Workflow Management
Outline

1) Introduction
   a) background
   b) concepts
   c) evolution

2) Workflow Management
   a) overview
   b) functional areas
   c) reference architecture
   d) workflow patterns
   e) workflow solutions
   f) summary

3) Business Process Management
   a) overview
   b) aspects
   c) standards
   d) technologies
   e) BPM and WF
   f) summary

4) e-Government Applications
   a) e-service delivery
   b) inter-government WFMS

5) Conclusions
Benefits of Workflow Management

Introducing workflow in an organization delivers benefits at:

1) business level
   a) improved efficiency
   b) better process control
   c) improved customer service
   d) flexibility
   e) business process improvement

2) software level
   a) reduced development risk
   b) centralized implementation
   c) rapid application development
Business-Level Benefits

1) **Improved efficiency** - automation of many business processes results in the elimination of many unnecessary steps.

2) **Better process control** - improved management of business processes achieved through standardizing working methods and the availability of audit trails.

3) **Improved customer service** – consistency in the processes leads to greater predictability in customer response levels.

4) **Flexibility** – software control over processes enables their re-design in line with changing business needs.

5) **Business process improvement** - focus on business processes leads to their streamlining and simplification.
Software-Level Benefits

1) **Reduced development risk** - business analyst talks the same language as the developer, therefore no need for translation from user requirements to software design.

2) **Centralized implementation** - business processes that change without requiring major changes in the software application.

3) **Rapid application development** – composition of processes leads to faster development and better maintainable.

The biggest advantage of using a workflow system is that the implementation is no longer a fuzzy combination of software pieces scattered over various systems.
Functional Areas

Workflow Management Systems provide support in the areas of:

1) build-time functions
2) run-time functions
3) run-time interaction functions
Functional Areas

Run Time

Process Designer

Business Process Analysis, Modelling & Definition Tools

Process Definition

Process Design & Definition

Process changes

Administrator / Supervisor

Workflow Management System

Distributed Infrastructure Environment

Run-time interaction with Users and Application Tools

Users

Work Presentation

Application Launch

Applications & IT Tools

Build Time
Build-Time Functions

Concerned with defining and modeling the workflow process and its constituents activities:

1. A business process is translated from the real world into formal and computer processable definition called process definition.
2. Process definition could expressed in a textual, graphical or even formal notation.
3. Some WFMS may allow dynamic alteration of process definitions at run-time.
Process Definition - Graphical
<?xml version="1.0" encoding="UTF-8"?>

<process-definition name="NewBenefitApplication">
  <start-state name = "ReceiveApplication">
    <transition to= "AnalyzeCompleteness"/>
  </start-state>

  <task-node name = "AnalyzeCompleteness">
    <task name = "AnalyzeCompleteness">
      <assignment class = "edu.unu.WorkflowTaskHandler"/>
    </task>
    ...
  </task-node>
  ...
</process-definition>
Process Definition - Modeling

Demonstration:

1. We shall use JBoss JBPM (Java Business Process Management) as our workflow engine.

2. JBPM applies JPDL (Java Process Definition Language) as the underlying process definition language.

3. We use JBoss JBPM Process Designer to model the steps of a business process.

This is to facilitate a link between a business analyst and a technical developer.

Let's see ...
Run-Time Functions 1

Process definition is interpreted by a Workflow Engine.

A Workflow Engine is responsible for:

1) creating, deleting and controlling instances of the process
2) scheduling the various activities steps within the process
3) invoking the appropriate human and IT application resources
Run-Time Functions 2

Run-time process control acts as the linkage between

1) the process as modeled within the process definition and

2) the process as it is seen in the real world, reflected in the runtime interaction with users and IT application tools

Let's see ...
Run-Time Interactions 1

Individual activities within a workflow process are typically concerned with human operations.

They are often realized in conjunction with:

1) the use of IT tools, for example filling a form

2) application programs to operate on some defined information, for example uploading a new record to an order database
Run-Time Interactions 2

Interaction with process control software is necessary:

1) to transfer control between activities
2) to ascertain the operational status of processes
3) to invoke application tools and
4) pass appropriate data
Workflow Distribution

Ability to distribute tasks and information is a major distinguishing feature of a workflow runtime infrastructure.

The infrastructure may operate at various levels:

1) workgroup
2) intra-organization
3) inter-organization

depending on the scope of the workflow.
Communication Mechanism

May use a variety of underlying communication mechanisms:

1) electronic mail
2) message-passing through MOMs
3) distributed object technology, etc.
WF Distribution and Interfaces
WFM Coalition

WFM - Workflow Management Coalition

A non-profit making organization whose aim is to develop and promote workflow integration technologies.

Founded in 1993.

Working arrangements with OMG, W3C, etc.
WFM Coalition: Membership

Current membership is about 220, made up of:

- Analyst / Consultant
- Academic & Research
- Integrator/VAR
- User
- Vendor

Particularly, develops and promotes the Workflow Reference Model.
Workflow Reference Model 1

Workflow Reference model describes the modules and interfaces of a Workflow Management System in a consistent manner.

This enables interoperability between workflow products.

To achieve this:

1) defines a standard set of interfaces
2) specifies data interchange formats
Workflow Reference Model 2

Distinct interoperability scenarios can be constructed by:

1) referencing such interfaces

2) identifying different levels of functional conformance as appropriate to the range of products in the market
Workflow Model

- **Interface 1**: Process Definition Import/Export
- **Interface 2**: Client Apps, Worklist Handler
- **Interface 3**: Tool Agent, Invoked Applications
- **Interface 4**: Legacy, Desktop, etc
- **Interface 5**: Administration & Monitoring Tools
Workflow Model Interfaces

Five interfaces defined by the model:

1) Interface 1 – Definition Tools

2) Interface 2 – Client Application

3) Interface 3 – Invoked Application

4) Interface 4 – Workflow Enactment Service (WES)

5) Interface 5 – Administration Tool
Interface 1: Definition Tool

Defines a point of separation between the build-time and run-time workflow environments.

Enables to use a process definition as input to a workflow engine.

Offers the potential to export a given process definition to several workflow engines.
Interface 1: Definition Tool
Interface 2: Client Application

Interaction occurs between an application and the workflow engine through an interface embracing the concept of a worklist:

1. Worklist is a queue of work items assigned to a particular user (or group of users) by the workflow engine.

2. A worklist may contain items relating to:
   a) several different active instances of a single process or
   b) individual items resulting from the activation of several different process.
Interface 2: Client Application
Interface 3: Invoked Application

Defines an interface for calling an application to handle an activity.

Invoked application may be:

1) local to the workflow engine,
2) co-resident on the same platform
3) located on a separate, network accessible platform

The process definition contains sufficient application type and addressing information to invoke the application.
Interface 3: Invoked Application
Interface 4: Workflow Enactment

This interface enables one workflow system to pass a work item seamlessly to another workflow system.

This allows multiple workflow engines to work together to achieve the goal of a business process.
Interface 4: Workflow Enactment

Activity or sub-process invocation
Process/Activity status/control
Application/workflow relevant data transfer
Synchpoint coordination
Process definition read/write
Interface 5: Administration Tool

This interface includes the following operations:

1) user management
2) role management
3) resource control
4) process supervisory functions
5) process status functions
Interface 5: Administration Tool

Typical Functional Areas
- User management
- Role management
- Audit management
- Resource control
- Process supervisory functions, etc.

WAPI Interface 5

Workflow Enactment Service A
- Workflow Engine(s)

Workflow Enactment Service B
- Workflow Engine(s)
Workflow Patterns 1

Workflow patterns address comprehensive workflow functionality.

They can:

1) be used to examine the expressive power of a WF server
2) serve as ideas on how to implement business requirements
Workflow Patterns 2

Six categories of workflow patterns:

1) Basic control patterns
2) Branching and Synchronization patterns
3) Structural patterns
4) Multiple instances patterns
5) State –based patterns
6) Cancellation patterns
Basic Control Patterns

Five basic control patterns:

1. **sequence** – executes activity in sequence
2. **parallel split** – executes activity in parallel
3. **synchronization** - synchronize two parallel threads of execution
4. **choice** - choose one execution path from many alternatives
5. **merge** - merge two alternative execution paths
Pattern 1: Sequence

An activity in a workflow process is enabled after the completion of another activity in the same process.

Demo
License Example: Sequence

Application form and supporting documents are checked after they are submitted.
Pattern 2: Parallel Split

A point in the workflow where a single thread of control splits into multiple threads of control which can be executed in parallel, thus allowing activities to be executed simultaneously or in any order.

Demo
License Example: Parallel Split

If an applicant is eligible for a license, his application will be evaluated internally, and also the supporting documents will be sent to external agencies for verification.
Pattern 3: Synchronization

A point in the workflow process where multiple parallel subprocesses or activities converge into one single thread of control, thus synchronizing multiple threads.

Demo
License Example: Synchronization

After the successful completion of the internal evaluation and the supporting documents are certified correct by external agencies, the application can then be sent for decision making.
Pattern 4: Exclusive Choice

A point in the workflow process where, based on a decision or workflow control data, one of several branches is chosen.

Demo
License Example: Exclusive Choice

An application can either be approved or rejected during decision making. If approved, post approval action is determined and if rejected follow up action is determined.
Pattern 5: Simple Merge

A point in the workflow process where two or more alternative branches come together without synchronization.

Demo
License Example: Simple Merge

A notification will be sent to the applicant for both follow up action and post-approval.
Branching and Synchronization

Net groups of patterns. We shall be considering:

1) **Multiple Choice** - choose an execution paths from alternatives
2) **Synchronizing Merge** - merge execution paths: synchronize if many paths are taken, simple merge if only one path is taken
3) **Discriminator** - merge many execution paths without synchronizing, execute the subsequent activity only once
Pattern 6: Multiple Choice

A point in the workflow process where, based on a decision or workflow control data, a number of branches are chosen.

Demo
Example: Multiple Choice

Damage Claim:

After executing the activity `evaluate_damage`:

1) the activity `contact_fire_department` or
2) the activity `contact_insurance_company` is executed.

At least one of these activities is executed.

However, it is also possible that both need to be executed.
Pattern 7: Synchronizing Merge

A point in the workflow where multiple paths converge into a single thread. If more than one path is taken, synchronization of the active threads must take place. If only one is taken, alternative branches should reconverge without synchronization.

Demo
Example: Synchronizing Merge

License Application:

Before approving an application, verification responses need to be received from all external agencies.
Pattern 8: Discriminator

A workflow that waits for one of the incoming branches to complete before activating the subsequent activity. Then, it waits for all remaining branches to complete and "ignores" them. Once all have been triggered, it resets itself so that it can be triggered again.

Demo
Example: Discriminator

Assume there is a business rule that says an applicant is eligible for a benefit if he is resident or born in Macao.

• DSAJ – keep birth records
• DSI - identification information

Requests are sent to both agencies, the first positive response starts the next activity. The second response is ignored.
Structural Patterns

We shall consider:

1) **Arbitrary Cycles** - execute workflow graph without any structural restriction on loops
Pattern 9: Arbitrary Cycles

A point in a workflow process where one or more activities can be done repeatedly.

Demo
Example: Arbitrary Cycles

License Application:

Requesting for more information from an applicant.
State-Based Patterns

We shall consider:

1. **Deferred Choice** - execute one of the two alternatives threads. The choice which thread is to be executed should be implicit.
Pattern 10: Deferred Choice

A point in the workflow where one of several branches is chosen. In contrast to the XOR-split, the choice is not explicit (e.g. based on data) but several alternatives are offered to the environment.
Example: Deferred Choice

An applicant applying for a particular service is presented with a list of options which he can chose from. Based on the selection, a set of activities is executed.
Workflow Solutions

There are many commercial workflow solutions in the market.

They implement the Workflow Reference model.

Example of such products are:

1) COSA
2) FLOWer
3) Domino Workflow
4) Eastman
5) Visual Workflow
6) Forte Conductor
7) Meteor
8) Mobile
9) MQSeries
10) Staffware
11) Verve Workflow
12) I-Flow
13) InConcert
14) Changegine
15) SAP R/3 Workflow
## Workflow Solutions: Evaluation 1

<table>
<thead>
<tr>
<th>Patterns</th>
<th>Staffware</th>
<th>COSA</th>
<th>InConcert</th>
<th>Eastman</th>
<th>FLOWer</th>
<th>Domino</th>
<th>Meteor</th>
<th>Mobile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sequence</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Parallel Split</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Synchronization</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Exclusive Choice</td>
<td>+</td>
<td>+</td>
<td>+/-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Simple Merge</td>
<td>+</td>
<td>+</td>
<td>+/-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Multi Choice</td>
<td>-</td>
<td>+</td>
<td>+/-</td>
<td>+/-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Synchronizing Merge</td>
<td>-</td>
<td>+/-</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Discriminator</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+/-</td>
<td>-</td>
<td>+/-</td>
<td>-</td>
</tr>
<tr>
<td>Arbitrary Cycles</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Deferred Choice</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+/-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
## Workflow Solutions: Evaluation 2

<table>
<thead>
<tr>
<th>Patterns</th>
<th>Products</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MQSeries</td>
</tr>
<tr>
<td>Sequence</td>
<td>+</td>
</tr>
<tr>
<td>Parallel Split</td>
<td>+</td>
</tr>
<tr>
<td>Synchronization</td>
<td>+</td>
</tr>
<tr>
<td>Exclusive Choice</td>
<td>+</td>
</tr>
<tr>
<td>Simple Merge</td>
<td>+</td>
</tr>
<tr>
<td>Multi Choice</td>
<td>+</td>
</tr>
<tr>
<td>Synchronizing Merge</td>
<td>+</td>
</tr>
<tr>
<td>Discriminator</td>
<td>-</td>
</tr>
<tr>
<td>Arbitrary Cycles</td>
<td>-</td>
</tr>
<tr>
<td>Deferred Choice</td>
<td>-</td>
</tr>
</tbody>
</table>
Summary

1) Introducing workflows in an organization delivers benefits at business and software levels.

2) Workflow management systems provide support in three functional areas: Build time, Run-time and Run-time interactions.

3) Workflow Reference model describes the modules and interfaces of a workflow management system in a consistent manner.

4) Workflow patterns address comprehensive workflow functionality. They can be used to examine the expressive power of a workflow server and also to implement a given business requirement.