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
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, XPDL (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:
  o easy to use/ understand: to be used to quickly & easily model business processes, & be easily understandable by non-tech users (usually mgmt).
  o offers expressiveness to model very complex BPs & can be naturally mapped to business execution languages.
– Steps:
  o model the *events* occurring to start, run & end BPs, with interplay/ results
  o business decisions and branching of flows is modelled using *gateways*.
  o 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*. 

*CA4101 Lecture Notes (Martin Crane 2018)*
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

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#### Table 7.1  BPD Core Element Set

<table>
<thead>
<tr>
<th>Element</th>
<th>Description</th>
<th>Notation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Event</td>
<td>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.</td>
<td><img src="image" alt="Event" /></td>
</tr>
<tr>
<td>Activity</td>
<td>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 contained within a Pool.</td>
<td><img src="image" alt="Activity" /></td>
</tr>
<tr>
<td>Gateway</td>
<td>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.</td>
<td><img src="image" alt="Gateway" /></td>
</tr>
<tr>
<td>Sequence Flow</td>
<td>A Sequence Flow is used to show the order that activities will be performed in a Process.</td>
<td><img src="image" alt="Sequence Flow" /></td>
</tr>
<tr>
<td>Message Flow</td>
<td>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).</td>
<td><img src="image" alt="Message Flow" /></td>
</tr>
<tr>
<td>Association</td>
<td>An Association is used to associate information with flow objects. Text and graphical nonflow objects can be associated with the flow objects.</td>
<td><img src="image" alt="Association" /></td>
</tr>
<tr>
<td>Pool</td>
<td>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.</td>
<td><img src="image" alt="Pool" /></td>
</tr>
<tr>
<td>Lane</td>
<td>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.</td>
<td><img src="image" alt="Lane" /></td>
</tr>
</tbody>
</table>
BPM Notation: Flow Objects: Events

- Represented with a circle
- Something that happens (Vs 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
BPM Notation: Flow Objects: Events (/2)

**Flow Objects**

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

**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.
BPM Notation: Connecting Objects

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

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

- **Association**:
  o represented by a dotted line with a line arrowhead
  o used to associate data, text, & other Artifacts with flow objects.
  o used to show inputs & outputs of activities..
Order Management Process in BPMN
First Try

This symbol denotes a break in normal flow

Check stock availability

Any Stock?

Reject order

Send invoice

Confirm order

Ship goods
A little bit more on Gateways ...

**Flow Objects**
- Events
- Activities
- **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.
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

- **What?**
  - Function

- **Who?**
  - Organization

- **When?**
  - Process

- **Which?**
  - Data / Service / Product
Organisational Elements in Process Models

Grouping Objects
- Pools
- Swimlanes

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
Lecture 3: Business Process Modelling

Grouping Objects

- Pools
- Swimlanes
Order Management Process with Pools

Grouping Objects
- Pools
- Swimlanes

Customer:
- Place purchase order
- Make payment
- Invoice
- Order Rejection Notification

Supplier:
- Purchase order
- Check stock availability
- Reject order
- Confirm order
- Send invoice
- Ship goods

Lecture 3: Business Process Modelling
**Grouping Objects**

- Pools
- Swimlanes

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**Order Management Process with Lanes**

[Diagram of the Order Management Process with Lanes, showing the flow from Customer, through Sales & Distribution, to Warehouse.]
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.

Grouping Objects
- Pools
- Swimlanes

BPMN To-Do Exercise 2: Lanes, Pools
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
BPM Notation: Artifacts Example

- BP Segment with Data Objects, Groups, and Annotations

Note the use of a swimlane for a Computing Resource.
Artifacts

• Data Objects
• Data Stores
• Annotations

Order Processing Example with Artifacts

- Check stock availability
- Purchase Order
- Confirm order (Set PO to approved)
- Reject order (Set PO to rejected)
- Send invoice
- Ship goods

Lecture 3: Business Process Modelling
When a claim related to a major car accident is evaluated, a clerk first retrieves the corresponding car accident report in the Police Reports database. If the report is retrieved, it is attached to the claim file. The claim file and the police report serve as input to a claims handler who calculates an initial claim estimate. Then, an “action plan” is created based on a “checklist”. Based on the action plan and the initial claims estimate, a claims manager negotiates a settlement with the customer. After this negotiation, the claims manager makes a final decision, updates the claim file to record this decision, and sends a letter to the claimant to inform him/her of the decision.

Please depict all relevant documents in the model.
BPMN Main Elements - Recap

Connections

- Message
- Association
- Flow

Swimlanes

- Pool
- Lane

Flow Objects

- Gateway
- Event
- Activity

Artifacts

- Data Store
- Text Annotation
- Group
- Data Object
BPMN Flow Elements – Recap

- Start Event
- Task
- End Event
- Flow
- AND-Split
- XOR-Decision
- XOR Merge

Lecture 3: Business Process Modelling
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

(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

Note the tic to represent default option
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 parallel gateway representing all sequences happening.

Note the intermediate timer event.
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)

Note the parallel splitting & complex merging gateways representing some sequences happening and some not.

Note the ‘terminate’ End event meaning “Stop everything”
Exercise

Check also the self-test quiz available at:
References

• “Introduction to BPMN”, Stephen A. White, IBM Corporation, available to download on http://www.bpmn.org/
