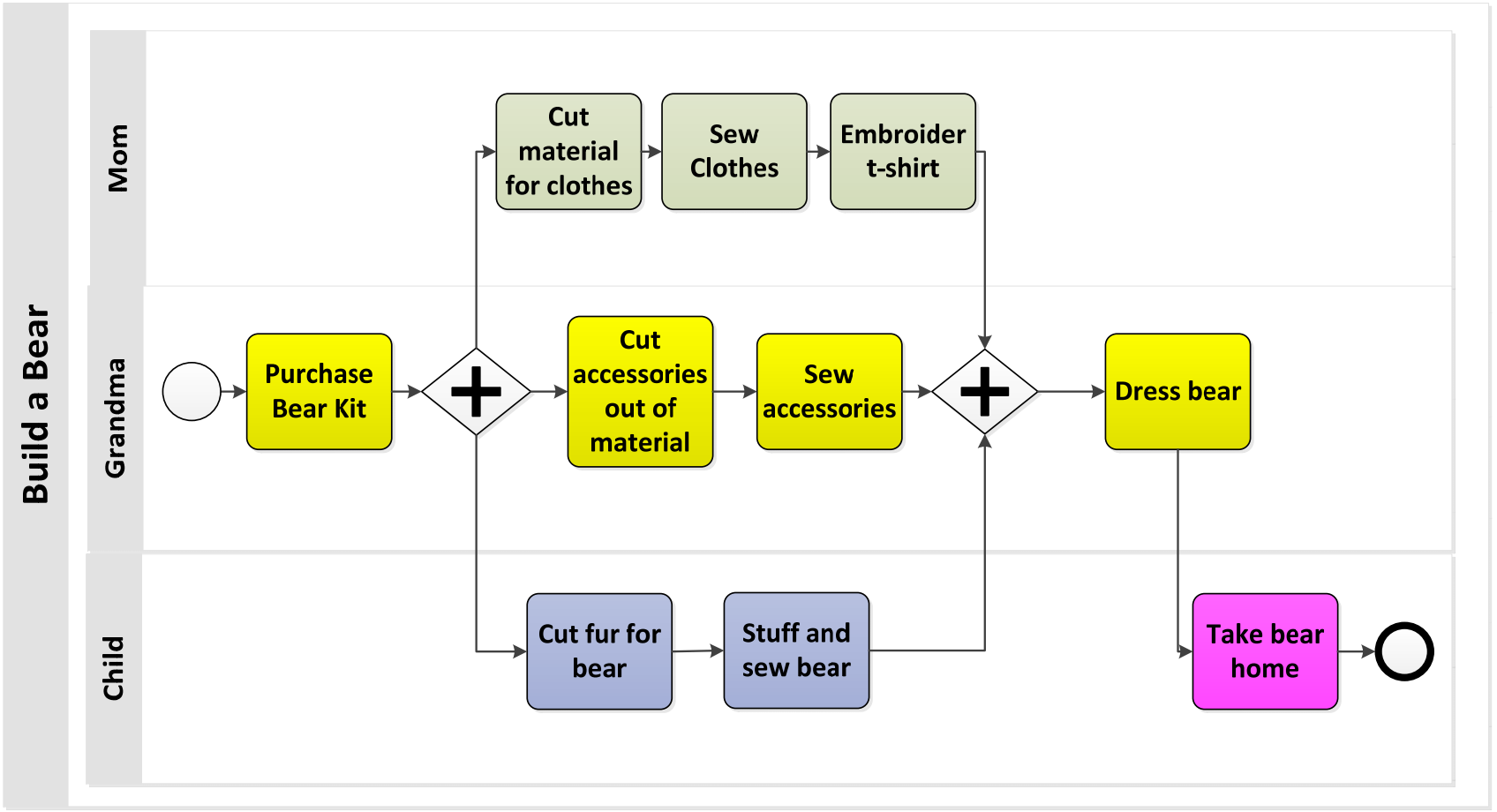
Process Modeling with BPMN



Dr. Joyce Statz – Austin IIBA – September 20, 2019

First, some questions for you…

- How many of you know something about BPMN?
- How many have modeled business processes?
  - Using basic flowcharts?
  - Using swim lane diagrams? (also called cross-functional flowcharts)?
  - Using UML activity diagrams?
  - Using BPMN?

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Why is BPMN interesting?

- Years of process modeling with swim lanes were frustrating – similar limitations in Activity Diagrams
- Attempts to augment them to handle…
  - Documents and data used in process steps … clumsy!
  - Decisions with multiple outflows … strings of decisions, parallel flows ... very hard!
  - Dealing with external organizations … not allowed
  - Activities in a process done by a system … not allowed
  - Adding notes or annotations … no common way
- And… my unique ways to represent were note easily recognized by new readers – not a standard thing!

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Learning Objectives

- You'll learn how to:
  - Identify some elements that distinguish BPMN models from swim lane diagrams
  - choose which of 5 different types of decision gateways to use in process flows
  - model the interactions of several unique organizations via messages
  - add notes and annotations to process models
- Feel free to raise questions as we go along

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Topics

- ***Process Models in Context***
- Swim Lane Diagrams
- Basics of BPMN
- BPMN Gateways

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Process Modeling of "As Is" and "To Be" Processes

- Depicts how work is performed by (human) roles in a sequence of activities, to meet a goal
  - Process flow: Graphical model of flow, decision points, roles, activities
  - Process Description: Textual description of key steps involved, with supporting elements
  - (sometimes) support to Process Automation
- Usually need several levels of detail (both graphical and text) to accurately depict a business process
- Our focus today: the graphical flow

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Methods for Graphical Process Modeling

- Flowcharts – classic method from software development and Total Quality Mgt (TQM); usable when *role identification with activity doesn't matter*
- Swim Lane diagrams – a popular method, derived from TQM cross-functional flowcharts
- Unified Modeling Language (UML) Activity Diagrams
- Business Process Model and Notation (BPMN) – global standard gradually being adopted by organizations and industry tools – goes beyond what we can do with swim lanes and activity diagrams

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Topics

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- ***Swim Lane Diagrams***
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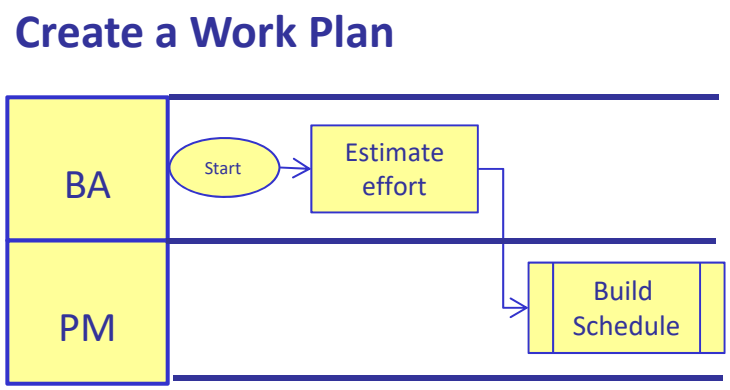
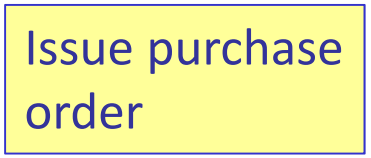
Primary Swim Lane Symbols - 1

- *Name of the process* at the top of the diagram
- Swim Lane has *role name* at left – shows work of a single role (human roles or organizations, not systems)
- *Start* (white) – oval or circle; only one start
- *End* (black) – oval or circle; only one end
- *Activity (Process Step)* - rectangle describing what is done (action verb-object phrase)





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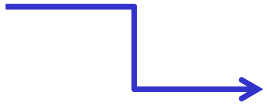
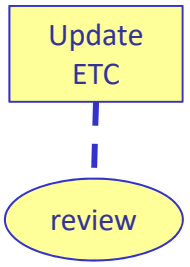
Primary Swim Lane Symbols - 2

- *Sub-process* documented in detail elsewhere– depicted with rectangle with double lined sides
- *Flow lines* show time order of step blocks (in left, out right)
- *Decision* (by 1 role) diamond with choice given as a question (exclusive or)
- *Involvement of a passive role* shown with oval with type of involvement, connect with dotted line to an Activity block (an extension to classical symbols; enables concise flows)





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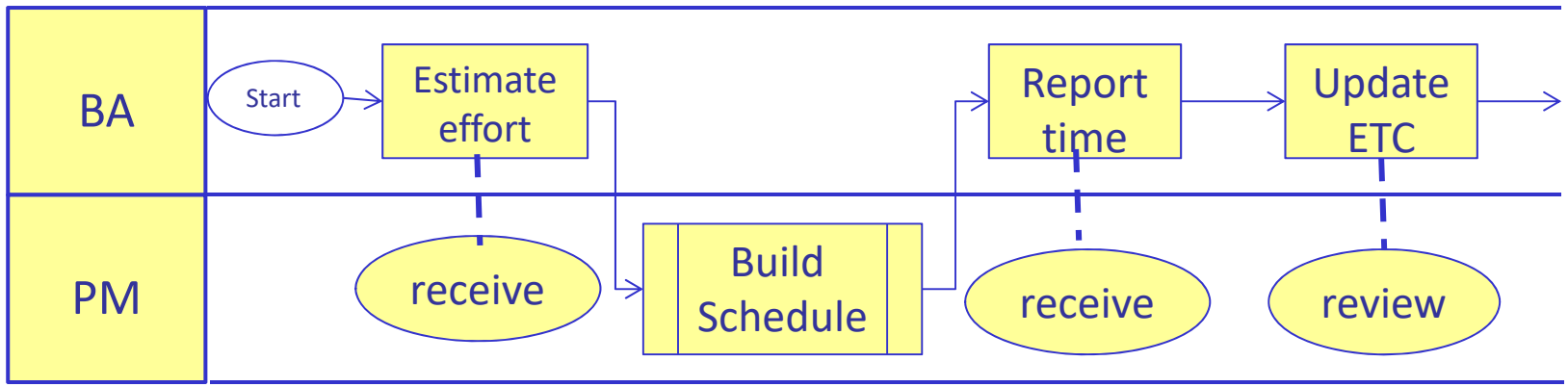
Swim Lane Conventions

- Arrange activity blocks in time order, left to right (horizontal diagram), in the swim lane of the role responsible for the step
  - If numbering the blocks, do so only after the diagram is complete
- Flow lines enter activity block at left, leave at right
- (extension) Connect ovals to blocks for roles involved in an activity with a vertical dotted line (no arrows)



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Steps in Building a Swim Lane Process Flow Diagram

1. Name the process, using <active verb-object phrase> format (ex. “Develop map,” “Request user input”)
2. Identify key (human) roles, put them on the role axis [*note: use only roles internal to the organization*]
3. Identify the first step in the process, and which role is responsible for it
   - Put the start node in that role lane
   - Insert a process step box in that lane and name it
4. Ask “what happens next” and repeat step 3 until done; then insert the end node

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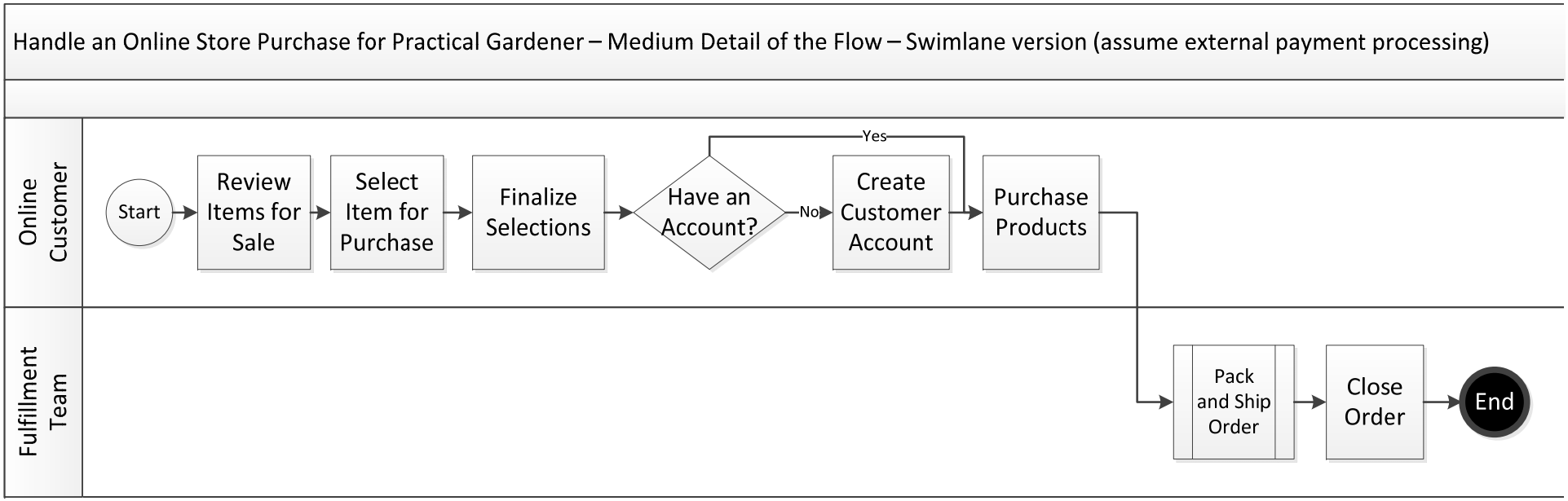
Example: Online Store Purchase – Swim lane version



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Topics

- Process Models in Context
- Swim Lane Diagrams
- ***Basics of BPMN***
- BPMN Gateways

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Intent and Levels of Use of BPMN

- Business Process Model and Notation (v 2.0.2, 2014)
  - Result of many years of collaboration, now a standard managed by the Object Management Group
  - v 2.0 Jan. 2011, added criteria for tool-compliance
  - Implemented in many modeling tools; BPMN metamodel enables interchanges among modeling tools
- Levels of definition and use
  - (Notation) Graphical language for describing processes
  - (Model) Metamodel and execution semantics for executing business process models – used for simulators and business process management systems

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Business Process Elements BPMN Can Model

- Business processes of an organization
  - Processes, sub-processes
  - Tasks (activities) of different types (user, service (system), manual, business rule, …); default is user
  - Data generated, data used
  - Events that trigger or affect processes or tasks
  - Data exchange
- Interactions between organizations
  - Message exchange

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Organization Represented in a Pool

- BPMN diagrams can represent work of multiple organizations
  - Each has its own pool of lanes for its roles
  - A private pool is a local organization's, shown with activity detail
  - A public pool of another organization may show activities; or it may be a "black box," with only the name of the organization on it – no activity detail
- Organization interactions are generally shown using message exchanges

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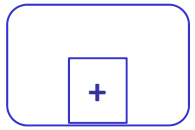
Basic BPMN Process Elements

- Start
- End – can be more than one; common ones
  - Normal End
  - Termination within the process
  - *See big chart for more possibilities*
- Process Activities
  - Rounded rectangles
- Subprocesses 
  - Rounded rectangles with +

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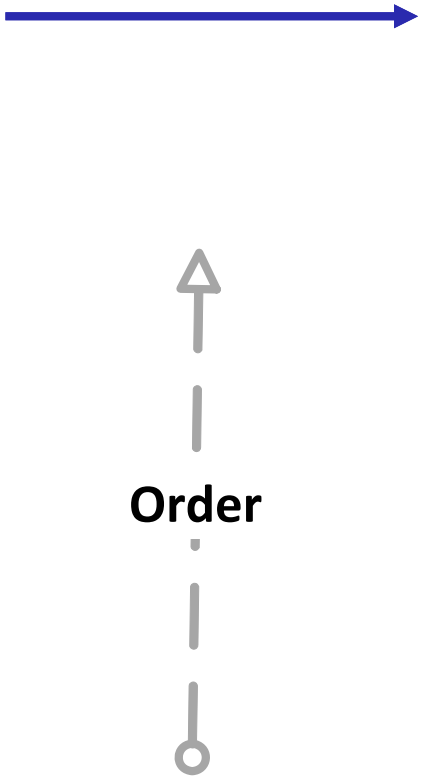
Connecting Objects

- Sequence flow – directed arrow, as in swim lane diagrams
- Message flow – dashed line, with the name of the message on the line, a common way to show interaction between organizations; here we show an order being passed as a message



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BPMN Artifacts Inform Readers

- Grouping of objects in a diagram

  - Doesn't affect the flow; merely informative
  - Example: cluster a set of activities covered by one use case
- Text annotations
  - Can be attached to any element
  - No impact on meaning or flow of the diagram

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Example BPMN Process Flow

Review *Online Store Purchase Process* in both simple swim lane format and BPMN

- Key differences between BMPN and swim lane
  - Pool for each organization, with lanes for roles
  - "Black box" pool for unknown external process
  - Start and End symbols can have annotations for condition (event) that starts the process, condition at the end
  - Decision usually described in an activity block, with the diamond as a gateway with alternative paths
  - Sub-process shape is different; activity has rounded edges
  - Groups and annotations in use

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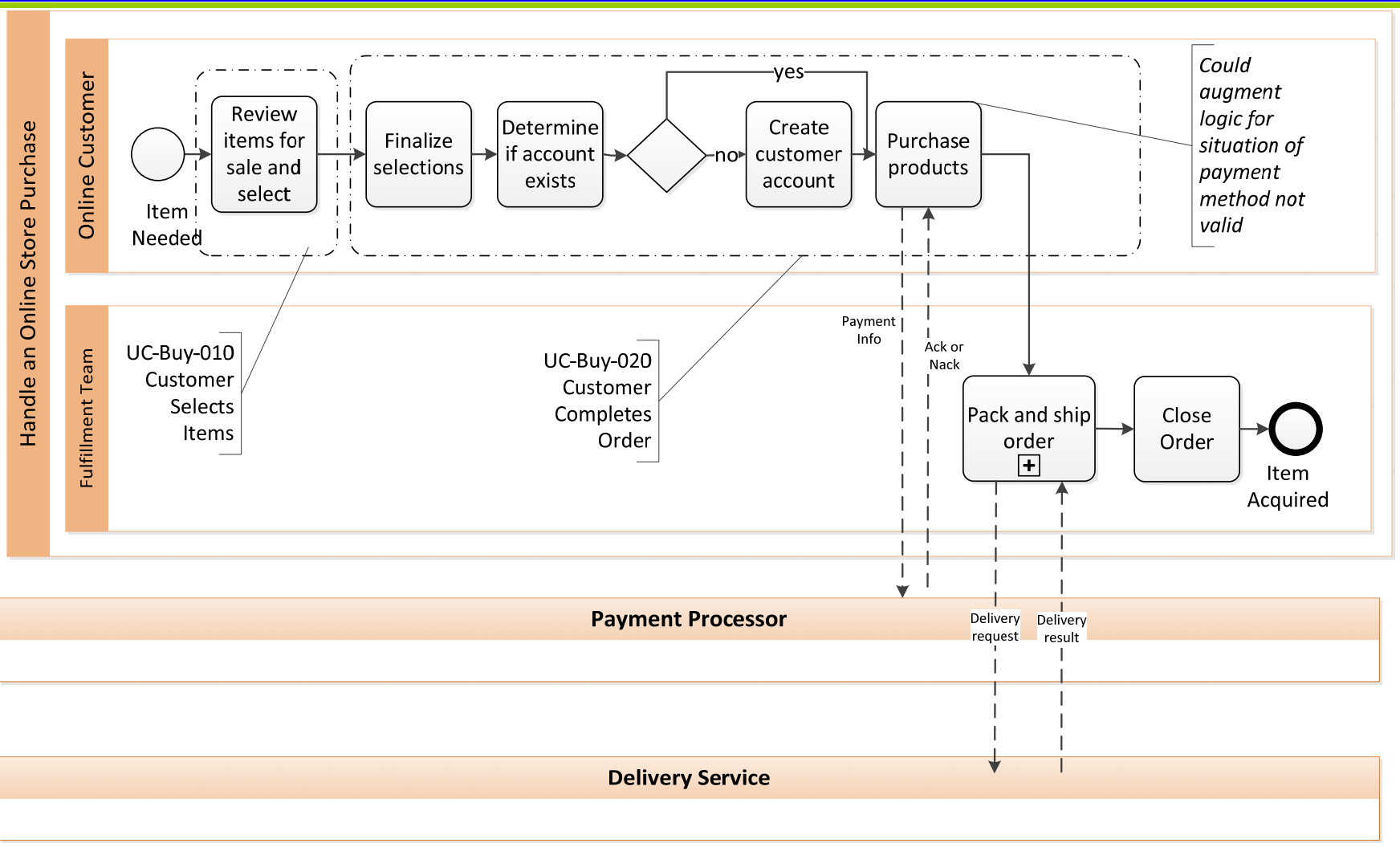
Online Store Purchase in BPMN



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Topics

- Process Models in Context
- Swim Lane Diagrams
- Basics of BPMN
- ***BPMN Gateways***

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BPMN Supports Robust Flows

- As well as sequential process flow, BPMN can depict
  - Five types of decision gateways
  - Parallel flows in a process
  - Events as well as activities (tasks and sub-processes) in the flow
  - (and much more… which we won't touch today)

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Decision Gateways in BPMN

- Depict how a process flow splits apart and how flows converge
  - Fork and Join for parallel flows
  - Branch and merge for flows that are not parallel
- Default gateway is the Exclusive OR (which is the only gateway in swim lane diagrams)
- Next most used is the Inclusive OR gateway

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BPMN Exclusive OR Gateways

- Exclusive OR – at this branch, exactly one of the alternative flows is activated
- Since this is the default gateway, the diamond symbol may be empty
- Merge after Exclusive OR shows the flow waits for the active alternative to finish, if all go to the same next activity

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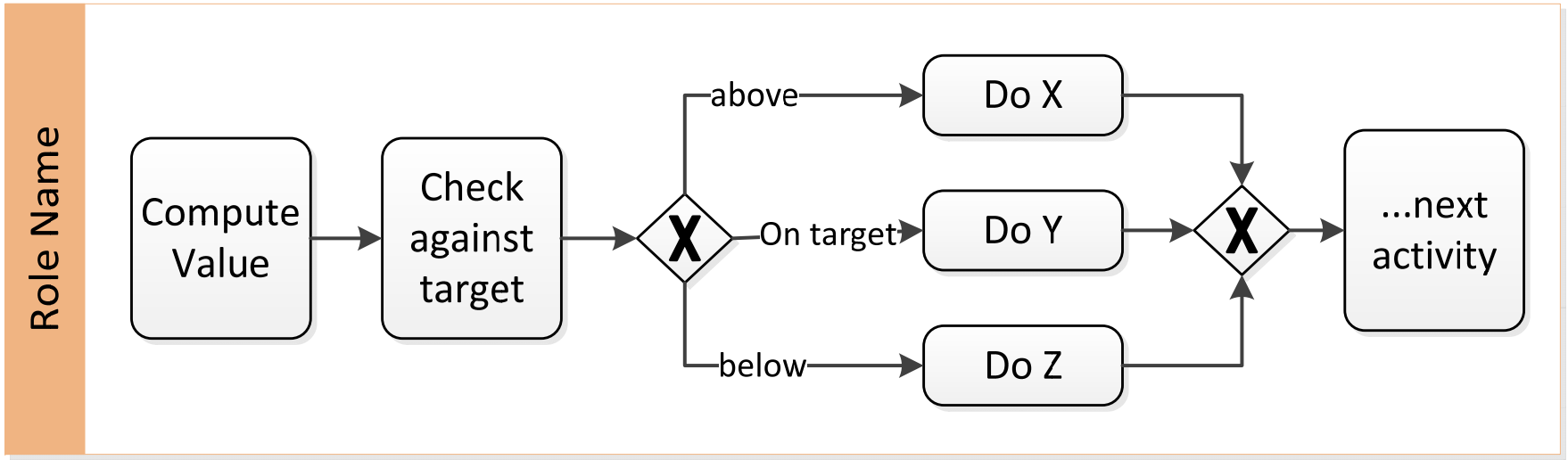
Exclusive OR Gateway – exactly one alternative is used

- **This gateway uses data in the process flow to make the decision, thus is called a data-based exclusive gateway**
- **Since this is the default gateway, a blank diamond can also be used for this one**
- **A default path can be indicated with a slash mark, if that makes sense**



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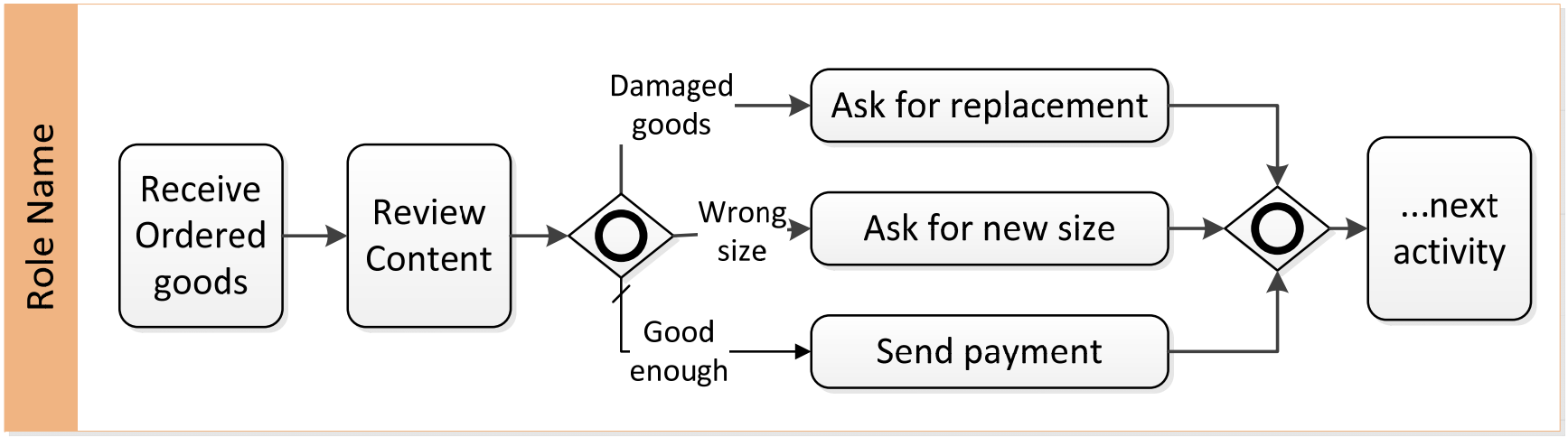
Inclusive OR Gateway



At the branch, each alternative is examined

- **For each with a true condition, the flow is followed**
- **If no condition is true, an exception (error) will occur**
- **A default path can be indicated with a slash mark, so that path is followed, and no exception occurs**
- **Merge occurs when all true flows have finished**

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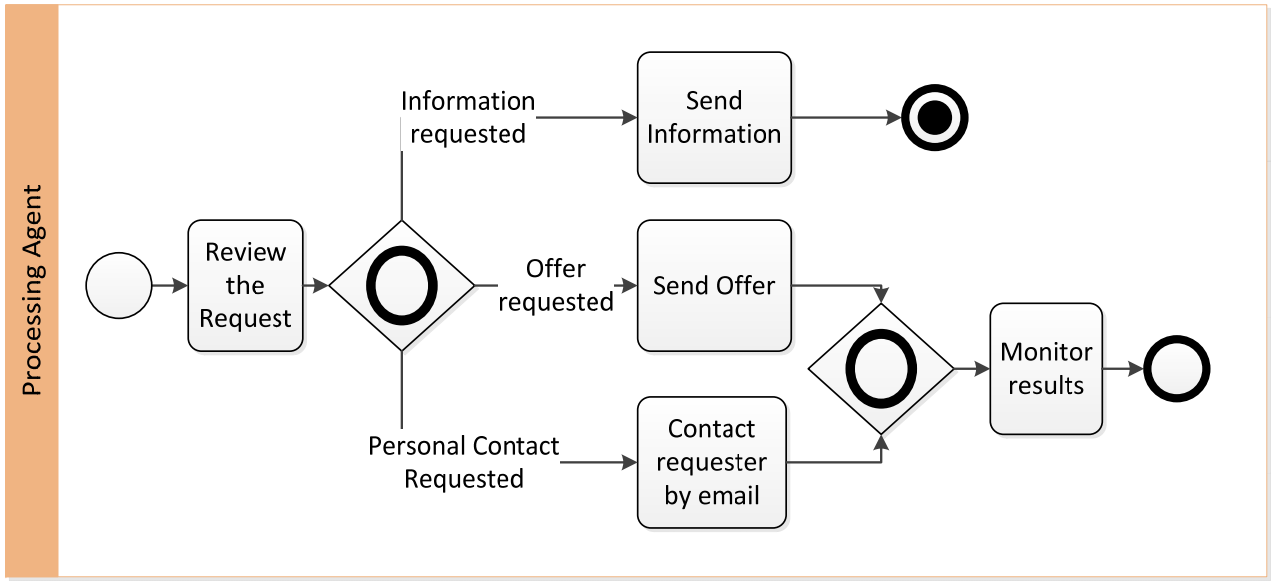
The Merge May Diverge

- Here, one path leads to an end state, while either or both of the other two would lead to an activity that monitors results



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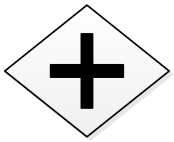
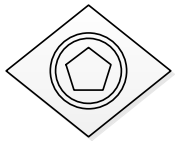
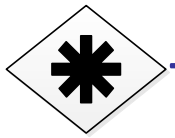
Other Decisions and Gateways in BPMN


– Parallel – alternative flows are synchronized to occur concurrently; join waits for all to finish


– Event-based gateway – alternative flows depend on which event has happened at the gateway (time, message, or other condition)


– Complex gateway – used to represent complex cases that cannot be done with the others

- Annotations can be used to express the conditions that apply

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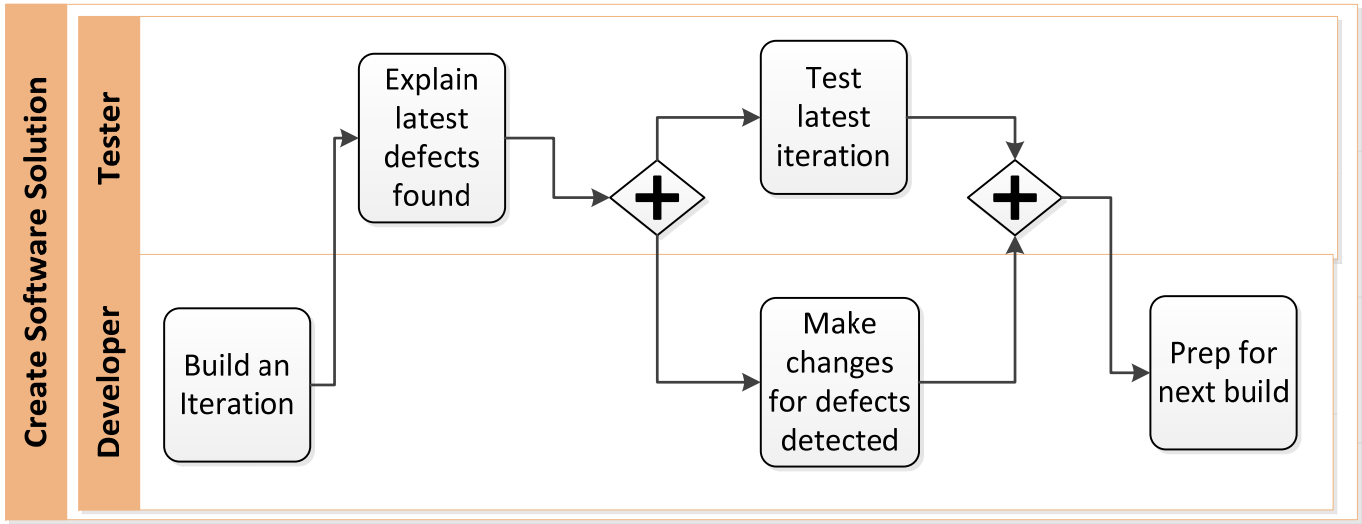
Parallel Gateway - Fork and Join



At the Fork, things need to be synchronized

- **Testers working on the right software**
- **Developers fixing the right software**

At the Join, again, things are synchronized before next activity

- **Testers have completed their testing**
- **Developers have made all relevant changes**

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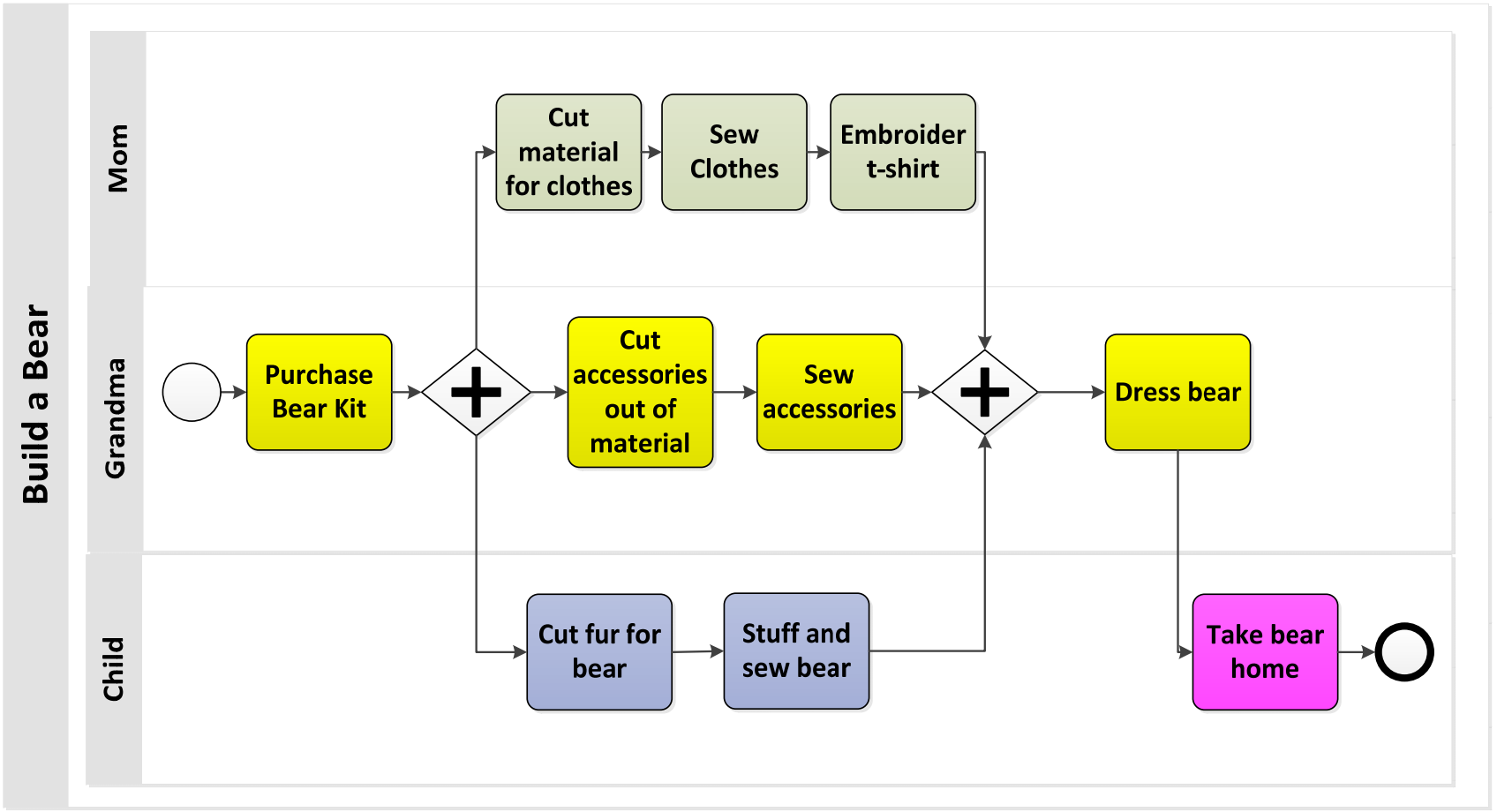
Another Example of Parallel Gateways – Building a Bear with 3 People



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Events in BPMN

- An event represents a point in time when
  - A condition has been met, time has elapsed, a message arrived, an error occurred, etc.
- Basic event types – start, intermediate, end

- Intermediate events with icons in a flow show that an activity must wait for a given event to occur before the flow proceeds (see next slide)
- Specific icons represent specific types of event

See the Events portion of the BPMN poster

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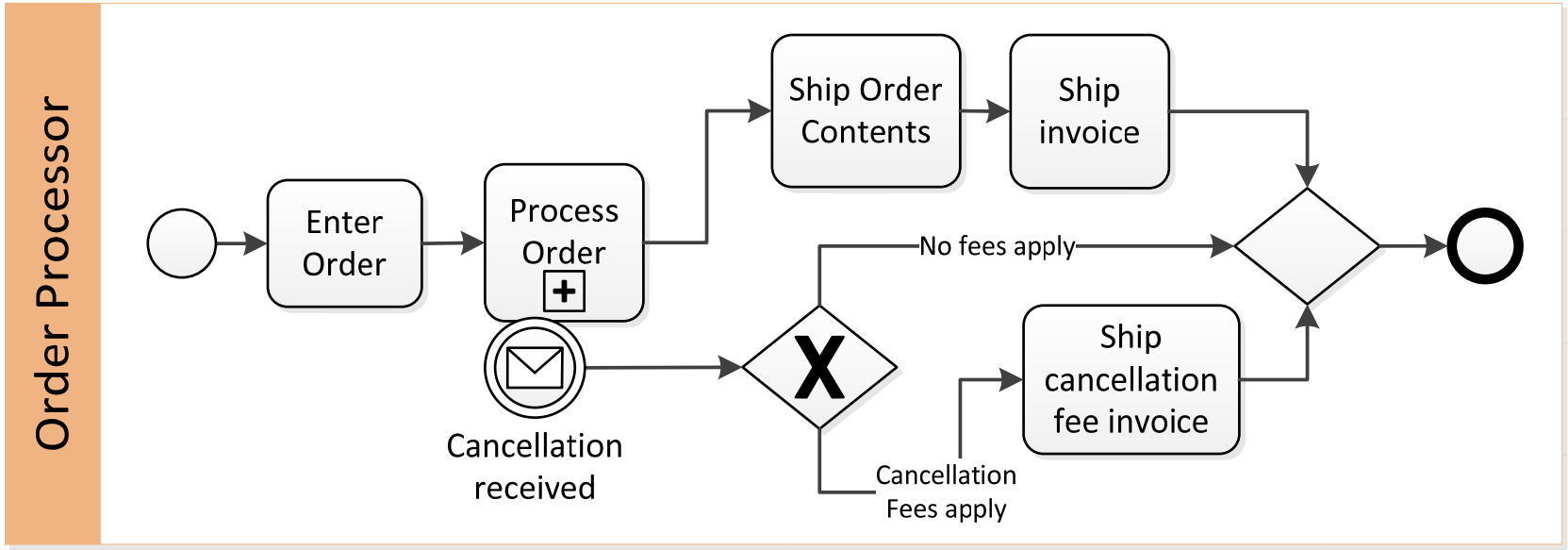
Events Used With Activities

- Using an event on an activity is a good way to handle situations like order cancellation; if the event occurs as the activity is underway, the activity terminates; otherwise the flow continues on the usual path



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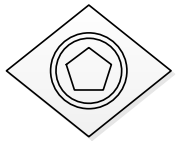
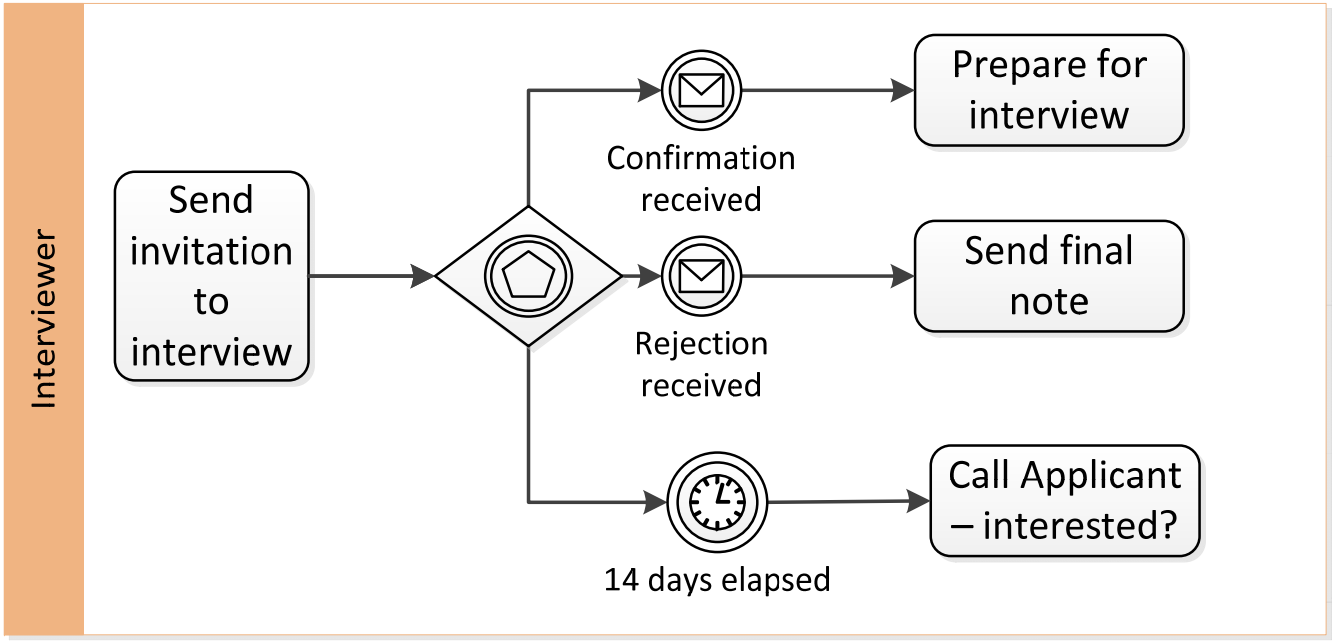
Event-Based Gateway



- Events at a gateway can be of various types
- The first one that occurs causes the process flow to proceed; only one alternative is used



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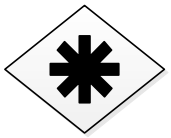
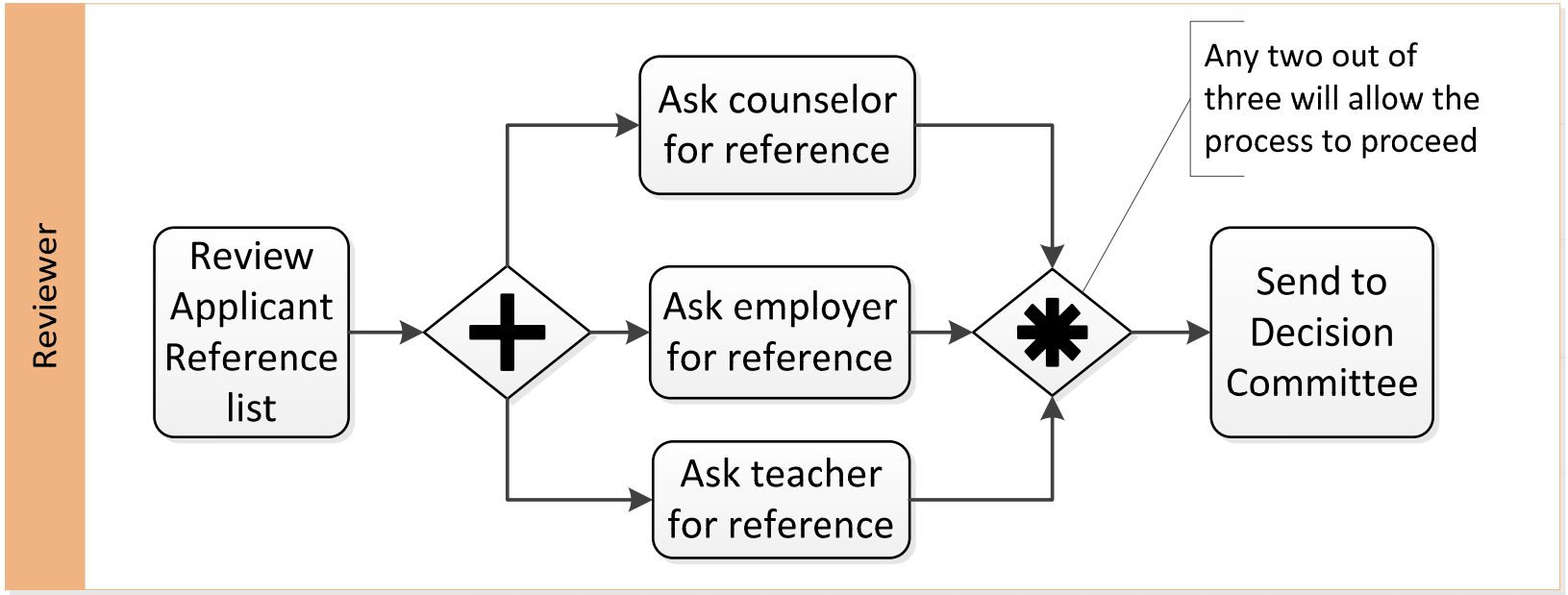
Complex Gateway Example



- This fragment shows how a complex gateway can be used at a join of parallel flows; the rules that apply are shown in an annotation



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Discussion: Which gateway to use?

Modeling Situation	Exclusive Or	Inclusive Or	Parallel	Event-Based	Complex
When signing up for class a student may need to pay a library fine, buy a parking permit, and/or make a tuition payment before being allowed into class.					
An insurance policy pays a benefit when the first of these happens: policy matures, insured person dies, insured person stops paying and collects cash value of the policy.					
A customer applying for a loan is assigned to one of 4 different risk levels, based on a set of criteria.					
Cooking an order in a restaurant kitchen involves specialists who handle different parts of the order, plating the full order together before it gets served					
A manager must be consulted when none of the standard conditions for refunds is satisfied.					

Group Exercise: Create a Process

- As time allows, in teams, use the supplied template to create a BPMN process flow from the point of view of you, the car owner for having a car repaired after a tree falls on it during a storm. Assume
  - You may choose to rent a car while yours is in the shop
  - Your need to file a claim before proceeding to get repair, but no adjuster comes to check your car
  - You must submit two estimates from repair shops to the insurance company; they select the repair shop
  - The process ends when you get the repaired car back

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Summary

- BPMN provides us a rich standard for
  - Notation – describing processes
  - Modeling – enacting processes
- BPMN supports
  - Robust ways to handle flows and decisions
  - Depicting work of multiple organizations
  - Including activity of systems and business rules, as well as work of individuals and organizations in a process

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For more information

- BPMN standard documents
  - http://www.bpmn.org/
  - Current version 2.0.2, published Jan. 2014, minor changes from 2.0
- Some useful books on using BPMN
  - Thomas Allweyer, *BPMN 2.0.* Norderstedt, Germany: Herstellung and Verlag, 2010.
  - Bruce Silver, *BPMN Quick and Easy.* Altadena, CA: Cody-Cassidy Press, 2017.
- See following reference slides for a bit more BPMN

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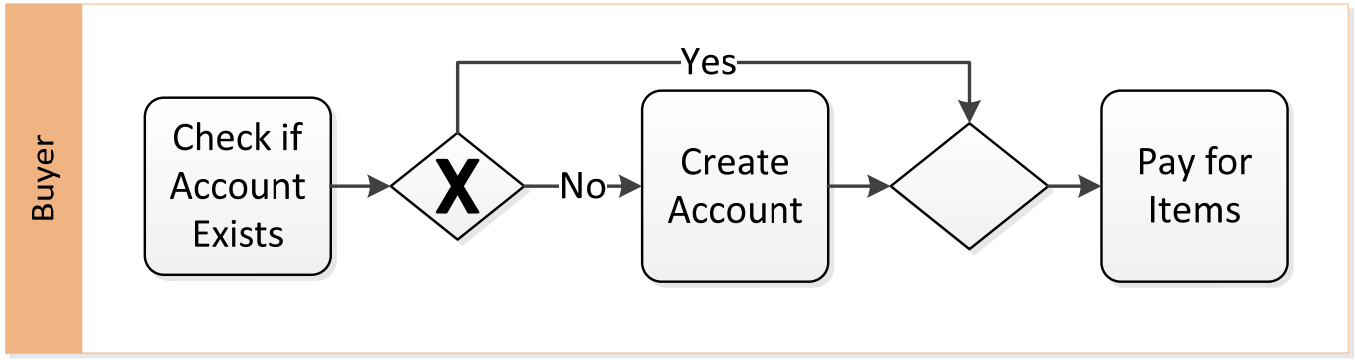
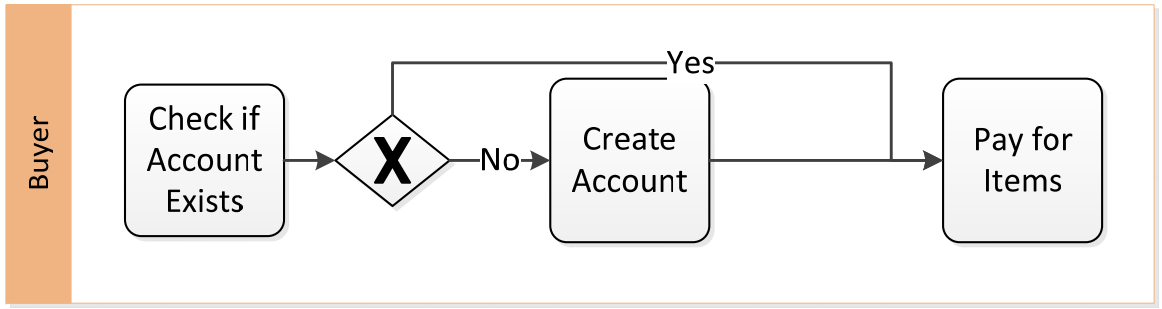
Readability Use of Exclusive OR

- Completely optional, the use of the second gateway in the top example here might help readers to see the flow of a diagram better than what is shown in the bottom example





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Other Gateway Conventions

- Forks can be done without gateways, using conditional flow symbols attached to a prior activity; similarly, joins can be shown without gateways; however, using gateways makes the diagram logic clearer and easier to analyze

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Other Interesting BPMN Aspects - 1

- Lanes can categorize process activities by whatever split is useful, most common: roles or systems
- Lanes can be split into sub-lanes, for roles within departments or other uses
- Start and end states can be labeled or not; can be of several types, and there can be multiples of each
- Terminate state halts a process or sub-process
- Data and data stores can be used in a process – attached to a flow line with data associations (or shown in the flow with data associations)

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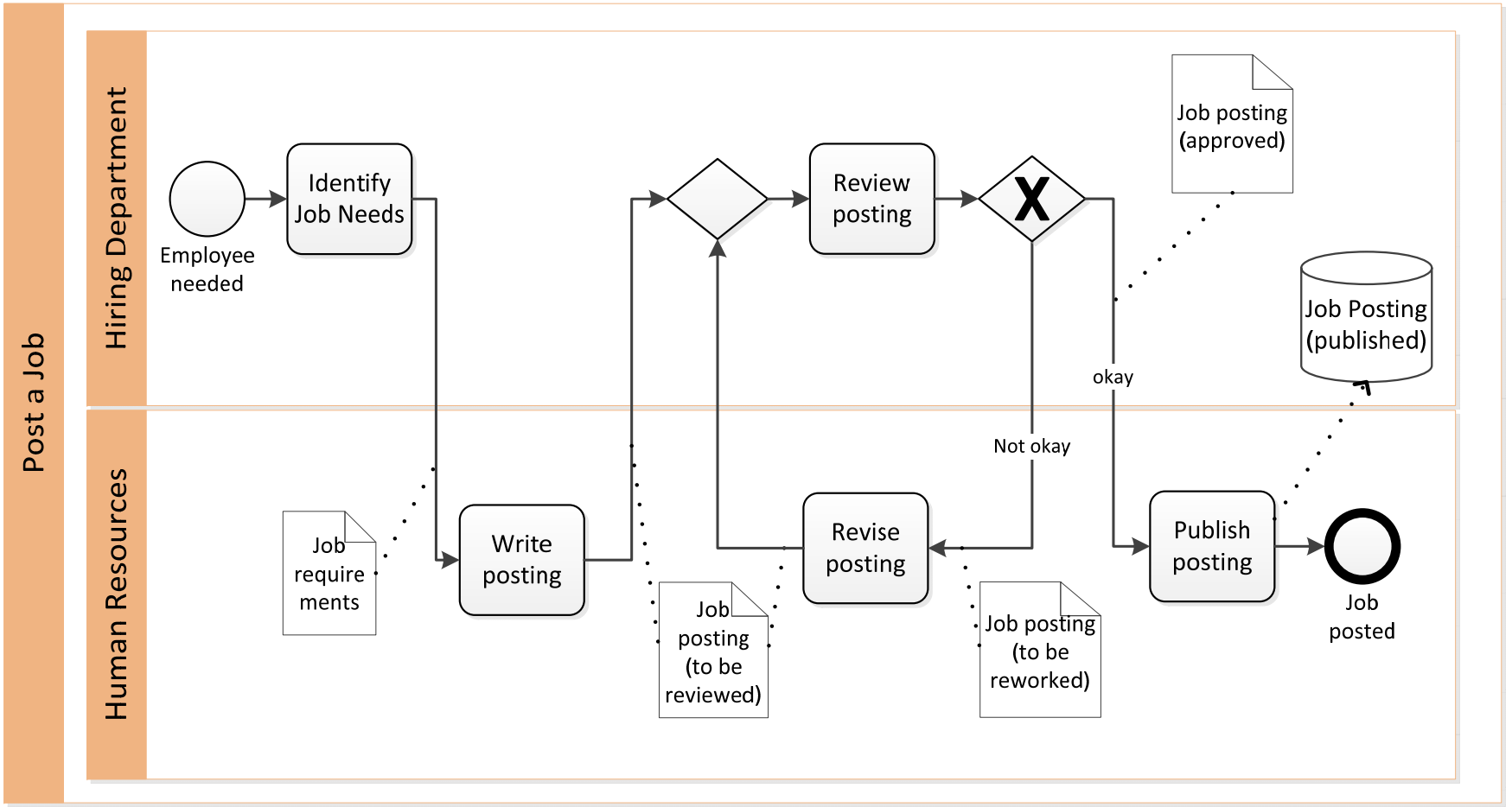
Examples of Data Associations



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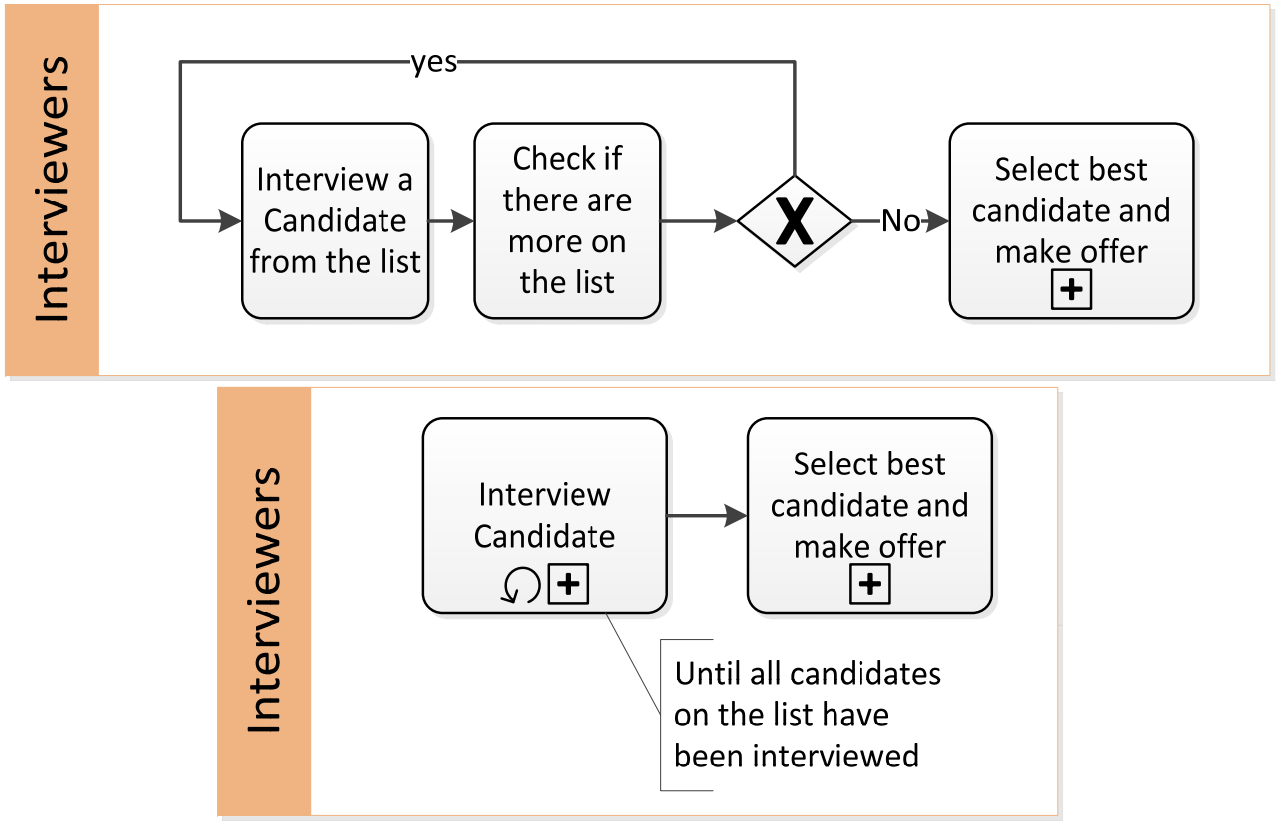
Other Interesting BPMN Aspects - 2

- Looping (top example) can be shown in a compact way (bottom example) with a loop symbol – the annotated condition is evaluated at the end of each loop



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Other Interesting BPMN Aspects - 3

- A pool contains one process defined and controlled by the participants (lanes) in that pool; it interacts with another independent process using message exchanges into the pool of the other process
- A pool may represent an organization or some other construct, such as a system
- Collaboration diagrams show the interface between two processes, public or private
  - Message flows go between pools only, not between lanes

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Other Interesting BPMN Aspects - 4

- When a sub-process or task applies to more than one instance (ex. Multiple applicants for a job), a series of 3 bars indicates multiples

- If the work is done in parallel, the lines are vertical; if sequential, the lines are horizontal
- Tasks can be designated graphically of different types (see poster)

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