

## **LECTURE 3: BUSINESS ARCHITECTURE ASPECTS: BUSINESS PROCESS MODELLING**

### Historical View of BP Modelling

- **Work Process Flow (early to mid 1900s)**
  - Frank Gilbreth & his 'Flow Process Charts' (= *flowcharts*)
  - First structured method for documenting process flow
- **Work Flow (mid-1940s)**
  - Motivation was disenchantment with the above
  - Also a need to show the role of the performer
  - Acted as a genesis for BP Modelling
- **Business Process Modelling (2000s)**
  - Trend towards more complex manufacturing paradigms
  - E.g. 'Virtual Enterprises': distributed, parallel BP in each VE entity
  - Need effective process modelling with strict model analysis
  - Standardisation: reuse of process templates

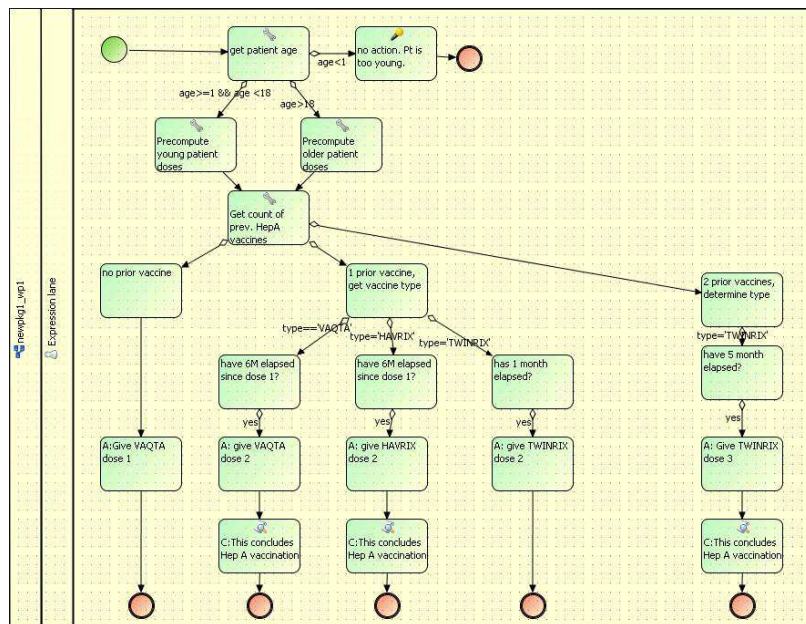
## Business Process Modelling

- What is it?
  - Activity of representing enterprise's BPs, to analyse/ improve current BP.
  - Usually done by business analysts/ managers to improve BP efficiency, quality.
  - The process improvements identified by BPM may or may not require IT involvement, although that is a common driver behind modelling a BP
- BPM helps companies to:
  - To become more process-oriented thro using standardised BPs
  - To optimise business processes thro Process Change Mgmt: long term planning, execution & control of processes
  - To document and manage processes on an ongoing basis
  - To simulate BP using, i.a. Monte Carlo simulation & Discrete Event Simulation

## Business Process Modelling Notation

- Why BPM Notation (BPMN)?
  - => a notation that can be understood by all business users.
  - i.e. business analysts (creating initial drafts of processes)
  - & technical developers (implementing technology performing those BPs).
- Where does BPMN fit in with tools (WF/UML diagrams)?
  - swimlanes/WF not flexible for whole orgs so BPMN encapsulates WF models thro use of swimlane diagrams
  - process is sound = a pathway exists leading system to the final state.
    - In a BP model with formal execution semantics, these properties are defined precisely & verified automatically by tools.
  - BPM Diagrams can be translated to Petri Nets for analysis & verification.
  - Can map to UML, XPD (XML-like, for serialization of BPMN diagrams)

## XML Process Definition Language (XPDL)



## BPMN: Business Process Diagrams

- BPMN specifies one Business Process Diagram (BPD).
- Diagram designed to do two things well:
  - easy to use/ understand: to be used to quickly & easily model business processes, & be easily understandable by non-tech users (usually mgmt).
  - offers expressiveness to model very complex BPs & can be naturally mapped to business execution languages.
- Steps:
  - model the events occurring to start, run & end BPs, with interplay/ results
  - business decisions and branching of flows is modelled using gateways.
  - process can have sub-processes,
    - a '+' mark in process symbol denotes that process is decomposed;
    - if it doesn't have a '+' mark, it is a task.

# Business Process Modelling Notation (BPMN)

- **OMG Standard, supported by many tools:**
  - Pegasystems
  - Appian
  - IBM Websphere Business Modeler
  - ARIS
  - Oracle BPA
  - Business Process Visual Architect (Visual Paradigm)
  - Progress Savvion Business Modeller
  - **Signavio** (<http://www.signavio.com/>)

## BPMN Elements

3 primary modelling elements (flow objects):

- **Events**
- **Activities**
- **Gateways**

Three ways of connecting primary modelling elements (Connecting Objects):









- **Sequence Flow**
- **Message Flow**
- **Association**

There are two ways of grouping the primary modelling elements through Swim lanes (Grouping Objects):

- **Pools**
- **Lanes**

... And there are some Artifacts

Table 7.1 BPD Core Element Set

Element	Description	Notation
Event	An event is something that "happens" during the course of a business process. These events affect the flow of the process and usually have a cause (trigger) or an impact (result). Events are circles with open centers to allow internal markers to differentiate different triggers or results. There are three types of Events, based on when they affect the flow: Start, Intermediate, and End.	
Activity	An activity is a generic term for work that the company performs. An activity can be atomic or nonatomic (compound). The types of activities that are a part of a Process Model are Process, Subprocess, and Task. Tasks and Subprocesses are rounded rectangles. Processes are either unbounded or a contained within a Pool.	
Gateway	A Gateway is used to control the divergence and convergence of Sequence Flow. Thus, it will determine branching, forking, merging, and joining of paths. Internal Markers will indicate the type of behavior control.	
Sequence Flow	A Sequence Flow is used to show the order that activities will be performed in a Process.	
Message Flow	A Message Flow is used to show the flow of messages between two entities that are prepared to send and receive them. In BPMN, two separate Pools in the diagram will represent the two entities (participants).	
Association	An Association is used to associate information with flow objects. Text and graphical nonflow objects can be associated with the flow objects.	
Pool	A Pool is a "swimlane" and a graphical container for partitioning a set of activities from other Pools, usually in the context of B2B situations.	
Lane	A Lane is a subpartition within a Pool and will extend the entire length of the Pool, either vertically or horizontally. Lanes are used to organize and categorize activities.	

Flow Objects

- Events
- Activities
- Gateways

## BPM Notation: Flow Objects: Events

- Represented with a circle
- Denotes something that happens (rather than Activities which are something that is done).
- Icons within the circle denote type of event (e.g. envelope for message, clock for time).
- Events are also classified as
  - *Catching* (ie catch an incoming message to Start process) or
  - *Throwing* (ie throw a message at End of process).
- Types: Start, Intermediate, End



Flow Objects

- Events
- Activities
- Gateways

## BPM Notation: Flow Objects: Events (/2)


- *Start event*: triggers process;
  - indicated by a single narrow border;
  - can only be *Catch*, so shown with open (outline) icon.
- *End event*: represents result of a process;
  - indicated by a single thick/bold border;
  - can only *Throw*, so shown with a solid icon.
- *Intermediate event*: something happening btw start & end events;
  - indicated by a tramline border;
  - can *Throw* or *Catch* (using solid/open icons as appropriate)
  - eg, task could flow to an event throwing a message to another pool
  - & a subsequent event waits to catch the response before continuing.

### Connecting Objects


- Sequence Flow
- Message Flow
- Association

## BPM Notation: Connecting Objects


### – Sequence Flow:

- represented by a solid line with a solid arrowhead 
- used to show order (sequence) that activities will be performed in a BP.

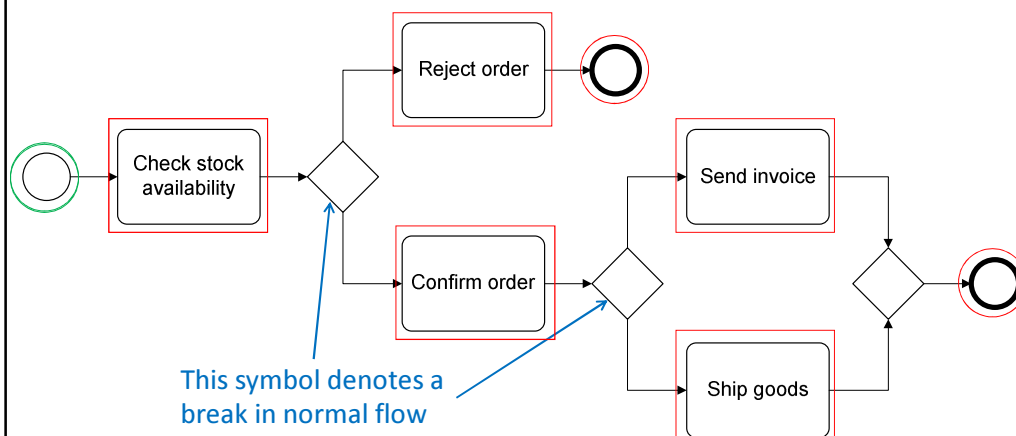
### – Message Flow:

- represented by a dashed line with an open arrowhead 
- used to show flow of messages btw 2 separate Process
- Participants (business entities/business roles) can send & receive them.
- in BPMN, 2 separate Pools in Diagram will represent two Participants in msg flow.

### – Association:

- represented by a dotted line with a line arrowhead 
- used to associate data, text, & other Artifacts with flow objects.
- used to show inputs & outputs of activities..

## Order Management Process in BPMN First Try



Flow Objects

- Events
- Activities
- Gateways

## 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”.

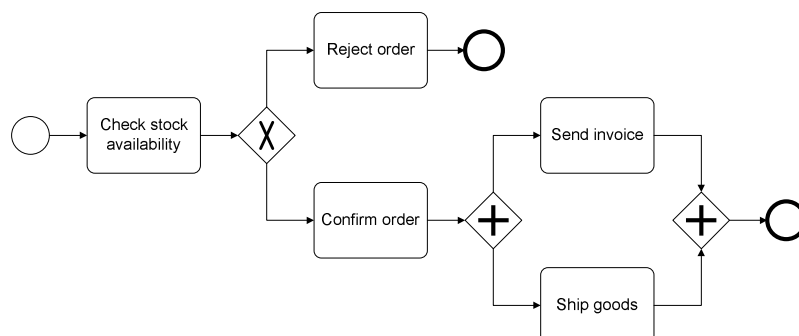
- Parallel Fork / Join



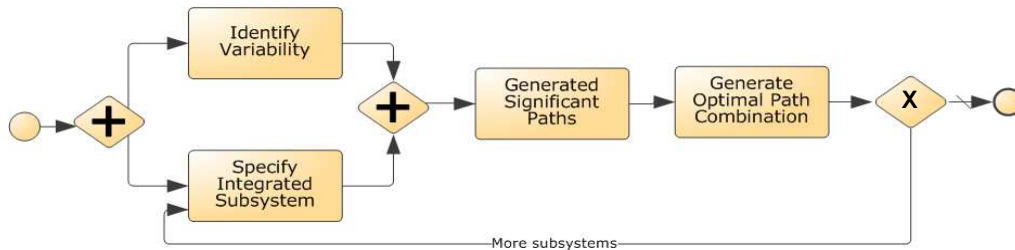
- Provide a mechanism to synchronize parallel flow and to create parallel flow.

- Depicted by a diamond shape that *must* contain a marker that is shaped like a plus sign.

## Revised Order Management Process



## What's wrong with this model?



## BPMN Gateways

### Exclusive (XOR)

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

### Parallel (AND)

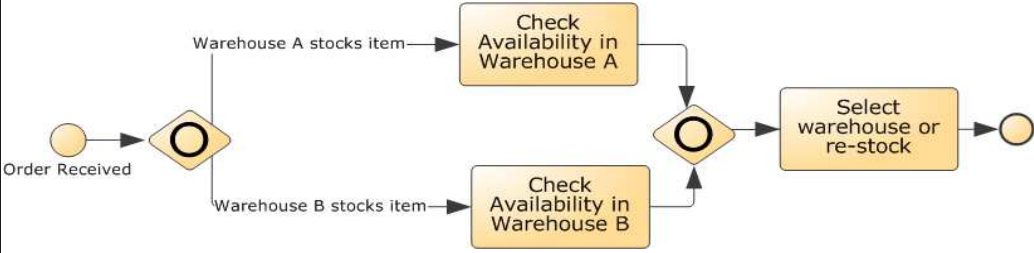
- Parallel split  
take all branches
- Parallel join  
proceed when all incoming branches have completed

### Inclusive (OR)

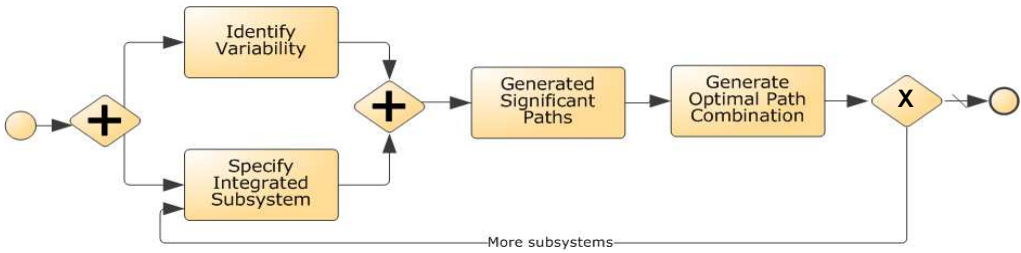
- Inclusive decision  
take one or several branches depending on conditions
- Inclusive merge  
proceed when all active incoming branches have completed



# Example: OR gateways



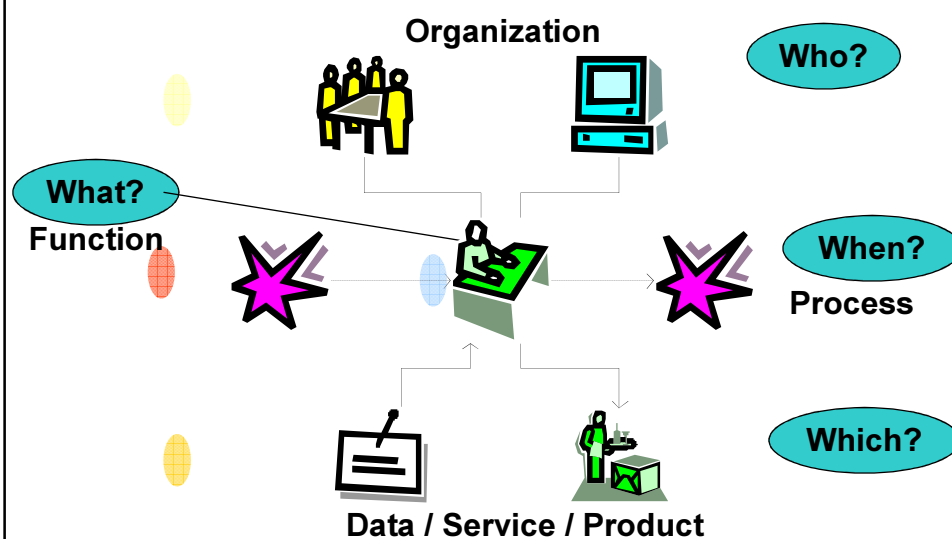
# How can we fix this model?



## BPMN Exercise To-Do Exercise 1: Simplified Insurance Claim Registration

1. 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.
2. 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.
3. 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



### Grouping Objects

- Pools
- Swimlanes

## Organisational Elements in Process Models

### Two basic abstractions:

- **Resource**: Human actor/equipment (e.g. printer) needed for an activity
- **Resource class**: Resource set sharing characteristics, e.g. Clerk, Manager

### 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.

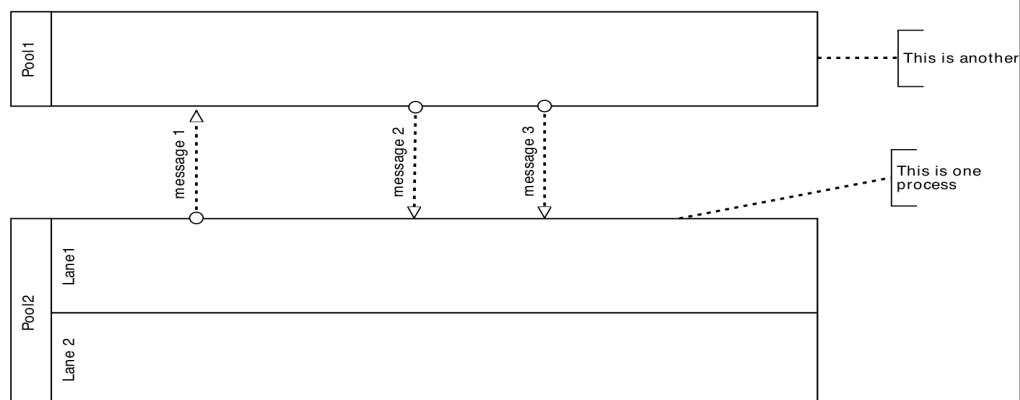
### In BPMN resource classes are captured using:

- **Pools** – independent organizational entities, e.g.
  - Customer, Supplier, East-Tallinn Hospital, Tartu Clinic
- **Lanes** – resource classes in same org space & sharing common systems
  - Sales Department, Marketing Department
  - Clerk, Manager, Engineer

### Grouping Objects

- Pools
- Swimlanes

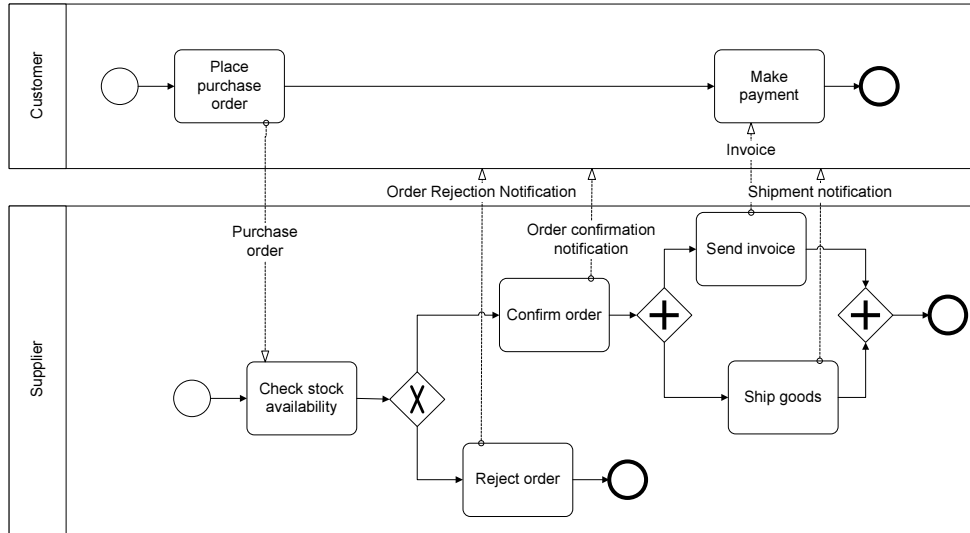
## Lanes and Pools – Notation



Grouping Objects

- Pools
- Swimlanes

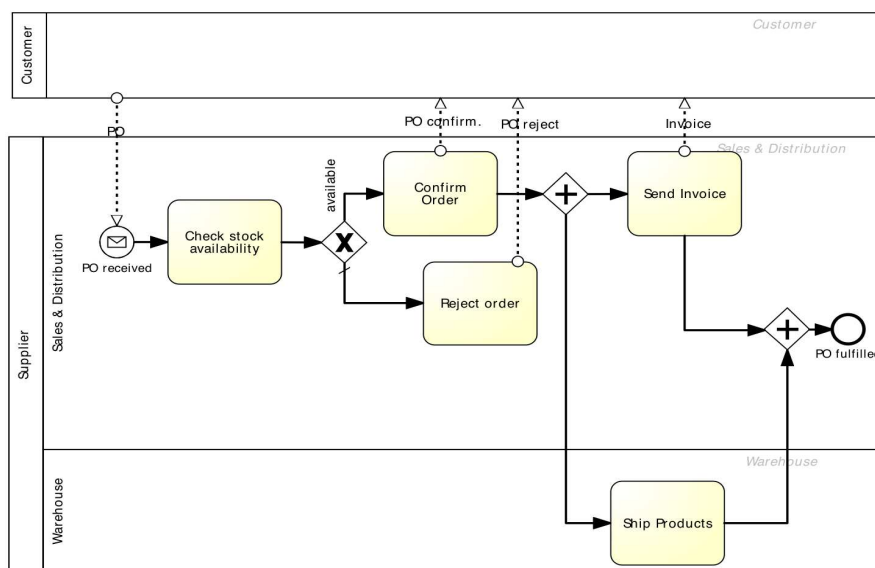
## Order Management Process with Pools



Grouping Objects

- Pools
- Swimlanes

## Order Management Process with Lanes



### Grouping Objects

- Pools
- Swimlanes

## BPMN To-Do Exercise 2: Lanes, Pools

- **Claims Handling process at a car insurer**
  - A customer submits a claim by sending in relevant documentation.
  - Customer Service department checks the documents for completeness and registers the claim.
  - 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.

### Artifacts

- Data Objects
- Data Stores
- Annotations

## BPM Notation: Artifacts

- BPMN allows modelling tools flexibility to extend basic notation and permits adding extra context for a specific modelling situation.
- Can add Artifacts as needed but currently BPMN pre-defines three:

### 1. Data Objects:

- mechanism to show how data is required or produced by activities.
- connected to activities through Associations.



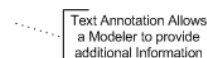
### 2. Groups:

- shown as a rounded corner rectangle drawn with a dashed line
- used to document /analyse, but does not affect Sequence Flow.
- used to organize & categorize activities.



### 3. Annotations:

- shown as open rectangle containing annotation text.
- allows for extra textual info for reader of a BPMN Diagram



**Artifacts**

- Data Objects
- Data Stores
- Annotations

## BPM Notation: Artifacts Example

– BP Segment with Data Objects, Groups, and Annotations

Note the use of a swimlane For a Computing Resource.

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**Artifacts**

- Data Objects
- Data Stores
- Annotations

## Order Processing Example with Artifacts

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Artifacts

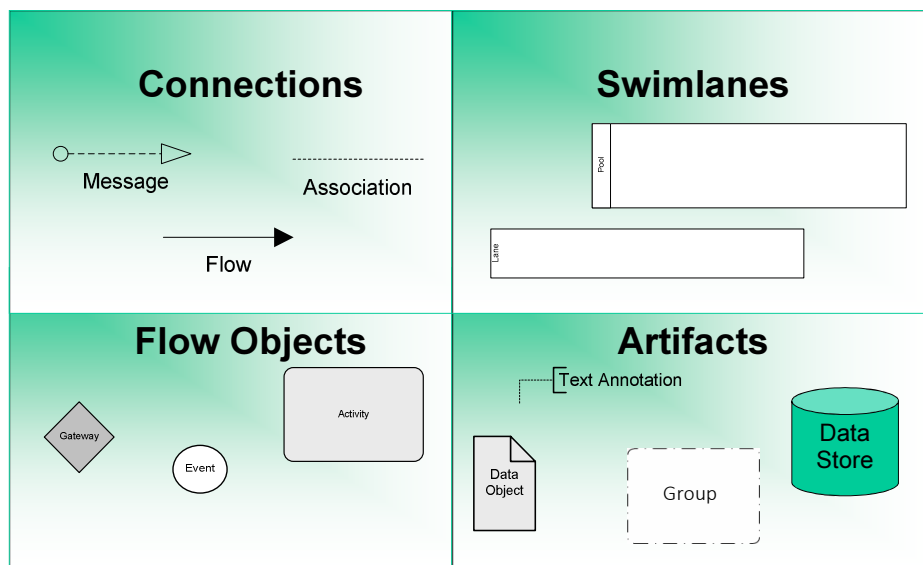
- Data Objects
- Data Stores
- Annotations

## BPMN To-Do Exercise 3: Artifacts

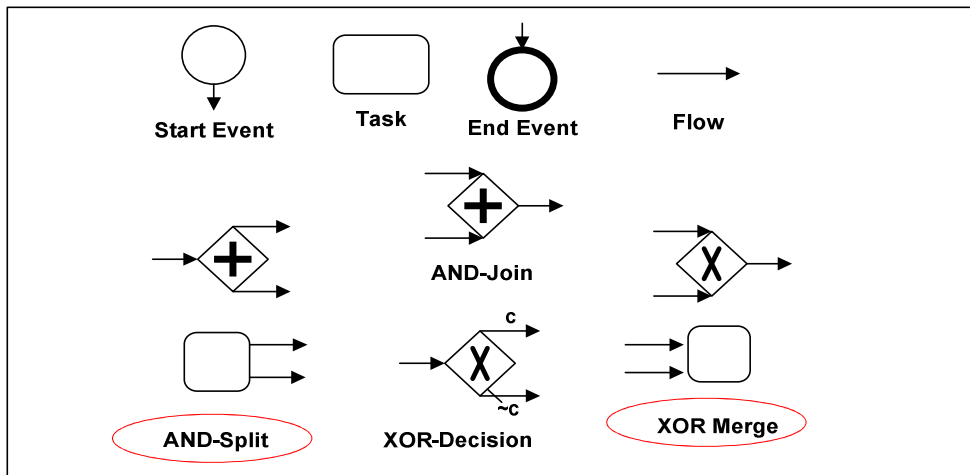
When a claim related to a major car accident is evaluated, a clerk first retrieves the corresponding car accident report in the Police Reports database. If the report is retrieved, it is attached to the claim file. The claim file and the police report serve as input to a claims handler who calculates 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

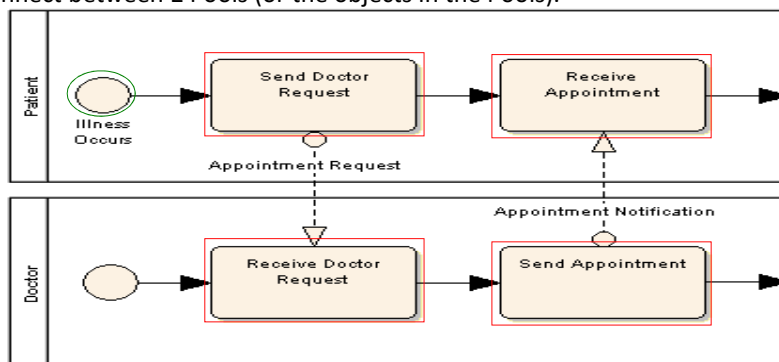


## BPMN Flow Elements – Recap



## BPM Notation: Example 1: Swimlanes

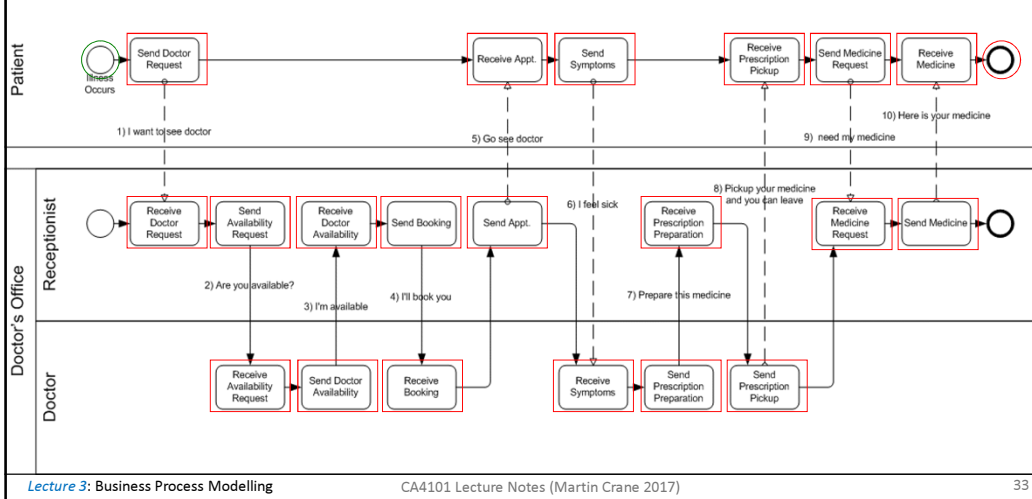
- Pools are used when diagram involves 2 separate business entities or participants & are physically separated in the diagram.
- The activities in separate Pools are considered self-contained Processes.
  - Sequence Flow may not cross a Pool boundary.
  - Message Flow defined as how to show comms between 2 participants thus, must connect between 2 Pools (or the objects in the Pools).





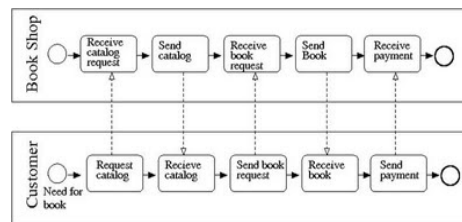
## BPM Notation: Example 2: Swimlanes

- BPMN Diagram below shows a more pedantic form of 1
- Here, Patient/Doctor's Office interaction is thro requests which must take the form of messages.



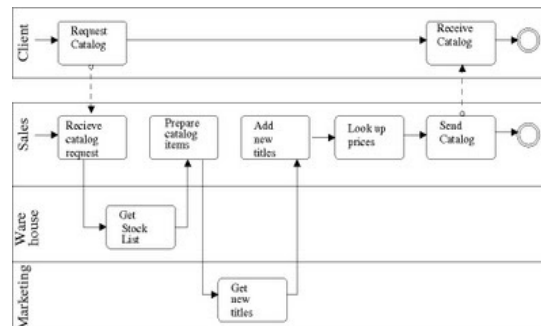
## Example 3: Buying a Book

(a) Some conversation between 2 pools



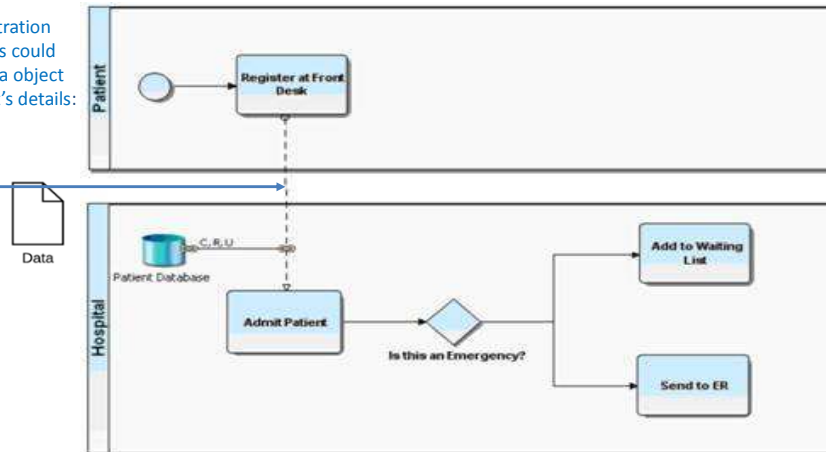
Example BPD with pools

(b) A more complex version of (a) involving more interplay in one pool

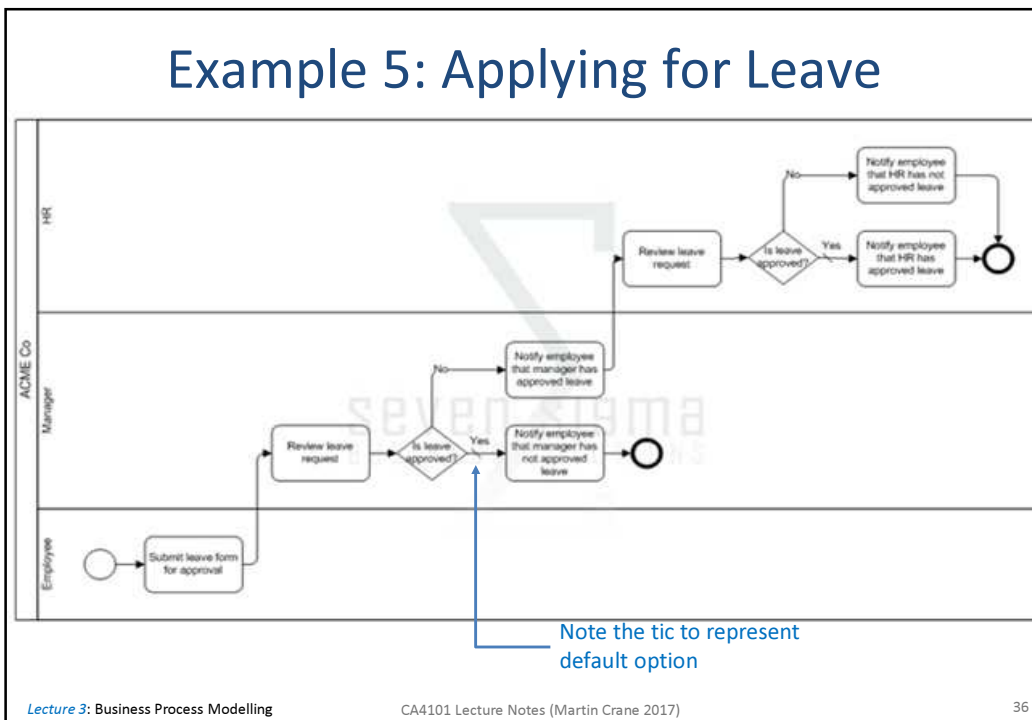


## Example 4: Hospital Admission

Note the way that Registration Details are handled. This could also be done using a data object representing the patient's details:



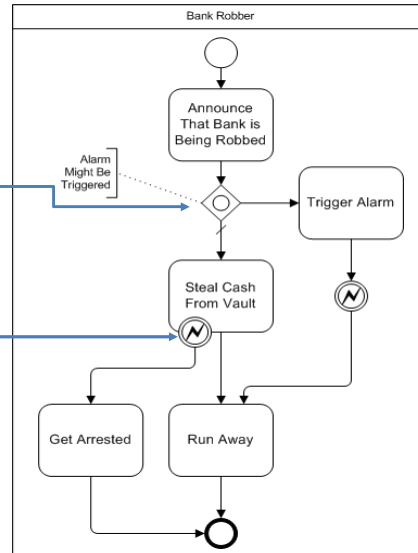
## Example 5: Applying for Leave



## Example 6: The Bank Robber

Note the inclusive gateway.  
This is used to represent a decision where one, some or all options are valid.

Note the new intermediate event representing an error or exception

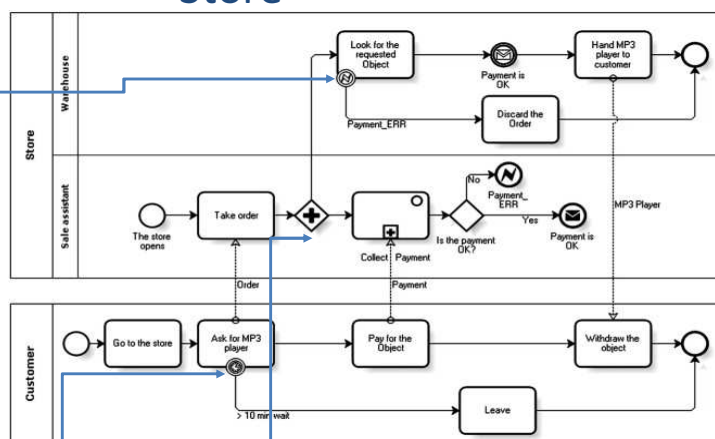


## Example 7: Buying an MP3 at An Argos Store

Note the new intermediate event representing an error or exception

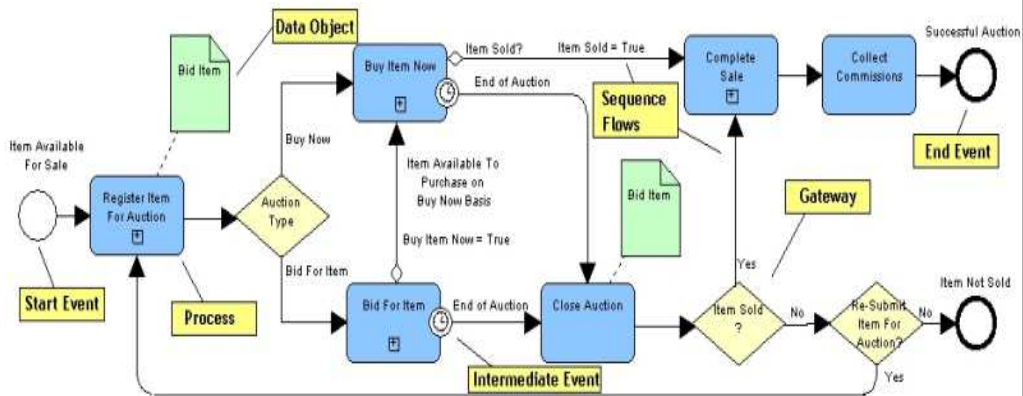
Note the intermediate timer event

Note the parallel gateway representing all sequences happening

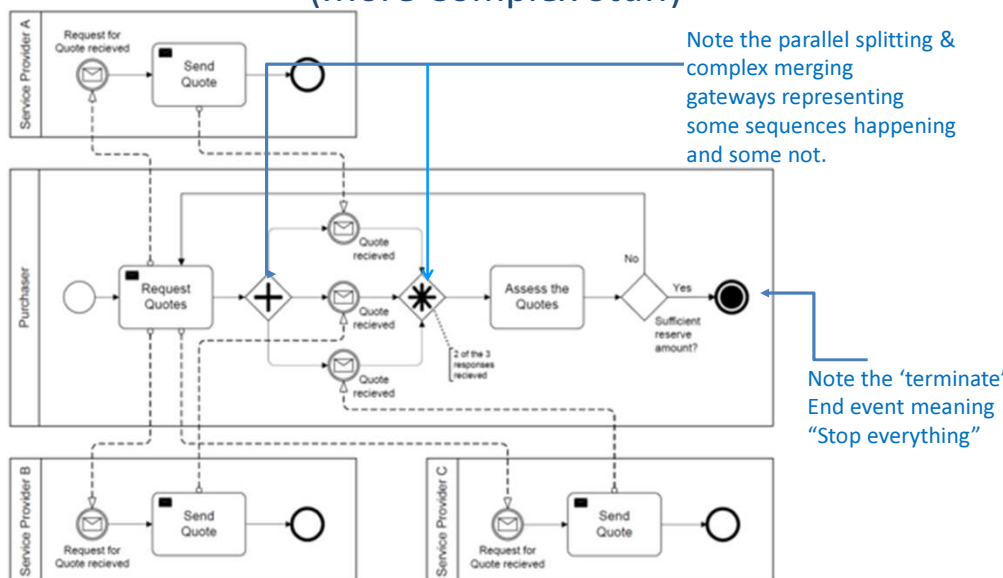


## Example 8: An Ebay Auction

- “Draw a BPMN diagram for an online auction purchase process. Your diagram does not need to include the “make-offer” components, but should include components for “buy-it-now” and “bid”. Identify the different categories of BPMN elements in your diagram.”



## Example 9: Client Getting Quotes (More Complex Stuff)



## Exercise

**Check also the self-test quiz available at:**

<http://www.proprofs.com/quiz-school/story.php?title=essentials-of-process-modeling>

## References

- “Introduction to BPMN”, Stephen A. White, IBM Corporation, available to download on <http://www.bpmn.org/>
- “BPMN and Business Process Management: Introduction to the New Business Process Modeling Standard” Martin Owen and Jog Raj, Popkin Software available to download on <http://www.bpmn.org/>
- “Process Management, A Guide for the Design of Business Processes”, By Jorg Becker, Martin Kugeler, Michael Roseman, Springer Verlag