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
- Web site: http://www.csd.uoc.gr/~hy565
- Mailing list: hy565-list@csd.uoc.gr
- Registering for the mailing list
  - send email to 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 (25%), written reports (40%)

- **Teaching Assistants:** Vassilis Glabedakis (glabed@csd.uoc.gr)
  Giwrgos Parasiris (gparasir@csd.uoc.gr)

- **TA office hours will be announced during the term as required for the assignments**
Timeline

- Starting 13 February
- 9 lectures (12-14 class lessons) until Easter vacations
- 2 assignments
  - 1\textsuperscript{st} on Petri Nets (end of February – 2 weeks deadline)
  - 2\textsuperscript{nd} on BPMN modelling (end of March – 3 weeks deadline)
- Students’ presentations (group of 2) on course topics (starting immediately after Easter vacations).
- Reports 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
- Applications
- 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.
- **Finance** – an invoicing process, a billing process, a risk management process
- **Health** – a medical assessment, a drug approval
- **Banking** – customer on-boarding, credit check
- **Travel** – trip booking, agent billing
- **Defense** – emergency management process
- **Human resources** – a starters process, a leavers process, vacation request
- **Public Sector** – application for a government service
Business Processes

- **Business process instances** are created for delivering a particular service
  - establishing a particular instance resembles AI planning and scheduling
  - involves allocation of resources, target start and completion times
  - integrates planning and scheduling techniques
  - complicated problem: current planning / scheduling techniques applied in Business Process Management select activities from a predefined set of templates (patterns)
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.
Workflow Management Systems

- Automate the *coordination* of activities and the *transfer of documents / information / control* within a business process
- Follow pre-defined rules (*process or workflow definition*) for delivering work to the appropriate software component or human worker / team
- Such considerations must be *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 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)
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.

- Workflow is more general term than process. A process has some input and gives some output after performing some series of activities. In contrast, a Workflow may not has some input. it shows the flow of activities simply, e.g. flow of document within different departments of an organization.
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

13/2/17
Process Modeling

• Involves designing, modeling, evaluating, simulating, modifying and optimizing processes

• 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>Definition</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>Objective</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>Question</td>
<td>Are we building the product <em>right</em>?</td>
<td>Are we building the <em>right</em> product?</td>
</tr>
<tr>
<td>Items</td>
<td></td>
<td></td>
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<tr>
<td>Activities</td>
<td>• Reviews</td>
<td>• Testing</td>
</tr>
<tr>
<td></td>
<td>• Walkthroughs</td>
<td>Source: <a href="http://softwaretestingfundamentals.com/">http://softwaretestingfundamentals.com/</a></td>
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<td></td>
<td>• Inspections</td>
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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 Stakeholders

- Chief Process Officer (standardize, harmonize & evolve BPs)
- Business Engineer (define strategic goals & organisational BPs)
- Process Designer (model BPs)
- Process Participant (conduct operation work during BP enactment)
- Knowledge Worker (use sw systems to autonomously execute BP activities)
- Process Responsible (correct & efficient BP execution, inefficiency detection, BP improvement)
- System Architect (develop & configure BP management systems)
- Developer (develop sw artefacts to realize BP activities)
Current State of the Art

• Process management (past):
  ■ Organizational processes were \textit{implicit} in structure and culture
  ■ Procedures and practices were known within the department but no individual had a clear end-end view of a process
  ■ Software supporting operations used to be (and still is to a large extent) a \textit{monolithic application} in which business processes are implicit
    • Difficult to change and tend to tie the organization into the process encoded in the software
    • Software is costly to replace; many \textit{legacy systems} are still in use
Current State of the Art

- Process management (now):
  - Business process is represented in an explicit and distinct manner
    - Easier to study how to improve a process, easier to implement the improvement
    - Software must be modifiable and reusable (component-based philosophy, service orientation)
    - Functionality is encapsulated in reusable modules that can be combined in different ways to construct new virtual applications rapidly
  - WFMSs can be viewed as the architectural view that links components together to form the application
Current State of the Art

- In theory, the process definition can be changed independently of the components and functionally equivalent components can be substituted without changing the process definition.
- Components do not replace legacy systems; rather, they use them as servers in providing their functionality.
- Groupware software systems (e.g., Lotus Notes, Microsoft Exchange) are often described as workflow systems.
  - These systems provide a messaging and information sharing environment that can be used by participants in a business process.
Current State of the Art

- Industry is in a **transition phase** from the “old style” applications to workflow-based and service-based systems
  - Components and workflow systems will gradually diminish the role of legacy systems
- **Shortcomings** of current process management software
  - **Automates** the flow of work items between work queues according to **predetermined rules**. It does not deal with **allocation of resources to tasks** nor does it take **resource availability** into account in prioritizing or scheduling work
- **Requirement**: **integration** of scheduling and resource allocation / management algorithms into WFM software
Current State of the Art

- Must incorporate the ability to modify the process instance automatically during execution to cope with failure, changed objectives and other exceptions
  - Can be done by altering the process instance plan being executed (inserting / deleting steps) or by creating and executing a conditional plan containing the additional steps

- Generation of workflow definition from high-level process models. Process modeling tools work with relatively high-level process definitions, whereas WFMSs require low-level definitions. Both types of definitions may not allow for analysis. They can also lead to rework & disconnection between users and implementers
Current State of the Art

- **Feedback** data captured in the workflow engine back into the modeling and simulation tool to improve modeling at that level.

- Little process support for intermediate and high-level work skills. Must use “process-aware” and “knowledge aware” support.

- Workflow systems must be enriched with semantic knowledge of the process they enact.

- Challenges: Transactionality, reusability, flexibility, evolvability, adaptivity, conformance, security, decentralized management.
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]
Summary

- Workflow management fits nicely with other trends such as:
  - Re-engineering
  - Downsizing / right-sizing
  - Network computing
  - Groupware
  - Client-server computing
  - Web services
Research Disciplines Contributing to Workflow Management

- Database Management/Information Systems
- Distributed Computing/Systems
- Software Engineering, HCI, etc.
- MIS/Reengineering/Methodology
- Quantitative and Formal Methods/Modeling
- CSCW
Recommended Reading

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