Business Process Concepts and Modeling

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• **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

Payment

Issue-to-resolution

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 interrelated 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**

- **a]** Get information about the patient
- **b]** Calculate the dosage of the drugs
- **c]** Fill the prescription
- **d]** Notify the farmacy that a new drug needs to be produced
- **e]** Send the prescription to the farmacy
- **f]** Verify the dosage
- **g]** Produce drugs
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
“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
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)
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
- In this phase, a business problem is posed, processes relevant to the problem being addressed 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
• 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
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.

1. **a]** Get information about the patient
2. **b]** Calculate the dosage of the drugs
3. **c]** Fill the prescription
4. **d]** Notify the farmacy that a new drug needs to be produced
5. **e]** Send the prescription to the farmacy
6. **f]** Verify the dosage
7. **g]** Produce drugs
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

1. Get information about the patient
2. Calculate the dosage of the drugs
3. Fill the prescription
4. Notify the pharmacy that a new drug needs to be produced
5. Send the prescription to the pharmacy
6. Verify the dosage
7. Produce drugs
Basic Concepts

Control Flows

• Sequential

A ➔ B

• And-Split

A ➔ And ➔ B

• And-Join

B ➔ And ➔ C ➔ D

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.
Components of Process

**Diagram:**
- **Outcome**
  - Positive Outcome
  - Negative Outcome
- **Business Process**
  - delivers
  - involves
- **Customer**
  - gives value to
- **Event**
  - Activity
  - Decision Point

**Legend:**
- **consists of**
- **is a**
  - zero, one or many
  - one or many

Dumas, 2013
Business Process Concepts and Modeling Requirements Elicitation
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...*

- Seldon 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 focus 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
• 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 processes. Infra-structure, RH and technology development and acquisition
## Process Identification

### Methods

<table>
<thead>
<tr>
<th>Technique</th>
<th>Positive</th>
<th>Negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brainstorm</td>
<td>Easy to configure Interaction between people</td>
<td>No preparation ??</td>
</tr>
<tr>
<td>Interviews</td>
<td>Motivates the participants Makes possible a complete conversation Keeps the focus in specific aspects Personal opinion can be expressed</td>
<td>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</td>
</tr>
<tr>
<td>Scenarios</td>
<td>Efficient to understand the goals of the users</td>
<td>Don’t allow to obtain all the requirements</td>
</tr>
<tr>
<td>5W1H</td>
<td>Systematic questionnaire</td>
<td>Don’t contribute to group discussion</td>
</tr>
</tbody>
</table>
Process Identification

Methods

- 5W1H

<table>
<thead>
<tr>
<th>What</th>
<th>What will be done</th>
</tr>
</thead>
<tbody>
<tr>
<td>When</td>
<td>When will be done</td>
</tr>
<tr>
<td>Where</td>
<td>Where will be done</td>
</tr>
<tr>
<td>Why</td>
<td>Why will be done</td>
</tr>
<tr>
<td>Who</td>
<td>Who will done</td>
</tr>
<tr>
<td>How</td>
<td>How will be done</td>
</tr>
</tbody>
</table>
The Business Process Modeling Notation (BPMN)
Process Modeling

Organizational Analysis

“AS IS” Process Models

Process Analysis & Design

“TO BE” Process Models

Process Evaluation

Measures for Improvement

Target Values

Process Enactment & Monitoring

Process Metrics

Executable Process Models

Process Implementation
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-requisite to the analysis, redesign and implementation of business process (Dumas, 2013)*
Problems

- Communication problems between the analyst and the users.
- 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

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

Mendling, 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 a look in the [BPMNPoster](http://bpmb.de/index.php/BPMNPoster)
  - Spanish version: Ildefonso Montero, Luciano García-Bañuelos, Marlon Dumas
  - Portuguese version: Lucinéia Heloisa Thom and Cirano Iochpe
• 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 addition information in a process. There exist three types:
    • Data objects
    • Group
    • Annotation
A BPMN model is a graph composed of four elements:

- **Event**
- **Activity**
- **Gateway**
- **Flow**
• Purchase Order Process
BPMN Process
Start and End Events

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

- **End Event**
  - Indicates when a process instance completes execution
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.
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

Dumas, 2013
BPMN elements

Gateways

- AND-Split and AND-Join

Dumas, 2013
BPMN elements

Gateways

- XOR-Split and XOR-Join

Dumas, 2013
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.

\[\text{Dumas, 2013}\]
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

Dumas, 2013
BPMN elements

Artefacts

Dumas, 2013
BPMN elements

Pools and Lanes

Dumas, 2013
BPMN elements
Message Flow

Dumas, 2013
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.
• First, correlated activities must be identified, i.e. those activities which collectivity 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

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**
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

Receive Intermediate Message Event

Send Intermediate Message Event

Loan application

Loan application [checked]

Loan application

Loan application [checked]

Loan Provider

Loan Provider

Return application back to applicant

Check application form completeness

Check application form completeness

Form complete

Form complete

Form incomplete

Form incomplete

Application returned to applicant

Application returned to applicant

Updated application received

Updated application received

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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
Discussion

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