



Business Process Concepts and Modeling

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About myself

- **Professional**

- Associate Professor at Informatics Institute of the Federal University of Rio Grande do Sul (INF-UFRGS) since 2013
- Institutional Representative of INF-UFRGS at the Computer Brazilian Society

- **Academic**

- Post-doc in Computer Science (UFRGS, Porto Alegre, Brasil, 2012)
- Post-doc in Computer Science (University Joseph Fourier, Grenoble, France, 2011)
- Post-doc in Computer Science (Ulm University, Germany, 2009)
- PhD in Computer Science (UFRGS, Porto Alegre, Brasil, 2006)
- PhD stage (Stuttgart University, Germany, 2005)
- Master in Computer Science (UFRGS, Porto Alegre, Brasil, 2002)
- Bachelor in Computer Science (UNISC, Santa Cruz do Sul, Brasil, 1999)

- **Research Areas of Interest**

- Business Process Management (BPM)
- Ontology and BPM
- Information technology applied in Healthcare
- Software Engineering



Agenda

- **Business Process Concepts and Modeling**
 - Introduction to Business Process Management
 - Basic Concepts in Business Process Management
 - Requirements Elicitation in Process Modeling
 - Business Process Modeling and Notation
- **Research Topics in Business Process Management**
 - Verification and Completeness of BPMN Specification Code
 - Ontology Building based on Process Models
 - Extraction of Process Models based on Textual Procedures
 - Big Data classification based on Process Models



Business Process Concepts and Modeling Introduction

Business Process are Everywhere



Order-to-cash



Order-to-order



Issue-to-resolution



Payment

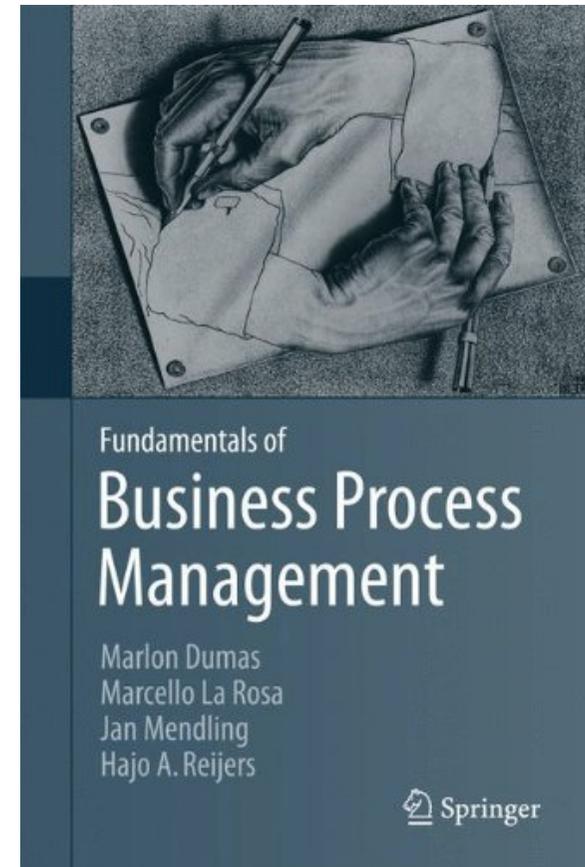


Application-to-approval

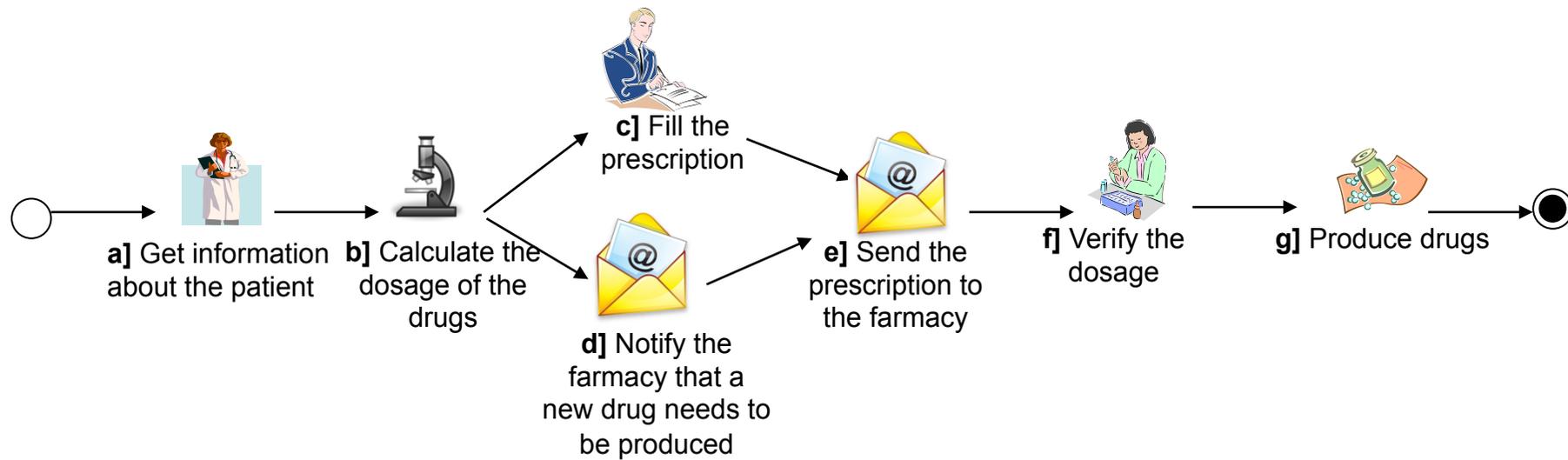
Business Process

- *A set of one or more linked procedures or activities which collectively realize a business objective or policy goal, normally within the context of an organizational structure defining functional roles and relationships (WfMC, 1999)*
- *A business process consists of a set of activities that are performed in coordination in an organizational and technical environment. These activities jointly realize a business goal (Dumas, 1998)*

A business process is as collection of inter-related events, activities and decision points that involve a number of actors and objects, and that collectively lead to an outcome that is of value to at least one customer (Dumas, 2013)



Example of Business Process



Business Process Management (BPM)

Business Process Management is the art and science of overseeing how work is performed in an organization to ensure consistent outcomes and to take advantage of ***improvement*** opportunities (Dumas et al 2013)

BPM as a body of methods, techniques and tools to discover, analyze, redesign, execute and monitor business processes



Why BPM

“The first rule of any technology used in a business is that automation applied to an efficient operation will magnify the efficiency.

The second is that automation applied to an inefficient operation will magnify the inefficiency.”

To learn how to model and improve business process rather than only to know how to build information systems is a fundamental ability to whatever IT professional



Benefits of BPM

- Dynamic distribution of work
- Work monitoring
- Applications can be automatically invoked during process execution
- Standardization of non-standardized processes
- Improvement of process efficiency
- Reduction in time to complete workflows, and increase in their quality
- Reduction in human resources
- Better ability to cope with and handle changes to processes
- Increase in the relevance of existing IT systems within an organization

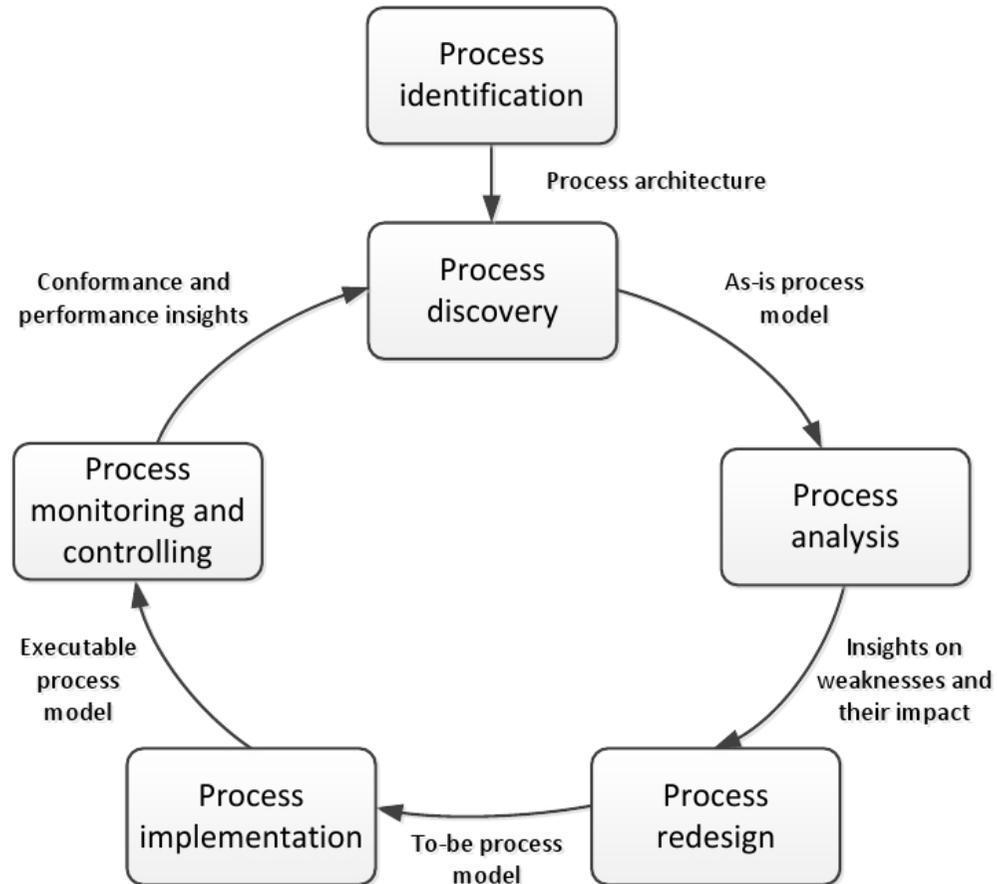


Many process improvement ideas were discovered by mistake.

BPM Applications

- Applications based on activity control and ordering can be automatized by a WfMS
- In Robotics, BPM and Workflow have been used to standardize and document processes
- Healthcare processes that require dynamic adaptation and also exception handling
- E-learning
- E-science

BPM lifecycle



Dumas, 2013

Process Identification

Which process need to be improved?



- Which process present operational problems?
- Which are the limits of a process (start and end)?
- The complexity to answer these questions is directly related to the process – oriented thinking existent in organizations

Dumas, 2013



BPM Lifecycle

Process Identification

- In case the organization already had a BPM initiative it is possible that it has also process documentation
 - The process scope can be defined
- In case there exists no BPM initiative, the BPM team must:
 - Identify the processes related to organizational problems
 - Demimitate the process scope
 - Identify relations between process (part-of-relations)

Process Identification → Process Architecture



BPM Lifecycle

Process Identification

- Estimate the value of a process execution is fundamental

**“YOU CANNOT CONTROL WHAT YOU ARE NOT ABLE TO ESTIMATE
” (Tom DeMarco)**

- Before analyze a process in details it is important to define clear metrics to measure the process performance
- Costs metrics
 - Quantity of equipment's allocated in time space
- Time metrics
 - Time between an equipment request and its delivery
- Quality metrics (error rates)
 - Number of times a process finalize with undesirable result. E.g. an equipment is returned because it is not suitable



BPM Lifecycle

Process Identification

- In this phase, a business problem is posed, processes relevant to the problem being addresses are identified, delimited and related to each other
- **The outcome is a new or updated process architecture that provides an overall view of the processes in an organization and their relationship**



BPM Lifecycle

Process Discovery

- Also called process modelling
- The current state of each relevant processes is documented, typically in the form of one or several as-is process model
- **Why “Process Discovery”?**
 - *Why process already exist at least in the mind of people working in an organization*
- **The goal of this phase is to discover and to document the processes being executed in an organization**





BPM Lifecycle

Process Analysis and Redesign

- Issues associated to the as-is process are identified, documented and whenever possible quantified using performance measures
- **The output is a structured collection of issues**
- **These issues are typically prioritized in terms of their impact and effort to solve them**
- The **redesign** aims to identify changes to the process that would help to address the issues identified in the analysis phase
- **The output of the redesign phase is typically a to-be process model**



BPM Lifecycle

Process Implementation and monitoring

- Changes required to move from the as-is process to the to-be process are prepared and performed
- Process implementation covers two aspects
 - Organizational change management
 - Process automation
- Relevant data are collected and analyzed to determine how well is the process performing with respect to its performance measures and performance objectives



Stakeholders in the BPM Lifecycle

- Management team
- Process Owners
- Process Participant
- Process Analysts
- System Engineering
- The BPM Group



Business Process Concepts and Modeling

Basic Concepts



Basic Concepts

Workflow

The automation of a business process, in whole or part, during which documents, information or tasks are passed from one participant to another for action, according to a set of procedural rules

- **Workflow Management System**
 - interpret a process definition
 - creates and manages the execution of workflows through the use of software, running on one or more workflow engines, which is able to interpret the process definition, interact with workflow participants and, where required, invoke the use of IT tools and applications.





Basic Concepts

Task vs. Activity

- **Task**

- Atomic step in a process
- In a buying process to verify if a received product is the one requested



- **Activity**

- A variety of consecutive steps
 - Verification of equipment involving several steps
 - Verify if the received equipment is the specified
 - Verify if the equipment works properly
 - Verify if the equipment includes all devices

Basic Concepts

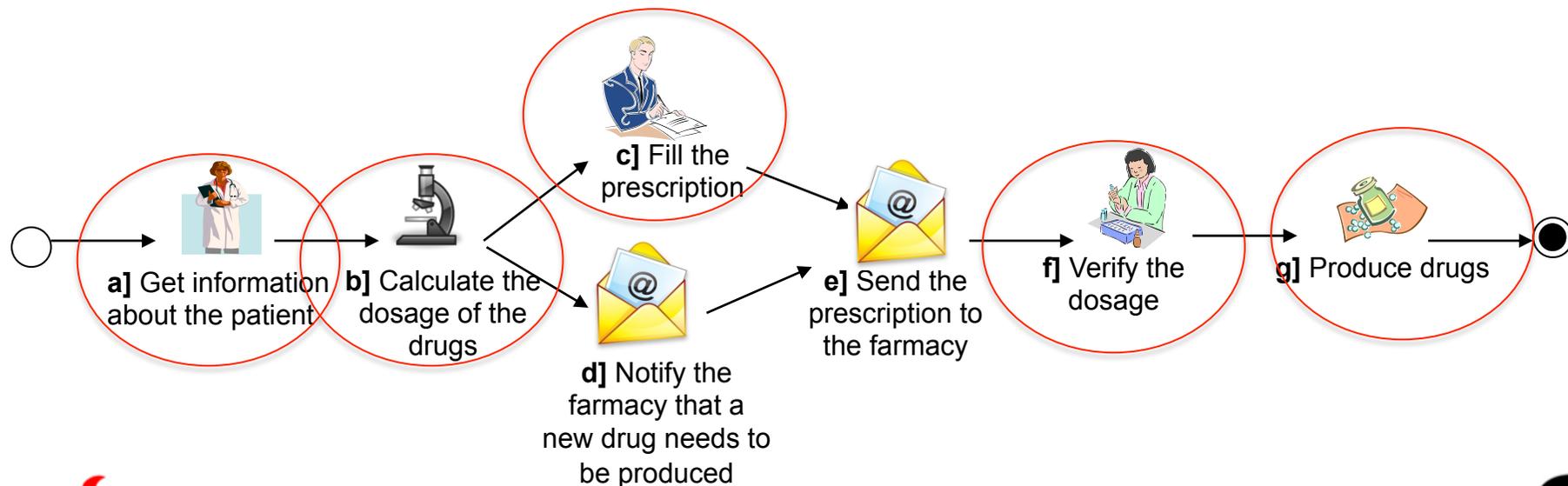
Manual and Automatic Tasks

- **Manual Task**

- Cannot be automatized

- **Automatic Task**

- An activity which is capable of computer automation using a workflow management
- system to manage the activity during execution of the business process of which it
- forms a part.





Basic Concepts

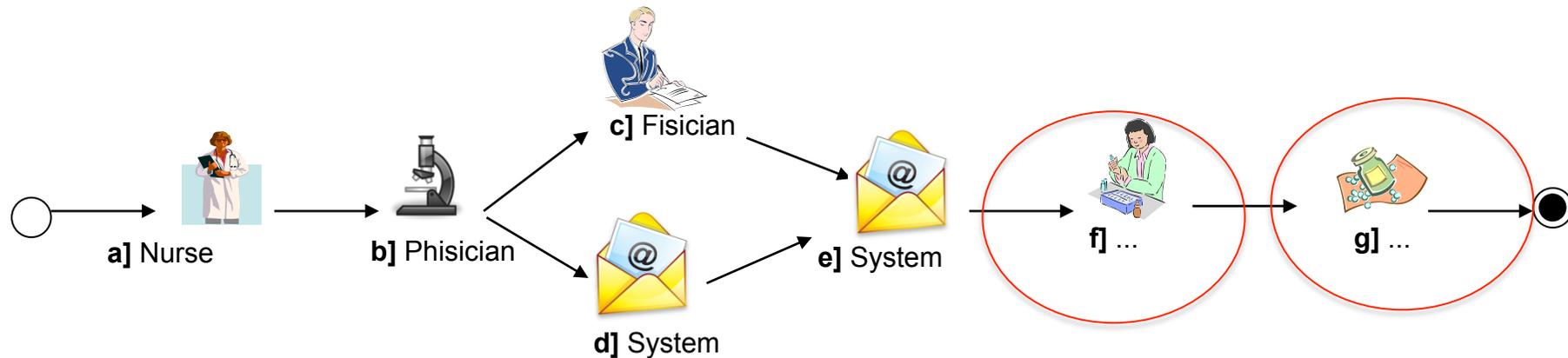
Role and Actor

- **Role**

- A set of actors or process participants sharing specific characteristics, abilities, etc.

- **Actor**

- Human actors, organizations, or software systems acting on behalf of human actors or organizations), physical objects (equipment, materials, products, paper documents) and immaterial object (electronic documents and electronic records)



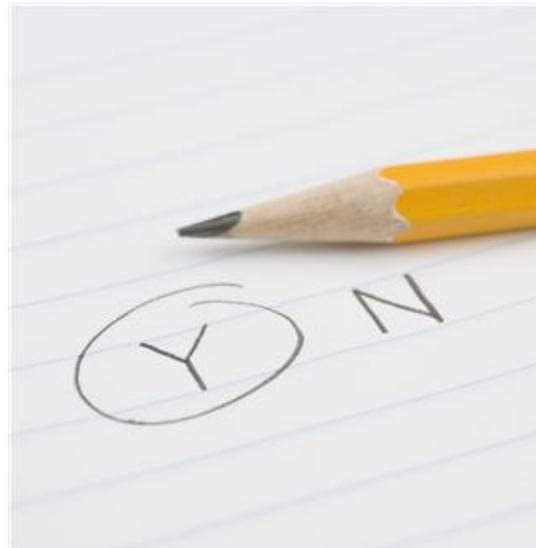


Basic Concepts

Decision Point

- points in time when a decision is made that affects the way the process is executed.
 - For example, as a result of the inspection, the site engineer may decide that the equipment should be returned or that the equipment should be accepted.

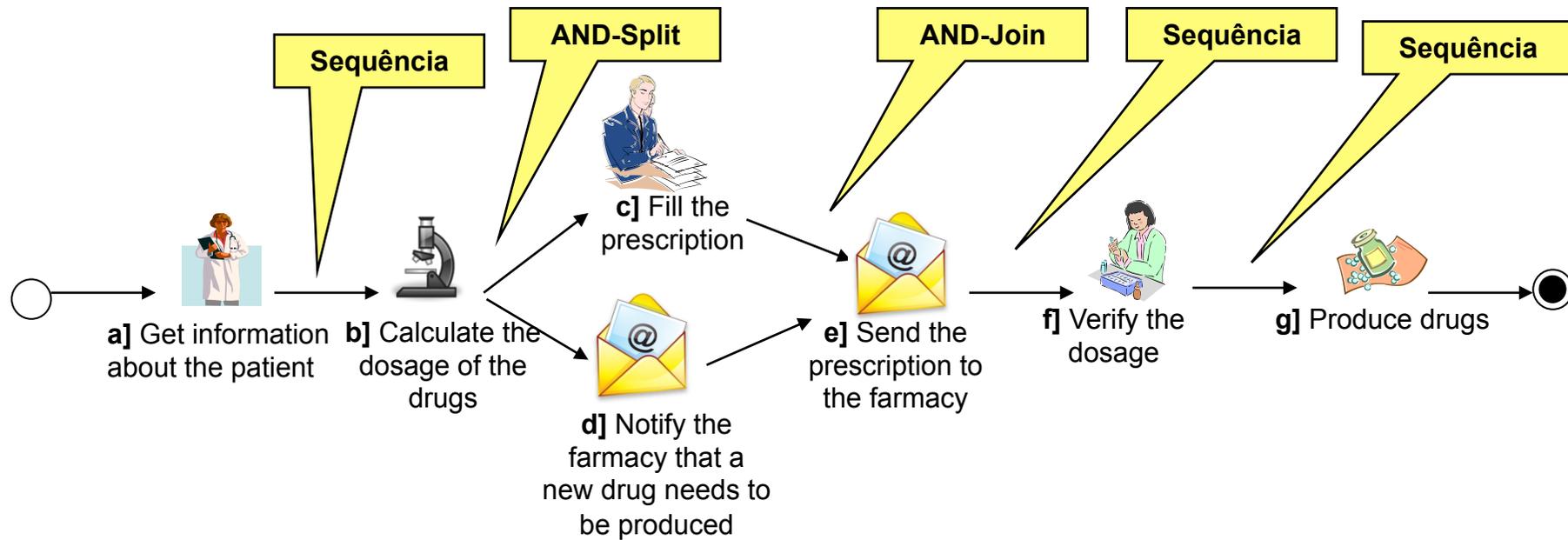
This decision affects what happens later in the process





Basic Concepts Control Flows

- Process activities are connected with control flows

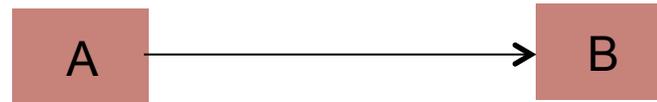




Basic Concepts

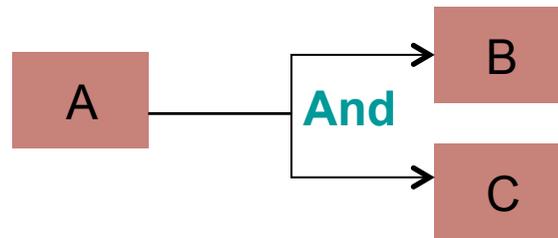
Control Flows

- Sequential



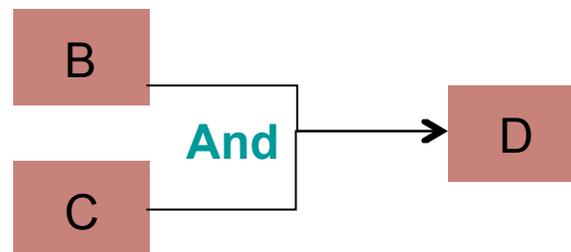
Animation

- And-Split



Animation

- And-Join



Animation



Basic Concepts

Partitions

- Represent the entities responsible by the activities of a process
 - Refer to the participants of a process and can be an organization, a role, a human actor, a system
 - E.g., Financial, Buying, Selling, Marketing departments



Basic Concepts

Work items

The representation of the work to be processed (by a workflow participant) in the context of an activity within a process instance

on	Commit Date	Commit By	Comments
	6/02/2011 00:26:56	Susan Duncan	TeamTasks 21 - Run tests from Cruise Control and displ
	6/01/2011 23:54:48	Susan Duncan	TeamTasks 21 - Run tests from Cruise Control and displ
	6/01/2011 23:52:53	Susan Duncan	TeamTasks 21 - Run tests from Cruise Control and displ
	6/01/2011 18:46:42	Susan Duncan	TeamTasks 21 - Run tests from Cruise Control and displ
	6/01/2011 18:11:58	Susan Duncan	TeamTasks 21 - Run tests from Cruise Control and displ
	6/01/2011 17:41:14	Susan Duncan	TeamTasks 21 - Run tests from Cruise Control and displ
	6/01/2011 17:37:53	Susan Duncan	TeamTasks 21 - Run tests from Cruise Control and displ
	6/01/2011 17:36:35	Susan Duncan	TeamTasks 21 - Run tests from Cruise Control and displ
	6/01/2011 17:29:57	Susan Duncan	TeamTasks 21 - Run tests from Cruise Control and displ
	6/01/2011 17:29:25	Susan Duncan	TeamTasks 21 - Run tests from Cruise Control and displ

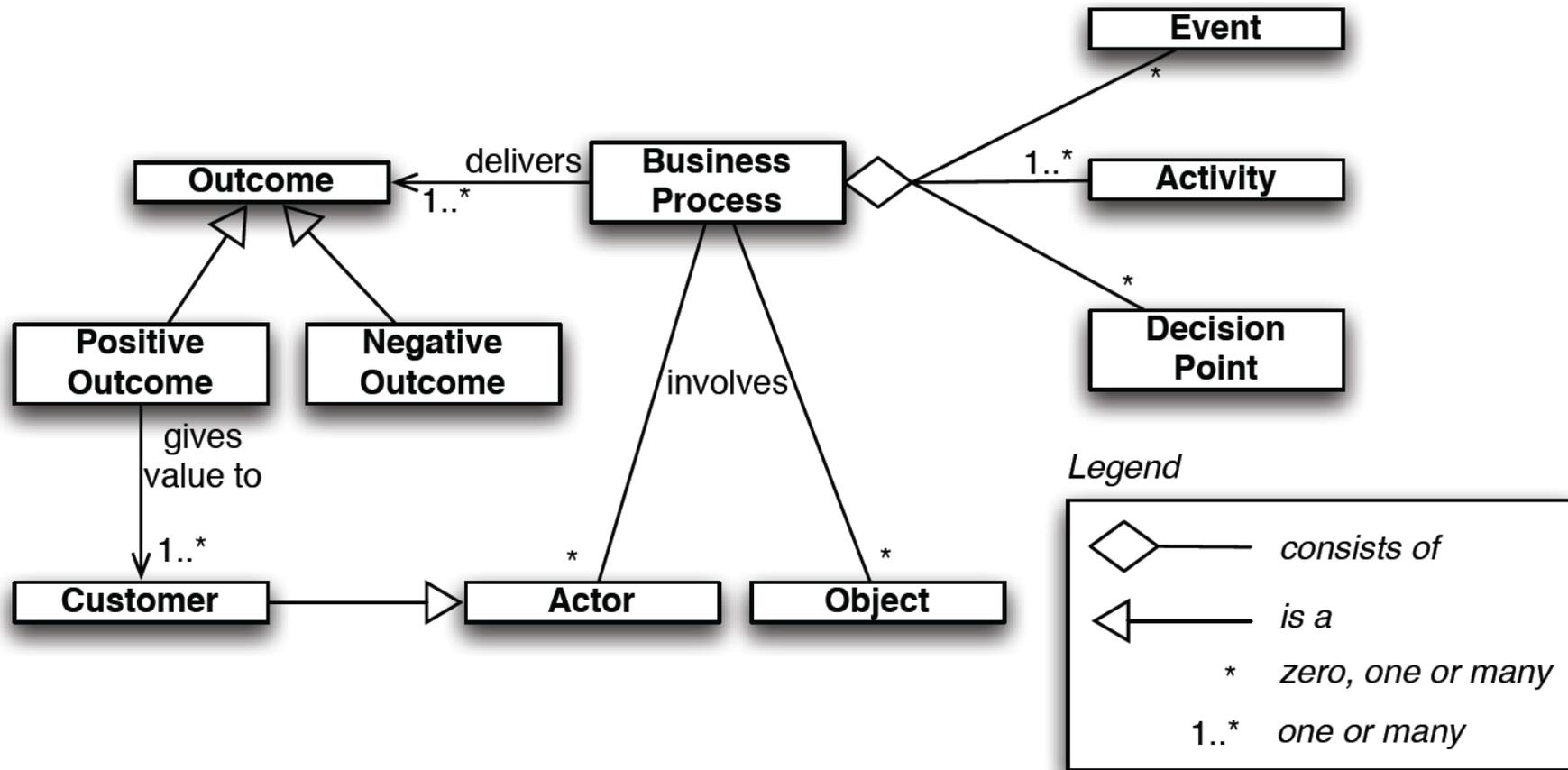
Included Files

Oracle

Related Builds

Build	Date	Status	Transactions	Tests Run	Errors	Failures	To
build.17	Thu Jun 0...		1	4	0	1	1

Components of Process





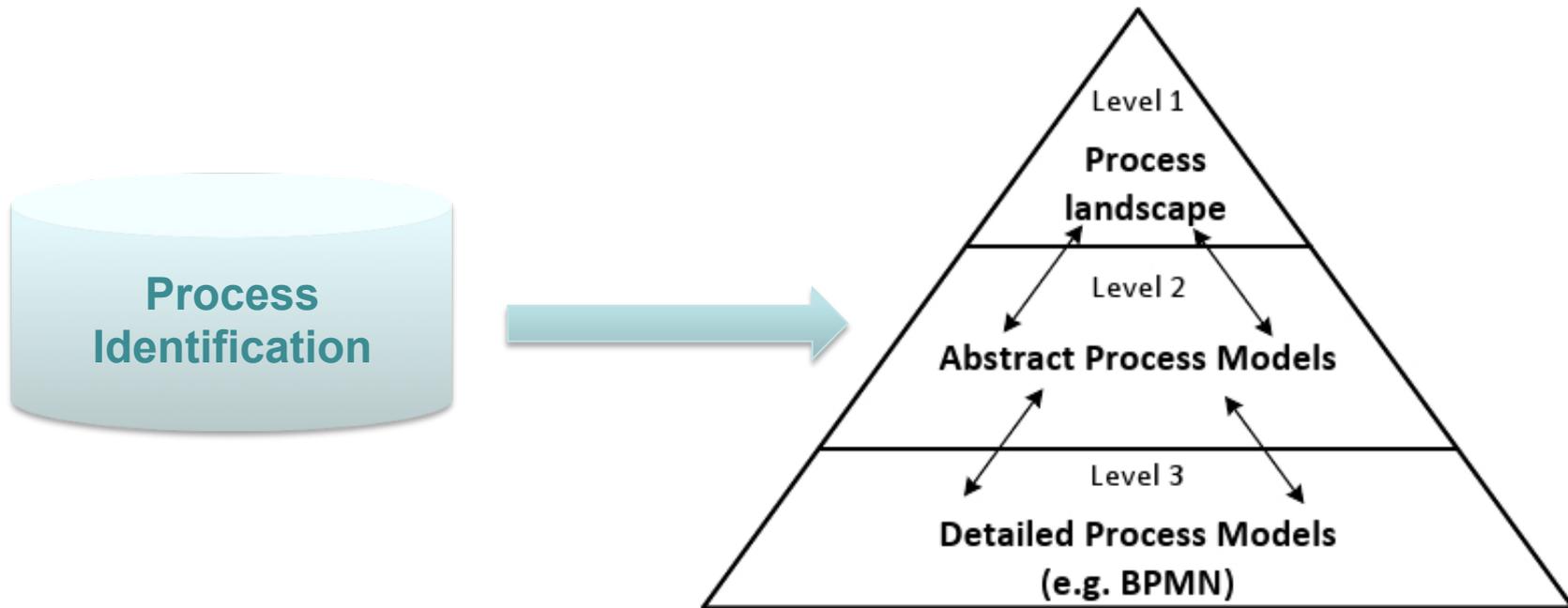
Business Process Concepts and Modeling Requirements Elicitation



Process Identification Definition

Process identification is a set of activities aiming to systematically define the set of business processes of a company and establish clear criteria for prioritizing them

Dumas, 2013





Process Identification

Keep the key process in mind...

- Seldom organizations can define, analyse and redesign all their processes
 - It is technically expensive to support all the processes of an organization and at the same time to monitor their performance
 - ***It is mandatory to whatever organization interested in a BPM solution to foccus on a subset of its processes***
- ▶ Some **processes need to be prioritized due to their importance** for the organizational estrategical level
 - ▶ Other processes can pose **problems which also need to be solved**





Process Identification

Key phases

- Process identification includes two phases
 - **Designation**
 - To understand the processes executed in an organization and their relationships
 - **Validation**
 - To prioritize the process that will be (re)-designed

Important: none of these phases is related with a detailed process design



Process Identification

Process Categorization

- Michael Porter presents two process categories
 - **Core processes** (primary activities)
 - Includes key processes of the organization such as product manufacture and service offer (add value)
 - **Additional Processes** (secondary activities)
 - Support the execution of the core the processes. Infra-structure, RH and technology development and acquisition



Michael Porter



Process Identification *Methods*

Technique	Positive	Negative
Brainstorm	Easy to configure Interaction between people	No preparation ??
Interviews	Motivates the participants Makes possible a complete conversation Keeps the focus in specific aspects Personal opinion can be expressed	Difficult to achieve a consensus Participants must want to contribute Interviewers must be trained to do good interviews Has the risk of conduct the interviewed
Scenarios	Efficient to understand the goals of the users	Don't allow to obtain all the requirements
5W1H	Systematic questionnaire	Don't contribute to group discussion



Process Identification *Methods*

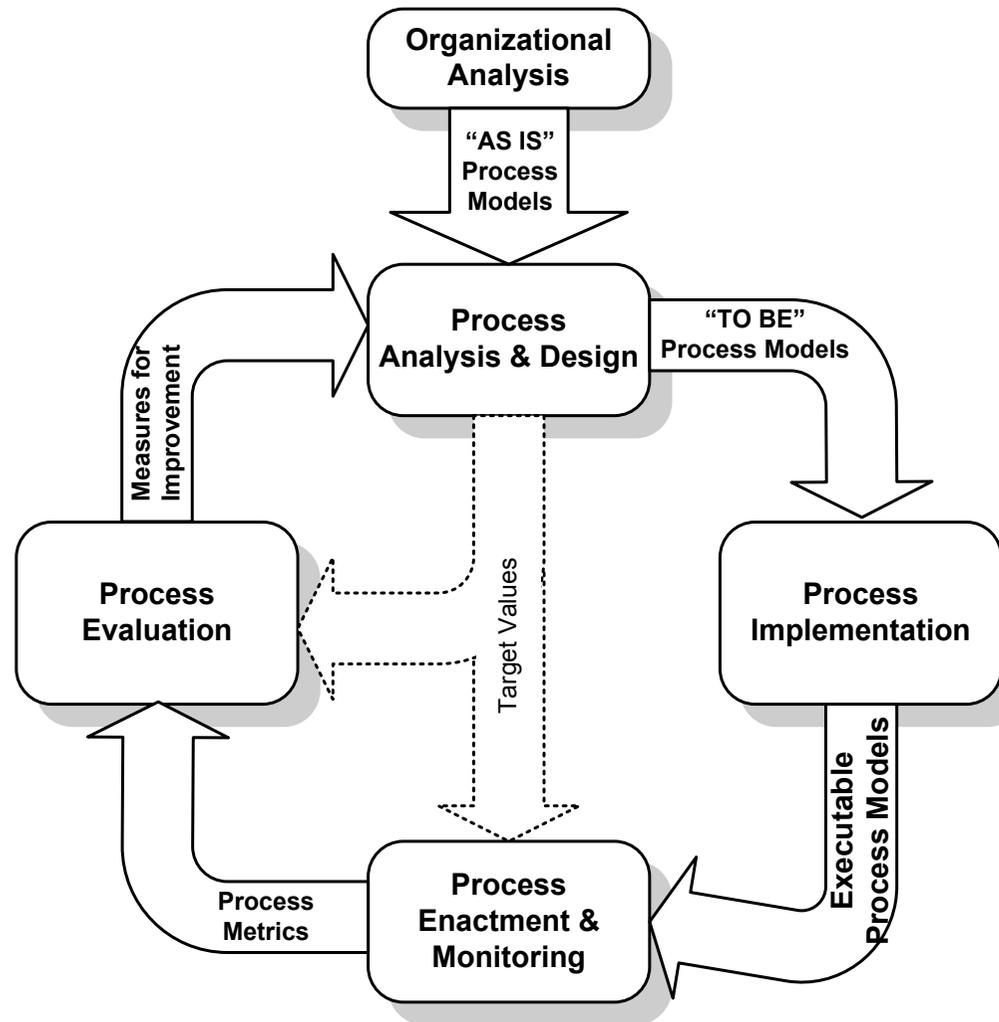
- **5W1H**

What	What will be done
When	When will be done
Where	Where will be done
Why	Why will be done
Who	Who will done
How	How will be done



The Business Process Modeling Notation (BPMN)

Process Modeling



Why Process Modeling

- Process models are important in several stages of the BPM lifecycle
- The main reason for process modeling are:
 - Make easier process understanding and the sharing of knowledge between process participants
 - Help to prevent and to identify execution problems

Process modeling is a pre-requirement to the analysis, redesign and implementation of business process (Dumas, 2013)

Process Modeling

Problems

Illustration by Randy Glasbergen.
www.glasbergen.com



“A new automated ordering system has speeded up our business. We’re losing customers faster than ever.”

- Communication problems between the analyst and the users/problems
- Lack of process documentation;
- User resistance to provide process information

Process Modeling Language

- Includes three parts:
 - **Syntax, Semantics, Notation**
- **Syntax:** set of process modeling elements and business rules regarding these elements
- **Semantics:** combines syntax and textual description of the elements (must be precise)
- **Notation:** set of graphical symbols representing the modeling elements

Process Modeling Rules

Overview 7PMG

G1	Use as few elements in the model as possible
G2	Minimize the routing paths per element
G3	Use one start and one end event
G4	Model as structured as possible
G5	Avoid OR routing elements
G6	Use verb-object activity labels
G7	Decompose a model with more than 50 elements

Mending, 1999

Business Process Modeling and Notation (BPMN)

- More than 100 elements
 - **Do not panic!!!**
- A subset of the elements is already enough to model process
- Learn first the basic set of elements
 - Further elements should be gradually learned



What is BPMN

- BPMN is a notation based on flow diagrams for process modeling
- BPMN allows to generate an execution process (e.g. BPEL) from a process diagram
- The current version of BPMN is translated for several idioms
- Have look in a <http://bpmb.de/index.php/BPMNPoster>
 - Spanish version: Ildfonso Montero, Luciano García-Bañuelos, Marlon Dumas
 - Portuguese version: Lucinéia Heloisa Thom and Cirano lochpe



BPMN in Action

- OMG standard supported by several BPM tools
 - Bizagi Process Modeller
 - Signavio (<http://www.signavio.com/>)
 - TIBCO Business Studio (free download, quite large)
 - IBM Websphere Business Modeler
 - ARIS
 - Oracle BPA
 - Business Process Visual Architect (Visual Paradigm)
 - Bonita





- ***Flow Objects***

- Are the main elements to represent process behaviour. There exists three:

- Activities
 - Events
 - Gateways

- ***Connectors***

- Connects flow objects, representing dependencies between them (execution flow)

- Sequence Flow
 - Message Flow
 - Association



- ***Swimlanes***

- Represent process participants, i.e. Organizational roles (humans, programs, machines) participating in a process execution
 - Pool
 - Lane (em Português, “faixa”)

- ***Artifacts***

- Elements that represent additional information in a process. There exist three types:
 - Data objects
 - Group
 - Annotation



BPMN

Reduced set

Flow Objects

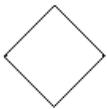
Events



Activities



Gateways



Connectors

Sequence Flow



Message Flow



Association



Artifacts

Data Object



Name
[State]

Text Annotation



Add Text Here

Group

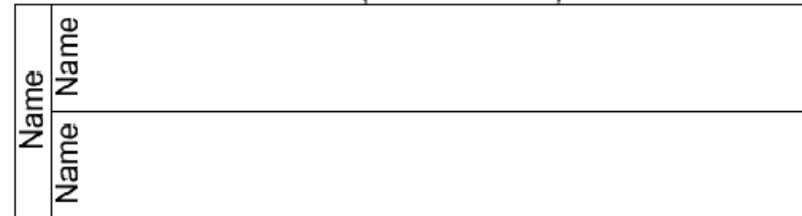


Swimlanes

Pool



Lanes (within a Pool)





BPMN

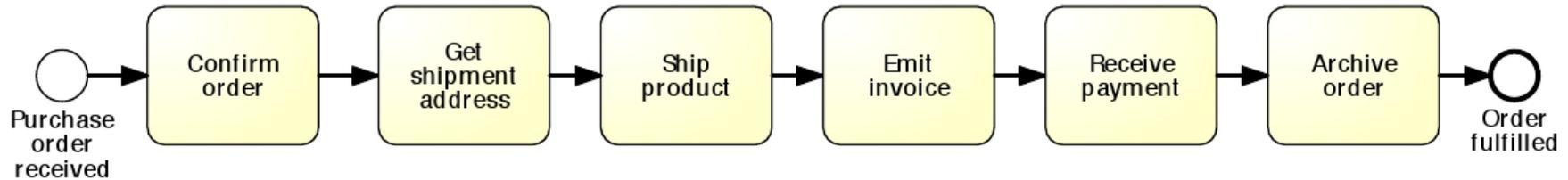
From 1.000 miles away

- A BPMN model is a graph composed of four elements

Event	
Activity	
Gateway	
Flow	

BPMN process

- Purchase Order Process



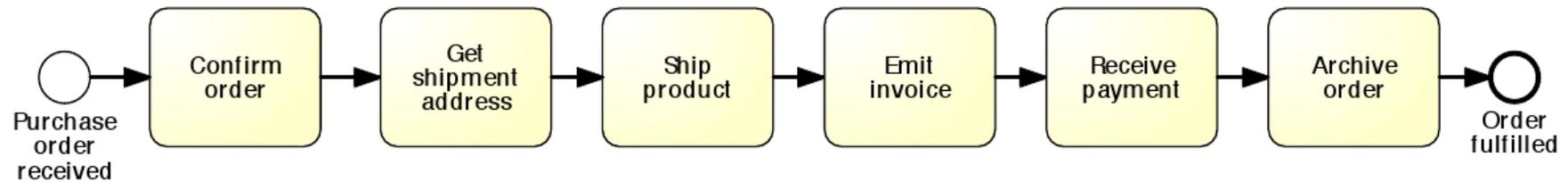
Dumas, 2013



BPMN Process

Start and End Events

- **Start Event**
 - Indicates when a process instance starts execution
- **End Event**
 - Indicates when a process instance completes execution



Start Event

End Event

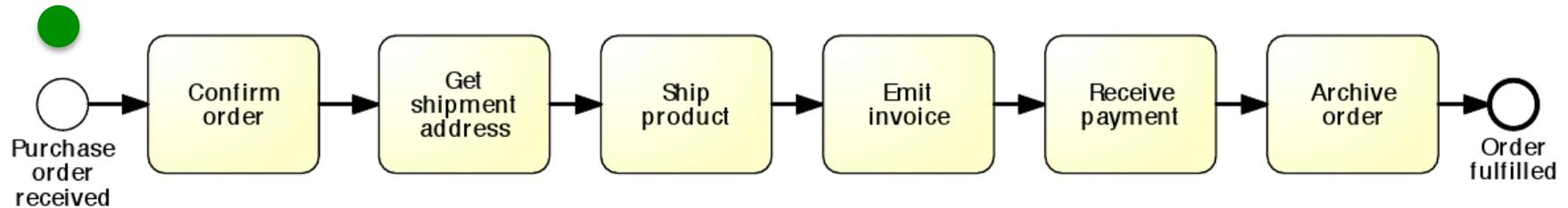


BPMN Process

Process Instance

- A new instance of the purchase ordering process is created always when a purchase order arrives and finishes when the order is fulfilled
- The *token* concept represents a process instance
- *Tokens* are created in the context of a start event and run through the process until the end of the process when they are destroyed

token





BPMN elements

Activities (label convention)

- **Name related to a process object + Verb in the imperative**
 - Ex.: Order Approval
 - Before the name an adjective can be placed
 - Submit Drive Licensing
 - The verb can be followed by a complement that indicates its purpose
 - Renew drive licensing though an agency

To avoid labels with more than 5 words



BPMN elements

Events

- Must start with a name (typically a process object) and finish with a verb in the participle
 - E.g.: Invoice submitted
- Before the name an adjective can be placed
 - Urgent purchase order submitted
- The first word must be Uppercase



BPMN elements

Process label convention

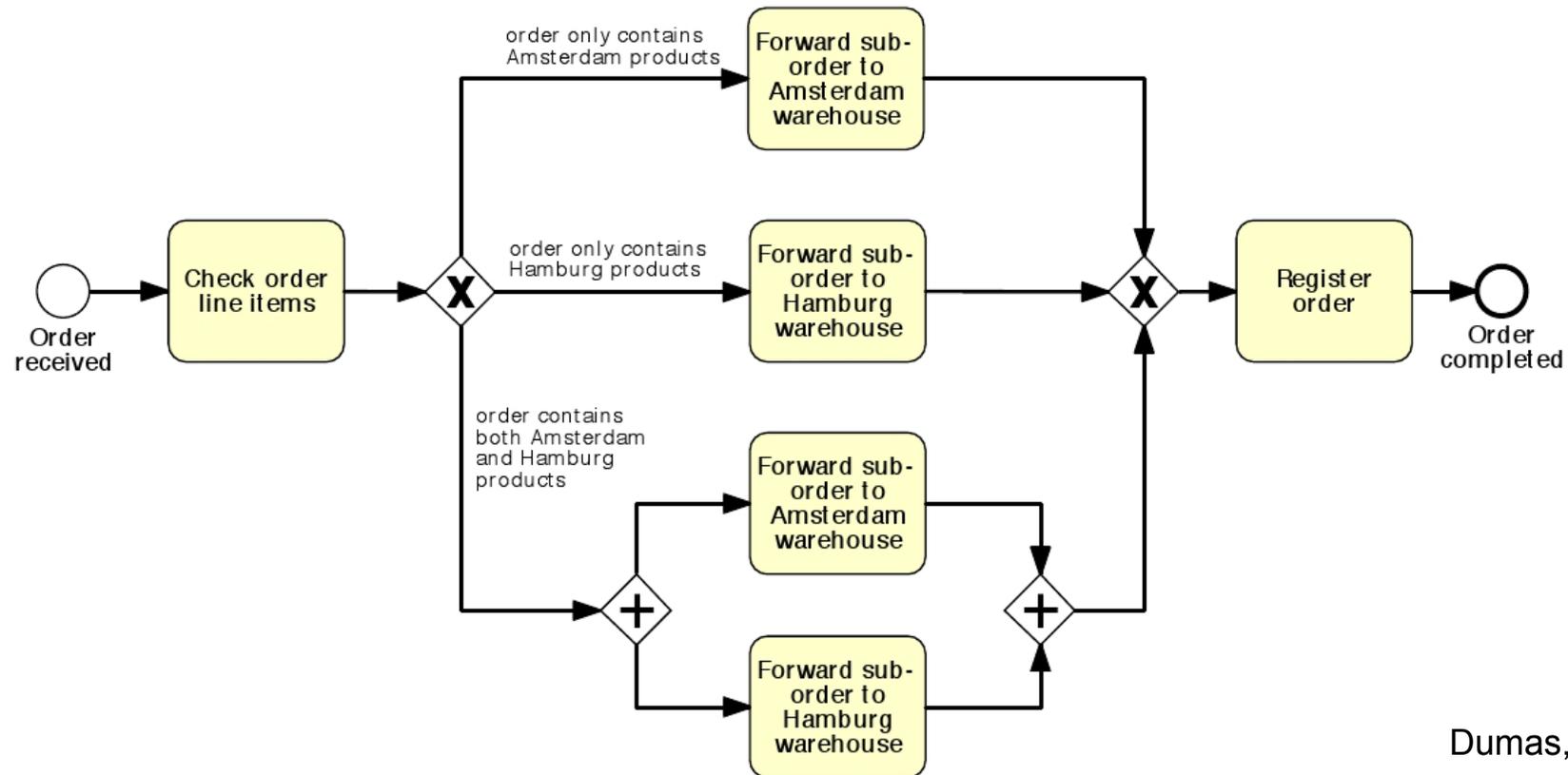
- The name of a process must come after an adjective
 - E.g. fulfillment of an purchase order
- Choose the verb that represents the process and give a name for that (e.g. full fill)
- To use “- “it is possible
- The first letter of a process name should not be Uppercase



BPMN elements

Gateways

- OR-Split and Or-Join



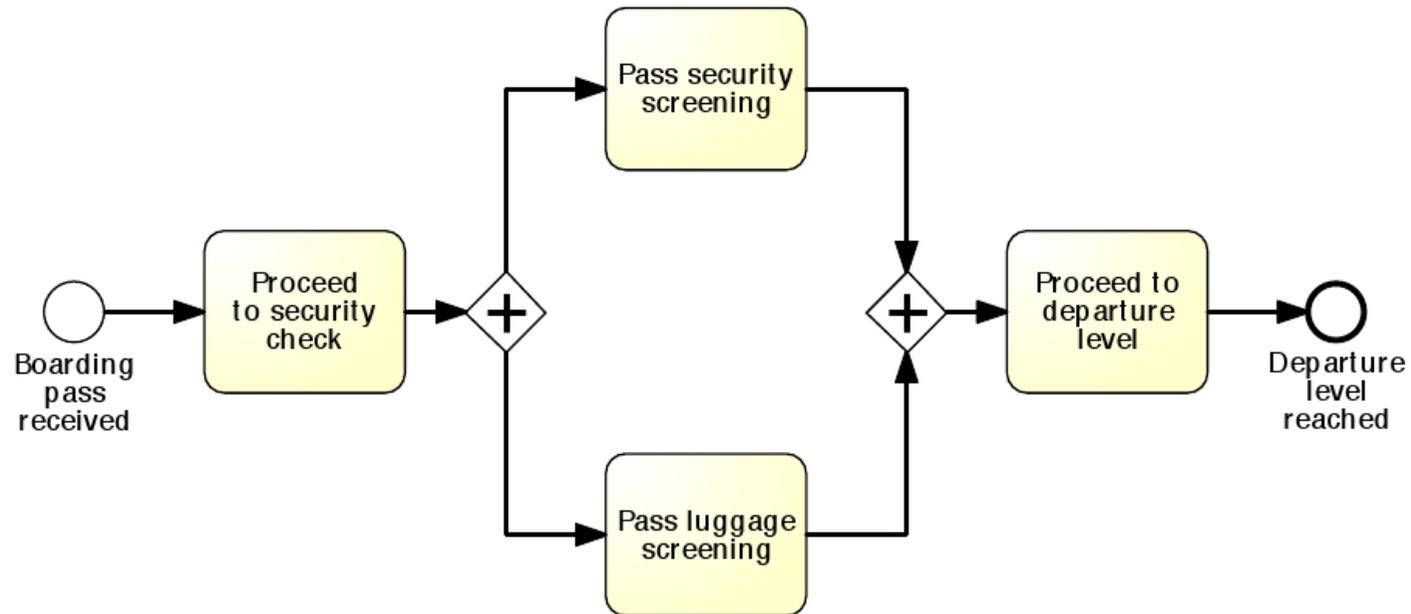
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BPMN elements

Gateways

- AND-Split and AND-Join



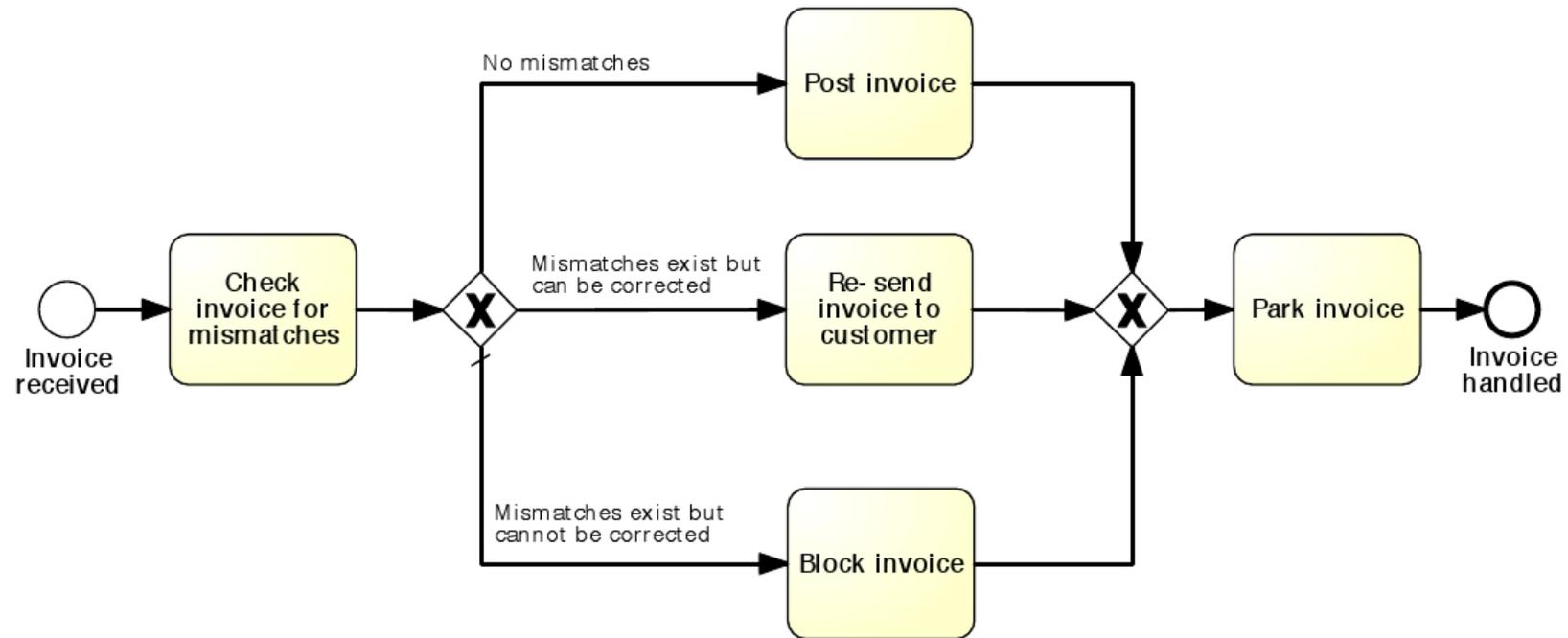
Dumas, 2013



BPMN elements

Gateways

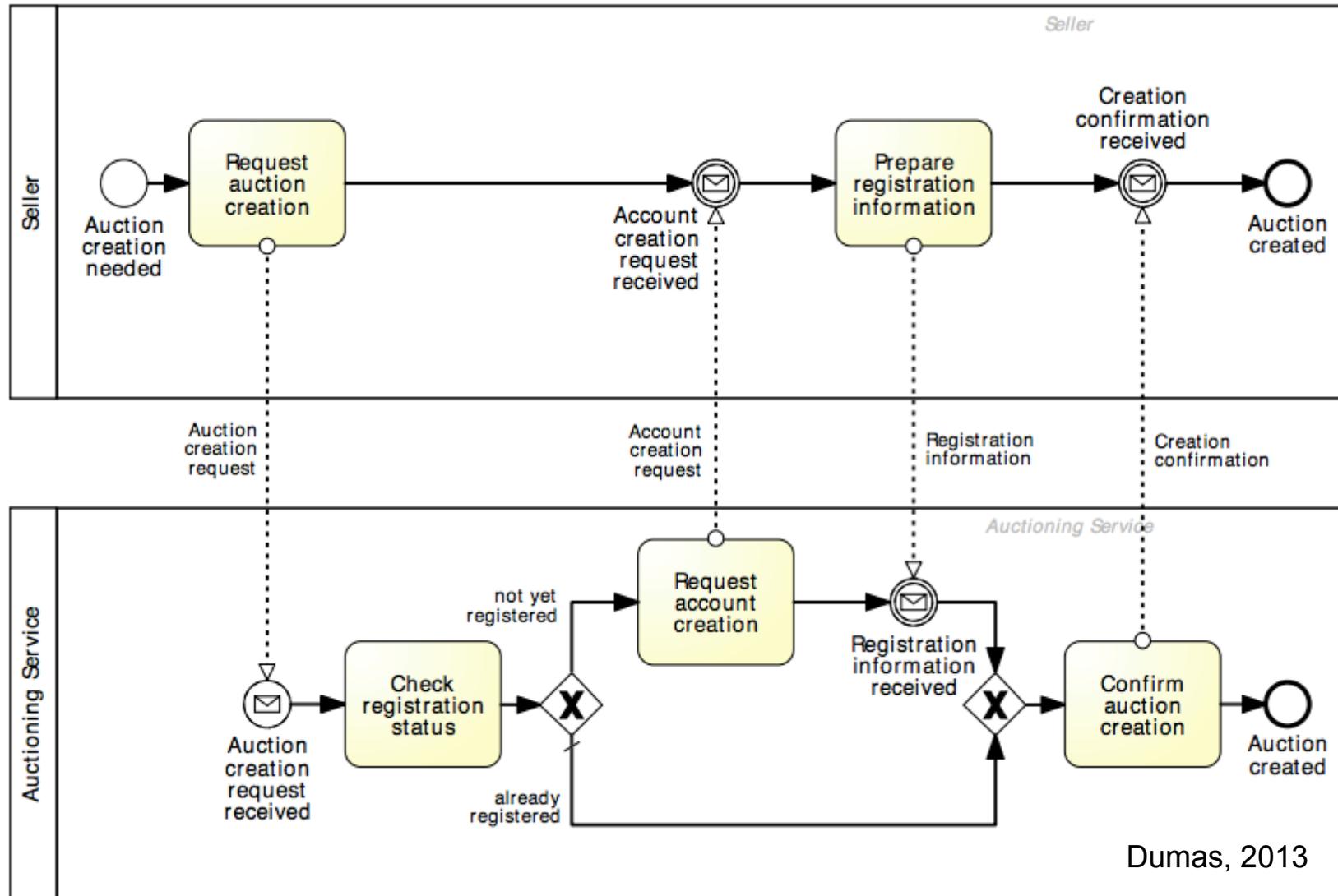
- XOR-Split and XOR-Join



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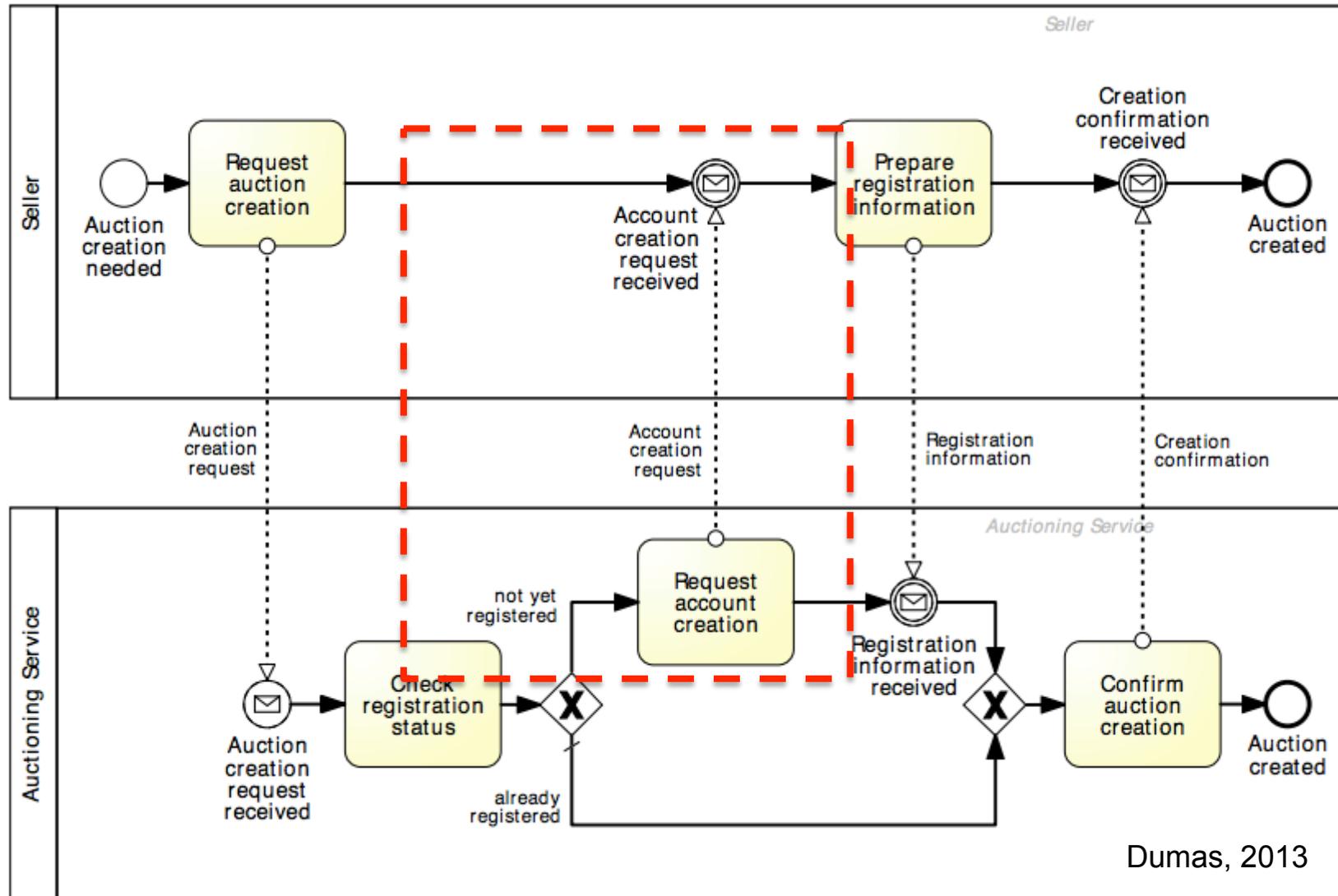
Exercise

- From what you learned until now find the error in this process:



Exercise

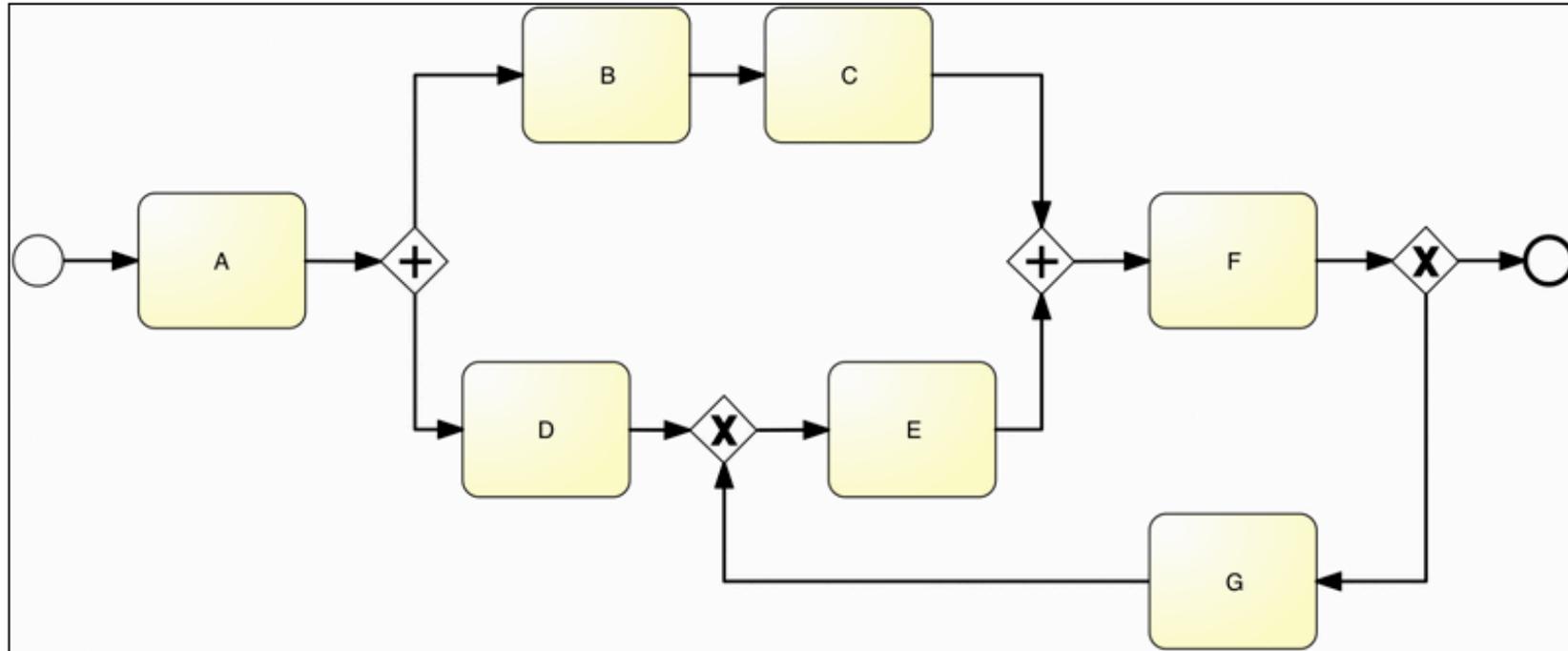
- If the seller is already registered, as this party will wait for the account creation request message which in that case will never arrive





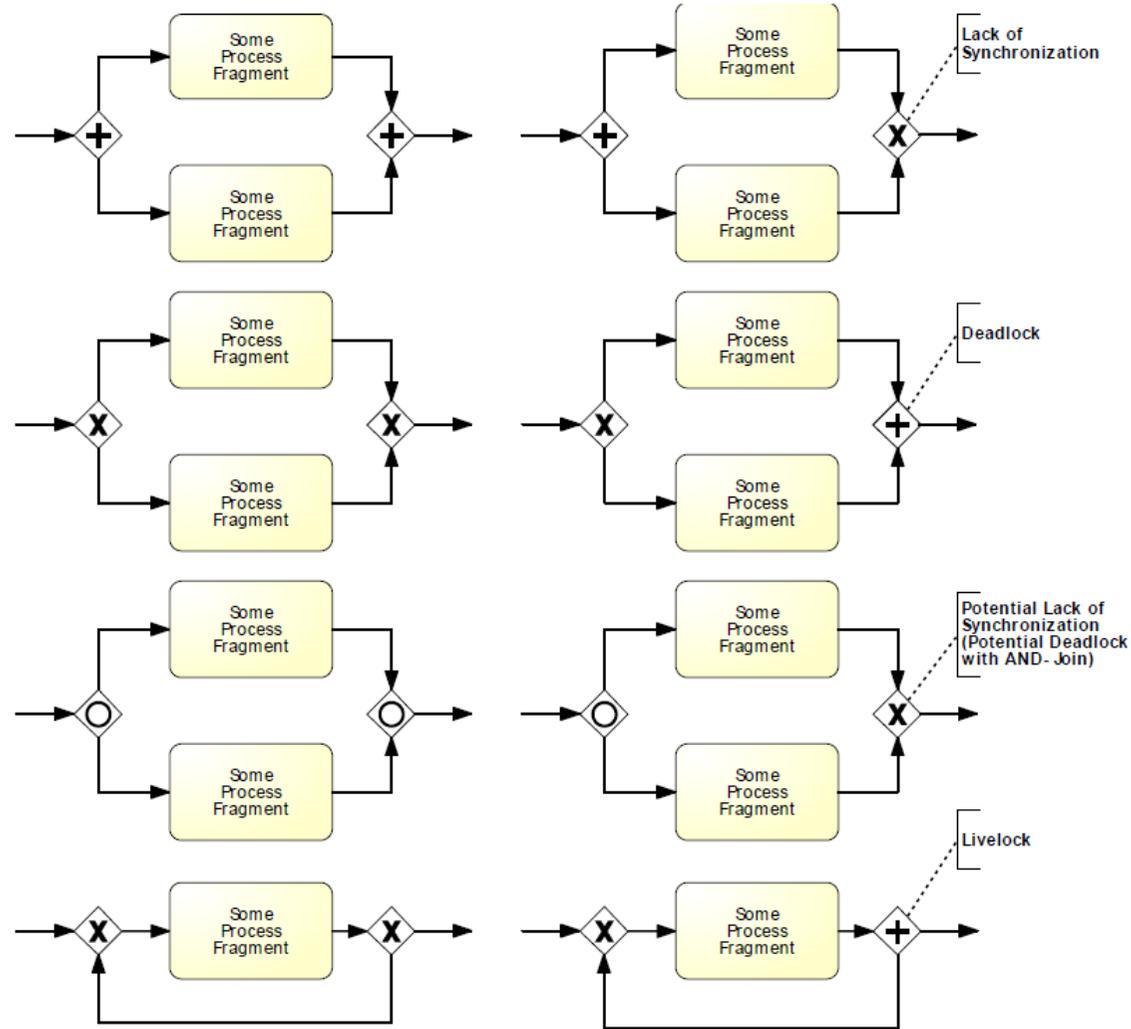
Exercise

Find the error in this model



- A. The AND control flow after activity A.
- B. The XOR control flow after activity D.
- C. The AND control flow before activity F.
- D. The XOR control flow after activity F.

Sound and No-sound Process

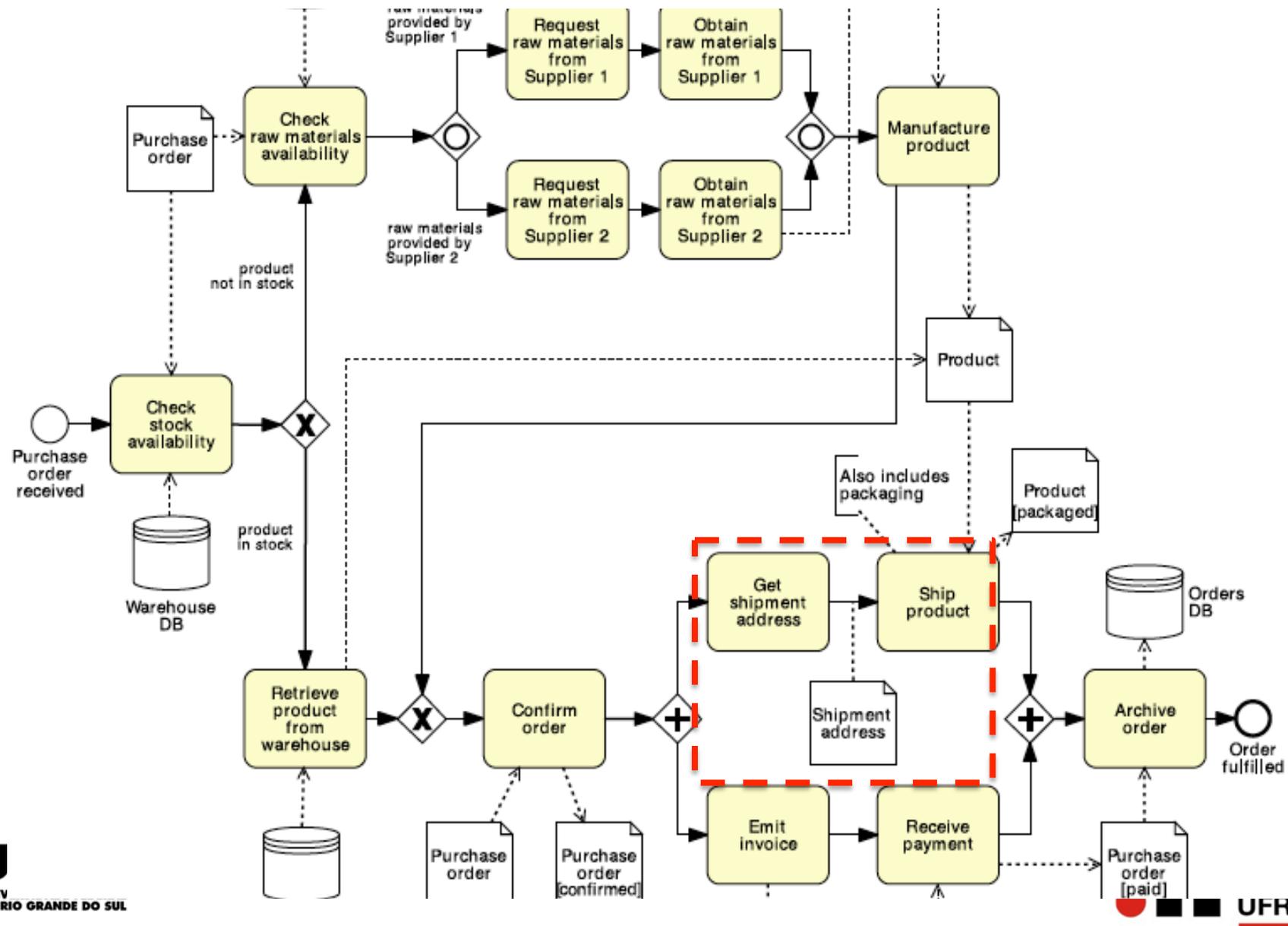


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BPMN elements

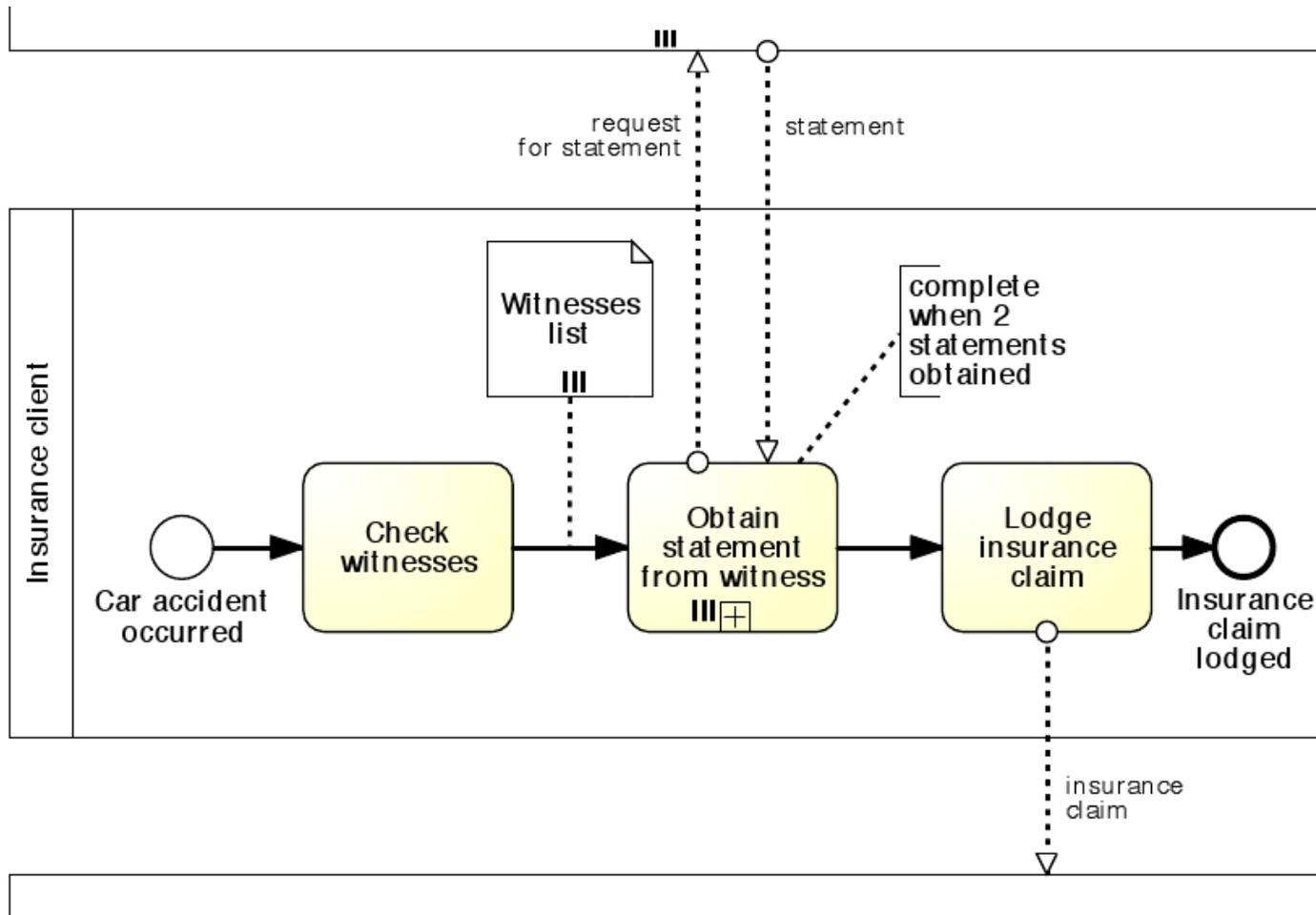
Artefacts





BPMN elements

Pools and Lanes

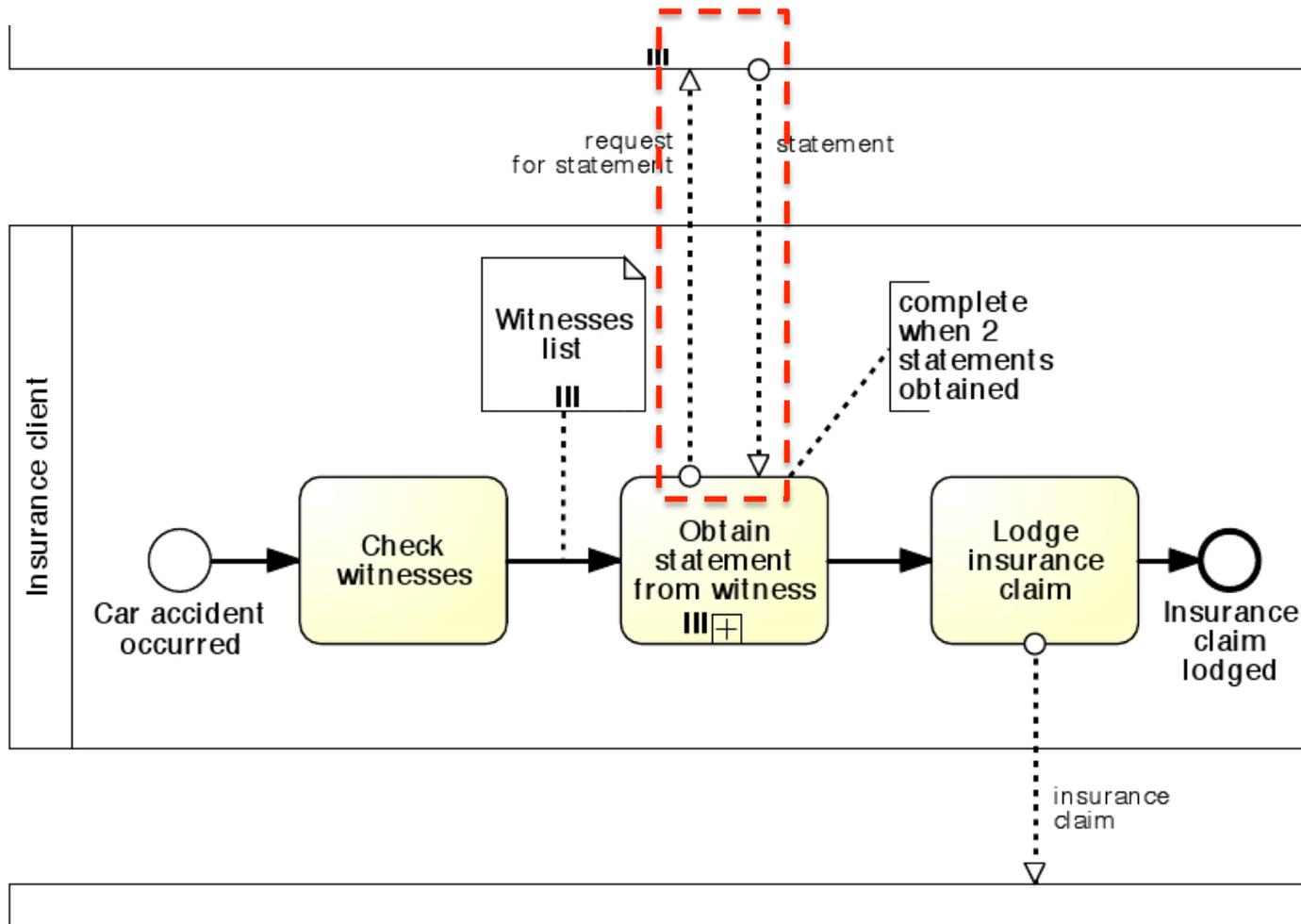


Dumas, 2013



BPMN elements

Message Flow



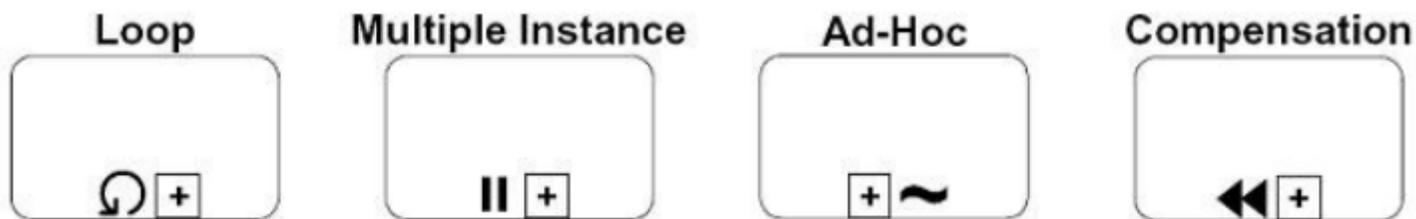
Dumas, 2013



BPMN elements

Subprocess

- A sub-process represents a self-contained, composite activity that can be broken down into smaller units of work
- In order to use a sub-process, first it is necessary to identify groups of related activities
 - those activities which together achieve a particular goal or generate a particular outcome in the process model under analysis





BPMN elements

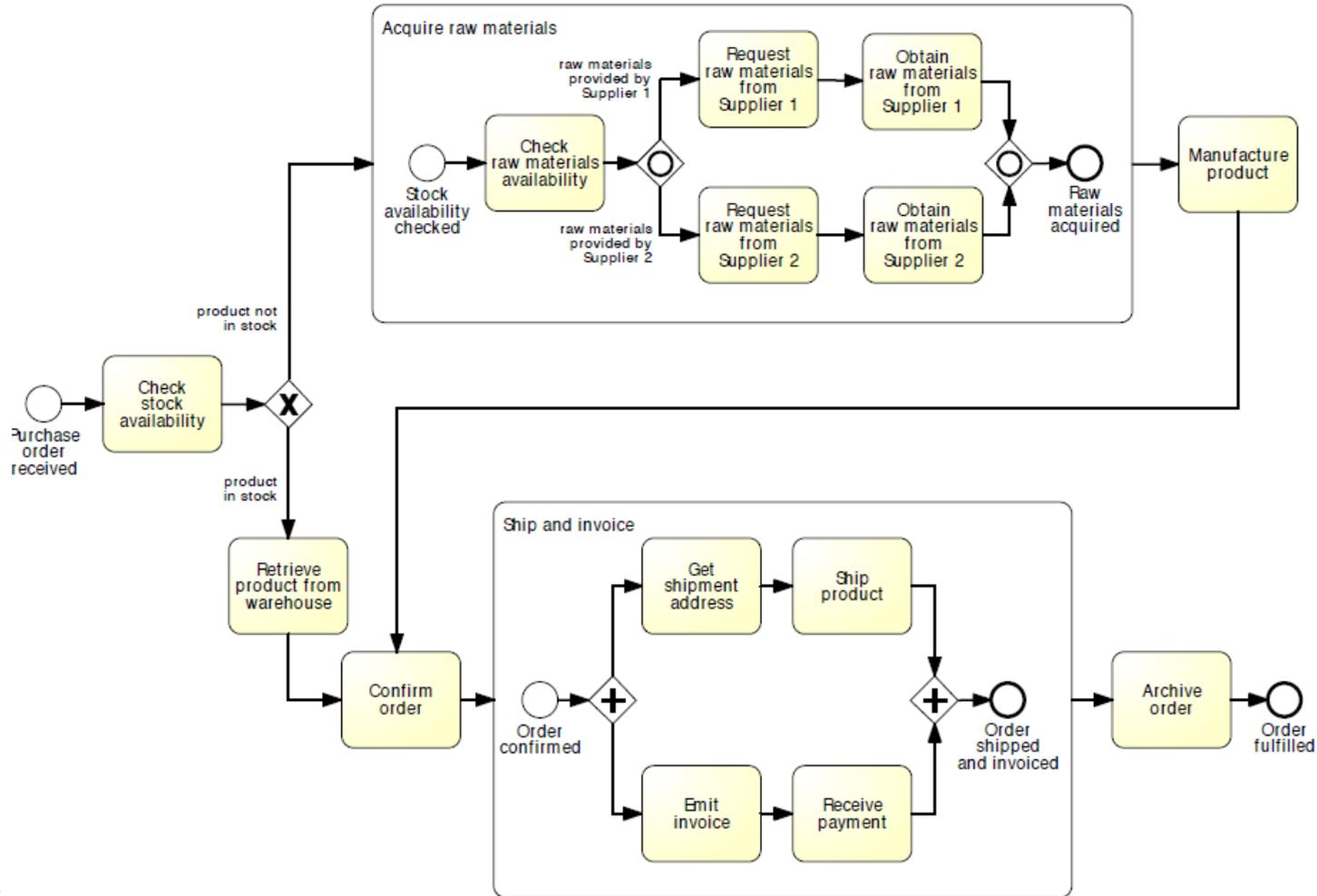
Using *Subprocesses*

- First, correlated activities must be identified, i.e. those activities which collectively help to achieve a goal or an specific outcome (encapsulated activities)
- A subprocess must have a start and end events
- A subprocess can be **Expanded** or **Collapsed**
- ***When to use subprocesses***
 - **When the process achieves a size that is difficult to read and understand the process**
- ***When a process is too is considered too big?***
 - ***There are evidences in the literature that a model with more than 30 elements (activities, gateways and events) deals to a process difficult to read***



BPMN elements

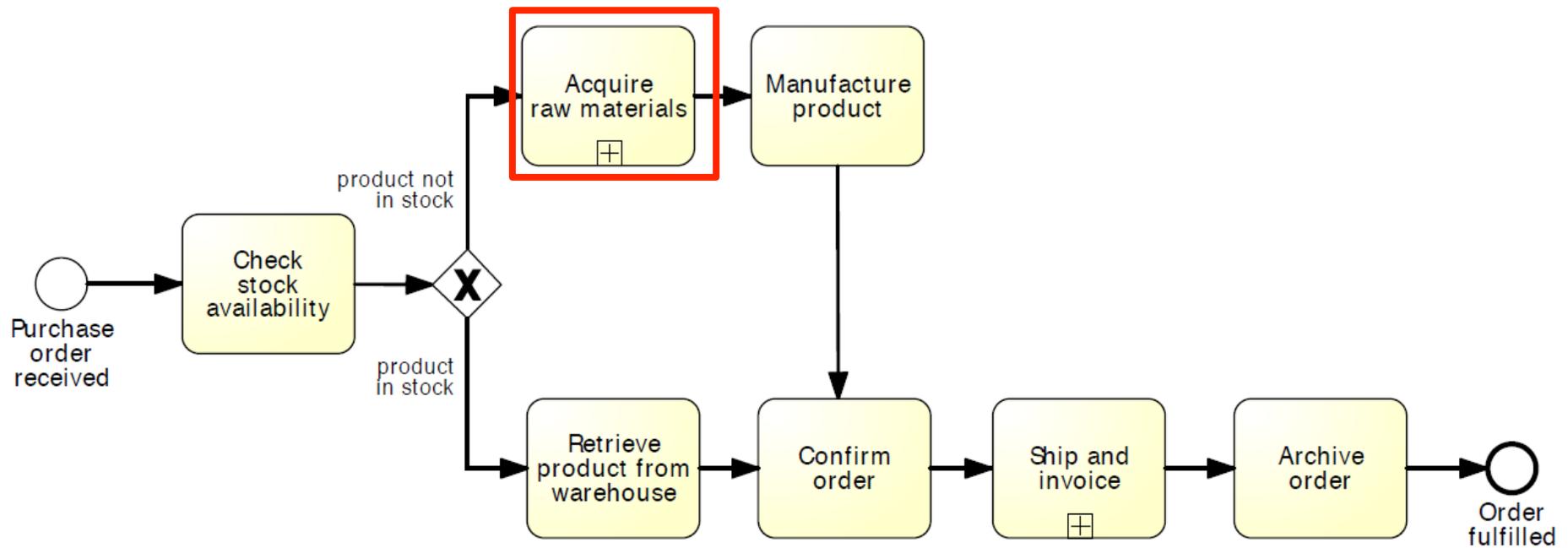
Subprocess expanded





BPMN elements

Subprocess collapsed





BPMN elements

Events

- Events are used to model something that happens
- Start events
 - Tokens are created
- End events
 - Tokens are destroyed
- An event that occurs in the middle of the process is called **intermediated**

	Evento de Início			Eventos Intermediários			Evento de Fim
	Eventos de Alto Nível	Evento que, quando ocorre, provoca a interrupção de um Sub-Processo	Evento que, quando ocorre, não provoca a interrupção de Sub-Processo	Captura	Interrompe a execução da Instância em uma divisão ou compartimento	Não interrompe a execução da Instância em uma divisão ou compartimento	Lançamento
Simples: Eventos sem tipo indicam pontos de início, de fim e mudanças de estado.							
Mensagem: Recebimento e envio de mensagens.							
Temporal: pontos no tempo, instante no tempo, intervalo de tempo, limite de tempo. Podem ser eventos únicos ou cíclicos.							
Escalável: ativa mudança para um nível mais alto de responsabilidade.							
Condicional: Reação a alterações nas condições de negócio ou a regras de negócio.							
Conector: Conector entre páginas. Dois eventos de conexão equivalem a um fluxo de sequência.							
Erro: Captura ou inserção de erros pré-identificados.							
Cancelamento: reagem ao cancelamento de uma transação ou ativam cancelamento.							
Compensação: Tratamento ou ativação de ação de compensação.							
Sinal: Emitem sinais entre processos. Um mesmo sinal pode ser capturado várias vezes.							
Múltiplo: Ou capturam um dentre um conjunto de eventos, ou lançam um ou mais eventos de qualquer dos tipos definidos.							
Múltiplo Paralelo: capturam, de uma só vez, todos os eventos de um conjunto de eventos que ocorrem em paralelo.							
Final: Ativam a terminação imediata de um processo.							



BPMN elements

Message *Event*



- Indicates that a new process instance is triggered with the arrival of a message
- An **end message event** indicates that the process ends with the sending of a message
- An **intermediate message event** indicates that a message is sent or received



BPMN elements Message Event

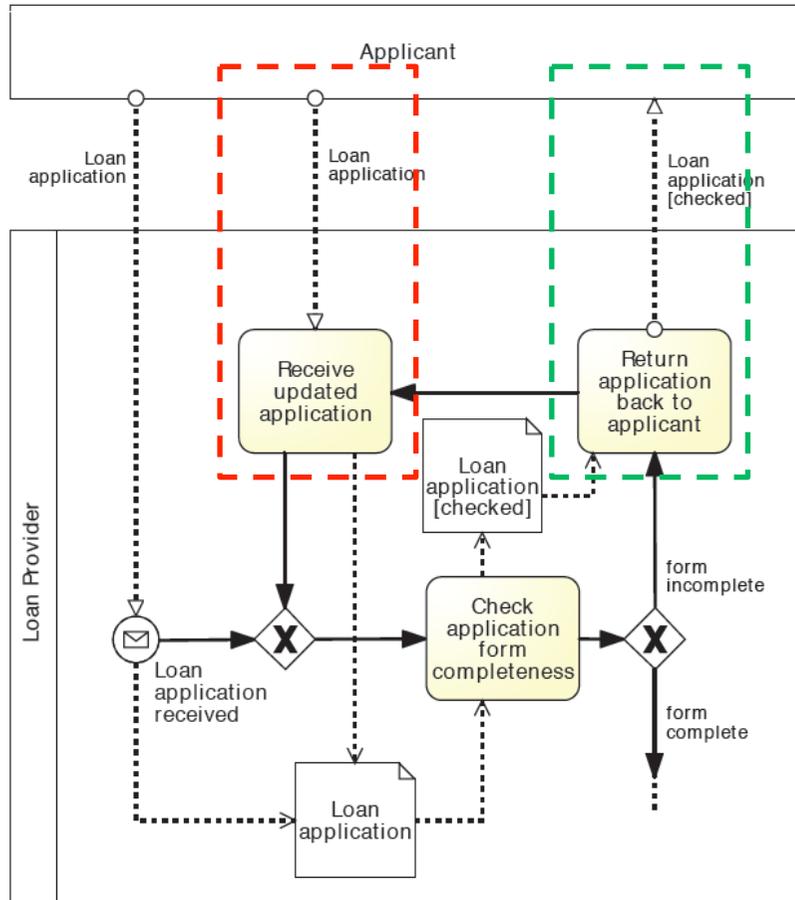
Send



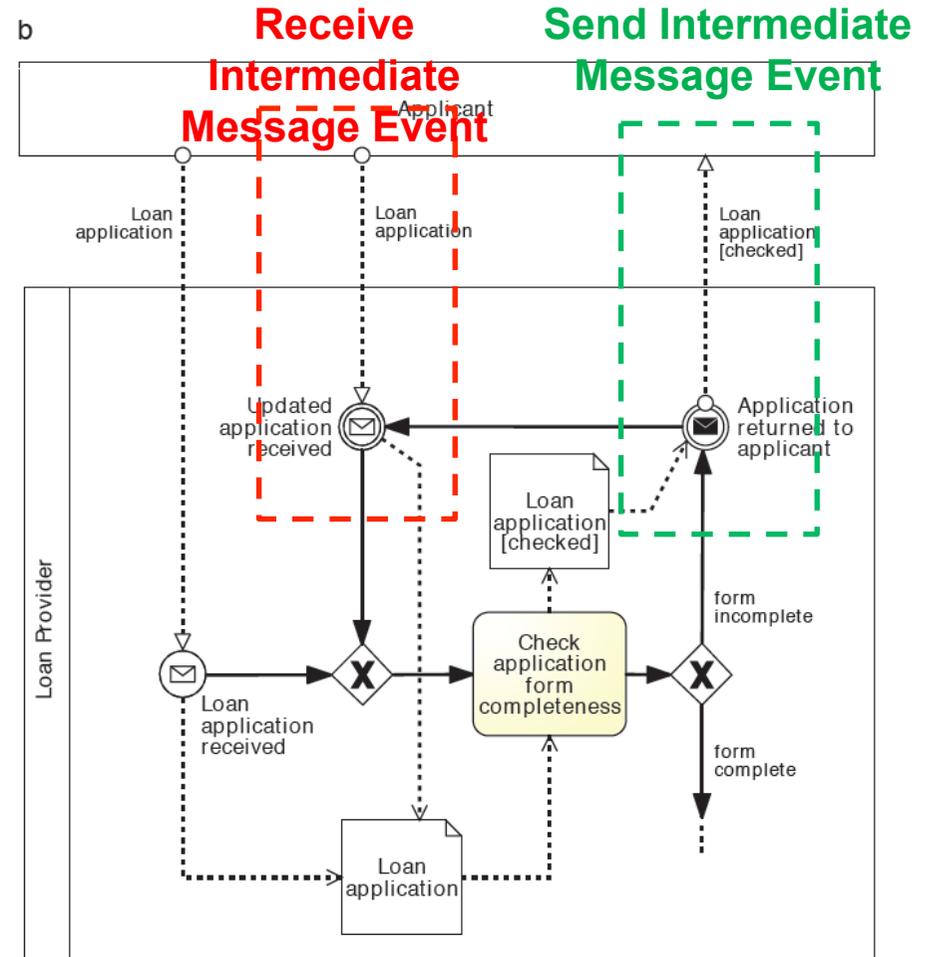
Receive



a



b



Final Remarks

- BPM is a very powerful area that is calling the attention not only from academy but also from industry
 - Academically it covers a complete lifecycle with several challenging research questions that goes from conceptual, formal to practical levels
 - In recent years research on BPM has been covered many topics including workflow patterns, exception handling, process modeling, etc
 - In industry BPM is being used in several perspectives
 - For process documentation and standardization
 - For process improvement
 - For process automation
 - To achieve CMMI levels



**Which are the main problems,
challenges regarding process
elicitation and modeling?**