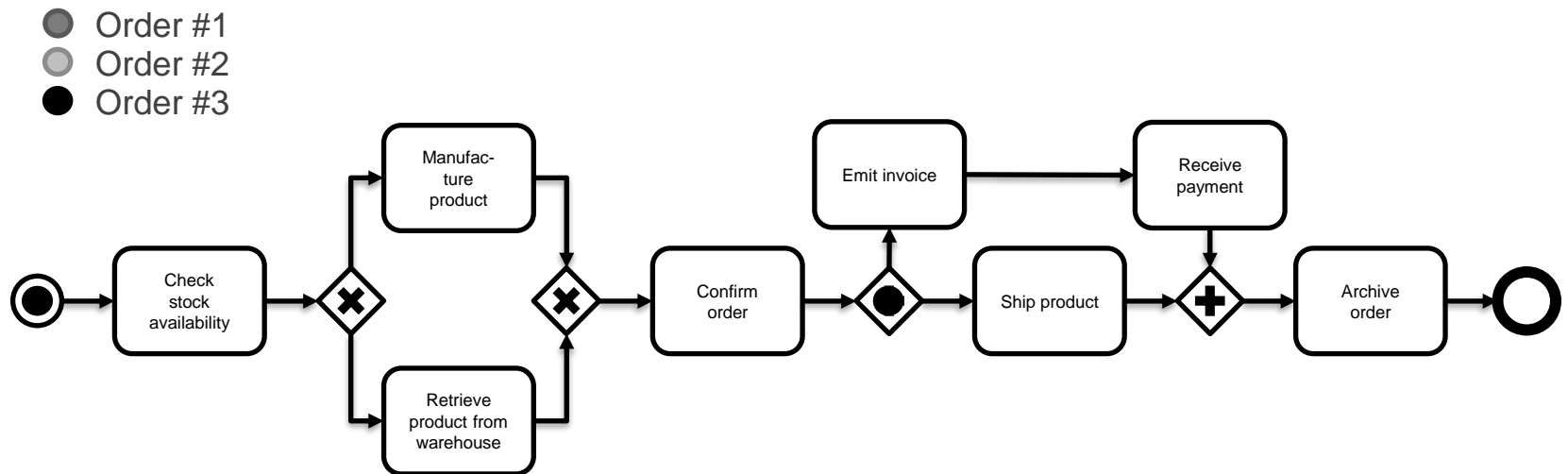
Invoice checking process

As soon as an invoice is received from a customer, it needs to be checked for mismatches.

The check may result in either of these three options:

i)   there are no mismatches, in which case the invoice is posted;

ii) there are mismatches but these can be corrected, in which case the invoice is re-sent to the customer;

iii) there are mismatches but these cannot be corrected, in which case the invoice is blocked. Once one of these three activities is performed the invoice is parked and the process completes.

Invoice checking process BPMN
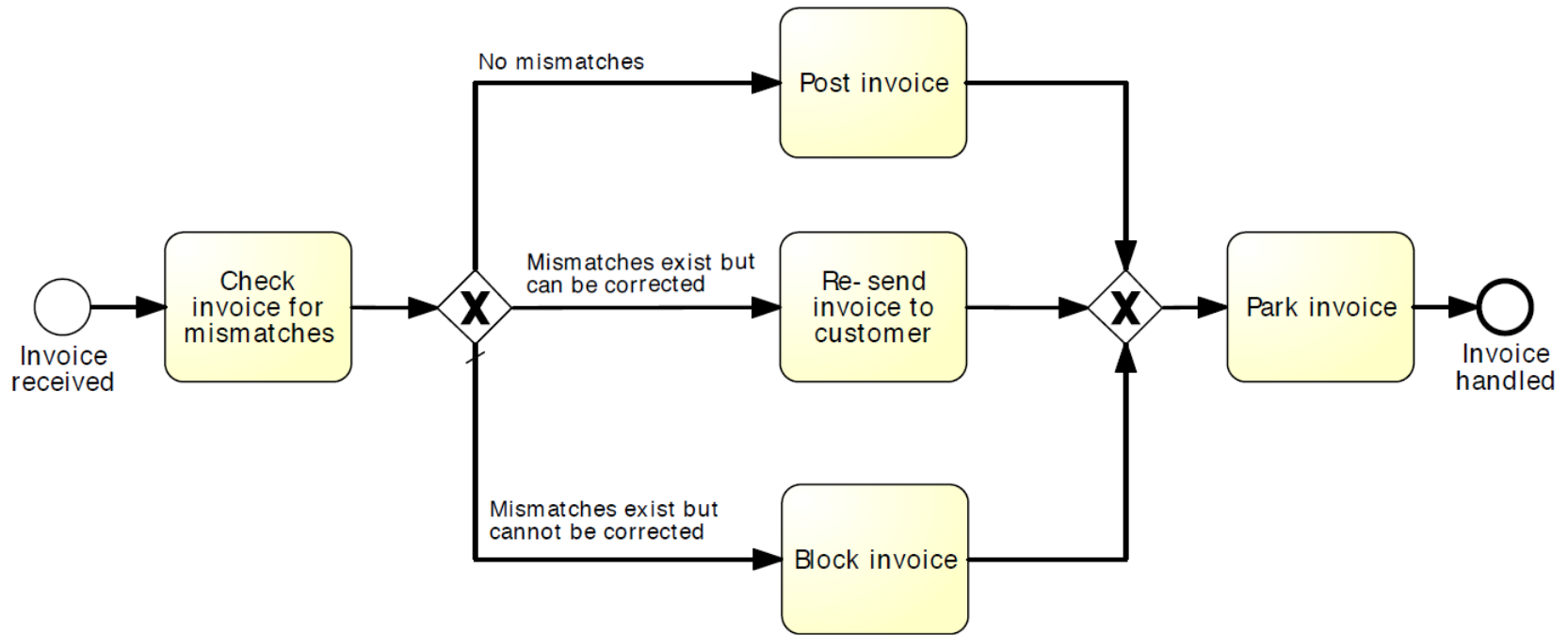
Security check at the airport

Once the boarding pass has been received, passengers proceed to the security check.

Here they need to pass the personal security screening and the luggage screening.

Afterwards, they can proceed to the departure level.

Security check at the airport BPMN
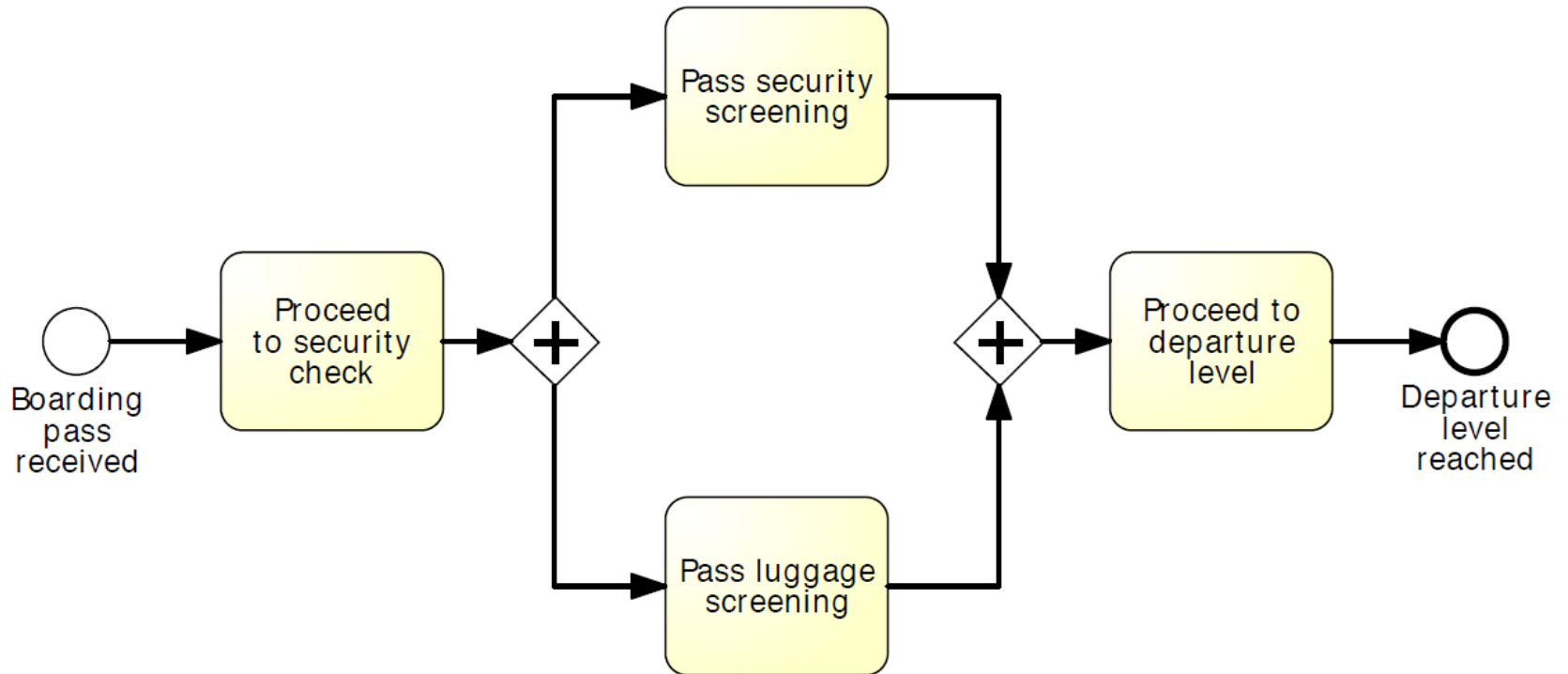
Order distribution process

A company has two warehouses that store different products: Amsterdam and Hamburg. When an order is received, it is distributed across these warehouses:

- if some of the relevant products are maintained in Amsterdam, a sub-order is sent there;

- likewise, if some relevant products are maintained in Hamburg, a sub-order is sent there.

Then, the order is registered and the process completes.

Order distribution process BPMN
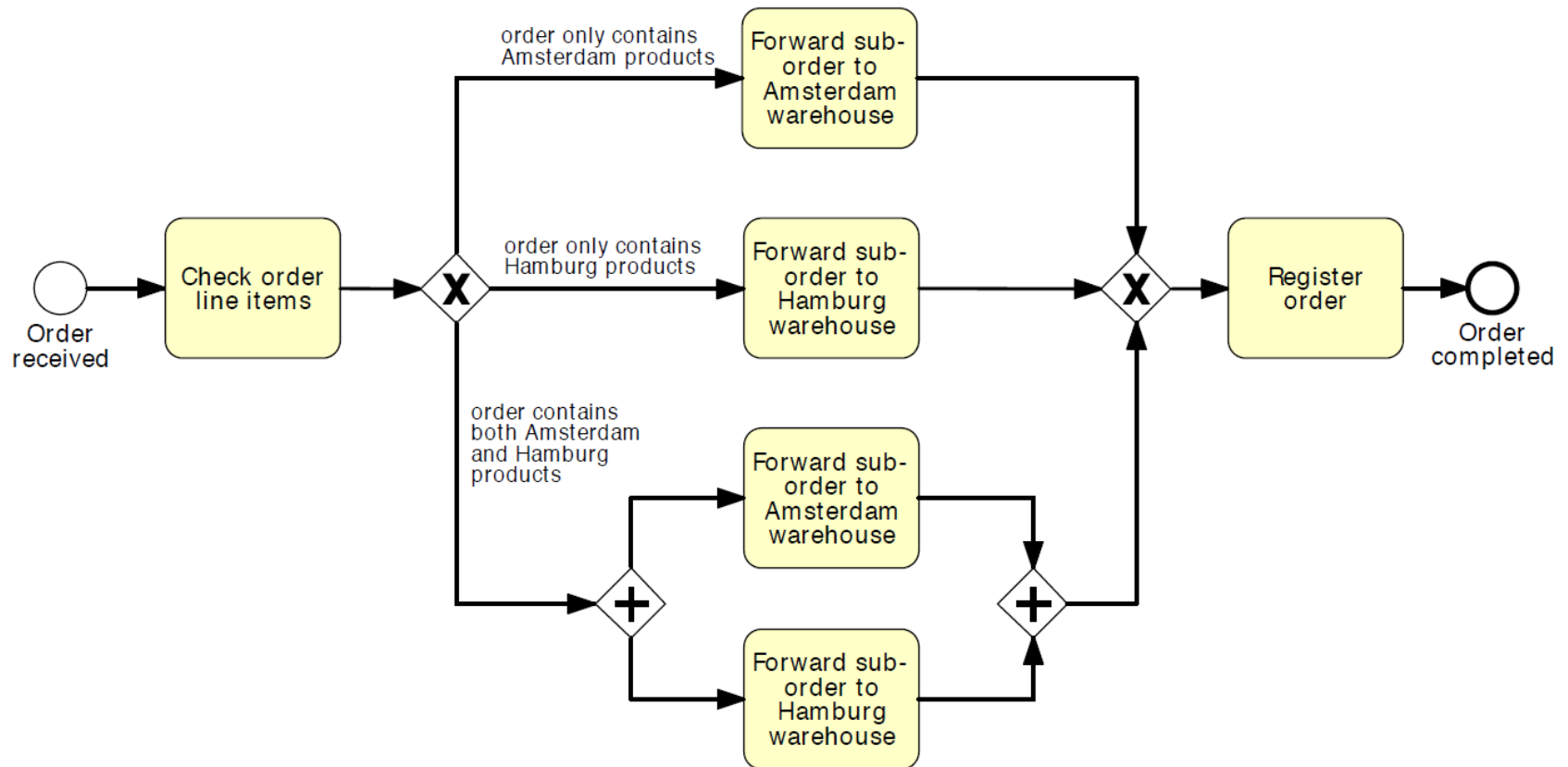
About the control structures: OR gateways
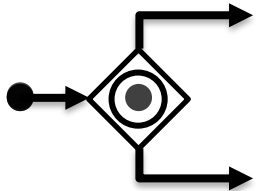
OR split:
take **one or more** outgoing branches
(we refer to them as *active*)
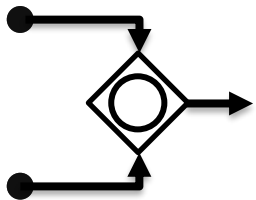
OR join:
proceed when **all** *active* incoming branches complete

Order distribution process with OR
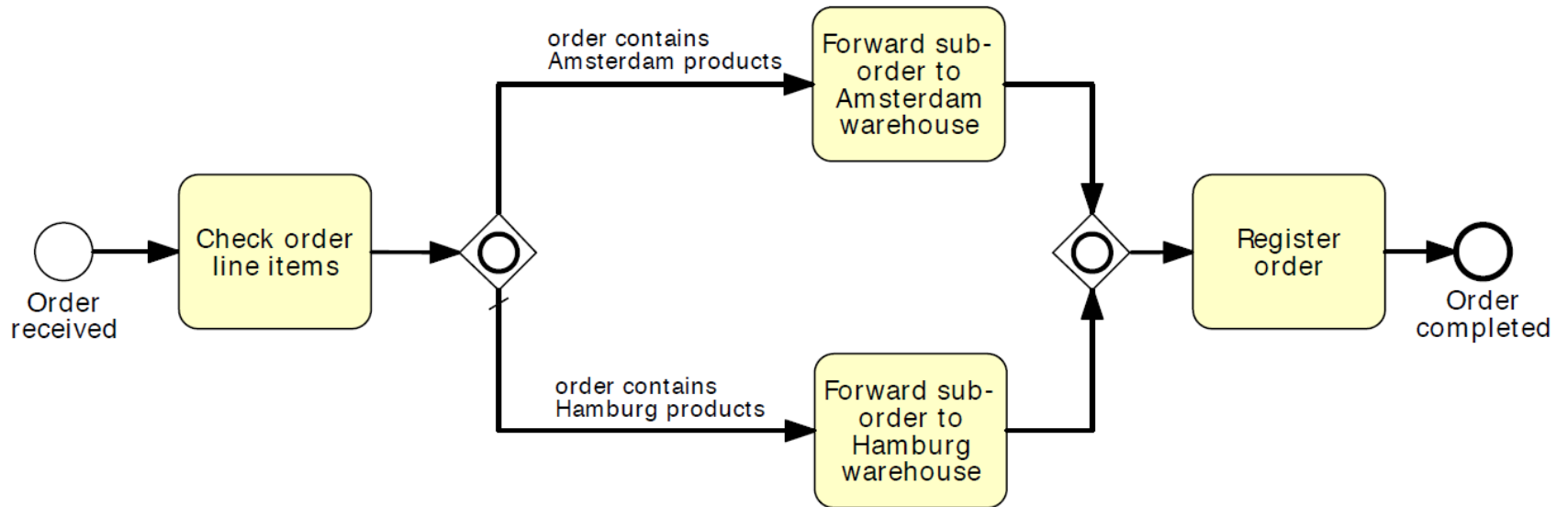
Ministerial correspondence

In treasury minister's office, once a ministerial inquiry has been received, it is first registered into the system.

Then, inquiry is investigated so that a ministerial response can be prepared.

Finalization of a response includes preparation by the cabinet officer and review by principal registrar.

If registrar does not approve response, the latter needs to be prepared again by the cabinet officer for review.

Process finishes only once response is approved.

Ministerial correspondence BPMN
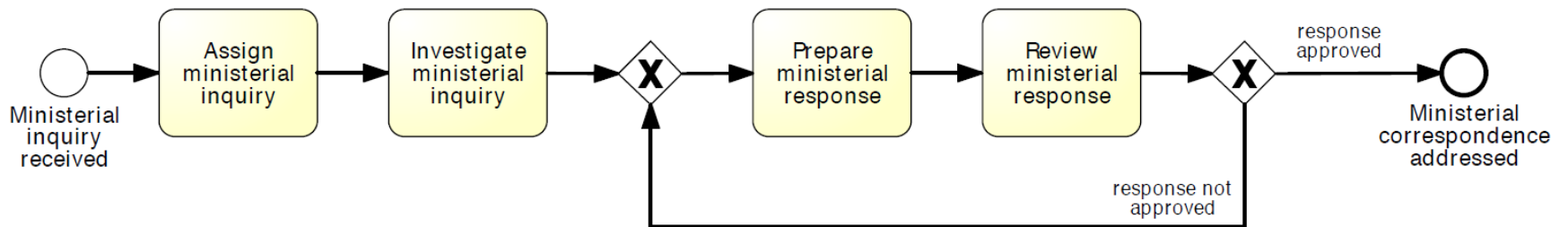
Process perspectives

- Control flow
- Resources
- Data
- Time

Artifacts in BPMN: the data perspective

(incoming)
Data association
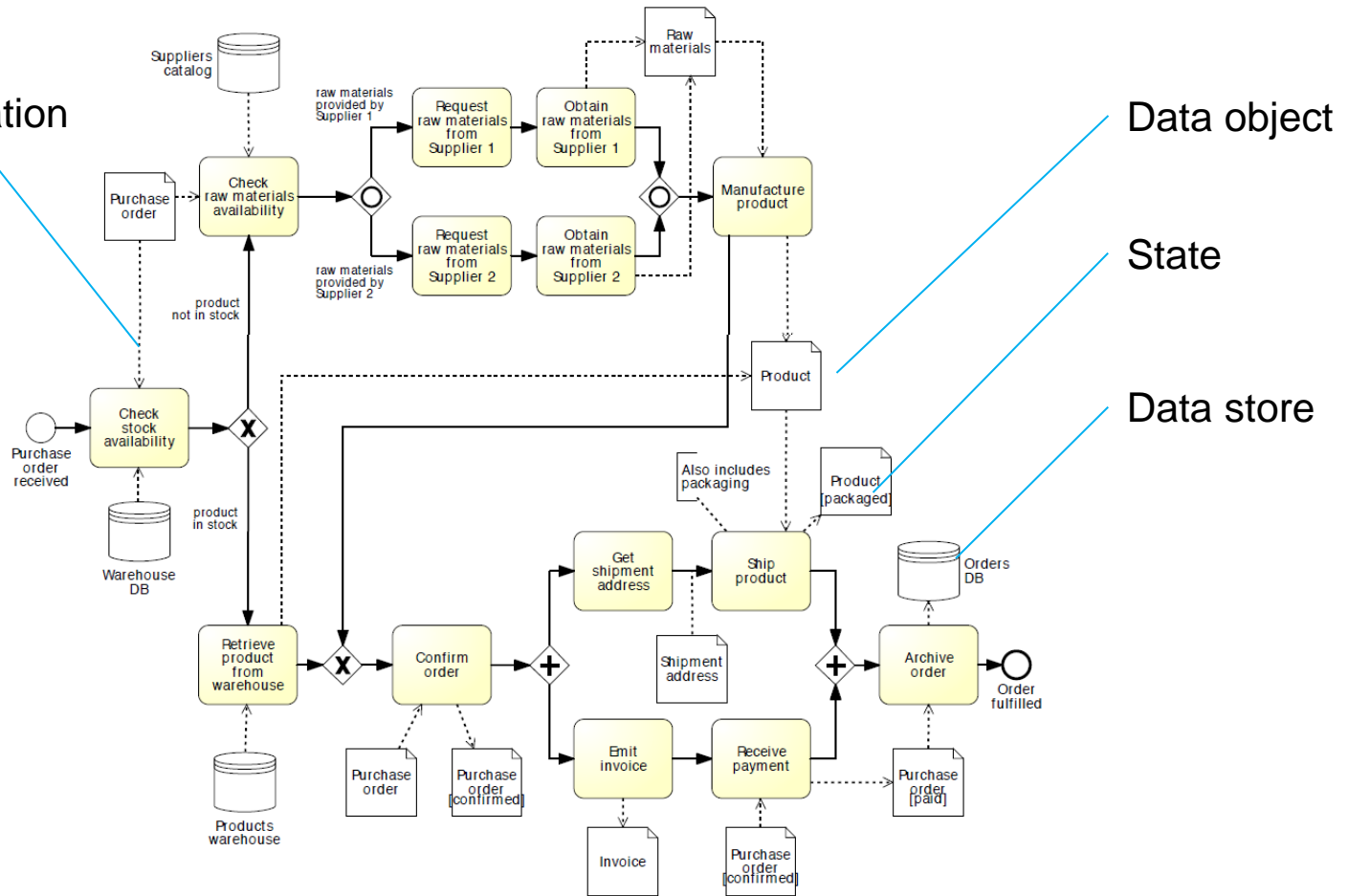
Data object

State

Data store

Resource perspective
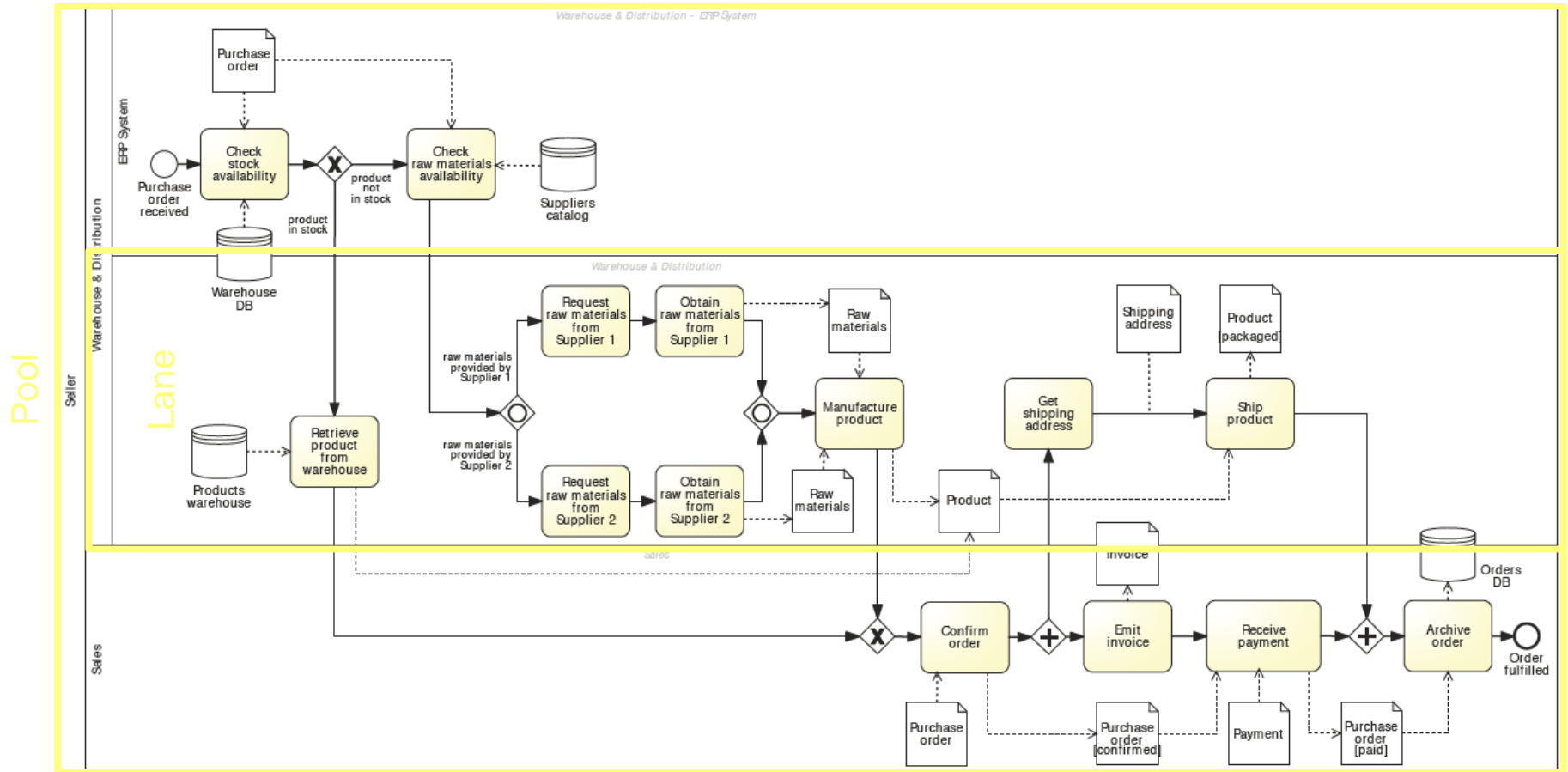
Collaboration diagram
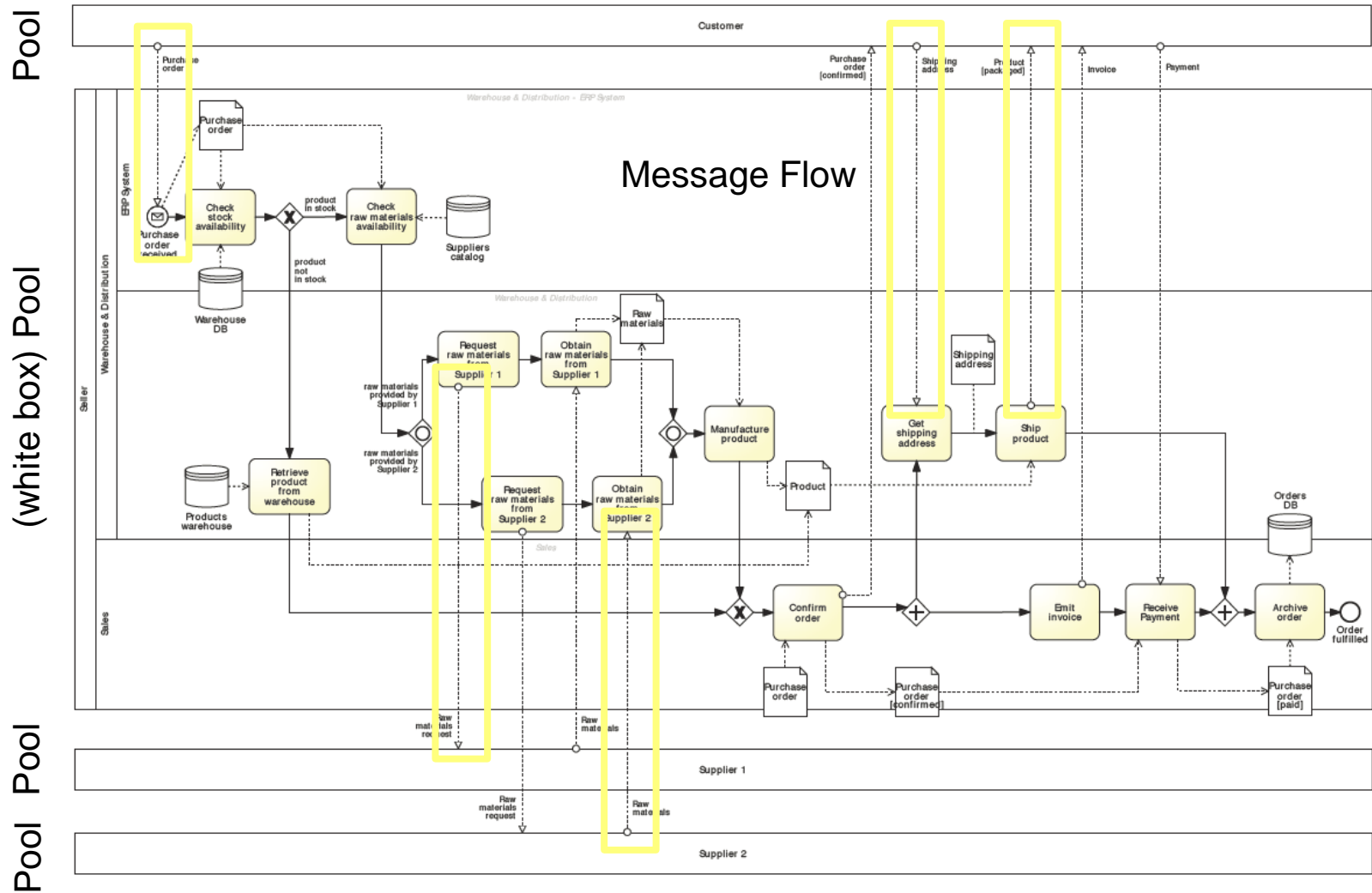
Message Flow

BPMN Dos and Don'ts

- Structure
- In every white-box pool there must be a path of sequence flow arcs from start event to end event
- Sequence flow not allowed to cross pool boundaries
- Message flow always has to cross pool boundaries
- Split gateway should have corresponding join gateway

BPMN Dos and Don'ts

- Names

- Activities are written as VERB OBJECT like "send bill"

- Events are written as OBJECT PAST PARTICIPLE like "bill sent"

- Decision gateways are annotated with a question like "Send bill how?"

- Arcs after decisions are annotated with answer to question like "via post" or "via email"

http://academic.signavio.com/p/login

https://bpmn.io/

Block2BPMN

Business Process Management

Suggested readings

- Marlon Dumas, Marcello La Rosa, Jan Mendling, Hajo A. Reijers: Fundamentals of Business Process Management, Second Edition. Springer 2018, ISBN 978-3-662-56508-7, pp. 1-527
  - Chapters 3, 5

- Jan Mendling, Hajo A. Reijers, Wil M. P. van der Aalst: Seven process modeling guidelines (7PMG). Information & Software Technology 52(2): 127-136 (2010)
  - https://pdfs.semanticscholar.org/f894/f07298bea01edde58ee643267315dce1bb75.pdf

Seven process modeling guidelines (7PMG)

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ABSTRACT

Business process modeling is heavily applied in practice, but important quality issues have not been addressed thoroughly by research. A notorious problem is the low level of modeling competence that many casual modelers in process documentation projects have. Existing approaches towards model quality might be of benefit, but they suffer from at least one of the following problems. On the one hand, frameworks like SEQUAL and the Guidelines of Modeling are too abstract to be applicable for novices and non-experts in practice. On the other hand, there are collections of pragmatic hints that lack a sound research foundation. In this paper, we analyze existing research on relationships between model structure on the one hand and error probability and understanding on the other hand. As a synthesis we propose a set of seven process modeling guidelines (7PMG). Each of these guidelines builds on strong empirical insights, yet they are formulated to be intuitive to practitioners. Furthermore, we analyze how the guidelines are prioritized by industry experts. In this regard, the seven guidelines have the potential to serve as an important tool of knowledge transfer from academia into modeling practice.

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1. Introduction

Since the 1970s and 1980s, conceptual modeling is a major research area in the IS field. The main motivation to engage in conceptual modeling is to reduce the chances on developing faulty requirements in the early phases of system development [1]. A recent empirical study has shown that business processes have become the central objects in many conceptual modeling efforts, e.g. to support their documentation, improvement and automated enactment [2]. This development can be explained by an increased focus of enterprises on those same business processes: they are perceived as the most relevant entities to be managed towards enhanced organizational performance [3].

Usability is an important quality issue of process documentation [4]. As understanding the process is a crucial task in any process analysis technique [5], the process model itself should be intuitive and easy to comprehend too. Process modeling tools, like ARIS and Casewise, have greatly eased the standardization, storage, and sharing of diagrams of process. Many enterprises have adopted such tools as they are perceived as much better alternatives to the use of pen and paper, or even general graphical drawing tools, e.g. Microsoft's Visio or Powerpoint. But despite the support that is provided by tools, users hardly get any support in creating process models that business professionals can easily

analyze and understand. Adequate guidance is of particular importance as large projects on process documentation heavily rely on novices and non-expert modelers [6]. To appreciate the impact of a model that is difficult to assess, it should be realized that in the execution of a single project dozens, hundreds or even thousands of process models may be developed [7,8]. This clarifies why a process model that is immediately usable towards its purpose is of great economic benefit.

Even though some theoretical frameworks and guidelines are available in the area of process modeling, for instance SEQUAL or the Guidelines of Modeling [9,10], these typically require a certain level of modeling competence. They distinguish the major quality categories, but remain too abstract to be directly applicable by non-experts. In other words, such guidelines are hardly related to the concrete actions that process modelers undertake in capturing e.g. the steps and actors in a process. More practice-oriented and -inspired guidelines are available too, see e.g. [11]. The problem behind such guidelines is that hardly any empirical support is provided for them and, if available, it is anecdotic at best. From a research perspective, it can be noted that much of the existing work into process modeling does not focus on providing modeling support either. Rather, the interest is with the more formal side of process modeling, see e.g. [12,13].

This paper seeks to support the builders of business process models by providing them with a set of seven modeling guidelines, called 7PMG. This set is thought to be helpful in guiding users towards improving the quality of their models, in the sense that these are likely (1) to become comprehensible to various