CS 565
Business Process Management Systems

Chrysostomos Zeginis, Dimitris Plexousakis
Post-doc researcher, Professor
Department of Computer Science, University of Crete &
ICS-FORTH
E-mail: zegchris@ics.forth.gr
Office: (Γ151 – ICS-FORTH)
Course Overview

- **Teaching hours**: Monday, Wednesday 10:00-12:00 (A.125)
- **Tutorial hours**: TBA
- **Office Hours**: Wednesday, after lesson, or by appointment
- **Mailing list**: hy565-list@csd.uoc.gr
- **Registering for the mailing list**
  - send email to [majordomo@csd.uoc.gr](mailto:majordomo@csd.uoc.gr)
  - subject empty; message body: subscribe hy565-list
  - you shall receive mailing list messages to the email account from which you sent the message
  - use it for posting questions
  - all course announcements will be posted on the mailing list
Course Overview

- **Prerequisite knowledge**: Database management systems
  CS360 - (formal prerequisite)
  - you’re also expected to be familiar with operating system concepts, and have extensive programming experience
- **Coursework**: 2 mandatory assignments (10% & 25%), class presentations – oral examination (25%), written reports (survey papers) (40%)
- **Teaching Assistants**: Eleni Politaki (politaki@csd.uoc.gr) Nena Basina (basina@csd.uoc.gr), Periklis Tziavas (ptziavas@csd.uoc.gr)
- **TA office hours will be announced during the term as required for the assignments**
Timeline

- Starting 5 February
- 9 lectures (12-14 class lessons) until Easter vacations
- 2 assignments
  - 1st on Petri Nets (end of February – 2 weeks deadline)
  - 2nd on BPMN modelling (end of March – 3 weeks deadline)
- Students’ presentations (group of 2) on course topics (starting immediately after Easter vacations).
- Reports - survey paper on the presentation topic (deadline end of May)
Course Overview

• Topics:
  - Business Processes (basic concepts, BP modeling)
  - Design, analysis and verification methods
  - Workflow systems organization and architecture
  - Synchronization, control, communication, monitoring of process enactment
  - Workflow analysis
  - Workflow patterns
  - Service-Oriented Computing
  - Web-services
  - Service lifecycle management
  - Cloud application Technologies
  - Business Process as a Service (BPaaS)
Business Processes

- A *business process* is a chain of activities involved in delivering a product or service to a customer
  - this chain of activities is not restricted to be *within* an organization; it may *span across* organizations

- *Business process design*
  - a knowledge-intensive human activity supported by modeling, analysis and simulation software tools
  - closely tied with business policy, enterprise organization, culture, etc.
Examples of Business Processes

- **Manufacturing** – an product assembly process, a quality assurance process, a corrective/preventive maintenance process.
- **Health** – a medical assessment, a drug approval
- **Banking** – bank transfer, credit check
- **Travel** – trip booking, agent billing
- **Human resources** – a starters process, a leavers process, vacation request
- **Public Sector** – application for a government service
- **Social events** – organize festival, camping
- **Personal activities**: plan a trip, apply for job, come to university, make coffee…
Business ProcessInstances

- **Business process instances** are created for delivering a particular service
- **Process**, simply how things should be done.
- **Instance**, a live execution of process workflow to achieve certain goal.
  - Involves *allocation of resources, target start and completion times*
  - Integrates planning and scheduling techniques
  - Thinking technically, objects are the basis of object oriented programming. When an object (process instance) of a class (business process) is created, the class is said to be instantiated. All the instances share the attributes and the behavior of the class.
Business Processes

- Technical challenges arise because organizations are distributed systems that execute many process instances concurrently in an uncertain environment that includes human intervention and decision making.
  - Furthermore, failures and exceptions occur frequently and re-planning must be integrated with execution.
- Need automated tools that not only instantiate process templates, but also have the ability to generate dynamically executable process templates.
Business Process vs Workflow

- A (core) *business process* is the *end-end* chain of activities involved in delivering a product or service to a customer (internal or external)
  - “*end-end*” means the following:
    - a business process starts with an initial contract with the customer
    - runs through to completion of the contract
  - can be viewed as a *closed loop*: a customer’s satisfaction with a service influences requirements for future services

- Core business processes are usually transactional & development processes (purchasing, manufacturing, marketing, sales)
Business process vs Workflow

- Business Processes are basically *collection of activities* cutting across various departments, producing a valuable output for the customers (e.g. Sales Process, Procurement Process).

- Workflow is used to *automate these repetitive activities* and hence business processes. So workflow will bring automation and efficiency to the business process.

- A *Business Process* in related to any kind of activity (manual, automated) which realizes a business objective.

- A *Workflow* is an (partial) automation of a *Business Process*. 
Business Process Management System

- Created through joining distinct pieces, such as Business Rule Engines, Business Process Modelling, Business Monitoring & Human Workflow

- Subsumes functionality of a WFMS by also supporting process-specific aspects, such as simulation, BP modelling, BP intelligence

- Comprise:
  - Process Engine (platform to model & execute BPs)
  - Business Analytics (reports & dashboards)
  - Content management (system to store & secure BP content)
  - Collaboration tools (intra- & interdepartmental tools, including discussion forums, dynamic workspaces & message boards)
Workflow Management Systems

- Automate the \textit{coordination} of activities and the \textit{transfer of documents / information / control} within a business process
- Follow pre-defined rules \textit{(process or workflow definition)} for delivering work to the appropriate software component or human worker / team
- Such considerations must be \textit{built into the process definition} or else handled by the resources themselves
- Specification of such low-level process or workflow definition is a human design activity assisted by software tools specific to the WFMS.
Business Process Lifecycle

Evaluation:
- Process mining
- Analytics/Warehousing

Enactment:
- Operation
- Monitoring
- Maintenance

Administration & Stakeholders

Configuration:
- System selection
- Implementation
- Test & Deployment

Design:
- Business Process Identification & Modelling

Analysis:
- Validation
- Simulation
- Verification
Gartner’s BPM lifecycle

Define → Model → Simulate → Implement → Execute → Monitor → Analyze → Optimize → Define

Figure 1: Gartner’s BPM Lifecycle
Process Modelling

- Involves designing, modeling, evaluating, simulating, modifying and optimizing processes
- What are the main business processes in an organization? how to describe them? (text, excel sheets, figures, …)
- One must define, for each basic product or service the organization offers, the activities involved, the relationships among them, their resource requirements etc.
- Human activity supported by computer-based tools to record the process model, run simulations, etc.
- Design decisions are usually made based on experience and analogy to previous designs, depending on the nature of business, its goals, standards, legacy, infrastructure etc.
Process Modelling

- **Validation** can be supported:
  - through workshops -> checking that model captures all possible instances
  - Simulation -> reveal model deficits, wrong behaviour
- **Verification** is used to check for the satisfaction of particular properties (e.g., deadlocks)
# Validation vs Verification

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Verification</th>
<th>Validation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Definition</strong></td>
<td>The process of evaluating work-products (not the actual final product) of a development phase to determine whether they meet the specified requirements for that phase.</td>
<td>The process of evaluating software during or at the end of the development process to determine whether it satisfies specified business requirements.</td>
</tr>
<tr>
<td><strong>Objective</strong></td>
<td>To ensure that the product is being built according to the requirements and design specifications. In other words, to ensure that work products meet their specified requirements.</td>
<td>To ensure that the product actually meets the user's needs, and that the specifications were correct in the first place. In other words, to demonstrate that the product fulfills its intended use when placed in its intended environment.</td>
</tr>
<tr>
<td><strong>Question</strong></td>
<td>Are we building the product right?</td>
<td>Are we building the right product?</td>
</tr>
<tr>
<td><strong>Evaluation Items</strong></td>
<td>Plans, Requirement Specs, Design Specs, Code, Test Cases</td>
<td>The actual product/software.</td>
</tr>
</tbody>
</table>
| **Activities**   | • Reviews  
• Walkthroughs  
• Inspections                                  | • Testing  
Source: http://softwaretestingfundamentals.com/ |
Process Configuration

- Different ways can be exploited to implement a business process:
  - a set of policies and procedures with no support from a business process management system
  - Through a selection of an implementation platform:
    - Technical information is completed for the proper enactment of the process by the business process management system:
      - Interaction of the employees with the system
      - Integration of existing software systems (incl. legacy ones)
  - Need for supporting transactional properties at the process and activity level
Process Configuration

- Implementation then needs to be tested to detect potential runtime problems
  - Integration & performance tests
- Finally, the business process system is deployed in the target environment
- Additional steps might be required, such as:
  - Training of personnel
  - Migration of process data to the realization environment
Process Enactment

- Process instances are enacted according to the organisation goals
  - Initiation usually follows a defined event
- Execution is distributed with different resources, programs or people carrying out the involved activities
- Usually an orchestration of process activities is carried out through the use of a process execution engine
Process Enactment

- Activities have to be coordinated to ensure correct sequencing and that compatible variants of the activities are performed.
- Coordination takes place via mechanisms such as events, message passing, document transfer etc.
- A WFMS uses information contained in a low-level process plan definition to route work items to appropriate resources and provide the necessary coordination signals.
- Resources will be involved in enacting multiple processes and instances of the same process in a time-sharing manner.
Process Enactment

- Resources are **encapsulated in components** which view the processes in which they participate as a **queue of work items** waiting to be acted upon.

- Depending on how the system is organized, a component may simply work on the next task whose **preconditions** are satisfied or consider **prioritization rules** if such exist.

- Processes may **interfere** with each other due to the **capacity** of shared resources.
Process Monitoring & Adaptation

- Process monitoring provides accurate information (e.g., notification about completed tasks, delays, interrupts) on the status of process instances (the state in particular) & statistics on process performance.
- Log data in the form of an ordered sets of log entries are also kept in a log file storing information about events occurring during process execution.
- Such information is fed to a managing process that compares progress with the concrete process plan.
- Minor differences may simply require updating process configuration (e.g., by shifting tasks).
- These changes need to be propagated to the resources executing the plan.
More significant differences may require the planned activities to be altered during execution.

- this may include **backtracking**
- or even **undoing effects** of previous activities and **regenerating** the plan
Process Evaluation

- Evaluation of execution logs through process mining & analytics/warehousing
  - Quality of business process models
  - Adequacy of execution environment
- In some cases, the business process itself will need to be updated (process evolution)
  - Changes at runtime seem to become permanent
  - Exist indications that the design needs to be improved
Main BP Stakeholders

- **Process participants** – domain experts
- **Process owners** – domain experts, management, business background
- **BPM consultants** – Process experts
- **Software architects and developers** – IT experts implementation

- All these people from different backgrounds, they speak different languages
Summary

- A process is a collection of activities related to a specific commitment for providing a product or service
  - Example: each damage claim represents a single instance of the process of damage claim handling
- An organizational process is a collection of activities related to a specific commitment, adding value to a product / service of an organization
  - Example: processing damage claims in an insurance company
- A workflow process is an automated organization process
  - Example: processing damage claims “orchestrated” by a workflow management system
Summary

• Workflow management is the automated coordination, control and communication of work, both of people and computers, in the context of organizational processes, through the execution of software in a network of computers whose order of execution is controlled by a computerized representation of the business processes.

• Workflow management system: “a system that defines, 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 IT tools and applications” [WFM Coalition]
List of notable WfMS

- Activiti
- Apache ODE
- Apache Taverna
- Bizagi
- Bonita BPM
- Camunda BPM
- Collective Knowledge
- IBM BPM
- SAP Business Workflow
- Signavio Workflow Accelerator
- YAWL
Research Disciplines Contributing to Workflow Management

- Database Management/Information Systems
- Distributed Computing/Systems
- MIS/Reengineering/Methodology
- Software Process
- Quantitative and Formal Methods/Modeling
- CSCW

- Software Engineering, HCI, etc.
Recommended Reading

- https://www.youtube.com/watch?v=04hnuyZWhAA