

**DOKUZ EYLÜL UNIVERSITY**  
**GRADUATE SCHOOL OF NATURAL AND APPLIED**  
**SCIENCES**

**IMPROVING BUSINESS PROCESS QUALITY AND**  
**SPEED USING ADVANCED WORKFLOW**  
**SYSTEMS**

**by**  
**Volkan ABUR**

**September, 2005**  
**İZMİR**

# **IMPROVING BUSINESS PROCESS QUALITY AND SPEED USING ADVANCED WORKFLOW SYSTEMS**

**A Thesis Submitted to the  
Graduate School of Natural and Applied Sciences of Dokuz Eylül University  
In Partial Fulfillment of the Requirements for the Degree of Master of Science  
in Computer Engineering, Computer Engineering Program**

**by  
Volkan ABUR**

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İZMİR**

## M.Sc THESIS EXAMINATION RESULT FORM

We have read the thesis entitled **IMPROVING BUSINESS PROCESS QUALITY AND SPEED USING ADVANCED WORKFLOW SYSTEMS** completed by **Volkan ABUR** under supervision of **Prof. Dr. Alp KUT** and we certify that in our opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Science.

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*dedicated to my family...*

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And of course I would also like to give my special thanks to my family and friends for everything and my company for their support during the whole period...

Volkan ABUR

# **IMPROVING BUSINESS PROCESS QUALITY AND SPEED USING ADVANCED WORKFLOW SYSTEMS**

## **ABSTRACT**

Nowadays, many companies and organizations face the necessity of business process automation on a standard framework. Due to this requirement, Workflow Management Systems are the ultimate solutions in order to speed up the business processes, increase the performance of employees and enhance the reliability of the decision making process, while standardizing and optimizing business processes.

In this thesis, it is tried to show that the quality and speed of business processes can be improved by using workflow management systems. This study also examines general concepts about workflow management systems and architectures. Workflow patterns are explained and some solutions are proposed about workflow design, definition and user interfaces design.

At the end of this study, a custom workflow based online application is proposed for Computer Engineering Department of Dokuz Eylul University which will improve the quality of educational processes in order to meet the accreditation requirements.

**Keywords:** Workflow, Workflow Management Systems, Business Processes, Data Flow, Time and Resource Management.

# GELİŞMİŞ İŞ AKIŞ SİSTEMLERİ KULLANILARAK İŞ SÜREÇLERİNİN KALİTE VE HIZINI ARTIRMA

## ÖZ

Günümüzde her türlü işletme ve organizasyon, standart bir altyapı kullanarak iş süreçlerinin otomasyonunu gerçekleştirme zorunluluğu ile karşı karşıyadır. İş akışı sistemleri; süreçlerin hızını, çalışanlarının performansını ve karar mekanizmalarının güvenilirliğini artırmaya; zaman ve kaynak israfını ise azaltmaya yönelik olarak günden güne gelişen ve ihtiyaç duyulan sistemlerin başında gelmektedir.

Bu tezde, iş akışı yönetim sistemleri kullanılarak mevcut iş süreçlerinin daha hızlı ve kaliteli bir şekilde işleminin sağlanabileceği gösterilmektedir. Çalışma, iş akışı terimiyle ilgili genel kavramların tanımları, iş akışı yönetim sistemleri, sözkonusu sistemlerin işletmelere olumlu katkısı ve iş akışı mimari altyapısı hakkında genel bilgiler vermektedir. Çalışmada ayrıca örnek iş akışı modelleri açıklanarak; iş akışı tasarımı, tanımlama ve iş akışı sistemlerinde kullanıcı arayüzleri üzerine yöntemler önerilmektedir.

Tezde son olarak, Dokuz Eylül Üniversitesi Bilgisayar Mühendisliği Bölümü bünyesinde, akreditasyon ve kalite kurumu beklentileri doğrultusunda programın eğitim öğretim amaçlarına uygun bir altyapı ve çalışma sisteminin var olduğunun gösterilmesine yönelik özelleşmiş iş akışı entegrasyonlu güncel bir uygulama önerilmektedir.

**Anahtar kelimeler:** İş Akışı, İş Akışı Yönetim Sistemleri, İş Süreçleri, Veri Akışı, Zaman ve Kaynak Yönetimi.

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# **CHAPTER ONE**

## **INTRODUCTION TO WORKFLOW AND WORKFLOW MANAGEMENT**

### **1. Introduction**

Workflow Management (WfM) is a fast evolving technology which is increasingly being used and conducted by businesses in many areas. WfM provides the automation of different type of processes which may include human and/or machine-based activities, and also provides interaction with any applications and tools. Although it's most prevalent use is within the office environment in staff intensive operations such as insurance, banking, legal and general administration, it is also applicable to some classes of industrial and manufacturing applications (Workflow Management Coalition, 1995).

Many software vendors have Workflow Management products available today which involve WfM technology and there is a continual introduction of more products into the market. The availability of a wide range of products within the market has allowed individual product vendors to focus on particular functional capabilities and users have adopted particular products to meet specific application needs. However, there are not any standards defined to enable different WfM products to work together. The number of patterns which is proposed in order to get workflow systems more efficient is being increased by both academic and industrial studies day by day.

The Workflow Management Coalition (WfMC) is a grouping of companies who have joined together to address the above situation. WfMC has been founded in August 1993; it is a non-profit, international organization of workflow vendors, users, analysts and university/research groups (WfMC, 1999). It has been recognised that all work flow management products have some common characteristics. WfMC has been established to identify the functional areas and design, develop and implement appropriate specifications for many workflow products over the world. It is



intended that such specifications will enable interoperability between heterogeneous workflow products and improved integration of workflow applications with other IT services such as electronic mail and document management, thereby improving the opportunities for the effective use of workflow technology within the IT market, to the benefit of both vendors and users of such technology.

Even there is no standardization and still having some problems, workflow technology is mostly favored one because the concept behind the Workflow Technology can be summarized with three important adjectives: “better, faster and cheaper”.

The chapters of thesis are summarized as follows;

In the second chapter, the evolution of workflows and new technologies on Knowledge and Work Management are summarized, a general introduction to the workflow systems technology is provided, advantages and challenges of developing and using workflow systems are also explained.

In the third chapter, general workflow architecture is discussed and Workflow Reference Model (WfRM) is shortly explained. This chapter also provides a general overview of the workflow application programming interface (WAPI).

In the fourth chapter, Process Definition Interface of WfRM (Interface 1) is detailed, workflow design and modeling concepts and patterns are discussed with examples; some models are proposed about time and resource management.

In the fifth chapter, Client Applications Interface of WfRM (Interface 2) is discussed. The general properties of workflow client applications are explained with examples.

In the sixth chapter, a real life example which does not use any workflow structure is briefly explained and by proposing a workflow system, the advantage of using workflows is tried to prove.

In the seventh chapter, a workflow and document management system is suggested for The Computer Engineering Department of Dokuz Eylul University (Izmir, Turkey) which will apply for an education-based quality program conducted by Mühendislik Denetleme Kurulu (MÜDEK) at the end of this year.

Finally, the last chapter gives a conclusion about this thesis.

## **CHAPTER TWO**

### **INTRODUCTION TO**

### **WORKFLOW MANAGEMENT**

## **2. Introduction**

This chapter introduces workflow concept and workflow management systems. The workflow history, advantages of workflow management systems, workflow types, a workflow project lifecycle are also explained in this chapter.

### **2.1 The Evolution of Workflow**

Many types of product in the IT market have supported aspects of workflow functionality for a number of years, yet it is only comparatively recently that its importance has been recognized in its own right. The evolution of workflow as a technology has thus encompassed a number of different product areas. (Hollingsworth, 1995)

#### ***2.1.1 Image Processing***

Workflow has been closely associated with image systems and many image systems have workflow capability either built-in or supplied in conjunction with a specific workflow product. Many business procedures involve interaction with paper-based information, which may need to be captured as image data as part of an automation process. Once paper based information has been captured electronically as image data, it is often required to be passed between a number of different participants for different purposes within the process, possibly involving interaction with other IT applications, thereby creating a requirement for workflow functionality (Hollingsworth, 1995).

### ***2.1.2 Document Management***

Document management technology is concerned with managing the lifecycle of electronic documents. Increasingly, this is including facilities for managing document repositories distributed within an organization as a shared resource with facilities for routing documents (or even separate parts of documents) to individuals for information access or updating according to their specific roles relating to a specific document. The document may form part of a particular business procedure which requires access to the document by individual staff undertaking separate activities according to a particular sequence according to some procedural rules - i.e. a document-centric form of workflow. (Hollingsworth, 1995)

### ***2.1.3 Electronic Mail & Directories***

Electronic mail provides powerful facilities for distributing information between individuals within an organization or between organizations; the use of directory mechanisms not only provides a way of identifying individual participants within an email domain but also potentially recording information about individual user attributes, such as organization roles or other attributes relating to business procedures. Thus electronic mail systems have themselves been progressing towards workflow functionality through the addition of routing commands to define a sequence of recipients for particular types of mail items in response to some form of identified business procedure. (Hollingsworth, 1995)

### ***2.1.4 Groupware Applications***

The groupware industry has introduced a wide range of software applications designed to support and improve the interactions between groups of individuals. Initially many of these applications supported improvements in group working via informal processes, accessing group bulletin boards or diary/scheduling applications on an ad-hoc

basis. As the scope of such applications has spread towards more formal business focused group interactions there has been an increasing requirement to provide a more formal and controllable procedural framework to support the use of groupware applications. Workflow technology provides a solution to this type of requirement. (Hollingsworth, 1995)

### ***2.1.5 Transaction-based Applications***

For many years applications to support certain classes of business procedures called transactions have been developed using transaction management facilities within TP monitors and/or Database Management software. From the initial centralized style of working, such application software has increasingly enabled the distribution of transaction based applications across a number of computer platforms. Transaction based applications typically exhibit important characteristics of robustness and support for "atomic" properties of the transaction; however, they do not typically exhibit a separation between the business procedure logic and the invocation of the various application tools which may be required to support individual activities within the business process. (Hollingsworth, 1995)

### ***2.1.6 Project Support Software***

Software to handle complex IT application project development (eg IPSEs - "Integrated Project Support Environments") has often provided a form of workflow functionality within the project environment, for "transferring" development tasks between individuals and routing information between individuals to support these tasks. In some cases this type of software has been generalized to support a wider, business-oriented view of process and a wider range of application tools - offering a more general workflow capability. (Hollingsworth, 1995)

### ***2.1.7 BPR and Structured System Design Tools***

Business Process Re-engineering tools have provided IT based support for the activities of analyzing, modeling and redefining the core business processes of an organization and the potential effects of change in such processes or organizational roles and responsibilities associated with such processes. This may include analysis of the process structure and information flows supporting it, the roles of individuals or organizational units within the process and actions taken in response to different events, etc. A natural extension of such tools is to facilitate the implementation of the process with IT support infrastructure to control the flows of work and associated activities within the business process. (Hollingsworth, 1995)

### ***2.1.8 Separation of workflow functionality***

The market for workflow has evolved from requirements across a spectrum of the IT industry and is likely to continue to do so, with a wide range of products focused on one or more particular aspects of the overall workflow requirement. Some may be provided in conjunction with other areas of technology, such as image processing or document management, others may be more general purpose. This multiplicity of products will allow wide choice for individual implementation circumstances and is recognized as something to be encouraged. However, it also increases the need for standards within the industry to enable different products to work together and integrate within a consistent overall architecture. The reference architecture described in this document provides a framework which separates the various functions within a workflow environment and identifies various interface points at which product integration and interworking may be accomplished. It forms the template within which the individual interfaces and interchange specifications are being developed by the Coalition. (Hollingsworth, 1995)

## 2.2 New Technologies

For the time being major technologies can be classified into three main areas of applications:

Knowledge Management (KM) technologies that provide the way to share and organize strategies, research and development, market research, and so on. Enterprise Resource Planning (ERP) is represented by application from vendors like SAP, People Soft, and Baan. They are used for traditional “accounting like” activities: accounting, inventory management, sales statistics, etc.

Work Management (WM) technologies provide assistance to groups work, and enhance productivity and quality of work. They are used to assist day-to-day production work. In this chapter, Work Management and Knowledge Management which can be related to work management are explained.

### 2.2.1 Knowledge Management

Knowledge Management (KM) technologies are a collection of tools designed to store and retrieve knowledge. (Ader, 2001)

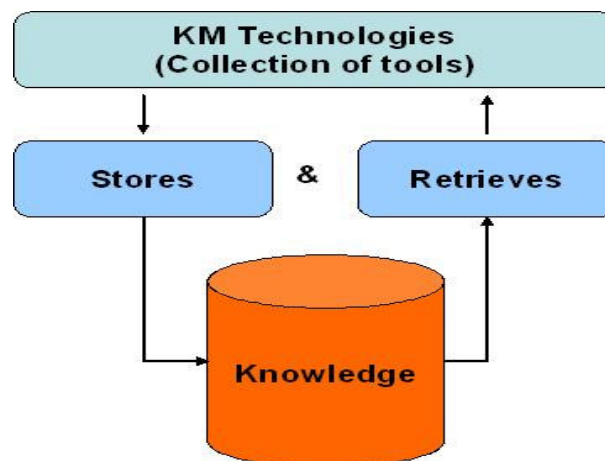


Figure 2.1 Knowledge Management Technologies

Knowledge Management technologies obviously deal with every type of knowledge the company needs or users. The reason of using KM technologies can be listed as shown:

- Collecting and providing any knowledge from employees, partners, customers, suppliers - at any time and any place.
- Classification and structuring common information
- Collecting information in a center storing location
- Being informed about new, changed or outdated information
- Linking information
- Easy and fast finding of any information
- Easy and efficient editing information

They include such tools as:

- Document Management to store and retrieve documents.
- Data Ware Houses and Data Mining tools to store and analyze data coming from accounting based applications.
- Full text indexing and search agents, basis of search engines as known today on the Internet, to search documents based upon their content.
- Linguistic tools to support natural language queries.
- Semantic networks to store meaning of documents as a network of actions on objects and enable powerful searches on a document based on network patterns matching (e.g. all documents speaking about transforming materials under high temperature conditions).
- Intelligent document retrieval tools with “learning capabilities” of both the user interest, and the target systems delivering capabilities.



All these tools are used for understanding the market place, and the possibilities that are offered in various areas, in order to take better decisions, orient product definition, organize production, enhance sales activities efficiency, and so on.

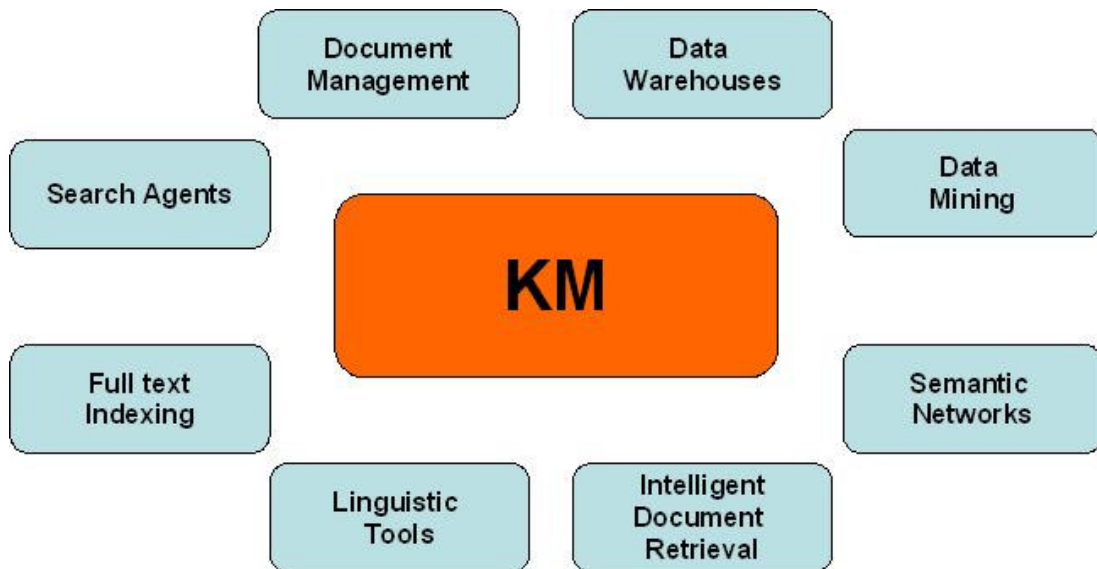


Figure 2.2 Knowledge Management Technologies Sub Disciplines

### ***2.2.2 Work Management***

Work Management technologies are a collection of tools designed to assist production work. (Ader, 2001)

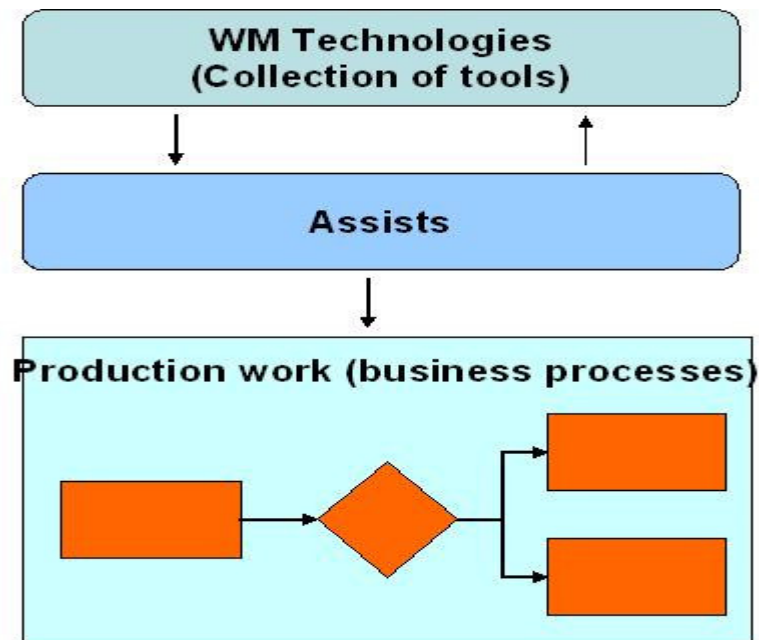


Figure 2.3 Work Management Technologies

They include such tools as:

- E-mail, which accelerates communication between people, and can monitor basic question and answer cycles.
- Meeting scheduling which assists a group in organizing and planning collective activities, as well as sharing common resources.
- Forum, which provides a shared space to a group for structured discussions and document base documents of many different forms (specifications, contracts, planning, budgets, proposals, etc.)
- Groupware, which combines above tools in a uniform environment, ready to use by groups.
- Document Management, which stores large quantities of documents in an organized way, and maintain versions, renditions, indexes and so on.
- Workflow, that supports business processes for their whole lifetime.

Those tools are used to assist the work done for producing products and services. In contrast with KM tools that are used to decide what to produce and how to produce it.

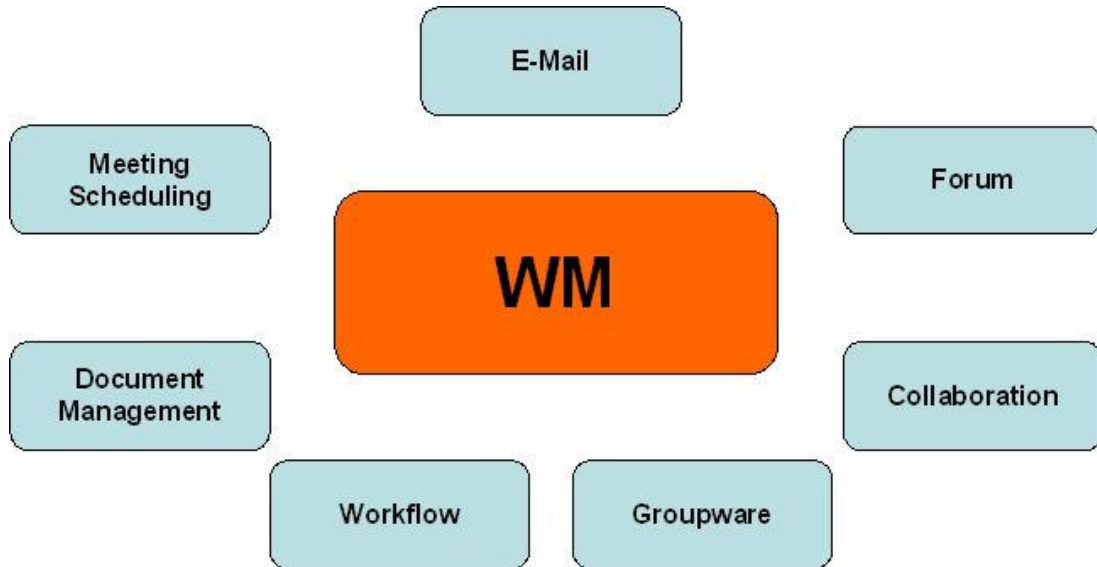


Figure 2.4 Work Management Technologies Sub Disciplines

## 2.3 Workflow & Workflow Management

Workflow's primary mission is to handle business processes that span several areas in the company to support external demand. The following are the general workflow related definitions given in the Workflow Management Coalition:

### 2.3.1 Business Process Definition

Business Process is a set of one or more linked procedures or activities that collectively realize a business objective or policy goal, normally within the context of an organizational structure defining functional roles and relationships. Business Process Definition is the computerized representation of a process that includes the manual definition and workflow definition. (WfMC, 1999)

### ***2.3.2 Workflow***

Workflow is 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. (WfMC, 1999)

In the early days, work was passed from one participant (or worker) to another. The main benefits were that work was delivered to people, and each worker could assume that work was ready for processing, because the workflow system would not forward incomplete items. Delivery was automated.

Now workflow technology has matured; it is the process itself that is automated. A work item or data set is created, and is processed and changed in stages at a number of processing points to meet business goals. Most workflow engines can now handle very complex series of processes. Any condition that can be expressed mathematically can be managed by a workflow system. (Allen, 2001)

Workflow normally includes a number of steps, each of which is known as an activity. An activity can involve manual interaction with a user or workflow participant, or the activity might be executed using machine resources. Delivering work to users does increase efficiency. Automating the actual work provides huge increases in efficiency, and provides managers with the facilities to create the Virtual Organization, and to participate effectively in the ecommerce revolution.

### ***2.3.3 Workflow Management System***

Workflow Management System is 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 appropriate IT tools and applications. (WfMC, 1999)

A workflow management system is absolutely responsible for

- separation of processes, resources and applications
- focusing on the logistics of work processes, not on the contents of individual tasks

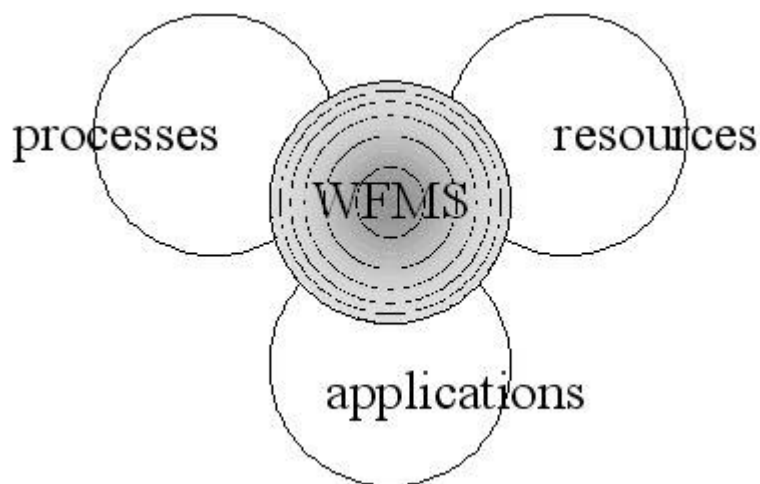


Figure 2.5 Basic Idea of Workflow Management Systems

Here are some examples which workflow management tools provide (Ader, 2001):

- Describing precisely the procedure the must follow the process required to support the service;
- Ensuring automatic validation of input required according to their specification;
- Applying automatically the procedure definition to each instance of the process with automatic creation of each activity that must be executed according to business rules applied to the context of each process instance;
- Dispatching activities to the adequate participant by interpreting a description of the organization in place;

- Following automatically deadlines and overdue situations, and alerting on those events participants able to react;
- Producing output that conform to intended specifications, and handle exceptions otherwise;
- Gathering detailed statistics on time and costs related to each process category; and
- Maintaining automatically detailed logs ensure full trace-ability of the processes.

For the time being, more than 250 workflow management systems are available.

It is possible to “do” workflow management without using a workflow management system.

#### ***2.3.4 Roles and Information***

A workflow management system has to be able to represent two major elements of a business process:

- The roles of the participants involved in the process, and
- Information handled by the process.

##### ***2.3.4.1 Roles***

Roles are abstractions of an organization model, which enable the representation of the procedure independently of the actual organization (how people are assigned to roles, how roles are grouped into organizational units). Using roles, and a database representing the organization of the enterprise, the workflow management tool is able to assign automatically each activity (or work item) to the adequate employee inside the company. There may be other groups of users and alternate ways to retrieve the

employee for the work, but role concept is obviously preferred for most workflow solution. (Beizer, ud)

#### *2.3.4.2 Information*

The set of documents used by the process, and produced by the process, as well as the set of fields used to identify each process instance (customer number, contract number, state of the process) constitutes the context of the process. This context is stored and maintained by the workflow tool in its database. It is used to determine through business rules which path in the procedure definition should be selected for each process instance. (Beizer, ud)

#### *2.3.5 Workflow Terminology*

All workflow systems are process oriented. A process definition is created and it typically comprises some sub-processes. For example, a business process might be to grant a new loan. This process would be split into sub processes such as reviewing the application for completeness and accuracy, executing a credit check, creating a new loan contract, sending it to the client, checking the form on its return, set-up of payment schedule, and finally issuing the check. (Allen, 2001)

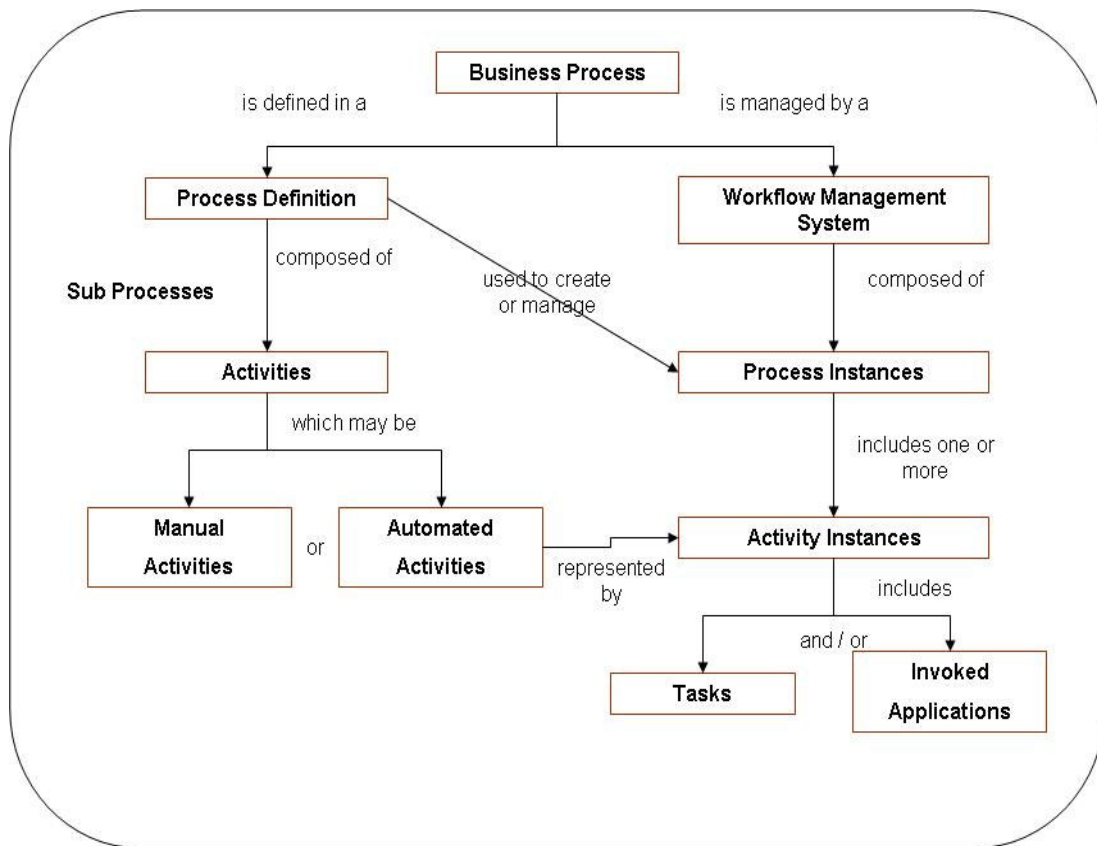


Figure 2.6 Basic Workflow Management Elements

Each process and sub-process comprises some activities. An activity is a single logical step in the process. Making a payment or NOT making a payment is an activity. It is sometimes not practical to automate all activities during a single project. Therefore workflow executes automated activities while process definitions will describe all activities whether they are automatic or manual. For example, if the law states that contracts for loans must be signed in front of independent witnesses, then this might be the one manual activity within the whole process of granting a loan.

The process definition describes how a loan is granted by the company; the instance is actually granting a loan to a client. The instance of a process comprises of activity instances that will include work items (tasks) that are passed to an individual (or workflow participant, or user) for action, or to another process for action. So, a user might receive all documents relating to a loan, and he may be asked to approve the loan.



Alternatively, the activity instance might invoke a query on a public credit checking system, and then take the result, measure it against pre-determined criteria, and pass to the next activity a binary result

Activities to be executed are usually interactive activities, operated by human beings on a workstation. But some of those activities can be completely automated, and executed on the server, because they are already supported by application programs. Some automated activity examples are listed below:

- An automatic activity can send notification e-mails to the predefined workflow participants.
- An automatic activity in the flow can create an account in the billing system, and initiate billing activities; and
- Another automatic activity can trigger provisioning activities to get a phone number allocated to a customer.

## **2.4 Workflow Types**

Selection of appropriate workflow type does depend on what is wanted to be achieved. Many large organizations use more than one workflow product supplied by different companies. It is not unusual for organizations to use the same workflow product in a number of different ways. To help people to understand the market better, a number of segmentations have been proposed. The following segmentation is most useful:

- Production
- Administrative
- Collaborative (Groupware)
- Ad-hoc

### ***2.4.1 Production Workflows***

The key goal of Production Workflow is to manage large numbers of similar tasks, and to optimize productivity. This is achieved by automating as many activities as practical, and to relentlessly pursue more and more automation until Straight-Through-Processing has been achieved and human input is required only to manage exceptions - those work items that fall outside pre-determined process tolerances. (Allen, 2001)

The events that require human contribution are minimized, as are the duration and complexity of that intervention. Production workflow is optimized to attain high levels of quality and accuracy by executing highly repetitious tasks, usually in a non-stop manner.

Production Workflow can manage hugely complex processes, and can be tightly integrated with existing (legacy) systems. In fact the trend is to embed the workflow component into large applications where its role is to act as a Rules Engine. This brings us to a further segmentation within Production Workflow.

#### ***2.4.1.1 Autonomous Workflow Engines***

An autonomous workflow management system is functional without any additional application software, with the exception of database management systems and message queuing middleware. (Allen, 2001)

For the deployment of an autonomous workflow solution, application systems that are external to the workflow management system are invoked at runtime; and workflow relevant data is passed between the workflow participants. Autonomous workflow management systems are separate pieces of application software that provide the workflow functionality. They normally have their own user interfaces and will access

data from other application. They are usually installed to support a variety of different applications.

The modeling of autonomous workflow applications requires the specification of interface information for the invoked applications, relevant data structures, and involved participants, and thus can become a complex challenge.

#### *2.4.1.2 Embedded Workflow*

An embedded workflow management system is only functional if it is employed with the surrounding (embedding) system; for instance, an Enterprise Resource Planning (ERP) system. (Allen, 2001)

#### *2.4.2 Administrative Workflows*

The most important feature of an administrative workflow system is the ease to define the process. Typically, there are many definitions running concurrently and they tend to involve a large number of employees. (Allen, 2001)

Process Definitions are usually created using forms and if the definition is too complex for the form then another product has to be used. Flexibility is more important than productivity, and these systems handle one or two orders of magnitude lower numbers of instances per hour than Production Workflow Systems.

#### *2.4.3 Collaborative Workflows*

Collaborative workflow focuses on teams working together towards common goals. Groups can vary from small, project-oriented teams, to widely dispersed people with interests in common. Effective use of collaborative workflow to support team working is now considered a vital element in the success of enterprises of all kinds. The use of

Internet and the World Wide Web to support team communications across enterprises is also a critical success factor to most organizations. (Allen, 2001)

#### ***2.4.4 Ad-Hoc Workflows***

Ad-Hoc Workflow systems allow users to create and amend Process Definitions very quickly and easily to meet circumstances as they arise. So it is possible to have almost as many Process Definitions as there are instances of the definitions. (Allen, 2001)

Ad-Hoc Workflow maximizes flexibility in areas where throughput and security are not major concerns. Whereas in Production Workflow, clearly the organization owns the process, Ad-Hoc Workflow users own their own processes.

### **2.5 Workflow Routing versus Work Management**

Routing is just one aspect of a workflow, not necessarily the most important one to automate in many situations. A business process consists of a set of tasks and the collection and the assembly of supporting content. When the work item content is relatively simple, and the order of tasks is fixed with each performed by a different person, a map and workflow routing engine are important. When the work item is more complex, either there is a large amount of the content or because the order of the tasks or the person performing the tasks may not be fixed, then the other aspects of the workflow become more important than routing. (Beizer, ud)

The ability to ensure that all work items contain consistent content, that the content is consistently processed, and that the tasks are completed in a timely manner, is critical. In such applications, management of the work item content would be more important than work item routing.

## **2.6 Advantages of Workflow Management Systems**

By supporting integration of existing applications, in the form of activities automatically invoking transactions on hosts or servers on the network, workflow ensures global integration of people and programs in the framework of a business process. The benefits of workflow can be seen at all levels (Ader, 1999):

### ***2.6.1 Company Benefits***

Workflow increases control over the productivity of information-related tasks. While reinforcing confidentiality and access-control measures, Workflow brings factory methods for managing and controlling processes.

### ***2.6.2 Client Benefits***

Client is served by an improved service quality, better response time, clear information about the status of their request and more accessible company agents.

### ***2.6.3 Company Agent Benefits***

Each agent sees a list of activities they have to carry out and can organize their own work accordingly. The context of each activity can be presented. For agents, workflow means flexibility in their work, speed of execution and a high comfort level.

### ***2.6.4 Manager Benefits***

Workflow present managers with decisions to be made at the appropriate time and with enough information to enable them to intervene effectively. They can act sooner, more rapidly and with greater fairness. Workflow gives constant access to the status of each case, and a monitoring system allows managers to keep processes under control.

Workflow can revolutionize the supervisory function, bringing it much closer to its industrial counterpart.

#### ***2.6.5 Organization Analyst Benefits***

With Workflow-assisted procedures, organization analysts have every kind of statistic necessary to analyze workloads, costs, peak periods and many other aspects of the company's operations. They can use simulation tools to model procedural refinements, at an unprecedented level of detail and accuracy and the logged data is available at marginal cost.

### **2.7 Affects to Workflow System Success**

A workflow project is very similar to other information technology projects. First it must be decided at the beginning of the project what its scope is. Then the implementation must be carefully planned, technology has to be developed and implemented and finally tested rigorously before putting it into production (realization).

#### ***2.7.1 User Requirements Elicitation Phase***

During user requirements elicitation phase, some questions about business process and management should be answered and documentation also should be prepared as an input to design phase. Some important issues to be done can be listed as it follows:

- Creating electronic business processes to make the company work much more quicker
- Creating files direct in a workflow instead of printing documents out
- Involving partners, suppliers or customers directly into your business processes
- Quality management and legal requirements need have a documentation of all company processes

- Over watching processes in a company
- Internal processes like resource planning in electronic way
- Binding decisions or tasks for later review
- Workflows with lots of content like more files
- Instant overview of all running and involved workflows
- Automatic escalation of processes
- Direct view of company workflows from CEOs or head of departments

### ***2.7.2 Project Scope***

It is vital to clearly identify the boundaries of the project. As the project progresses, changes to the scope must be controlled carefully.

Large organizations that are familiar with deploying workflow technology are now implementing global complex projects, but even they would recommend that the first workflow projects in each organization be done in a non-mission critical department.

Choices need to be made as to the type of workflow to be implemented (Production or Ad-Hoc, etc.). The project economics need to be discussed and determined. Each sector of the project should be assigned its own cash, but some flexibility is recommended. However, beware of over analysis, leading to insufficient time and money to conclude the important implementation phase of the project.

### ***2.7.3 Implementation Planning (System analysis phase)***

This is the crucial time for the project. The more attention to detail exercised, the better the success of the project. The first stage is to understand clearly how the business processes work right now. This is normally done by interviewing the participants and their management team.

The analyst should first define objectives for the automation project and the metrics with their baselines against which success will be measured (Moore & Graham, 1999):

- Number of supported partners and transaction types,
- Systems which needs integration with workflow system,
- Number of whole business processes,
- Number of documents,
- Number of electronic forms,
- Organization hierarchy,
- Number of non-automated tasks,
- Cost for processing customer/supplier transactions,
- Level of clerical support with greater customer/supplier self-service,
- Number of problem/resolution calls per customer to a call center,
- Elapsed time to change/modify a process in response to a business changes;

In a project in U.S.A., analyzing team conducted approximately 350 hours of interviews with operations staff to study the existing processes, and to receive input from users on potential improvements (Allen, 2001). The major factor found contributing to process inefficiencies is the total reliance on manual routing of hard copy procedures for review, approval, and actual use in the plant. In fact, total cycle time from initial procedure change to final distribution ranges from days for simple revisions, to weeks for revisions on administrative or upper tier procedures. The team's findings include the need to fully integrate the maintenance management system with the procedures management and document workflow system. They also identify the need to consolidate numerous software tools.

It is not unusual to get different pictures from different participants and it is important to gain consensus of the current process. Having achieved this, then process improvements can be studied, particularly reviewing the productivity improvements



which workflow technology can bring. After this work has been completed there will be two process models; the 'NOW' Model and the 'TO BE' model.

#### ***2.7.4 System Design and Technology Planning***

While requirements are gathered, the design and technology planning phase is already been started. Until all requirements will be collected and documented, the research study about workflow concept and related technologies can be done.

##### *2.7.4.1 Enabling Technologies for Modern Technology Solutions*

Technology research includes several issues and thus this process takes a lot of time. (Moore & Graham, 1999)

- Presentation platforms that make it feasible to interact with external suppliers and customers. Presentation services are organized in four areas:
  - They work natively in browsers to provide consistent behavior of business processes in another company's environment;
  - Use HTML as their base document type;
  - Use Extensible Markup Language (XML) for defining, packaging and sharing data; and
  - Use other Web browser plug-ins, such as Real Audio, for attaching explanations to business processes, VRML and JPEG for visually representing parts or whole products, and FTP for transferring large files.

- A messaging platform based on e-mail standards, such as SMTP and MIME. More advanced messaging products like Notes and Exchange can be used where the entire supply chain agrees to use one or the other. Other important services include Secure Sockets Layer (SSL) and encryption for secure transmissions.
- A queuing platform, such as IBM's MQSeries or BEA Systems' MessageQueue. These technologies are responsible for guaranteeing delivery of messages in the proper sequence. Microsoft is beginning to position MSMQ for integrated enterprise applications, but it is a first-generation product and needs to mature from real-world deployment.
- A persistence/state change platform, such as a database management system (DBMS). It's not critical that the entire supply chain uses a DBMS, but it is critical that your workflow engine is based on one.
- A scripting platform, such as Java for programming flow control logic.
- Design tools, such as Workflow.BPR (Holosofx), ProcessWise Workbench (Teamware), Workflow Analyzer (Meta Software) and Aris IDS Scheer).

#### *2.7.4.2 Workflow Design*

The analyzed and documented processes were designed using workflow process modeling. During this step, the team examines the intricate details of the processes and allowed for investigation of every possible opportunity for improvement. They involve all the people they had previously interviewed, and ensure that they achieve an organization-wide prospective of these processes. All the participants are encouraged to contribute new ideas, and the review process is kept as flexible as possible.

### ***2.7.5 Application Development***

Before getting involved in a workflow project, many people believe that application development is the most difficult part. In fact, it is clearly the easiest element. Workflow technology is mature; most software authors have produced easy-to-use tools to create process definitions and execute them in a test environment. In addition, there are well and defined API's that help the developer to access external data sources.

### ***2.7.6 Testing***

This portion of the project is no different from other relatively complex software projects. There has to be a test plan that covers every conceivable eventuality. During the testing, new situations may arise making it necessary to amend the process definitions. This should be done under strict project change management rules.

### ***2.7.7 System Deployment***

#### ***2.7.7.1 Pre-Implementation***

In most cases, workflow technology does not just run. People are involved in the new processes in many different ways. This means that training is a vital part of any workflow project. Some large system integrators are even employing industrial psychologists in their implementation teams to help with the education process. Not only do the workers have to adjust to work being delivered to their screens, (a transition from paper to electronic display), they also have to adjust to new business methods. If this transition has been managed smoothly, this makes a significant contribution to the project.

#### *2.7.7.2 Post-Implementation*

The technology has been delivered and the new process definitions are running smoothly through the whole organization. Now is the time to monitor the efficiency of the new methods and to learn from experience so that the efficiency can be increased incrementally. Most workflow projects deliver a new release of the application within six months of the first delivery. Many project managers understand that the secondary implementations can probably double the efficiencies of the first.

#### *2.7.8 The Reasons for a Negative Success*

As lots of project cannot succeed due to many reasons, workflow projects can also be failed. The list of failure reasons can be shown below (Moore & Graham, 1999).

- Aggressive time frames,
- Need for best practices,
- Impact of mergers on workflow projects,
- Technical complexity,
- Lack of skills in IT architecture ,
- Lack of skills in workflow tools,
- Local vendor support for newly announced products,
- User resistance to change.

# **CHAPTER THREE**

## **WORKFLOW REFERENCE MODEL**

### **AND ARCHITECTURE**

#### **3. Introduction**

In this chapter, Workflow Reference Model and its interfaces are explained with Workflow Application Programming Interface.

#### **3.1 What is Workflow Reference Model?**

The Workflow Reference model has been developed from the generic workflow application structure by identifying the interfaces within this structure which enable products to interoperate at a variety of levels. All workflow systems contain a number of generic components which interact in a defined set of ways; different products will typically exhibit different levels of capability within each of these generic components. To achieve interoperability between workflow products a standardized set of interfaces and data interchange formats between such components is necessary. A number of distinct interoperability scenarios can then be constructed by reference to such interfaces, identifying different levels of functional conformance as appropriate to the range of products in the market (Hollingsworth, 1995).

### 3.2 The Workflow Model

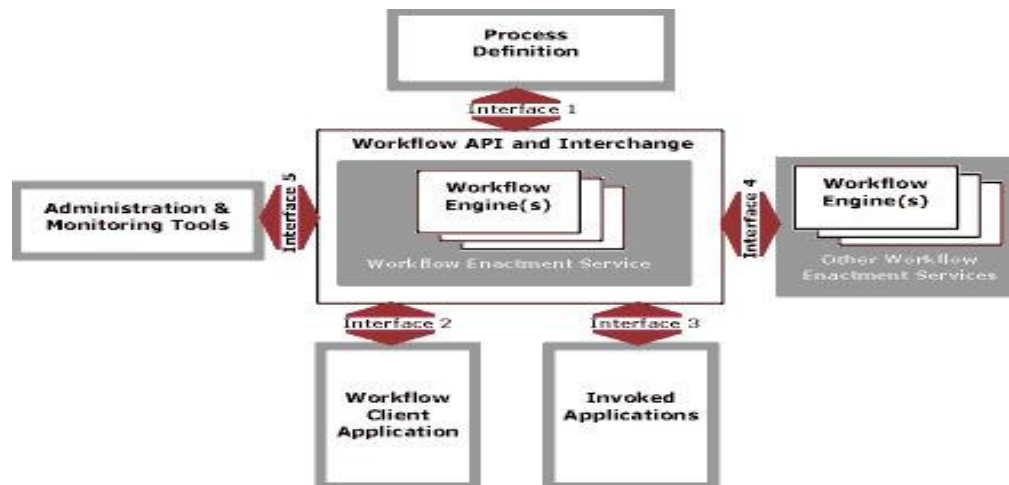


Figure 3.1 Workflow Reference Model - Components & Interfaces

The interface around the workflow enactment service is designated WAPI - Workflow APIs and Interchange formats, which may be considered as a set of constructs by which the services of the workflow system may be accessed and which regulate the interactions between the workflow control software and other system components.

### 3.3 Workflow Enactment Services

#### 3.3.1 What is a Workflow Enactment Service?

The workflow enactment service provides the run-time environment in which process instantiation and activation occurs, utilizing one or more workflow management engines, responsible for interpreting and activating part, or all, of the process definition and interacting with the external resources necessary to process the various activities (Hollingsworth, 1995). A Workflow enactment service is a software service that may consist of one or more workflow engines in order to create manage and execute workflow instances. Applications may interface to this service via the workflow application programming interface (WAPI).

In a distributed workflow enactment service, several Workflow engines each control a part of the process enactment and interact with that subset of users and application tools related to the activities within the process for which they are responsible. Such an enactment service is considered to have common naming and administrative scope, so that process definitions (or subsets) and user/application names may be handled on a consistent basis. Distributed workflow systems make use of specific protocols and interchange formats between Workflow engines to synchronize their operations and exchange process and activity control information. Workflow relevant data may also be transferred between Workflow engines. Within a single homogeneous workflow enactment service, such operations are vendor specific.

### ***3.3.2 The Workflow Engine***

A workflow engine is responsible for part (or all) of the runtime control environment within an enactment service. (Hollingsworth, 1995)

Typically such software provides facilities to handle:

- interpretation of the process definition
- control of process instances - creation, activation, suspension, termination, etc
- navigation between process activities, which may involve sequential or parallel operations, deadline scheduling, interpretation of workflow relevant data, etc
- sign-on and sign-off of specific participants
- identification of work items for user attention and an interface to support user interactions
- maintenance of workflow control data and workflow relevant data, passing workflow relevant data to/from applications or users
- an interface to invoke external applications and link any workflow relevant data
- supervisory actions for control, administration and audit purposes

A workflow engine can control the execution of a set of process, or sub-process, instances with a defined scope - determined by the range of object types, and their attributes, which it can interpret within the process definition(s).

In an enactment service consisting of multiple workflow engines, there is a partitioning of process execution across the constituent engines. This may be by process type, with a particular engine controlling a particular process type in its entirety, by functional distribution, with a particular engine controlling those parts of a process requiring user or resource allocation within its own control domain, or some other partitioning mechanism.

### ***3.3.3 Homogeneous & Heterogeneous Workflow Enactment Services***

A homogeneous workflow enactment service comprises one or more compatible workflow engines which provide the runtime execution environment for workflow processes with a defined set of (product specific) process definition attributes (Hollingsworth, 1995). The mechanisms by which process execution is organized across the various workflow engines and protocols and interchange formats used to support this is product specific and not standardized.

A heterogeneous workflow enactment service comprises two or more homogeneous services, which follow common standards for interoperability at a defined conformance level (Hollingsworth, 1995). It is envisaged that a number of conformance levels will be defined to support increasing levels of common functionality.

These are expected to include (amongst other things):

- A common naming scheme across the heterogeneous domain
- Support for common process definition objects and attributes across the domain



- Support for workflow relevant data transfer across the domain
- Support for process, sub-process or activity transfer between heterogeneous workflow engines
- Support for common administration and monitoring functions within the domain

Support for common workflow control data and its interchange (e.g. shared process and activity state data) would be necessary to support totally open interworking between heterogeneous products; whilst an interesting standardization challenge it is considered unattainable in the foreseeable future, hence the emphasis on levels of interoperability governed by defined conformance criteria.

#### *3.3.3.1 Instance*

Instance is the representation of a single enactment of a process, or activity within a process, including its associated data (WfMC, 1999). Each instance represents a separate thread of execution of the process or activity, which may be controlled independently and will have its own internal state and externally visible identity, which may be used as a handle, for example, to record or retrieve audit data relating to the individual enactment.

A process or activity instance is created and managed by a workflow management system for each separate invocation of the process or activity. Where a process includes parallel activities, a process instance may include multiple concurrent threads of execution.

*3.3.3.1.1 Process Instance.* Process instance is the representation of a single enactment of a process (WfMC, 1999). A process instance is created, managed and (eventually) terminated by a workflow management system, in accordance with the process definition.

Each process instance represents one individual enactment of the process, using its own process instance data, and which is (normally) capable of independent control and audit as it progresses towards completion or termination. It represents the unit of work with respect to a business process which passes through a workflow management system.

Each process instance exhibits internal state, which represents its progress towards completion and its status with respect to its constituent activities.

Some business processes may never “complete” within a defined timescale in the accepted sense of the word, but achieve a protracted, persistent dormant state, which may require the process instance to be placed in an archive state, for example to support legal requirements on the maintenance of process data.

*3.3.3.1.2 Activity Instance.* An activity instance is the representation of an activity within a (single) enactment of a process, i.e. within a process instance (WfMC, 1999).

An activity instance is created and managed by a workflow management system when required within the enactment of process, in accordance with the process definition.

Each activity instance represents a single invocation of an activity, relates to exactly one process instance and uses the process instance data associated with the process instance. Several activity instances may be associated with one process instance, where parallel activities exist within the process, but one activity instance cannot be associated with more than one process instance.

Each activity instance is normally capable of independent control and audit and exhibits internal state.

### 3.3.3.2 Process and Activity State Transitions

The workflow enactment service may be considered as a state transition machine, where individual process or activity instances change states in response to external events (e.g. completion of an activity) or to specific control decisions taken by a workflow engine (e.g. navigation to the next activity step within a process).

**3.3.3.2.1 Process State Transition.** Process state is a representation of the internal conditions defining the status of a process instance at particular point in time. Most workflow management systems maintain such status information as part of their workflow control data.

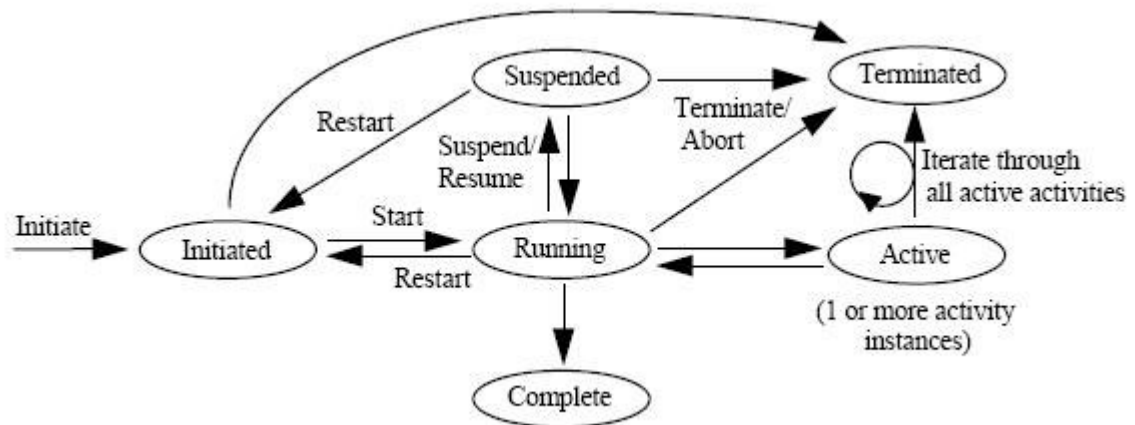


Figure 3.2 Process State Transition

The state of each process instance under enactment is maintained by the workflow management system. Different vendor systems have different ways of representing process state and may have their own set of state definitions.

As the execution of a process instance proceeds it follows a series of transitions between the various states which it may take. The complete set of process states for a

process definition fully defines the internal behavior which its process instances may follow.

The WfMC Reference Model identifies a number of common states which a process instance may take (WfMC, 1999):

- **Initiated** - the process instance has been created, but may not yet be running.
- **Running** - the process instance has started execution and one or more of its activities may be started.
- **Active** - one or more activities are started and activity instances exist (Further sub-states may be supported by particular implementations to record more detailed information about active activities.)
- **Suspended** - the process instance is quiescent; no further activities are started until it is resumed
- **Complete** - the process instance has achieved its completion conditions and any post-completion system activities such as audit logging are in progress.
- **Terminated** - the execution of the process has been stopped (abnormally) due to error or user request.
- **Archived** - the process instance has been placed in an indefinite archive state (but may be retrieved for process resumption - typically supported only for long-lived processes).

**3.3.3.2.2 Activity State Transition.** Activities may be non-interruptible; i.e. once a workflow service has started a particular activity within a process instance, it may not be possible to suspend or terminate that activity. This means that suspension / restart / terminate functions cannot be completed until all active activities have completed and the process instance returned to a running state. In addition, it may be required to mark a set of activities as an atomic unit, which are either executed in entirety or the process instance "rolled-back" to a restart point.

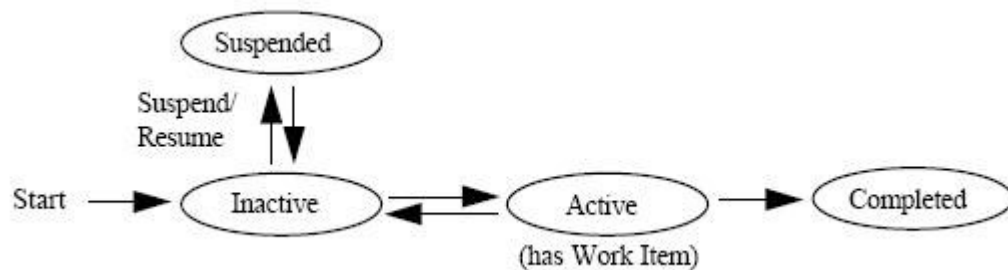


Figure 3.3 Activity State Transition

Activity state is a representation of the internal conditions defining the status of an activity instance at a particular point in time. Most workflow management systems maintain such status information as part of their workflow control data. (WfMC, 1999)

The state of each process instance under enactment is maintained by the workflow management system. Some systems extend this to maintain state information about each activity instance which has been created. Different vendor systems have different ways of representing activity state and may have their own set of state definitions.

The WfMC Reference Model identifies a number of common states which an activity instance may take (WfMC, 1999):

- **Inactive** - the activity instance has been created, but may not yet been activated; no work item exists for that activity.

- **Active** - one or more work items have been created and assigned for processing.
- **Suspended** - the activity instance is quiescent; no further work items are started until it is resumed. (Note that some activities may not be suspendable.)
- **Completed** - the process instance has achieved its completion conditions and any post-completion system activities such as audit logging are in progress.

### 3.4 Workflow Application Programming Interface & Interchange (WAPI)

The WAPI may be regarded as a set of API calls and interchange functions supported by a workflow enactment service at its boundary for interaction with other resources and applications. Although this architecture refers to 5 "interfaces" within WAPI, a number of the functions within each of these interfaces are common (for example process status calls may be issued from the client application interface or the administration interface). The WAPI is thus being defined as a common core of API calls /interchange formats with specific extensions where necessary to cater individually for each of the five functional areas.

### 3.5 Workflow Data Structures

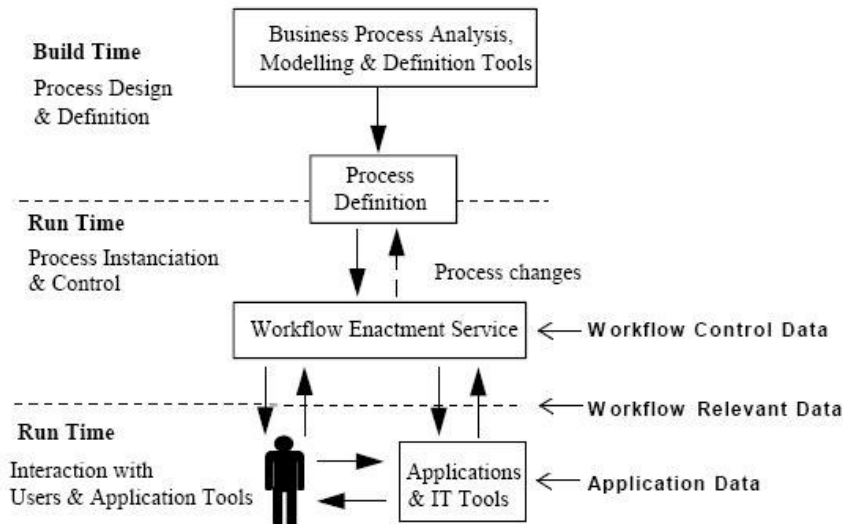


Figure 3.4 Types of Data in Workflow Management Systems

#### 3.5.1 Application Data

Data that is application specific and not accessible by the workflow management system can be called as “Application Data”. (WfMC, 1999)

This is data that the workflow management system generally will never see. It is data that is strictly managed by the applications supporting the process instance. (Such data may become process relevant data if it is used by the Workflow Management System to determine a state change.)

#### 3.5.2 Workflow Relevant Data (Process Flow Data)

Data that is used by a Workflow Management System to determine the state transitions of a workflow instance, for example within pre- and post-conditions, transition conditions or workflow participant assignment. (WfMC, 1999)

Workflow relevant data may be manipulated by workflow applications as well as by the workflow engine.

Workflow relevant data may be made available to a subsequent activity or another process instance and thus may affect the choice of the next activity to be chosen (for example decision data and/or reference values to be passed between activities)

Data may be of two broad types:

- Typed - the structure of the data is implied by its type (typically a workflow management system will understand the structure of such data and may be able to process it)
- Untyped - the workflow management system will not understand the data structure, but may pass the data (or a reference to the data) to workflow applications

### ***3.5.3 Workflow Control Data (Workflow System Data)***

Workflow control data is the data that is managed by the Workflow Management System and/or a Workflow Engine. Such data is internal to the workflow management system and is not normally accessible to applications. (WfMC, 1999)

Workflow control data represents the dynamic state of the workflow system and its process instances.

Workflow control data examples include:

- state information about each workflow instance,



- state information about each activity instance (active or inactive),
- information on recovery and restart points within each process,

The workflow control data may be written to persistent storage periodically to facilitate restart and recovery of the system after failure. It may also be used to derive audit data.

### ***3.5.4 Data Interchange***

Interchange of workflow relevant and application data is (potentially) required across the WAPI to support interworking within three runtime functions. (WfMC, 1999)

- work list handler (interface 2)
- invoked application (interface 3)
- workflow engine interchange (interface 4)

The proposed API command set may include specific calls to accept/return workflow relevant data from/to the enactment service across the WAPI; variants of these could be defined for both direct and indirect case data interchange.

## **3.6 Interfaces**

### ***3.6.1 Interface 1: Process Definitions Tools Interface***

Interface 1 is the definition of a standard interface between process definition and modeling tools and the work flow engine(s) is handled by Interface 1 (Hollingsworth, 1995). It deals with passing Process Definitions from external tools to the workflow engine where there are enacted. In fact, this proved to be a very difficult task and it was almost five years before a viable specification was published. The coalition published a

new language called Process Definition Language as a precursor to the Interface definition.

Process Definition Language is the representation of a business process in a form that supports automated manipulation, such as modeling, or enactment by a workflow management system. The process definition consists of a network of activities and their relationships, criteria to indicate the start and termination of the process, and information about the individual activities, such as participants, associated IT applications and data, etc. (Hollingsworth, 1995)

The new wave of interest in using the intelligent messaging language, XML, has swept through all areas of IT including workflow. Interface 1 has recently been rewritten to use Wf-XML. The goal of Interface 1 is to enable users to employ many different process visualization tools with each workflow engine deployed.

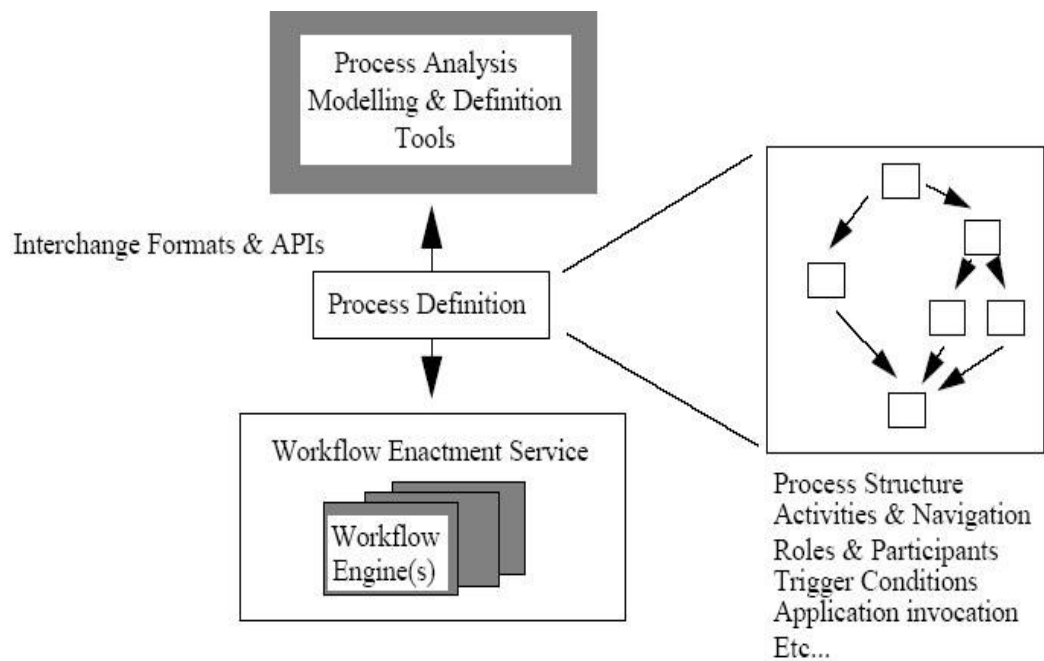


Figure 3.5 Process Definition Interchange

There are clear benefits in using a standardized form for this definition.

Firstly, it defines a point of separation between the build-time and runtime environments, enabling a process definition generated by one modeling tool to be used as input to a number of different workflow runtime products. This enables user choice of modeling tools and workflow runtime products to be independent.

Secondly, it offers the potential to export a process definition to several different workflow products which could co-operate to provide a distributed runtime enactment service.

There are two aspects to the Workflow Management Coalition's work in this area (Hollingsworth, 1995):

- Derivation of a meta-model which can be used to express the objects, their relationships and attributes within a process definition and which can form the basis for a set of interchange formats to exchange this information between products.
- API calls (within the WAPI) between workflow systems or between a workflow system and process definition product, providing a common way to access workflow process definitions. Access may be read, read/write or write only and may manipulate the set of standard objects defined within the meta-model or a product-specific set.

The Workflow Management Coalition is developing a meta-model for the process definition, which identifies a basic set of object types appropriate to an initial level for the interchange of relatively simple process definitions. Further object types may be

added, either by vendor specific extensions and/or by defining additional conformance levels with added functionality.

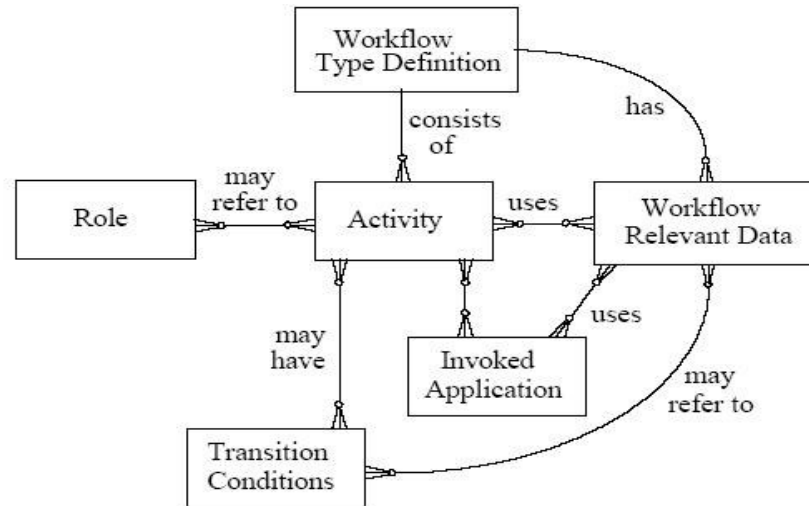


Figure 3.6 Basic Process Definition Meta-model

It is envisaged that particular attributes of the following types will be defined (Hollingsworth, 1995):

#### *Workflow Type Definition*

- Workflow process name
- Version number
- Process start and termination conditions
- Security, audit or other control data

#### *Activity*

- Activity name
- Activity type (sub flow, atomic flow, etc)
- Pre- and post- activity conditions
- Other scheduling constraints

*Transition Conditions*

- Flow or Execution conditions

*Workflow relevant data*

- Data name and path
- Data types

*Role*

- Name and organizational entity

*Invoked Application*

- Generic type or name
- Execution parameters
- Location or access path

**3.6.2 Interface 2: Workflow Client Application Interface**

The approach to meet the above requirement is to contain the variety behind a standard set of APIs (the WAPI), which may be used in a consistent manner for access from a workflow application to the Workflow engine and work list, irrespective of the nature of actual product implementation.

The APIs and its parameters will be mapped onto several alternative communications mechanisms to fit the variety of workflow implementation models. In the case of email based communications it is also possible, of course, for a work list handler to directly access the incoming mailbox for incoming work items using any local mailbox access interface, rather than via specific WAPI calls. In this case the work list handler application will take responsibility for filtering any non-workflow email items and handling them in an appropriate manner (Hollingsworth, 1995).

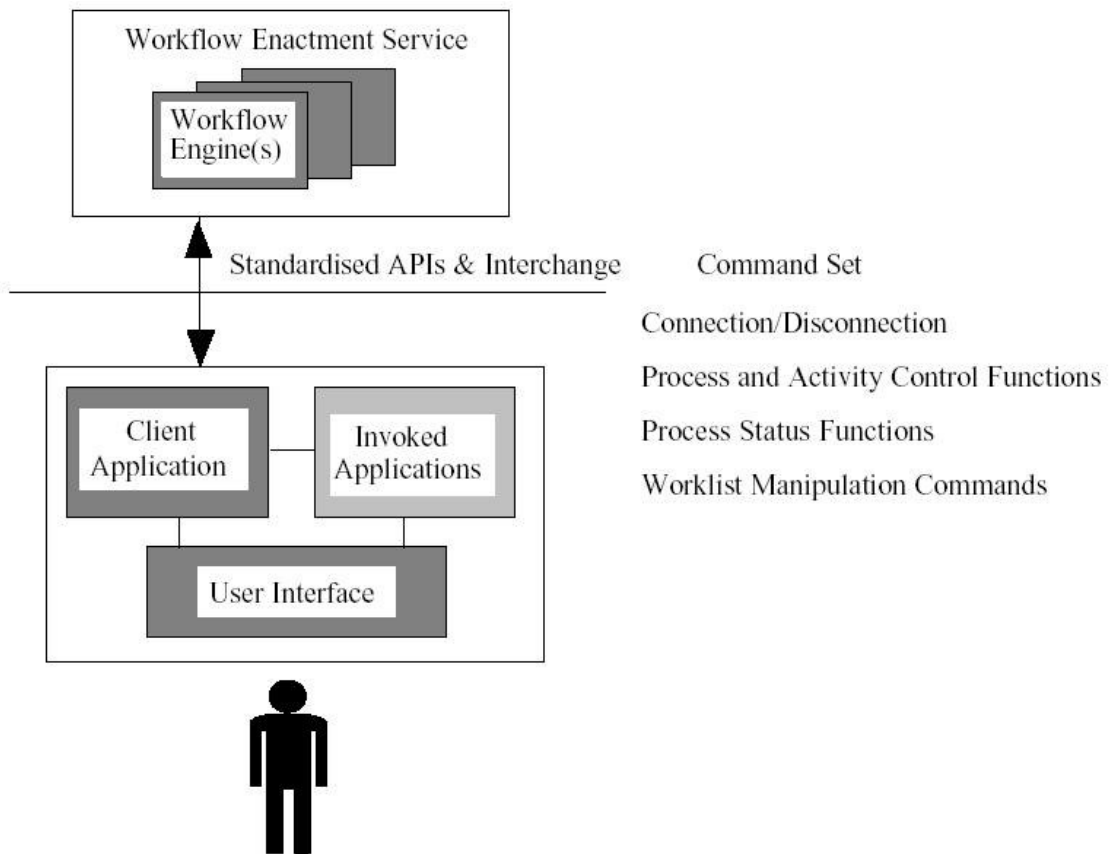


Figure 3.7 Client Application Interface

#### 3.6.2.1 Session Establishment

These are including such operations:

- Connection / disconnection of sessions between participating systems

#### 3.6.2.2 Workflow Definition Operations

These are including such operations:

- Retrieval / query functions (with optional selection criteria) on workflow process definition names or attributes

#### *3.6.2.3 Process Control Functions*

These are including such operations:

- Creation / starting / termination of an individual process instance
- Suspension / resumption of an individual process instance
- Forcing a state change within an individual process instance or activity instance
- Assignment or query of an attribute (e.g. priority) of a process or activity instance

#### *3.6.2.4 Process Status Functions*

These are including such operations:

- Opening / closing a process or activity instances query, setting optional filter criteria
- Fetching details of process instances or activity instances, filtered as specified
- Fetching details of a specific (individual) process or activity instance

#### *3.6.2.5 Work list / Work item Handling Functions*

These are including such operations:

- Opening / closing a work list query, setting optional filter criteria
- Fetching work list items, filtered as specified
- Notification of selection / reassignment / completion of a (specific) work item
- Assignment or query of a work item attribute

#### *3.6.2.6 Process Supervisory Functions*

The following functions operate on all process or activity instances and are deemed to operate in the context of a supervisory privilege level, which may, or may not, be granted to a specific client application or user logged onto such application.

- Changing the operational status of a workflow process definition and/or its extant process instances
- Changing the state of all process or activity instances of a specified type
- Assigning attribute(s) to all process or activity instances of a specified type
- Termination of all process instances

#### *3.6.2.7 Data Handling Functions*

These are including such operations:

- Retrieval / return of workflow relevant or application data

#### *3.6.2.8 Administration Functions*

Support for additional administration functions across the WAPI may be appropriate for certain client applications.

#### *3.6.2.9 Application Invocation*

The functions outlined above provide a base level of functionality to support application invocation by the work list handler function (e.g. by providing access to process/activity/work item attributes and workflow relevant data).



Some of the proposed commands for the application invocation function may also be relevant to the client application environment.

### ***3.6.3 Interface 3: Invoked Application Interface***

This interface is a standard interface definition of APIs to allow the workflow engine to invoke a variety of applications, through common agent software. An invoked application is a workflow application that is invoked by the workflow management system to automate an activity, fully or in part, or to support a workflow participant in processing a work item.

Application invocation may be a function of the workflow engine, and/or of the work list handler.

The application may be invoked directly by the workflow management system or may be invoked indirectly via an application agent (or “tool agent”). The application agent provides a general mechanism for application invocation independently from any native workflow management system facilities.

The Workflow Reference Model includes an interface for application invocation functions.

The diagram following shows the scope of this interface, which is intended to be applicable to application agents and (longer term) applications which have been designed to be "workflow enabled" (i.e. to interact directly with a workflow engine).

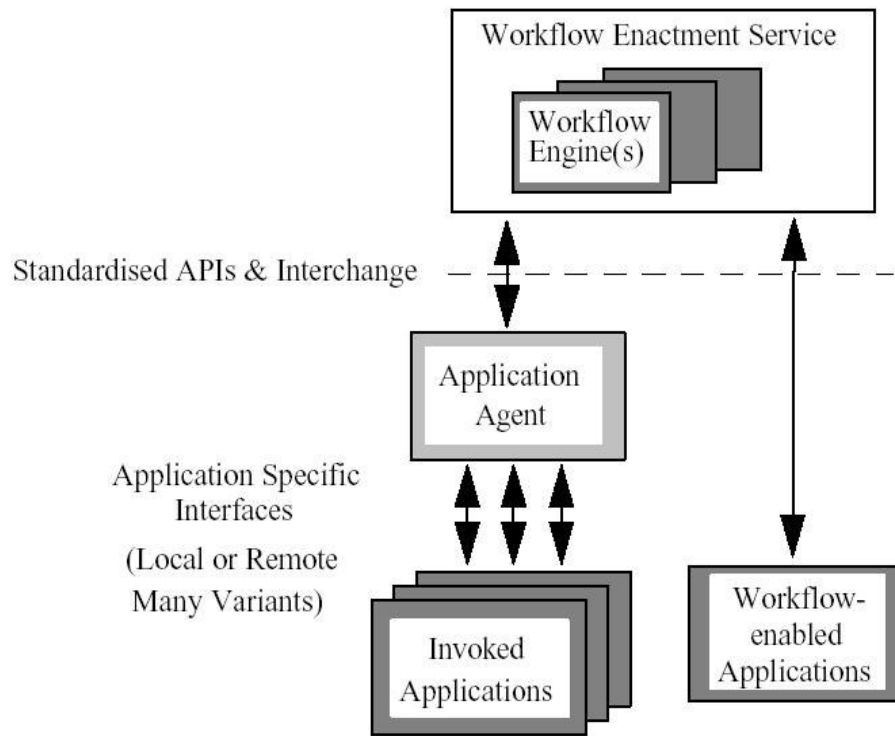


Figure 3.8 Invoked Application Interface

In the simple case, application invocation is handled locally to a workflow engine, using information within the process definition to identify the nature of the activity, the type of application to be invoked and any data requirements. The invoked application may be local to the workflow engine, co-resident on the same platform or located on a separate, network accessible platform; the process definition contains sufficient application type and addressing information (specific to the needs of the workflow engine) to invoke the application. In this case the conventions for application naming and addressing are local between the process definition and the workflow engine (Hollingsworth, 1995).

### *3.6.3.1 Session Establishment*

Session Establishment includes such operations:

- Connection / disconnection of application (or application agent) session

### *3.6.3.2 Activity Management Functions*

These functions are used in the way “Workflow engine to application”:

- Start activity (workflow engine to application)
- Suspend/Resume/Abort activity (where an asynchronous application interface is available)

These functions are used in the way “Application to workflow engine”:

- Activity complete notification
- Signal event (e.g. synchronization)
- Query activity attributes

### *3.6.3.3 Data Handling Functions*

- Give workflow relevant data (pre-activity to application, post activity from application)
- Give application data or data address

### 3.6.4 Interface 4: Workflow Interoperability Interface

It defines workflow interoperability models and the corresponding standards to support interworking.

Interface 4 defines the mechanisms that workflow product vendors are required to implement in order that one workflow engine may make requests of another workflow engine to effect the selection, instantiation, and enactment of known process definitions by that other engine. The requesting workflow engine is also able to pass context data (workflow relevant or application data) and receive back status information and the results of the enactment of the process definition. As far as possible, this is done in a way that is “transparent” to the user. This interface is intended for the use of WfSIs, and not users. As a side effect of facilitating communication between workflow engines, there is a requirement for audit data to be produced.

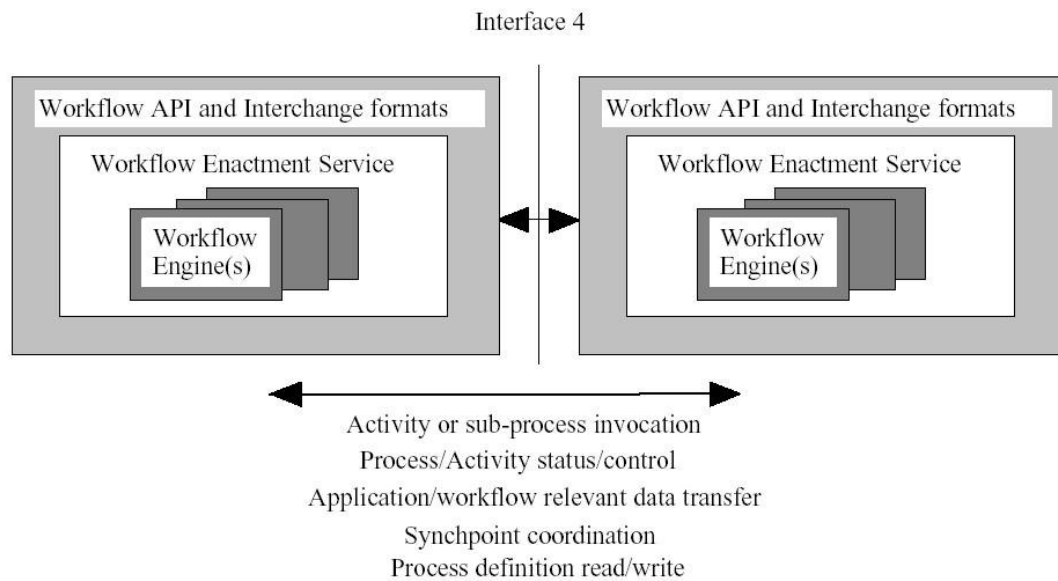


Figure 3.9 Workflow Interoperability Interface

There are two major aspects to the necessary interoperability:

- The extent to which common interpretation of the process definition (or a subset) is necessary and can be achieved
- Runtime support for the interchange of various types of control information and to transfer workflow relevant and/or application data between the different enactment services

#### *3.6.4.1 Use of Process Definitions across Multiple Domains*

Where both enactment services can interpret a common process definition, for example generated from a common build tool, this enables both environments to share a single view of the process definition objects and their attributes. This would include activity, application, organization and role names, navigation conditions, etc. This potentially enables individual workflow engines to transfer execution of activities or sub-processes to heterogeneous workflow engines within the context of a common naming and object model. This approach is particularly applicable to interoperability scenario 3, where several systems are co-operating at peer level, although can also be employed in simpler scenarios (Hollingsworth, 1995).

#### *3.6.4.2 Runtime Control Interactions*

At runtime, the WAPI calls are used to transfer control between workflow services to enact sub processes or individual activities on a specific service. Where both services support a common level of WAPI calls and a common view of the process definition objects (including naming conventions and any workflow relevant or applications data) this will be done directly between Workflow engines - although this will require agreement on common protocol support for WAPI primitives.

Where this is not the case the WAPI calls can be used to construct a gateway function providing interworking between the two workflow services by mapping the different object and data views between the two environments and (where necessary) supporting different protocol environments into each workflow service. This is illustrated in the following diagram.

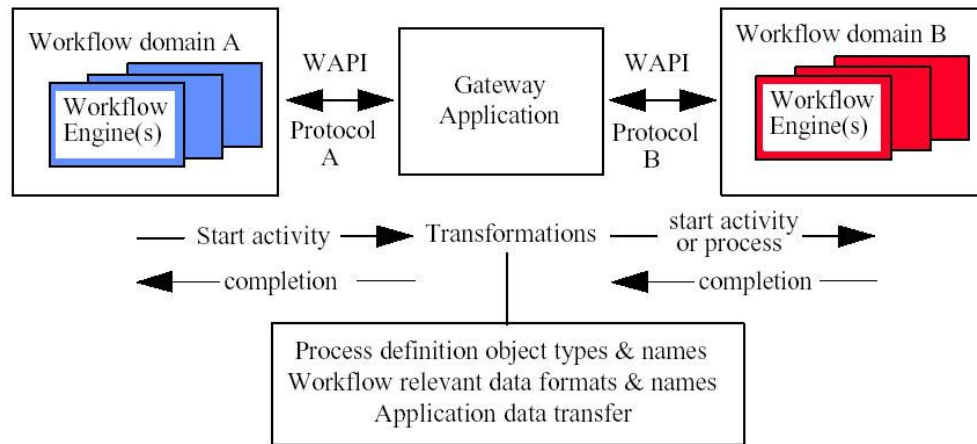


Figure 3.10 Gateway Operation using WAPI

The diagram illustrates the main principles of gateway operation; depending upon the particular interworking scenario an individual activity from one domain (A) may be mapped to a single activity or a new process / sub process in the second domain (B).

A large number of WAPI commands are (ultimately) likely to be exploited to support interoperability either by direct call between the two workflow services or via a gateway function. Many of the WAPI commands are also potentially applicable in workflow interoperability interactions (Hollingsworth, 1995):

- Session establishment
- Operations on workflow definitions and their objects
- Process control and status functions
- Activity management functions

- Data handling operations

### ***3.6.5 Interface 5: Administration & Monitoring Tools Interface***

It defines monitoring and control functions. Monitoring is the ability to track and report on workflow events during workflow execution (Hollingsworth, 1995).

Workflow monitoring may be used, for example, by process owners to monitor the performance of a process instance during its execution.

The support of the specification in workflow products allows analysis of consistent audit data across heterogeneous workflow products. During the initialization and execution of a process instance, multiple events occur which are of interest to a business, including WAPI events, internal workflow management engine operations and other system and application functions. With this information, a business can determine what has occurred in the business operations managed by workflow.

The audit information should be utilized for both analysis and derived status information. The workflow analysis tools will want the information presented in a consistent format, representing all events that occurred within a given set of criteria, such as, how long did process 'A' take, what activities have been performed within a given process instance?

When it is necessary to know what the current status is of a given process instance, an inquiry can be made using the process instance ID. The current state (e.g. open-running) is returned. To understand where the process really is, the audit information measured against the process definition can provide an indication of the true state (Hollingsworth, 1995).

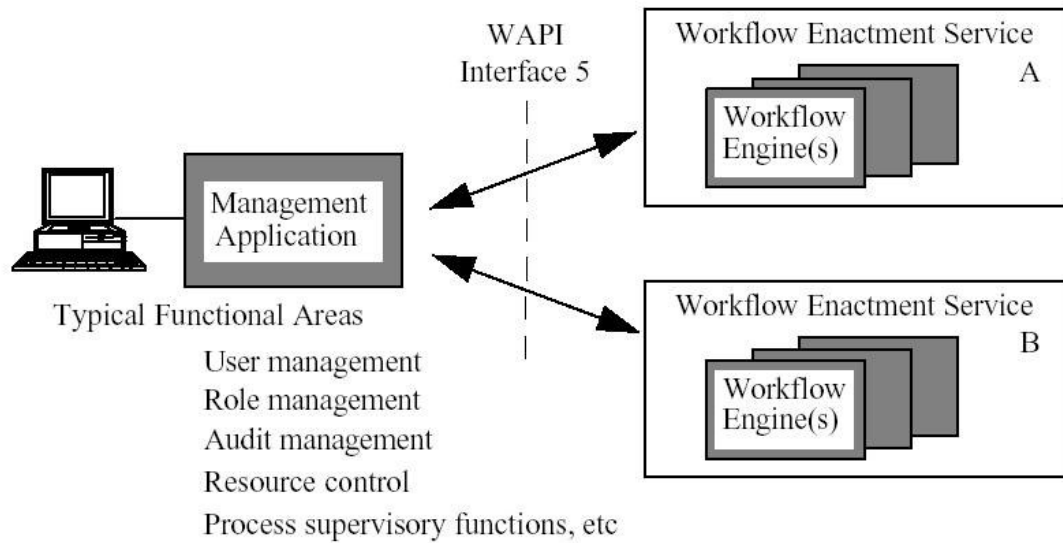


Figure 3.11 System Administration & Monitoring Interface

#### *3.6.5.1 User and Role Management operations*

- Establishment / deletion / suspension / amendment of privileges of users or workgroups
- Define / delete / amend role: participant relationships
- Set or unset role attributes

#### *3.6.5.2 Audit Management operations*

- Query / print / start new / delete audit trail or event log, etc

#### *3.6.5.3 Resource Control operations*

- Set / unset / modify process or activity concurrency levels
- Interrogate resource control data (counts, thresholds, usage parameters, etc)



#### *3.6.5.4 Process Supervisory Functions*

- Changing the operational status of a workflow process definition and/or its extant process instances
- Enabling or disabling particular versions of a process definition
- Changing the state of all process or activity instances of a specified type
- Assigning attribute(s) to all process or activity instances of a specified type
- Termination of all process instances

#### *3.6.5.5 Process Status Functions*

- Opening / closing a process or activity instances query, setting optional filter criteria
- Fetching details of process instances or activity instances, filtered as specified
- Fetching details of a specific (individual) process or activity instance

## CHAPTER FOUR

### PROCESS DEFINITION

#### 4. Introduction

In workflow based business managements, process definition is the most important and comprehensive phase of the whole staff. General Process Definition cycle is shown in Figure 4.1.

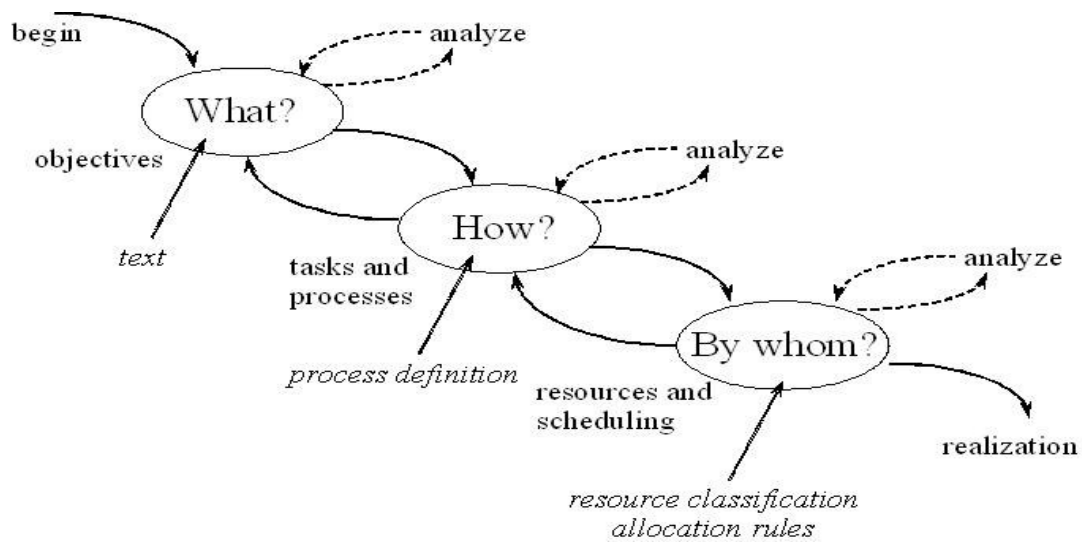


Figure 4.1 General Process Definition Cycle

First, business is briefly analyzed, all the questions about business should be answered, all related document and form templates should be ready; a documentation is necessary to increase the business readability. In the third chapter, analysis phase of business process has been mentioned.

The centralized part is process definition which is answering how business will be handled by computer applications / tools; it also deals with resource classification. Finding best person / people for a staff is the main subject of process definition

Interface. By getting benefit from analysis documentation, processes can be defined and designed according to some standards and rules.

In this chapter, process definition and design concept is briefly described and some models and ways are proposed for time and resource management in business.

#### **4.1 Process Definition Tools**

A variety of different tools may be used to analyze, model, describe and document a business process; such tools may vary from the informal ("pencil and paper") to sophisticated and highly formalized. The workflow model is not concerned with the particular nature of such tools nor how they interact during the build-time process. Such tools may be supplied as part of a workflow product or as a separate, for example, BPR (Business Process Reengineering) product toolset.

Where a workflow product provides its own process definition tool, the resultant process definitions will normally be held within the workflow product domain and may, or may not, be accessible via a programming interface for reading and writing information. Where separate products are used for defining and executing the process, the process definitions may be transferred between the products as and when required or may be stored in a separate repository, accessible to both products and possibly other development tools.

The final output from this process modeling and design activity is a process definition which can be interpreted at runtime by the workflow engine(s) within the enactment service. For today's workflow products each individual process definition is typically in a form specialized to the particular workflow management software for which it was designed. The workflow definition interchange interface will enable more flexibility in this area.

The process analysis, modeling and definition tools may include the ability to model processes in the context of an organization structure (although this is not a mandatory aspect of the workflow reference model). Where an organization model is incorporated into such tools the process definition will include organization related objects such as roles. These are related to system control data such as role: actor relationships (within an organizational directory) which may be referenced during process execution.

## 4.2 Workflow Graphical Design Elements

In recent years, the number of workflow definition tools is largely increased so the symbols used in graphical workflow design process may change from tool to another tool. What the important key is being applicable to Workflow Management Coalition standards.

### 4.2.1 Start Item



Figure 4.2 Start Item

Start item is an action indicating the start step of the process (Wil van der Aalst, ud). After Start item is added, the first activity can be defined and then a line should be drawn from start item to the first activity item.

### 4.2.2 Stop Item



Figure 4.3 Stop Item

Stop item is an action signifying that no further processing takes place on the branch (Wil van der Aalst, ud). This item may be optional but usage of it makes workflow clearer.

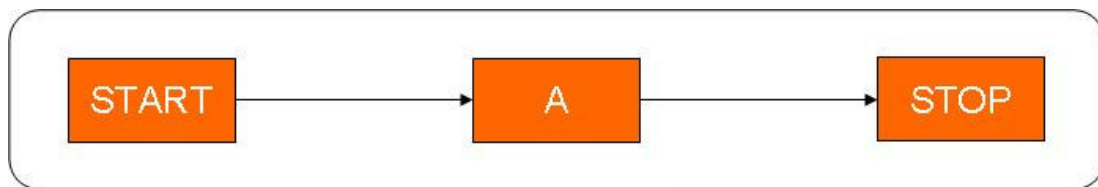


Figure 4.4 Start and Stop activities in a workflow design

### 4.2.3 Connector / Router

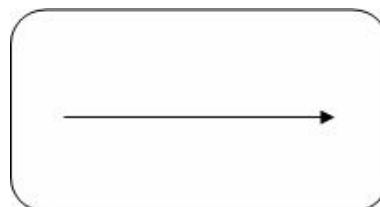


Figure 4.5 Connector Item

Connector is an object that is a line following a convenient route between two other objects (Wil van der Aalst, ud). Connectors have logic (formula) to manage the route among objects.

Some workflow systems use “router” key instead of connector. In these systems routers are different than a line.

#### ***4.2.4 Activity Item***

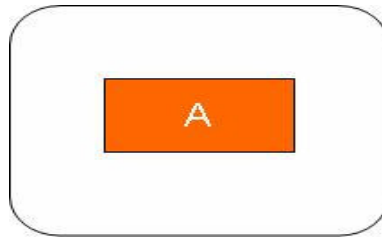


Figure 4.6 Activity Item

In a workflow definition, at least one activity item (or automated activity item) should be included. This item provides a manual activity, means the users who have necessary rights can access to the activity and complete it.

Activity item provides a user interface for some configuration and definition during process design. Process designers should define each of issue listed below.

- Timing
- Resource allocation
- Document / Parameter Form / E-Form Integration
- Security settings (Cancel / View / Delegate ...)
- Tasks
- Decisions

Some activities can be integrated with third party (invoked) applications. These type of activities are nearly same with general activity definition (Setting timing, decisions, tasks...). Additionally they integrate with some applications.

- Invoked Application Integration

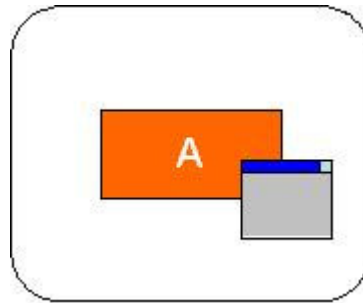


Figure 4.7 Activity Item with Third-Party Application

These activities may have an application path and description in addition to generic activity definition. When this type of activity is processed, the bounded application is automatically executed. This application can update some data source, fire new workflows initiation etc.

#### ***4.2.5 Automated Activity Item***

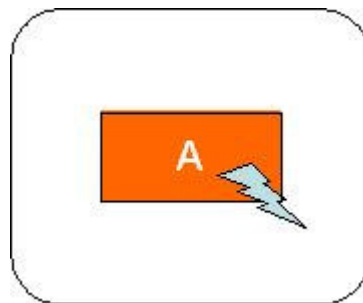


Figure 4.8 Automated Activity Item

Automated activity items are the activities which are executed automatically, not by any people. These items can be update some data sources, fires another events, cancels activity or workflow, initiates another activity, send mails or messages to the users, etc.

The timing for these types of activities should be similar to manual ones.

#### ***4.2.6 Multiple Activity Instances Item***

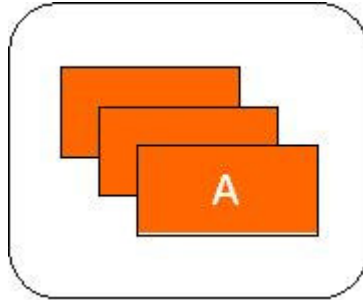


Figure 4.9 Multiple Activity Instances Item

Some processes have a set of activities which are repeated in a defined period of time. For example, a merchandiser can interact with a customer via a questionnaire 12 times in a year. The aim of the questionnaire is to determine the customer sales success and level. So a workflow about customer contracting can be initiated, passed through some approval mechanism and then the activity about questionnaire can be done till the required number of this job will be completed. Each activity item in Multiple Activity Instances Item has a common definition. In addition to generic activity definition, the number of activities should be defined somewhere by directly entering it or via a condition formula.

#### ***4.2.7 Multiple Automated Activity Instances Item***

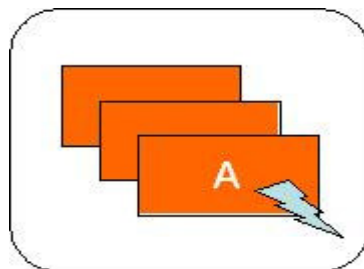


Figure 4.10 Multiple Automated Activity  
Instances Item



It is also possible to use automated activities multiple times according to the requirements. Reading from an excel file which is transferred several times via FTP in a day and updating database with these information for every transfer can be an example to the processing of multiple automated activity instances item.

#### ***4.2.8 Join Item***

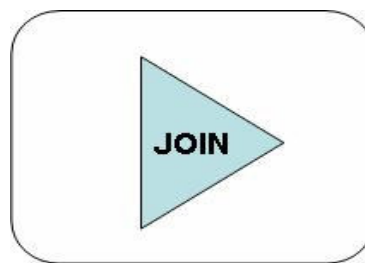


Figure 4.11 Join Item

Join item converts parallel lines of jobs into one, unique, serial line. There are three types of Join item which will be described briefly later:

- OR-Join
- XOR-Join
- AND-Join

#### ***4.2.9 Condition / Split Item***

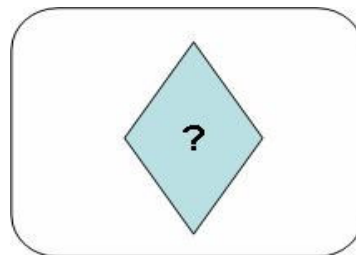


Figure 4.12 Condition (Split) Item

Split item divides a serial line of workflow into multiple lines. This item can treat as decision or data splitter so that according to a defined condition, it decides which way the workflow will process on. There are three types of Split item which will be described briefly later:

- OR-Split
- XOR-Split
- AND-Split

#### ***4.2.10 Loop Item***

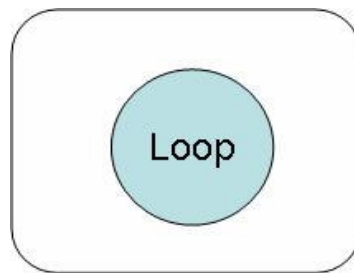


Figure 4.13 Loop Item

Loop item provides incoming process to one of the back steps according to a condition formula or activity definition.

Here is an example of another symboling. As it can be seen, although the symbols differ a bit, general structure is applicable to WfMC standards and main workflow concepts.

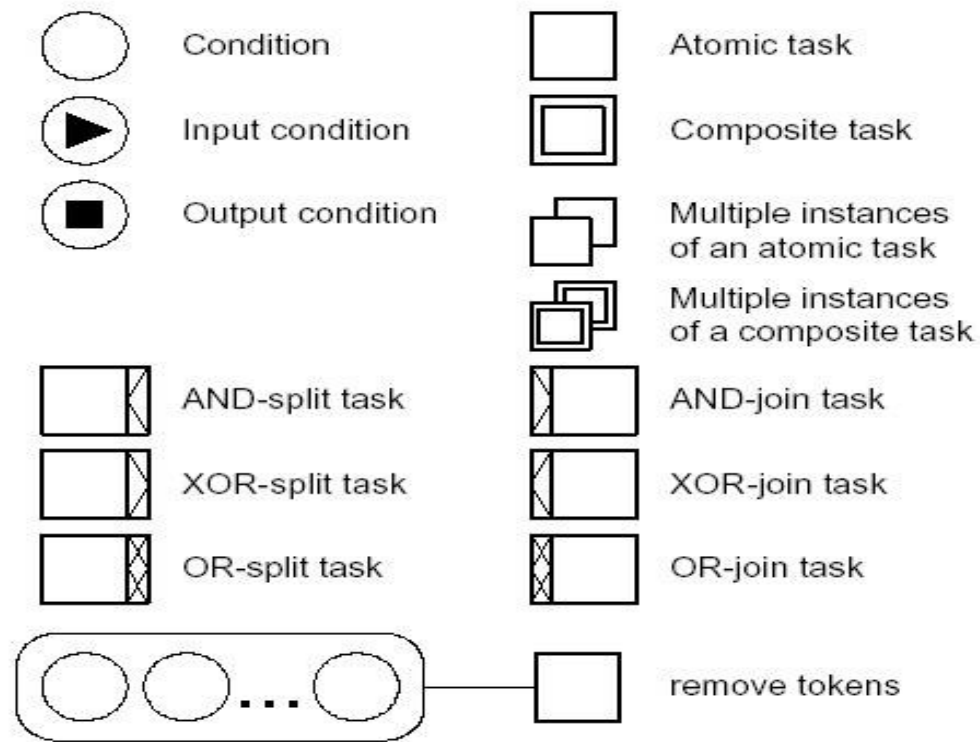


Figure 4.14 Symbols used in YAWL

### 4.3 Patterns

Despite the efforts of the Workflow Management Coalition (WfMC) a good standard for workflow design is missing. And also the available systems are really different with respect of basic workflow functionality. Selection processes typically do not address these differences.

In this section, far more than 30 patterns are described by using graphical examples. The patterns give insight into the basic constructs in operational processes and are a means to characterize processes and to train designers.

### 4.3.1 Basic Control Flow Patterns

These are the basic constructs present in most workflow languages to model sequential, parallel and conditional routing.

#### 4.3.1.1 Sequential (Serial) Routing

An activity in a workflow process is enabled after the completion of another activity in the same process (Wil van der Aalst, ud).



Figure 4.15 Sequential Routing Pattern

#### 4.3.1.2 Parallel Routing (Split)

Parallel routing is a point in the workflow process 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. The synonyms for parallel routing are AND-split, parallel routing, and fork. (Wil van der Aalst, ud)

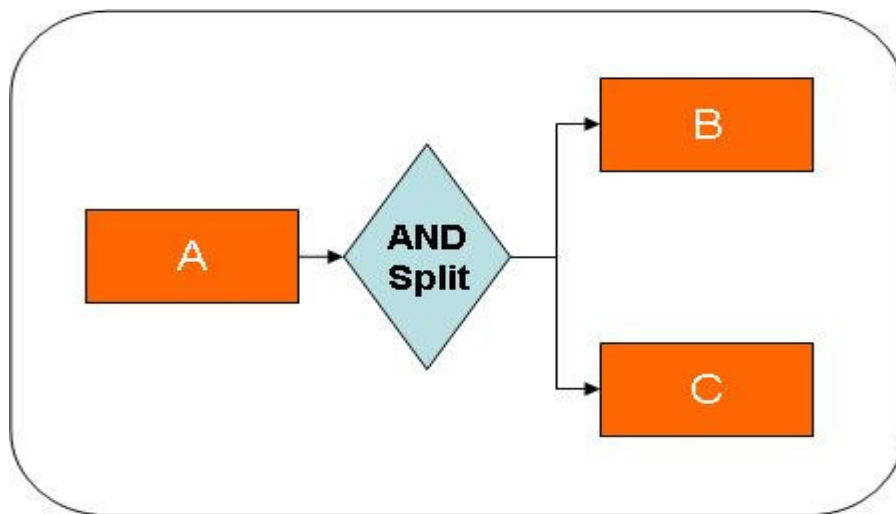


Figure 4.16 Parallel Routing Pattern

In the figure above, after the execution of A, both activities B and C will start to execute simultaneously.

#### *4.3.1.3 Synchronization*

Synchronization concept is a point in the workflow process where multiple parallel sub processes / activities converge into one single thread of control, thus synchronizing multiple threads (Wil van der Aalst, ud). It is an assumption of this pattern that each incoming branch of a synchronizer is executed only once. The synonyms for synchronization are AND-join, rendezvous, and synchronizer.

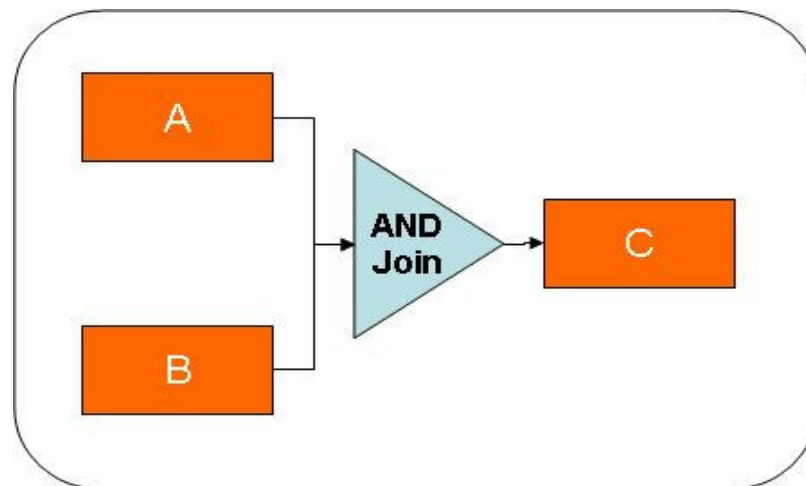


Figure 4.17 Synchronization Pattern

In the figure above, both activities A and B have to execute before the execution of the activity C.

#### 4.3.1.4 Exclusive Choice

This pattern is a point in the workflow process where, based on a decision or workflow control data, one of several branches is chosen (Wil van der Aalst, ud). The synonyms for exclusive choice are XOR-split, conditional routing, switch and decision.

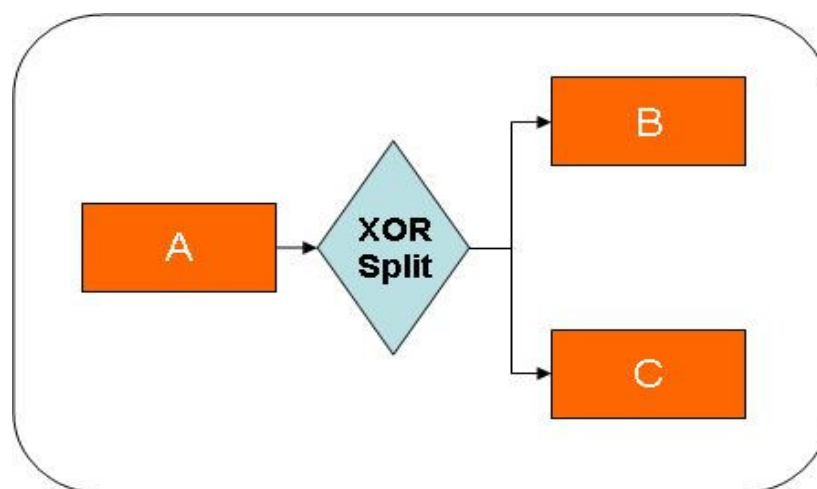


Figure 4.18 Exclusive Choice Pattern

In the figure above, one of the activities B or C would execute according to the decision of XOR Split.

#### 4.3.1.5 Simple Merge

Simple Merge is a point in the workflow process where two or more alternative branches come together without synchronization (Wil van der Aalst, ud). It is an assumption of this pattern that none of the alternative branches is ever executed in parallel. The synonyms for simple merge are *XOR-join*, *asynchronous join*, *merge*.

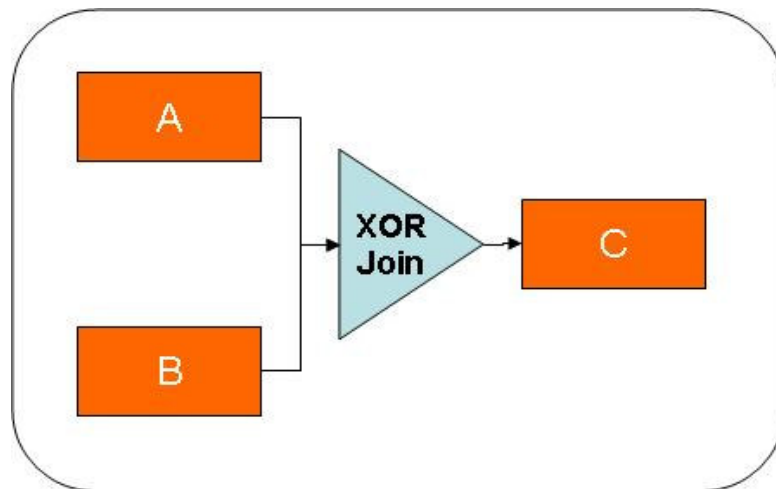


Figure 4.19 Simple Merge Pattern

In the figure above, first execution of A or B would be enough for the processing of the activity C. It means that XOR Split does not wait for the completion of all previous activities; first one activity arrives the process goes on.

#### 4.3.2 Advanced Branching and Synchronization Patterns

These patterns transcend the basic patterns to allow for more advanced types of splitting and joining behavior.

#### 4.3.2.1 Conditional Routing

Conditional routing is a point in the workflow process where, based on a decision or workflow control data, a number of branches are chosen. The synonyms for Conditional routing are multi-choice, selection, OR-split.

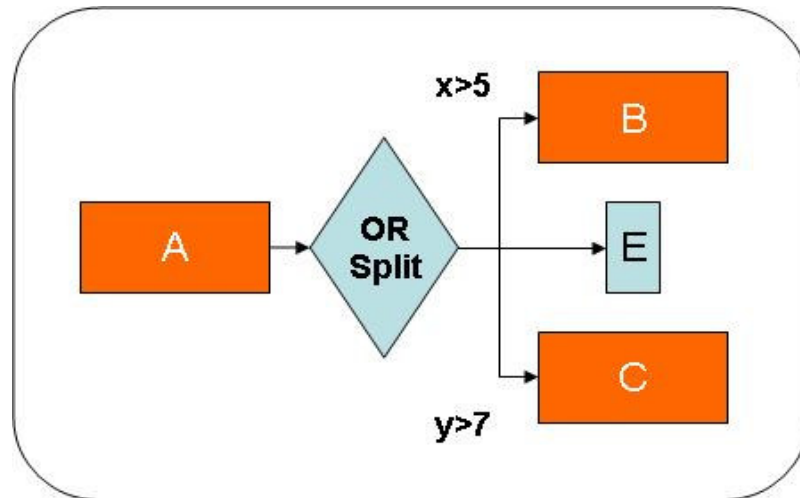


Figure 4.20 Conditional Routing Pattern

#### 4.3.2.2 Synchronizing join

Synchronizing join is a point in the workflow process where multiple paths converge into one single thread. If more than one path is taken, synchronization of the active threads needs to take place. If only one path is taken, the alternative branches should reconverge without synchronization. It is an assumption of this pattern that a branch that has already been activated, cannot be activated again while the merge is still waiting for other branches to complete.



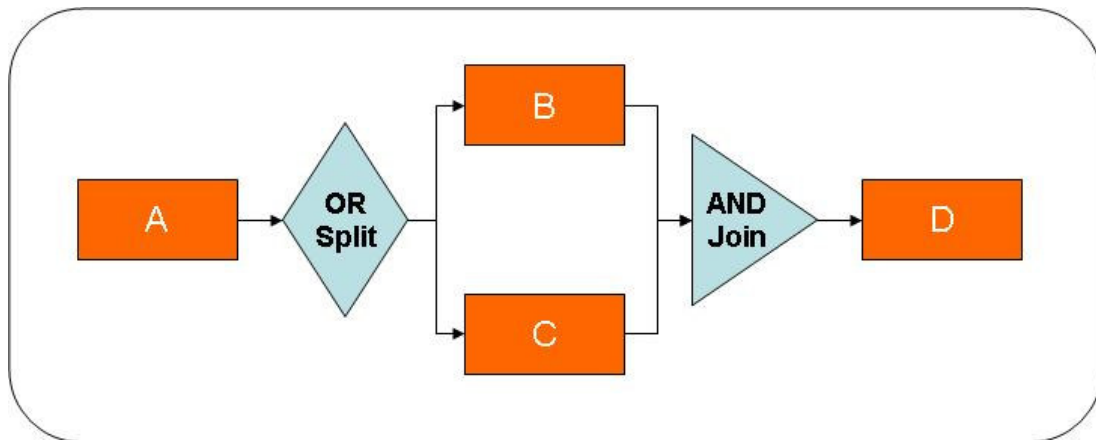


Figure 4.21 Synchronizing Join Pattern

#### 4.3.2.3 Multi-merge

Multi-merge is a point in a workflow process where two or more branches reconverge without synchronization. If more than one branch gets activated, possibly concurrently, the activity following the merge is started for any activation of every incoming branch.

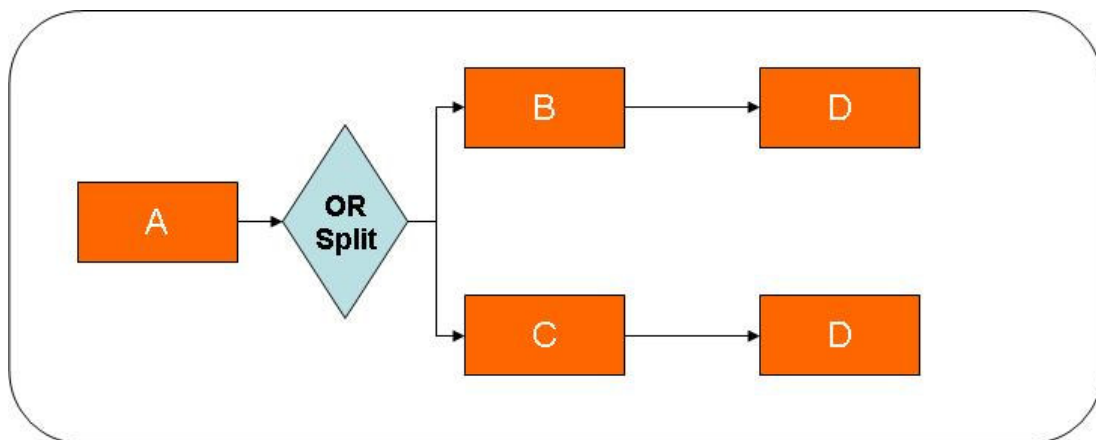


Figure 4.22 Multi-merge Pattern

#### 4.3.2.4 Discriminator

The discriminator is a point in a workflow process that waits for one of the incoming branches to complete before activating the subsequent activity. From that moment on it

waits for all remaining branches to complete and “ignores” them. Once all incoming branches have been triggered, it resets itself so that it can be triggered again.

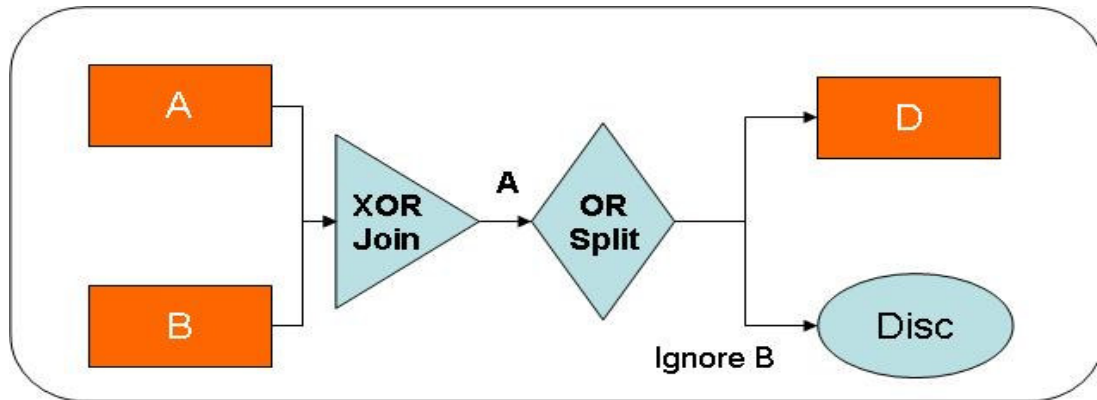


Figure 4.23 Discriminator Pattern

### 4.3.3. Structural Patterns

In programming languages a block structure which clearly identifies entry and exit points is quite natural. In graphical languages allowing for parallelism such a requirement is often considered to be too restrictive.

#### 4.3.3.1 Arbitrary Cycles

An arbitrary cycle is a point in a workflow process where one or more activities can be done repeatedly. The synonyms are Loop, iteration, cycle.

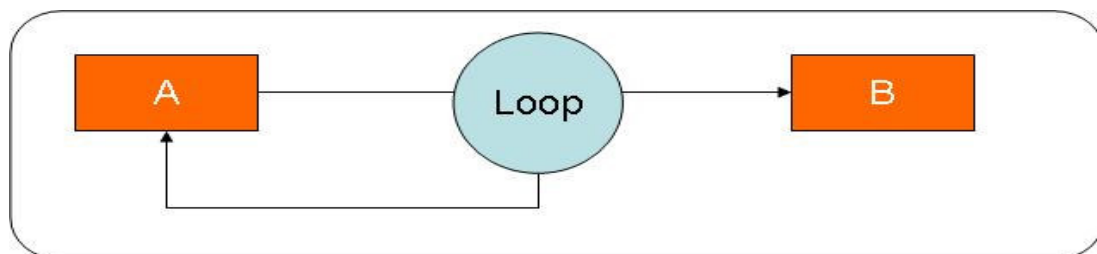


Figure 4.24 Arbitrary Cycles (Loop) Pattern

#### 4.3.3.2 Implicit Termination

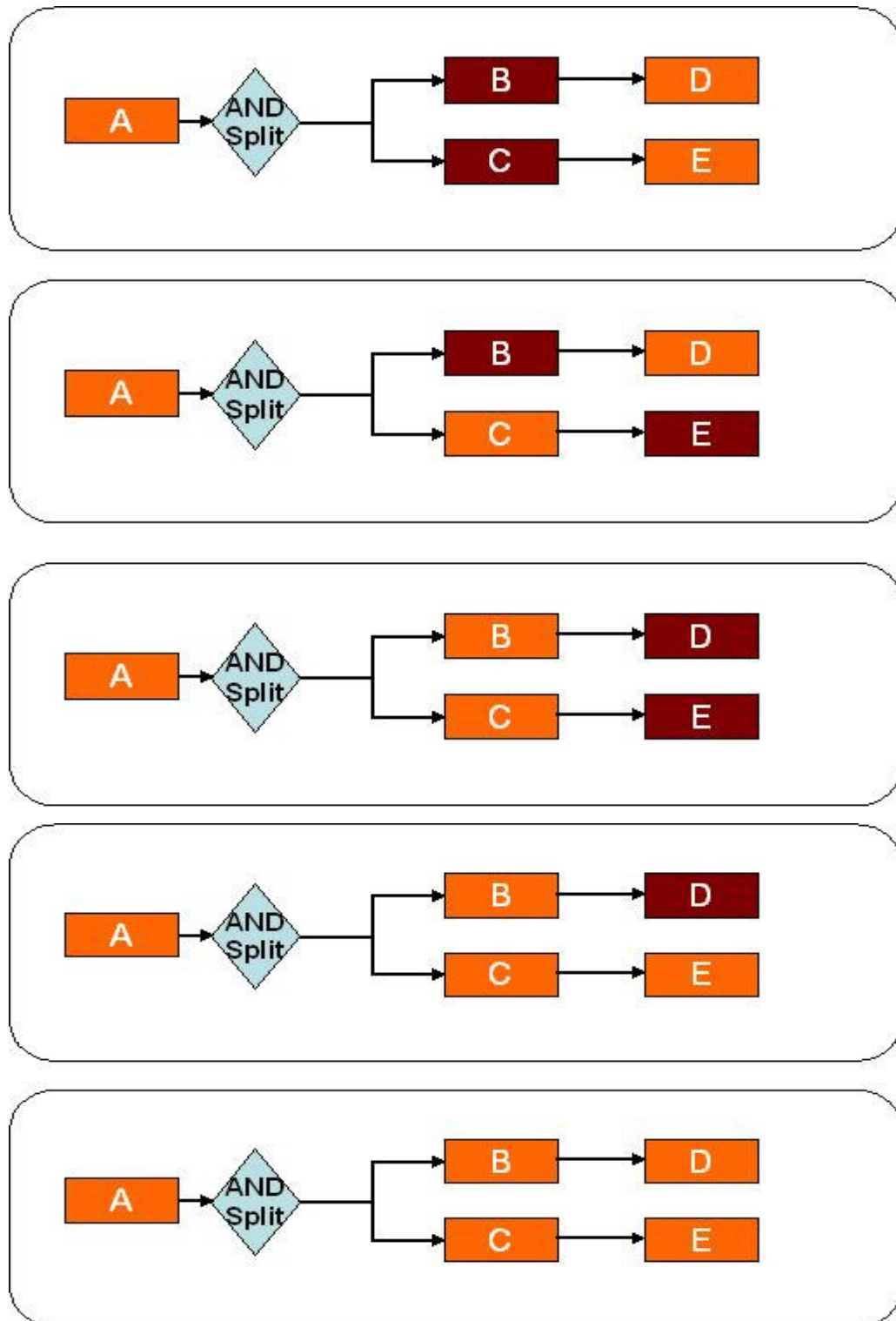


Figure 4.25 Implicit Termination Pattern

A given sub process should be terminated when there is nothing else to be done. In other words, there are no active activities in the workflow and no other activity can be made active (and at the same time the workflow is not in deadlock).

In implicit termination, the user can determine the order of by performing the enabled activities. In the example above, the order is B-C-E-D.

#### ***4.3.4 Patterns involving Multiple Instances***

Within the context of a single case (i.e., work-flow instance) sometimes parts of the process need to be instantiated multiple times, e.g., within the context of an insurance claim, multiple witness statements need to be processed.

##### ***4.3.4.1 Multiple Instances without Synchronization***

Within the context of a single case (i.e., workflow instance) multiple instances of an activity can be created, i.e., there is a facility to spawn off new threads of control. Each of these threads of control is independent of other threads. Moreover, there is no need to synchronize these threads. The synonyms for this pattern are multi threading without synchronization, spawn off facility.

A customer ordering a book from an electronic bookstore may order multiple books at the same time. Many of the activities (e.g., billing, updating customer records, etc.) occur at the level of the order. However, within the order multiple instances need to be created to handle the activities related to one individual book (e.g., update stock levels, shipment, etc.). If the activities at the book level do not need to be synchronized, this pattern can be used.

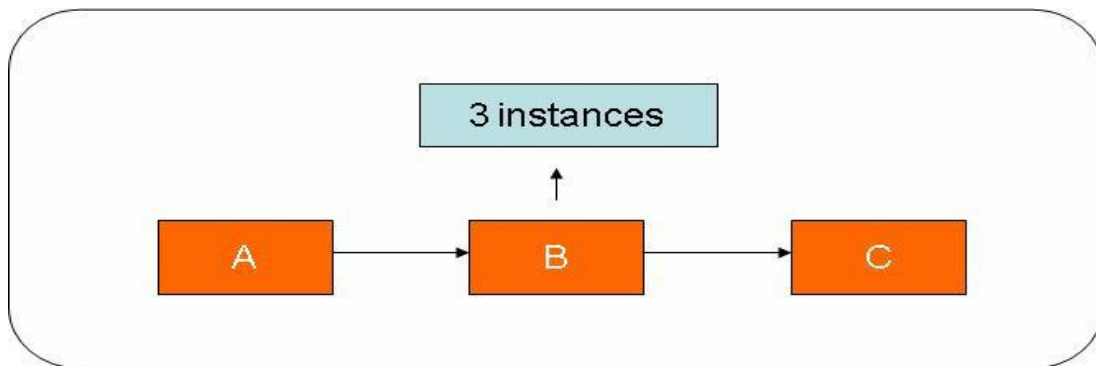


Figure 4.26 Multiple Instances without Synchronization

As it is shown in the figure above, during the execution of activity B, three instance of the activity are created. Then the work processing goes on.

#### 4.3.4.2 Multiple Instances with Priori Design Time Knowledge

For one process instance an activity is enabled multiple times. The number of instances of a given activity for a given process instance is known at design time. Once all instances are completed some other activity needs to be started (Wil van der Aalst, ud).

For example, the requisition of hazardous material requires three different authorizations.

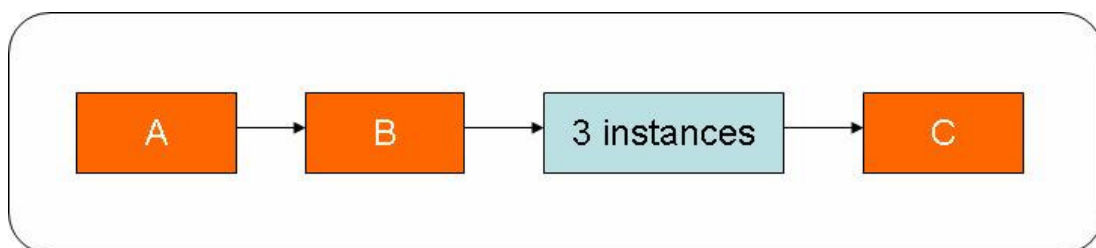


Figure 4.27 Multiple Instances With a Priori Design Time Knowledge Pattern

From figure, it is known at design time that the case enables three different instances; after these instances is finished in any order, the process continues.

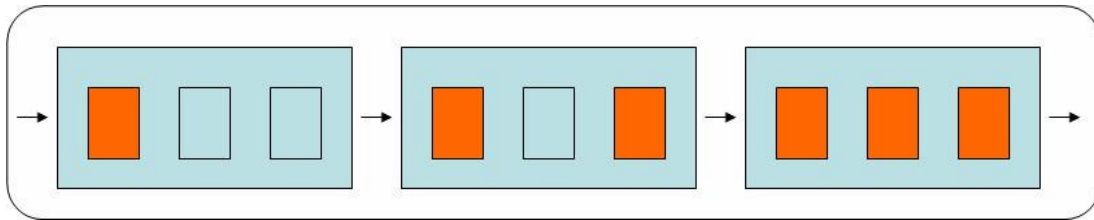


Figure 4.28 Multiple Instances with a Priori Design Time Knowledge Pattern Instance Example

If the number of instances is known a priori during design time, then a very simple implementation option is to replicate the activity in the workflow model preceding it with a construct used for the implementation of the parallel split pattern. Once all activities are completed, it is simple to synchronize them using a standard synchronizing construct.

#### 4.3.4.3 Multiple Instances with Priori Runtime Knowledge

For one case an activity is enabled multiple times. The number of instances of a given activity for a given case varies and may depend on characteristics of the case or availability of resources, but is known at some stage during runtime, before the instances of that activity have to be created. Once all instances are completed some other activity needs to be started (Wil van der Aalst, ud).

For example, when booking a trip, the activity *book\_flight* is executed multiple times if the trip involves multiple flights. Once all bookings are made, the invoice is to be sent to the client.

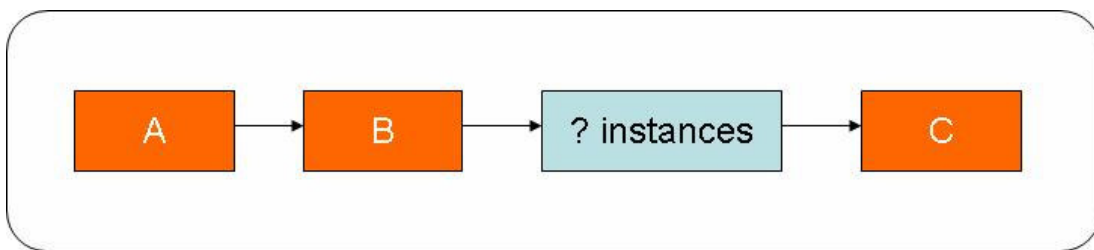


Figure 4.29 Multiple Instances with a Priori Runtime Knowledge Pattern

#### 4.3.4.4 Multiple Instances without Priori Runtime Knowledge

For one case an activity is enabled multiple times. The number of instances of a given activity for a given case is not known during design time, nor is it known at any stage during runtime, before the instances of that activity have to be created. Once all instances are completed some other activity needs to be started. The difference with previous pattern is that even while some of the instances are being executed or already completed, new ones can be created (Wil van der Aalst, ud).

Even when processing eyewitness reports for a given insurance claim, new eyewitnesses may surface and the number of instances may change.

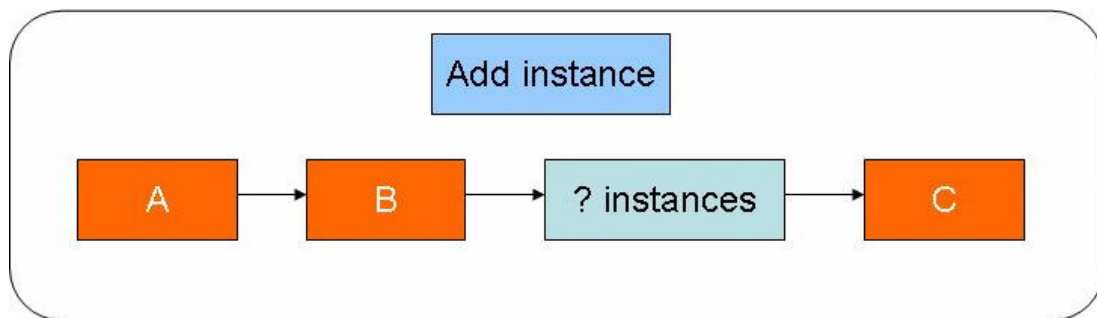


Figure 4.30 Multiple Instances without a Priori Runtime Knowledge Pattern

#### 4.3.5 State-based Patterns

Typical workflow systems focus only on activities and events and not on states. This limits the expressiveness of the workflow language because it is not possible to have state dependent patterns such as the Milestone pattern (Wil van der Aalst, ud).

#### 4.3.5.1 Deferred Choice

Deferred choice is a point in the workflow process where one of several branches is chosen. Once the environment activates one of the branches the other alternative branches are withdrawn.

#### 4.3.5.2 Interleaved Parallel Routing (Unordered sequence)

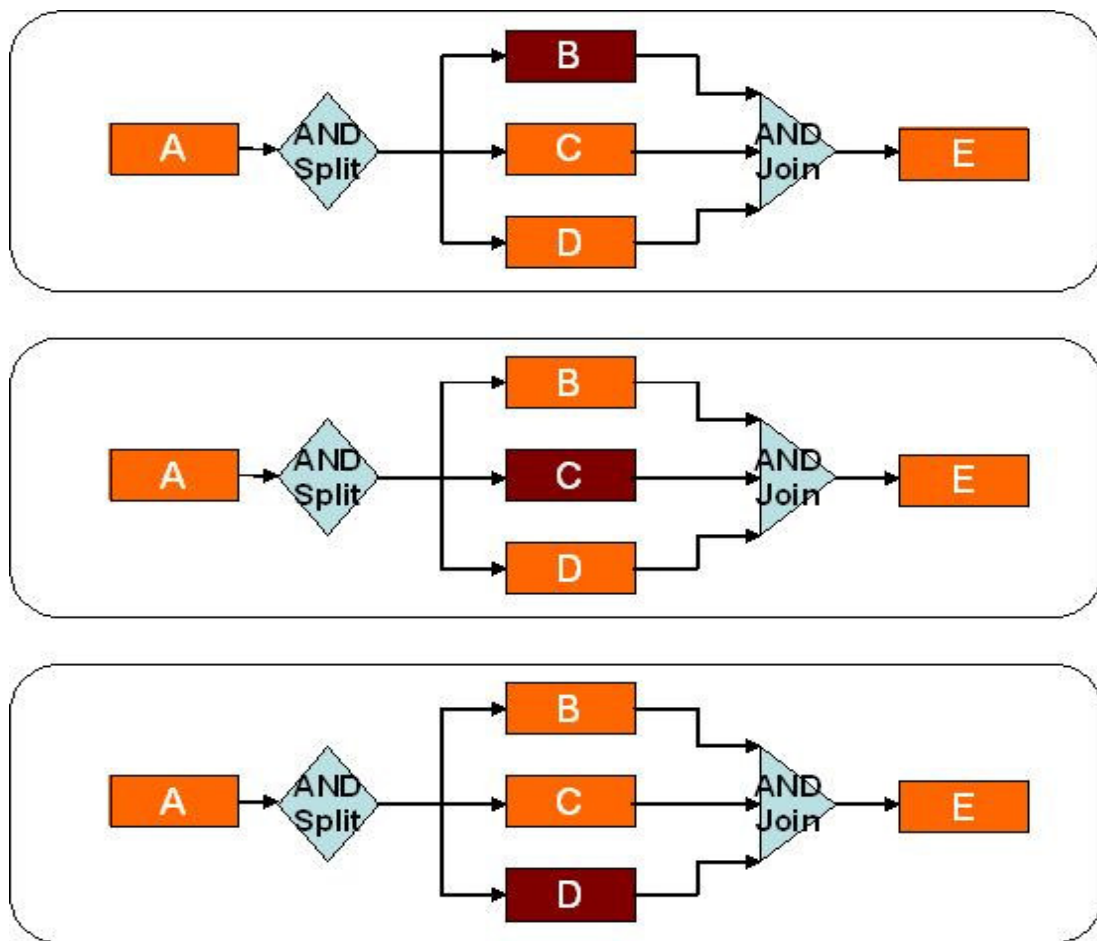


Figure 4.31 Interleaved Parallel Routing Pattern

This is a set of activities is executed in an arbitrary order: Each activity in the set is executed, the order is decided at run-time, and no two activities are executed at the same



moment (i.e. no two activities are active for the same workflow instance at the same time).

The Navy requires every job applicant to take two tests: *physical\_test* and *mental\_test*. These tests can be conducted in any order but not at the same time.

#### *4.3.5.3 Milestone*

It means that the enabling of an activity depends on the case being in a specified state, i.e. the activity is only enabled if a certain milestone has been reached which did not expire yet. The synonyms are test arc, deadline, state condition, withdraw message (Wil van der Aalst, ud).

In a travel agency, flights, rental cars, and hotels may be booked as long as the invoice is not printed. Again, a customer can withdraw purchase orders until two days before the planned delivery.

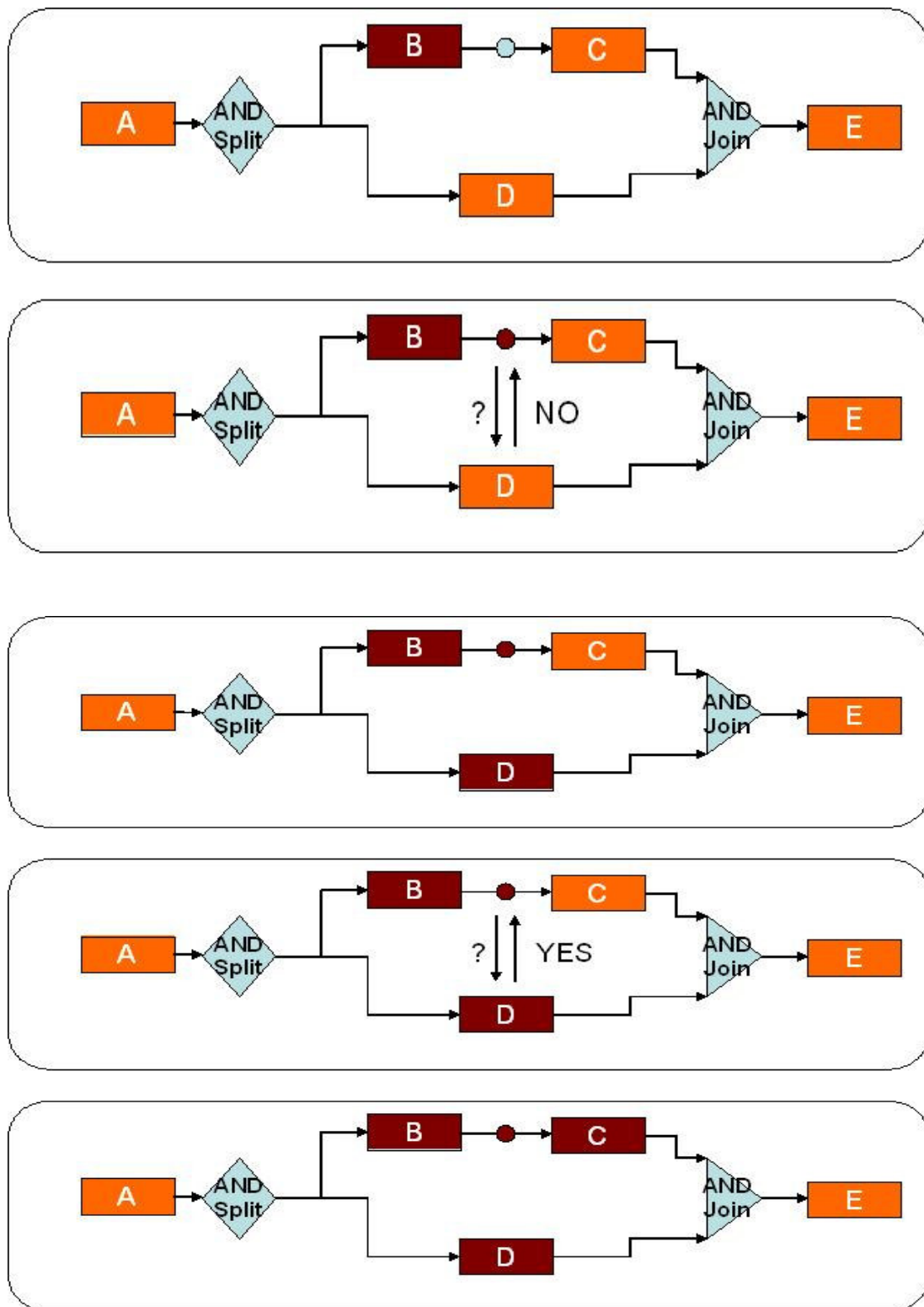


Figure 4.32 Milestone Pattern

### 4.3.6 Cancellation Patterns

The occurrence of an event (e.g., a customer canceling an order) may lead to the cancellation of activities. In some scenarios such events can even cause the withdrawal of the whole case.

#### 4.3.6.1 Cancel Activity (*Withdraw activity*)

An enabled activity can be disabled, i.e. a thread waiting for the execution of an activity is removed.

For example; if a customer cancels a request for information, the corresponding activity is disabled.

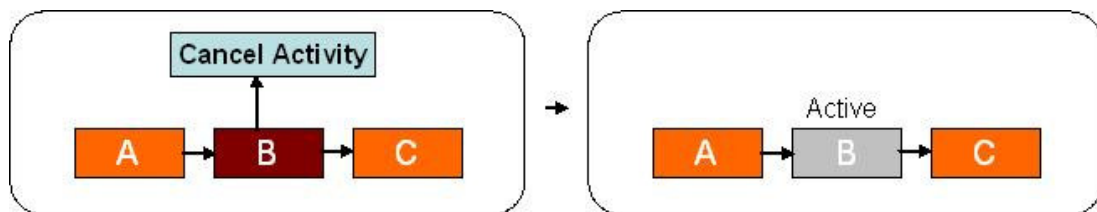


Figure 4.33 Activity Cancellation Pattern

If the workflow language supports Pattern 16 (Deferred Choice), then it is possible to cancel an activity by adding a so-called "shadow activity". Both the real activity and the shadow activity are preceded by a deferred choice. Moreover, the shadow activity requires no human interaction and is triggered by the signal to cancel the activity.

#### 4.3.6.2 Cancel Workflow

A workflow instance, is removed completely (i.e., even if parts of the process are instantiated multiple times, all descendants are removed).

A customer may withdraw an insurance claim before the final decision is made. This is an example to Cancel Workflow pattern.

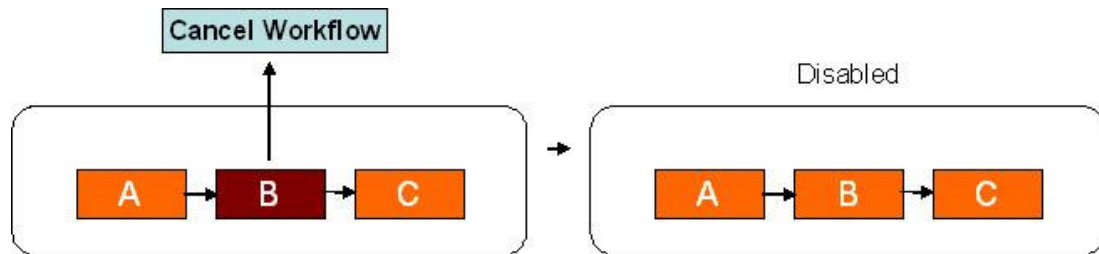


Figure 4.34 Workflow Cancellation Pattern

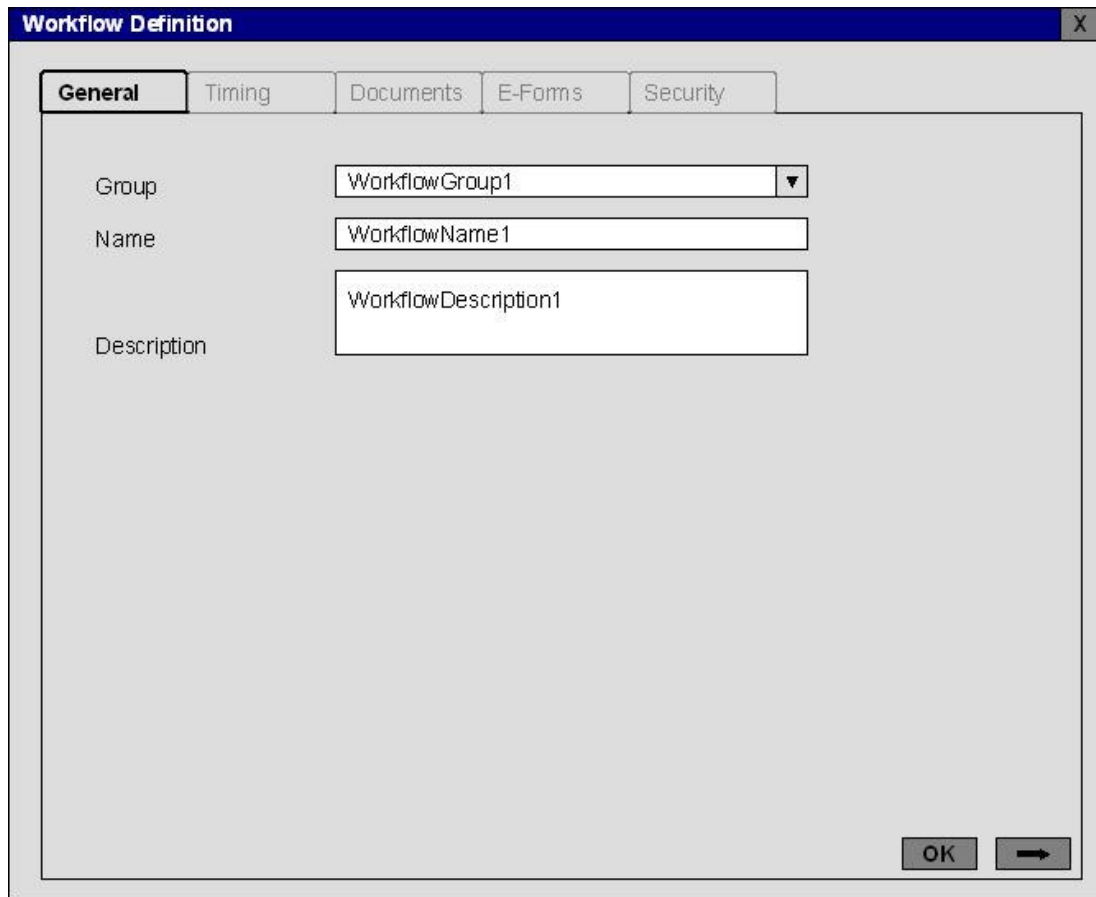
Pattern 19 (Cancel Activity) can be repeated for every activity in the workflow process definition. There is one activity triggering the withdrawal of each activity in the workflow.

#### 4.4 Workflow Definition

Workflow Definition is the most complex and enhancable part of Workflow Management Systems. The main functionality of workflow definition deals with timing, activity management, routing, expirations, form and document integration. So it doesn't matter whether complex graphical symbol-based interfaces are used or not.

### 4.4.1 Workflow Definition

#### 4.4.1.1 General



The screenshot shows a window titled "Workflow Definition" with a close button (X) in the top right corner. Below the title bar is a tabbed interface with five tabs: "General", "Timing", "Documents", "E-Forms", and "Security". The "General" tab is currently selected. Inside the "General" tab, there are three input fields: "Group" with a dropdown menu showing "WorkflowGroup1", "Name" with a text box containing "WorkflowName1", and "Description" with a larger text box containing "WorkflowDescription1". At the bottom right of the window, there are two buttons: "OK" and a button with a right-pointing arrow.

Figure 4.35 General part of Workflow Definition Screen

In General part; name, group and description fields of workflows can be set.

#### 4.4.1.2 Timing

Timing part of Workflow Definition screen deals with the whole workflow lifecycle. A workflow can start immediately after the workflow is activated or the users can start it via the client application. The other possibility is waiting for the starting for a time. It is also possible to hold the workflow in waiting status until a defined date.

When the workflow is started, it may be useful to send a notification message to some people.

In workflow system, all time durations can be represented with time units.

The screenshot shows a window titled "Workflow Definition" with a close button (X) in the top right corner. Below the title bar are four tabs: "General", "Timing" (which is selected and highlighted), "Documents", "E-Forms", and "Security". The "Timing" tab contains the following controls:

- A "Time" section with a text box containing "12" and a dropdown menu showing "Day".
- A "Send" checkbox, which is currently unchecked. To its right is a text box containing "WorkflowStartsMsg" and a button with three dots "...".
- A "To" label followed by a text box containing "WorkflowDesignAdmin" and a button with three dots "...". To the right of this is the text "when workflow starts".
- A "Start" section with four radio button options:
  - ☐ By Workflow User
  - ☐ Immediately when activated
  - ☐ After waiting: This option is selected. It is followed by a text box containing "6" and a dropdown menu showing "Hour".
  - ☐ At the date: This option is followed by two empty date/time input fields.

At the bottom right of the window are two buttons: "OK" and a button with a right-pointing arrow.

Figure 4.36 Timing part of Workflow Definition Screen

Table 4.1 Time Units in Workflow Timing

Time Unit
Unused
Second
Minute
Hour
Day
Week
Month
Year

#### 4.4.1.3 Documents

The screenshot shows the 'Workflow Definition' window with the 'Documents' tab selected. The window has a title bar with a close button (X). Below the title bar are tabs for 'General', 'Timing', 'Documents', 'E-Forms', and 'Security'. The 'Documents' tab contains a form with two input fields: 'Name' and 'Path'. The 'Path' field has a browse button (...). Below these fields are 'Add' and 'Remove' buttons. Below the form is a table titled 'Documents' with columns 'Name' and 'Path'. The table contains two rows: 'Document1' and 'Document2', both pointing to the same path. To the right of the table are 'Edit' and 'Sort' buttons. At the bottom right of the window are 'OK' and a right arrow button.

Name	Path
Document1	//server/path/folder/subfolder1/doc1
Document2	//server/path/folder/subfolder1/doc1

Figure 4.37 Documents part of Workflow Definition Screen

Workflows may have their own documents. Documents flow via workflow activities; they can be viewed or edited according to the defined access rights.

Table 4.2 Workflow Document Screen fields

Documents	Description
Name	Document name which represents the workflow document in user client application
Path	The physical path for the document template. (The instances which will be created when the workflow is initiated should be stored in another path)

#### 4.4.1.4 E-Forms

**Workflow Definition**

General Timing Documents **E-Forms** Security

Form

Add Remove

Forms Edit Sort

Name	Description
Form1	Invoice Form
Form2	HR Form

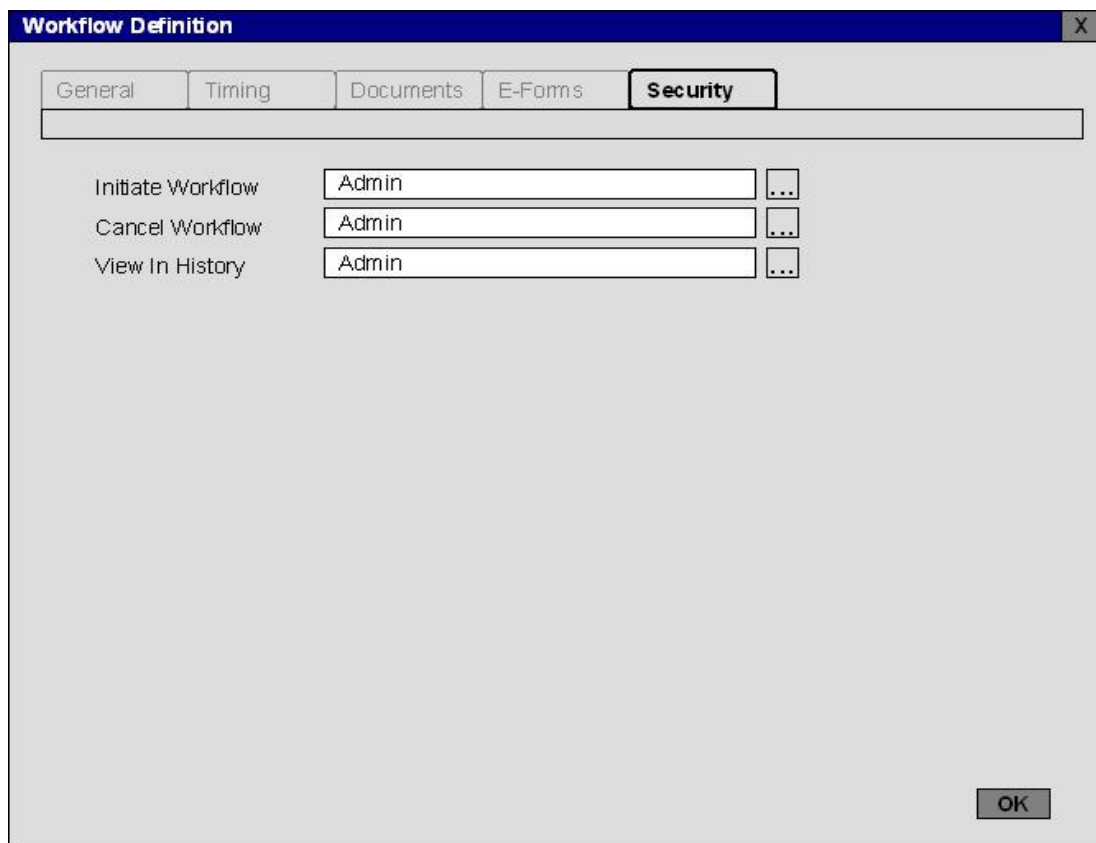
OK →

Figure 4.38 Forms part of Workflow Definition Screen



Workflows may have their own forms. As documents; forms flow via workflow activities; they can be viewed or edited according to the defined access rights. As it can be seen from the figure above, the user can select the form which already built by an administrator and add to the workflow. It is possible to view form properties, fields by clicking on it

#### 4.4.1.5 Security



The screenshot shows a window titled "Workflow Definition" with a tabbed interface. The "Security" tab is selected. Below the tabs, there is a table for assigning resources to workflow actions. The table has three rows: "Initiate Workflow", "Cancel Workflow", and "View In History". Each row has a text input field containing "Admin" and a small button with three dots "...". An "OK" button is located at the bottom right of the window.

Action	Resource
Initiate Workflow	Admin
Cancel Workflow	Admin
View In History	Admin

Figure 4.39 Security part of Workflow Definition Screen

Resource assignment for three important actions can be performed via the screen in the figure above.

Table 4.3 Workflow Security Actions

Workflow Security Actions	Description
Initiate Workflow	Sets the workflow initiators (starters)
Cancel Workflow	Sets the users who can cancel the workflow (especially a few number of users like supervisors)
View In History	Sets the users who can able to track workflow history

#### 4.4.2 Activity Definition

##### 4.4.2.1 General

**Activity Definition**

General | Timing | Tasks | Decisions | Documents | E-Forms | Security

Group: ActivityGroup1 ▼

Name: ActivityName1

Description: ActivityDescription1

Workflow: WorkflowTemplate1 ▼

Owner: AllEmployees ...

☐ Find best Participant now **Find**

If not Available:

☐ Find best Participant immediately during Run-time

☐ Send NotAvailableUserMsg ... To WorkflowDesignAdmin ...

**OK** **→**

Figure 4.40 General part of Activity Definition Screen

It is possible for the workflow designer to select a group of users for activity owner and then try to find best participant among these users by running the algorithm during

design time. It is important to note that the best user which is defined during workflow (activity) design may not be best while the related activity proceeds. If the owner is still a group of users, all these users can view and edit the activity according to their access rights after workflow proceeding starts. The first, who accesses the activity, can first complete it.

As it had already been described, availability of the workflow system user is dependent of the calendar definition of that user. If the user is not available due to some reason, the best user can be assigned to the activity definition during the run-time. Workflow designer and probably other roles (e.g. managers, supervisors) should be informed about the absence (or non-availability) of the defined activity owner. So a message can be attached to the activity by choosing the recipients.

#### 4.4.2.2 Timing

The screenshot shows the 'Activity Definition' window with the 'Timing' tab selected. The window has a title bar with 'Activity Definition' and a close button. Below the title bar are tabs for 'General', 'Timing', 'Tasks', 'Decisions', 'Documents', 'E-Forms', and 'Security'. The 'Timing' tab contains the following controls:

- Time:** A text box with '12' and a dropdown menu with 'Day'.
- Starts:** Three radio buttons: 'Immediately', 'After waiting', and 'At the date'. The 'After waiting' option is selected, with a text box containing '6' and a dropdown menu with 'Hour'.
- Expiration:** A checkbox labeled 'Send' is checked. Next to it is a text box with 'ExpirationBeforeMsg' and a dropdown menu. To the right, there are two text boxes: 'Before' with '5' and 'for every' with '5', each followed by a dropdown menu with 'Minute'.
- If activity expires:** A section containing:
  - A checkbox labeled 'Send' is checked. Next to it is a text box with 'ExpirationOccurredMsg' and a dropdown menu. To the right is a text box with 'To' and a dropdown menu with 'WorkflowDesignAdmin'.
  - Four radio buttons: 'Go to next step automatically', 'Find best Participant during Run-time', 'Wait', and 'End workflow'. The 'Wait' option is selected, with a text box containing '12' and a dropdown menu with 'Day'.

At the bottom right of the window are 'OK' and 'Next' buttons.

Figure 4.41 Timing part of Activity Definition Screen

Timing part of Activity Definition screen deals with the whole activity lifecycle and expiration case.

An activity can start immediately after the previous activity has been finished or after the workflow is initiated if it is the first activity. The other possibility is waiting for the starting for a time. The waiting duration represents “Workflow Wait” item which is described in the first section of this chapter.

It is also possible to hold the activity in waiting status until a defined date. It should be notified that if the defined date is smaller than the real starting time, the activity can be completed and the process directly jumps to next step.

When the activity due date is closer, it may be useful to send a notification message to the activity owner(s). This process can be repeated in a defined period of time or it occurs only once. (By setting frequency to 0)

After activity expiration (due date is over), a message can be sent to a defined users (obviously administrators or super roles). For an expiration case, there may be at least four possibilities which directly affect the flow:

Table 4.4 Expiration Actions

Action	Description
Go to next step automatically	Expired activity is ignored and the process goes to next activity if it is possible. If that activity is the last activity, then the workflow ends.
Find the Best Participant during Run-Time	When the expiration occurs, system tries to find best alternate user, if such user exists the activity then assigned to him/her. System can send an e-mail (or message) automatically to the user.
Wait	The activity expiration is delayed for a defined time duration and unit. After this time expires, due date is delayed again. It means the process could not go on if the activity is not completed.
End Workflow	If the activity expires, the workflow can be ended automatically.

Activity timing is important for user / employee evaluation processes. Business management absolutely desires to view the performance of the each user any time. By some reporting or Data Mining tools, they can find answers to any questions about the whole working. Number of expired activities, the user who completes his / her work before the required time, the reason of expirations can be collected and according to the analysis, business may decide some changes on the processes to improve both performance and business quality.

#### 4.4.2.3 Tasks

The screenshot shows the 'Activity Definition' window with the 'Tasks' tab selected. The window has a title bar with a close button (X). Below the title bar are tabs for 'General', 'Timing', 'Tasks', 'Decisions', 'Documents', 'E-Forms', and 'Security'. The 'Tasks' tab contains the following elements:

- Form fields for 'Task', 'Description', 'Severity' (a dropdown menu currently showing 'Fatal'), and 'Owner' (a text box containing 'AllEmployees' and a selection button '...').
- 'Add' and 'Remove' buttons next to the 'Owner' field.
- A 'Sort' button.
- A table with two columns: 'Task' and 'Severity'.
- 'OK' and a right-pointing arrow button at the bottom right.

Task	Severity
Task1	Fatal
Task2	Fatal
Task3	Mandatory
Task4	Optional
Task5	Optional

Figure 4.42 Tasks part of Activity Definition Screen

Tasks can be defined as the sub processes (sub-activities) of the activity. Even each task represents different actions, they belong to a parent activity (their targets are same). And routing of the tasks is not important.

Tasks can be classified by their severity for the activity:

Table 4.5 Task Severity

Task Severity	Description
Fatal	Task must be performed. The activity completion is not allowed if fatal task completion is not been indicated.
Mandatory	Mandatory task completion is important especially for the management or tracking units of the business but the user is not warned during the activity completion. Completion of these tasks can be used to measure user performance and efficiency.
Optional	The user is allowed to skip the task. These types of tasks may not used for measuring of user performance and working efficiency

Access rights for each task may vary. Therefore all the activity owners may not view all tasks according to the access right definition. And an important issue is that the activity owner has to cover the task owners. If activity owner and one of the tasks' owners are entirely different users, it means the task cannot be viewed by the activity owners and if that invisible task has a fatal severity the activity cannot be completed. This is completely a workflow design logic error.

#### 4.4.2.4 Decisions

The screenshot shows the 'Activity Definition' window with the 'Decisions' tab selected. The fields are as follows:

- Decision Group:** [Empty text box]
- Description:** [Empty text box]
- Type:** [Multiple Choice ▼]
- Severity:** [Fatal ▼]
- Owner:** [AllEmployees] [Add] [Remove]

Below the fields is a table titled 'Decision Groups' with the following data:

Decision Group	Type	Severity
DecisionGroup1	Multiple Choice	Fatal
DecisionGroup2	Single Choice	Fatal
DecisionGroup3	Multiple Choice	Mandatory
DecisionGroup4	Multiple Choice	Optional
DecisionGroup5	Single Choice	Optional

At the bottom right are 'OK' and 'Next' buttons.

Figure 4.43 Decisions part of Activity Definition Screen

Decision groups represent the decision of users and give direction to the flow. An activity can include more than one decision groups or has anyone.

Decision groups can be classified by chosen type:

Table 4.6 Decision Group Type

Decision Group Type	Description
Multiple Choice	Choosing at least one decision is allowed (In UI, they are represented with checkboxes)
Single Choice	Choosing only one decision is allowed (In UI, they are represented with option boxes)



Decision groups with multiple choices may branch out the workflow; it means parallel processes can simultaneously begin to execute. If single choice is used the process goes on sub sequentially.

Decision groups can be classified by their severity for the activity such as tasks:

Table 4.7 Decision Group Severity

Decision Group Severity	Description
Fatal	Decision must be chosen. The activity completion is not allowed if fatal decision completion is not been indicated.
Mandatory	Mandatory decision completion is important especially for the management or tracking units of the business but the user is not warned during the activity completion. These decisions can be used to measure user performance and efficiency.
Optional	The user is allowed to skip the decision. These types of decisions may not be used for measuring of user performance and working efficiency

As in the tasks, access rights for each decision group may also vary.

Decision groups include decision items.

Decisions

Decision Group: DecisionGroup1

Decision:

Description:

Default: ☐

Add Remove

Decisions Sort

Decision	Description
Yes	Approve Form
No	Reject Form

OK Cancel

Figure 4.44 Decisions Screen

Table 4.8 Decision

Decision Fields	Description
Decision Group	Group of decision Example: YESNO
Decision	Display Name for Decision Example: YES
Description	Optional description for decision (it may be displayed in client application, too)
Default	If one of decision items are defined as default, it is checked by default in UI.

#### 4.4.2.5 Documents

The screenshot shows the 'Activity Definition' window with the 'Documents' tab selected. The window has a title bar with 'Activity Definition' and a close button. Below the title bar are tabs for 'General', 'Timing', 'Tasks', 'Decisions', 'Documents', 'E-Forms', and 'Security'. The 'Documents' tab is active, displaying a table with the following data:

Name	Description	Access Right
Document1	Document1	Read ▼
Document2	Document2	Write ▼

At the bottom right of the window are 'OK' and 'Next' (represented by a right arrow) buttons.

Figure 4.45 Documents part of Activity Definition Screen

The document security is dependent on the privileges which can be defined for each workflow activity separately.

Table 4.9 Document Access Mode

Document Access Right	Description
Read	Document is read only
Write	Document is in read/write mode
Hidden	Document is not viewed by activity owners

Document security can be handled by setting Owner information as it is shown in the figure above. It will be generally same as activity owner. If activity owner and activity

document owner differ, basic mathematical set operations will be available to provide document access. It is also affected by “View Document” security action which is defined in Security tab.

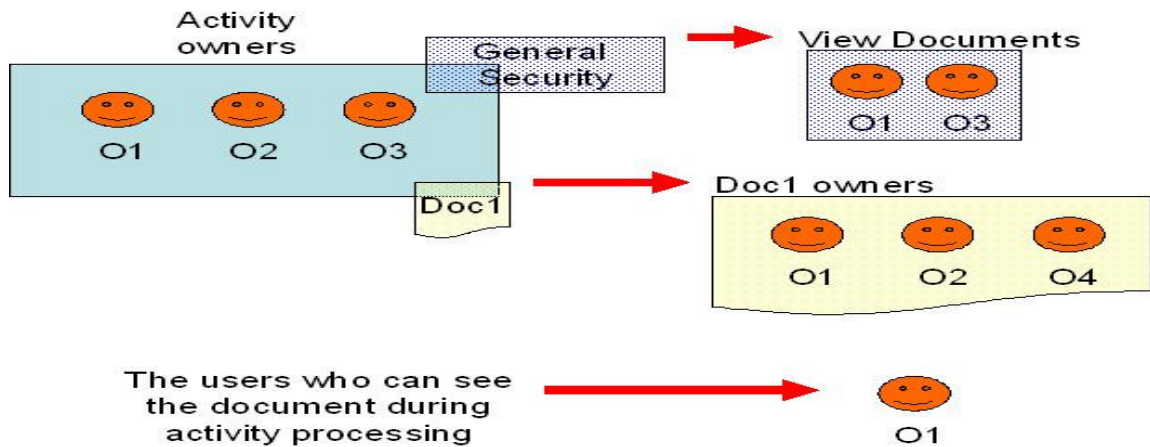


Figure 4.46 an example of Workflow Document Security

#### 4.4.2.6 Forms

**Activity Definition**

General | Timing | Tasks | Decisions | Documents | **E-Forms** | Security

Form Name: Form 1

Description: Form 1

Owner: AllEmployees

Parameters:

Form	Access Right
Parameter1	Read
Parameter2	Write

Forms:

Form	Description	Parameters
Form 1	Form 1	...
Form 2	Form 2	...

Buttons: OK, Edit, →

Figure 4.47 Parameter Forms part of Activity Definition Screen

Form security can be handled by setting Owner information as it is shown in the figure above. It will be generally same as activity owner. If activity owner and activity form owner differ, basic mathematical set operations will be available to provide form access. It is also affected by “View E-Forms” security action which is defined in Security tab.

Form parameters’ security can also vary for each different workflow activity and they can be defined during the process definition.

Table 4.10 Activity Parameter Forms Access Mode

Parameter Access Mode	Description
Read	Form field is read only
Write	Form field is in read/write mode
Hidden	Form field is not viewed by activity owners

#### 4.4.2.7 Security

Activity Definition	
Security	
Cancel Activity	Admin
Delegate Activity	Admin
Stop Activity	Admin
Edit Activity in Design Mode	Admin
Attach Ad-Hoc Message to Activity	Everyone
Cancel Workflow	Admin
Send Message	None
View History	WorkflowUsers
View Documents	WorkflowUsers
View E-Forms	WorkflowUsers

Figure 4.48 Security part of Activity Definition screen

Table 4.11 Activity Security Actions

<b>Security Action</b>	<b>Description</b>
Cancel Activity	Some activities can be cancelled during processing by the predefined users; activity cancellation can cause workflow cancellation / ending / resuming etc.
Delegate Activity	Some users should have to delegate activity to someone else during process.
Stop Activity	Users can be allowed to stop activity (or to wait)
Edit Activity in Design Mode	Activity definition should be accessible to a few number of users
Attach Ad-Hoc Document to Activity	Some users may be able to add some documents to activity. (Some restrictions or rules should be defined about the type, content or size of ad-hoc documents)
Cancel Workflow	Activity owners may have workflow cancellation privileges because of some important reasons.
Send Message	Users may request to send e-mail (or portal message) to other workflow users.
View History	Some forms can be viewed by a set of defined activity owners
View Documents	Some documents can be only viewed by a set of defined activity owners
View E-Forms	Some forms can be only viewed by a set of defined activity owners

### 4.4.3 Connector

The screenshot shows a 'Connector' dialog box with a 'General' tab. The fields are as follows:

Field	Value
Name	ConnectorName1
Description	ConnectorDescription1
Formula	true
From	Activity1
To	Activity2

Figure 4.49 Connector screen

Table 4.12 Connector Definition

Connector Fields	Description
Name	Connector name
Description	Optional description for connector
Formula	The condition which connector uses while managing the route between objects.
From	The item from which the connector draws line to another item (This item can be called as “source” item)
To	The item to which the connector draws line from another item (This item can be called as “target” item)

There are two generic formulas for connectors:

- True Connector
- Else Connector

#### 4.4.3.1. True Connector

True connector provides direct routing without any restriction.

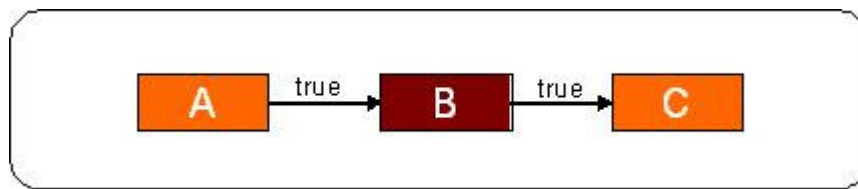


Figure 4.50 Connectors with True formula

As it can be seen from the figure above, “true” connector gets the job from A to B and then from B to C.

#### 4.4.3.2 Else Connector

Else connector is a connector that shares a source activity with another connector. If the condition (formula) of other connector is false then else connector routes.

In the proposed model, it is assumed that at most two connectors can be bound to the source activity.

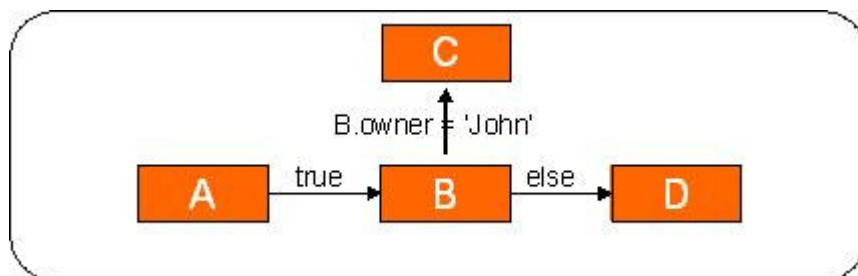


Figure 4.51 Connectors with Else formula



As it can be seen from the figure above, if activity B's owner is "John", the process will jump to C activity, otherwise the next activity will be "D".

## **CHAPTER FIVE**

### **CLIENT APPLICATIONS**

#### **5. Introduction**

In this chapter, the client application of workflow management systems is explained with some screen proposals.

#### **5.1 Workflow Participant**

Workflow participant is a resource which performs the work represented by a workflow activity instance. This work is normally manifested as one or more work items assigned to the workflow participant via the work list. (WfMC, 1999)

The term “Workflow Participant” is normally applied to a human resource but it could conceptually include machine based resources such as an intelligent agent.

A workflow participant may be identified directly within the business process definition, or (more normally) is identified by reference within the process definition to a role or organizational entity, which can then be filled by one or more of the resources available to the workflow system to operate in that role during process enactment.

Within the WfMC Process Definition Meta-Model, the workflow participant declaration may identify a participant as one of four types – human, (machine) resource, role, or organizational unit (WfMC, 1999). Alternatively reference may be may to an external Organization Model which provides details of participants fitting the selected criteria.

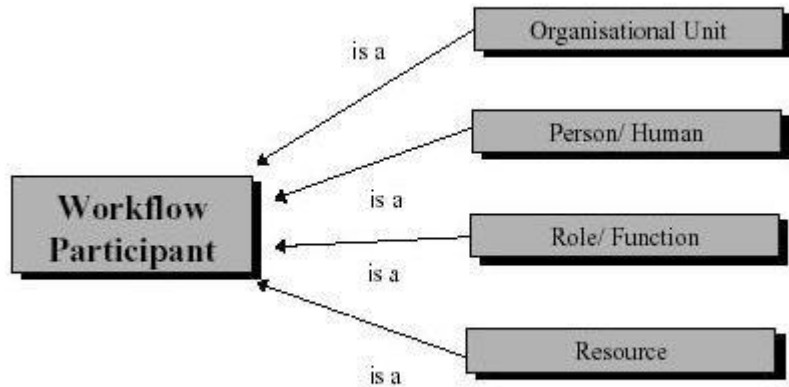


Figure 5.1 Types of Workflow Participant

These are the *synonyms* which can be used instead of the term “Workflow Participant”:

Table 5.1 Workflow Participant Synonyms (WfMC, 1999)

Synonyms
Actor
Agent
Player
User
Role Player
Work Performer

## 5.2 Client Application

The workflow participants could perform some operations by using the client application (portal) according to their predefined rights. Workflow Administrators can also restrict the User Interface access for some users via the administration console.

The operations which can be performed by workflow participants are listed as it follows:

- Searching active workflows
- Initiating workflows
- Viewing the status of initiated workflows
- Viewing pending activities
- Viewing activity documents / e-forms / invoked applications / other information
- Updating document / document attributes / e-forms
- Adding ad-hoc documents to processes / Removing existing ones
- Delegating activities
- Sending messages to other participants of the workflow
- Completing / refusing activities
- Viewing the status of activities
- Viewing / Searching different versions of documents / e-forms
- Viewing personal information and statistics
- Settings priority / importance to the activities
- Setting Out Of Office status

### ***5.2.1 Client Application Authentication***

Each security domain will normally be associated with a homogeneous product environment (WfMC, 1998). In addition to the support for interoperability security extensions, it is expected that a range of local (within domain) security related facilities will be provided, such as:

- Establishment of workflow user roles and associated privileges,
- Participant registration and role association,
- Authentication of participants,

- Administration of authorized operations via access control policy

Some of these facilities are likely to have commonality with the requirements for secure interoperability, for example process initiation and attribute modification may also need to be restricted to certain users or participant roles within a domain.

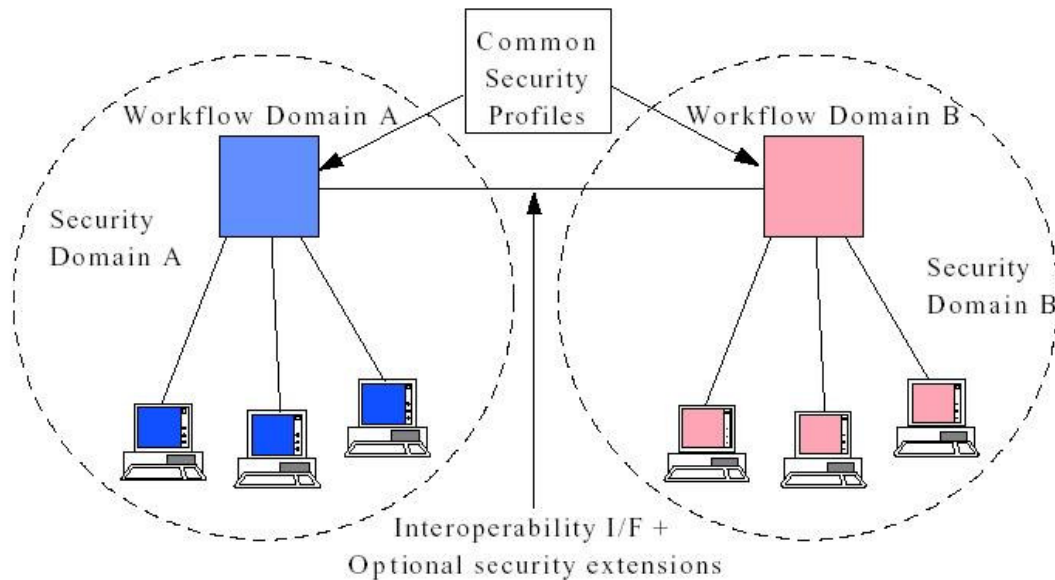
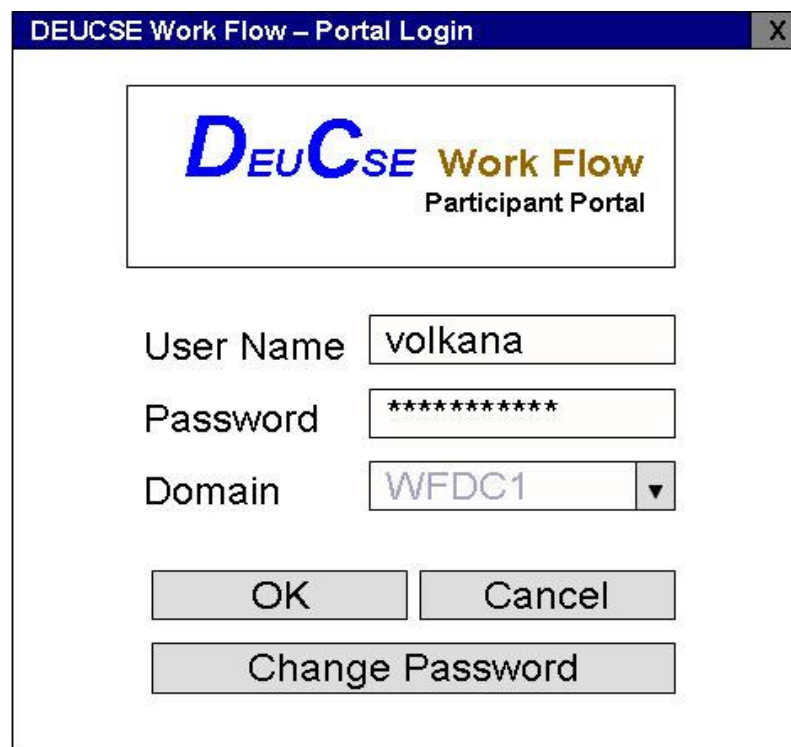


Figure 5.2 Workflow Domain Security

Authentication is the process by which a computer system or a (human) system user unambiguously identifies themselves to another computer system, normally in the context of gaining access to various services which the authenticated party is authorized to use on that computer system (WfMC, 1998).

In the context of workflow, the most common requirement is for the authentication of a user or systems administrator as part of the log-on activity prior to work assignment within a particular (single) workflow service. This typically occurs within a single administrative domain based upon the security services of the underlying platform or network service.

For simplicity it is assumed that all user access will use the authentication mechanisms within the local workflow domain even where access is granted to users within a different, but interoperating domain. This means that where users are required to interact with different workflow services they are required to be registered on each service and separately authenticate themselves to each domain. Thus the two workflow systems do not need to share a common model for user names and pass details of user credentials between themselves. (WfMC, 1998)



The image shows a Windows-style dialog box titled "DEUCSE Work Flow – Portal Login". Inside the dialog, there is a logo for "DEUCSE Work Flow Participant Portal". Below the logo, there are three input fields: "User Name" with the text "volkana", "Password" with masked characters "\*\*\*\*\*", and "Domain" with a dropdown menu showing "WFDC1". At the bottom of the dialog, there are three buttons: "OK", "Cancel", and "Change Password".

Figure 5.3 Client Application Authentication Dialog

### 5.2.2 Home Page

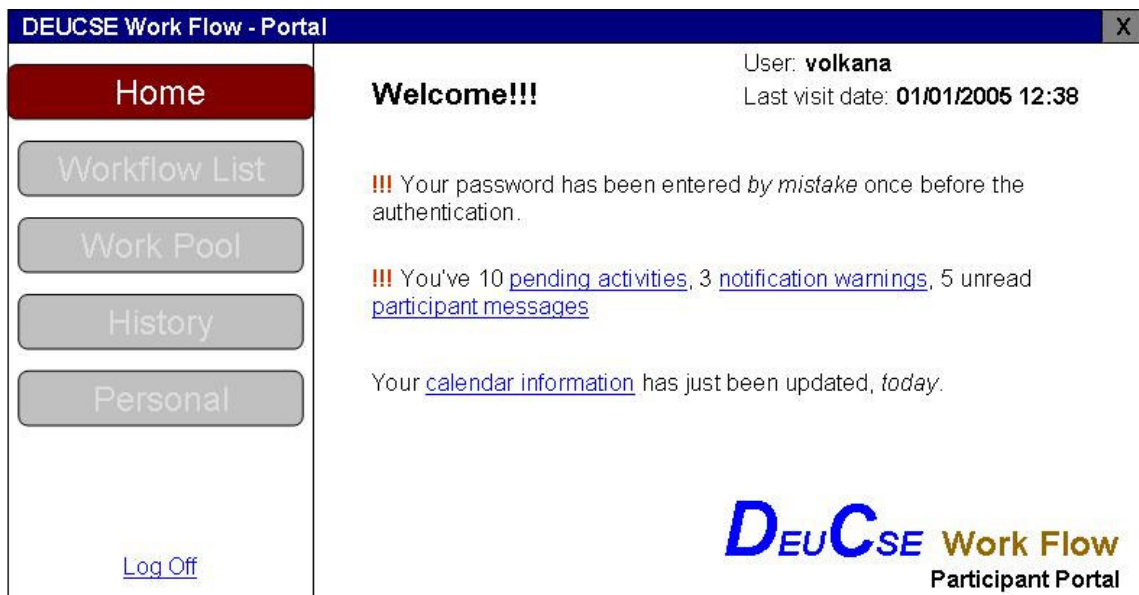


Figure 5.4 Client Application Home Page

After the user has successfully authenticated to the system, home page directly appears. This page can be designed to show some kind of important messages or news to the user. Personalization or customization of this page can be allowed and / or also some parts may be static so that the user could not remove them.

Here are some information which may be listed on the home page when the user logs in to the system:

- Wrong Password entry notification
- Password expiration notification
- Out of office information
- General logged user information
- Some custom messages which sent by an administrator
- Number of new pending activities
- Number of notification messages about activities

- Number of participant messages
- Number of refused / roll backed activities

Users should also be allowed to log off from the system from each part of screen. In the proposed model, it can be accessed from the bottom-left part of the application.

### 5.2.3 Workflow Initiation

Workflow Initiation is one of the main parts of client application. By initiating operation, the first activity (step / work) fires and falls in to the defined participant's work list immediately. If the workflow initiator and first activity owner is same then the activity screen could be displayed to the user.

According to the Workflow Definition settings, four security criteria should be applicable for a user, if he / she wants to initiate a workflow:

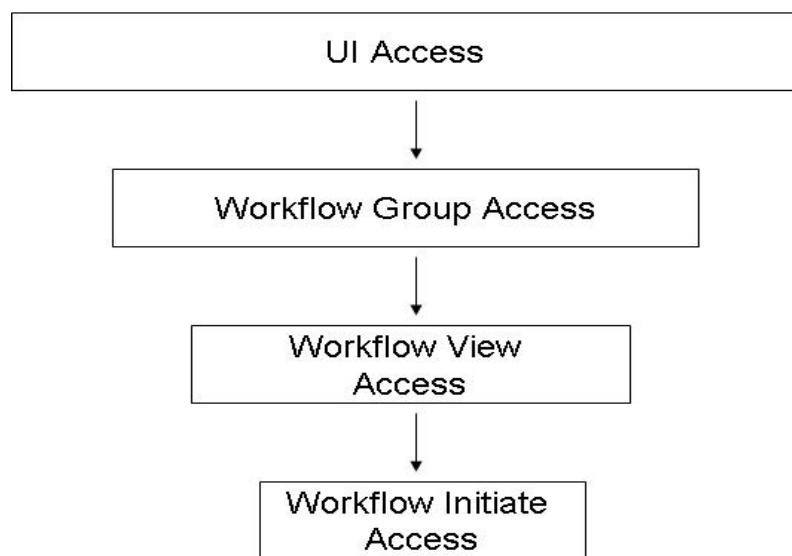


Figure 5.5 Workflow Initiation Security

As it can be seen from the figure above, if one of the steps' access definition fails for the workflow participant, the workflow cannot be started. UI and Workflow Group



Access can be set from administrator console while View and Initiate Access can be defined by using Workflow Definition tool.

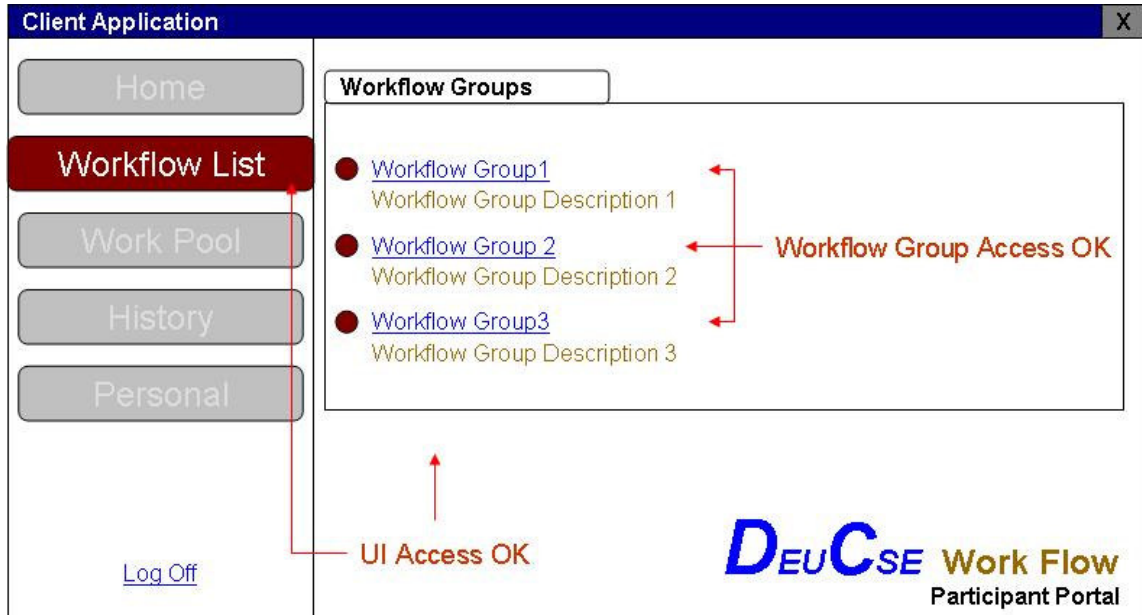


Figure 5.6 Client Application – Workflow Groups

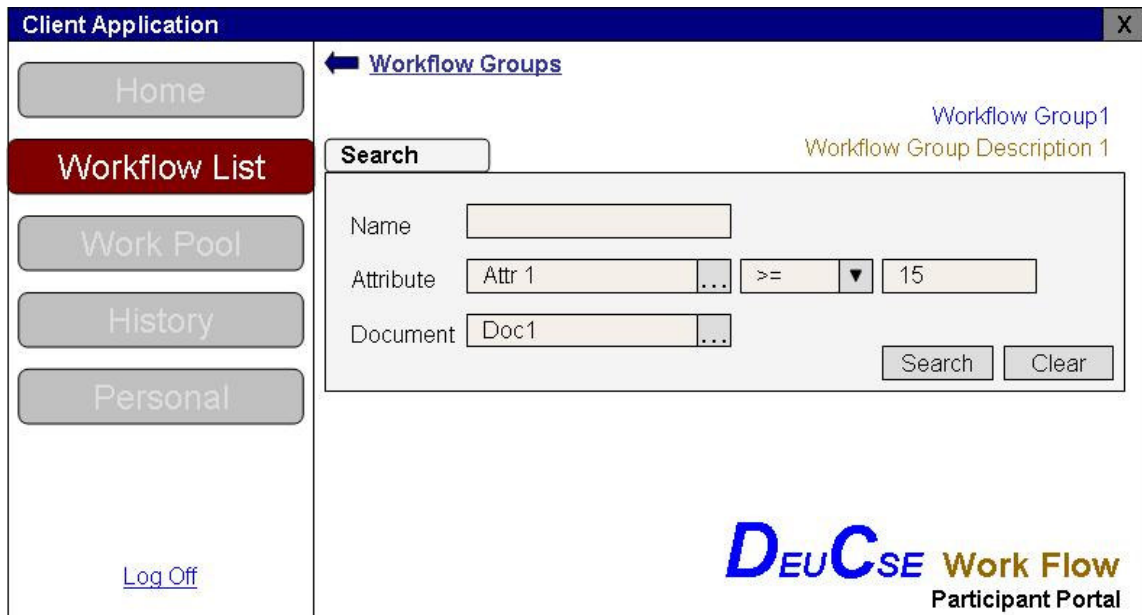


Figure 5.7 Client Application – Workflow List Search

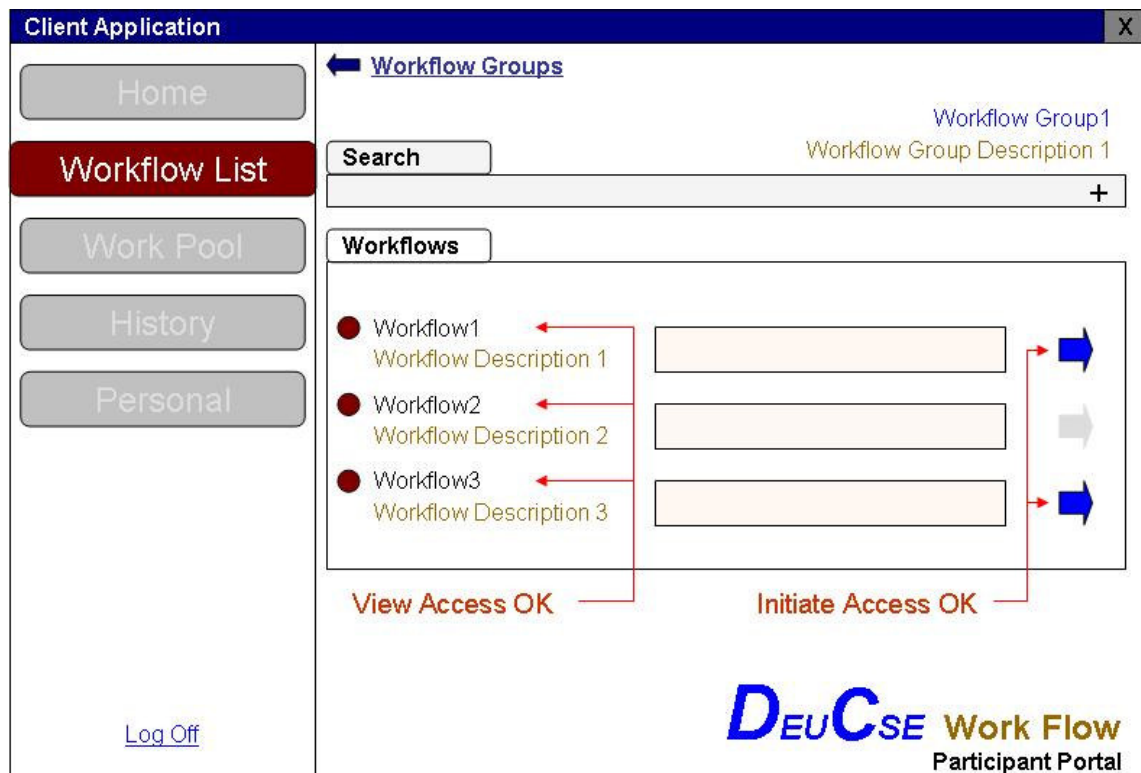


Figure 5.8 Client Application - Workflow List Initiation

## 5.2.4 Work list

### 5.2.4.1 Work Item

Work item is the representation of the work to be processed (by a workflow participant) in the context of an activity within a process instance (WfMC, 1999).

An activity typically generates one or more work items which together constitute the task to be undertaken by the user (a workflow participant) within this activity (In certain cases an activity may be completely handled by an invoked application which can operate without a workflow participant, in which case there may be no work item assignment.)

The work item(s) are normally presented to the user via a work list, which maintains details of the work items allocated to a user, and a work list handler, which interacts with the work list on the behalf of the user.

The control and progression of work items rests with the work list handler and the user, rather than the workflow engine, which is notified of work item status (e.g. completion) via the work list handler interface. The WfMC WAPI interface includes standard API calls for this purpose.

Tools or applications may be invoked to support the processing of a work item, or it may be processed independently by a workflow participant, with the workflow management system merely notified of the completion of particular work items

#### *5.2.4.2. Work list*

A work list is a list of work items associated with a given workflow participant (or in some cases with a group of workflow participants who may share a common work list). The work list forms part of the interface between a workflow engine and the work list handler (WfMC, 1999).

Generally, a work list handler will request work items from a workflow engine in order to create such a list. This is sometimes done via a query mechanism.

In some workflow management systems work items may be placed in the work list by a workflow engine for subsequently access and actioning by the work list handler.

#### *5.2.4.3 Work list Handler*

The work list handler is the software entities which interact with the end-user in those activities which require involve human resources. The work list handler may be supplied

as part of a workflow management product or may be written by a user, for example to provide a particular common house style for use with a number of different workflow applications utilizing different vendor's products. In other cases, workflow may be integrated into a common desktop environment alongside other office services such as mail and work-in progress folders to provide a unified task management system for the end-user. There is thus a need for a flexible mechanism of communication between a workflow enactment service and workflow client applications to support the construction of the many different operational systems which are expected to be encountered (WfMC, 1999).

In the workflow model interaction occurs between the client application and the workflow engine through a well defined interface embracing the concept of a work list - the queue of work items assigned to a particular user (or, possibly, group of common users) by the workflow engine. At the simplest level the work list is accessible to the workflow engine for the purposes of assigning work items and to the work list handler for the purpose of retrieving work items for presentation to the user for processing. There are various possible product implementations of this work list interaction.

Activation of individual work items from the work list (for example launching application and linking workflow relevant data) may be under the control of the workflow client application or the end-user. A range of procedures is defined between the workflow client application and the workflow enactment service to enable new items to be added to the work list, completed activities to be removed from the work list, activities to be temporarily suspended, etc.

Application invocation may also be handled from the work list handler, either directly or under the control of the end-user. In general it is expected that the range of applications invoked from the work list handler would be predominantly local to that environment, although it may place an unnecessary constraint on the generality of the model to assume that this will always be the case.

Part of the activity related data associated with the work list is the necessary information to enable the work list handler to invoke the appropriate applications(s). Where the application data is strongly typed, an association may be stored at the work list handler and used for this purpose. In other cases; an interchange of the full application name and address information may be necessary between the work list handler and Workflow engine, in which case the workflow Client Application may also implements some functions from the invoked application interface (Interface 3) to obtain the necessary information (WfMC, 1999).

A work list may contain items relating to several different active instances of a single process and/or individual items from activations of several different processes. A work list handler might potentially be interacting with several different Workflow engines and several different enactment services. (According to individual product implementation, separate physical work lists may be maintained for each process type, or the work list handler may consolidate the various work lists items into a single representation to the end-user.)

The interface between the client workflow application and Workflow engine must therefore be sufficiently flexible in terms of its use of:

- Process and activity identifiers
- Resource names and addresses
- Data references and data structures
- Alternative communications mechanisms

to contain these variations of implementation approach.

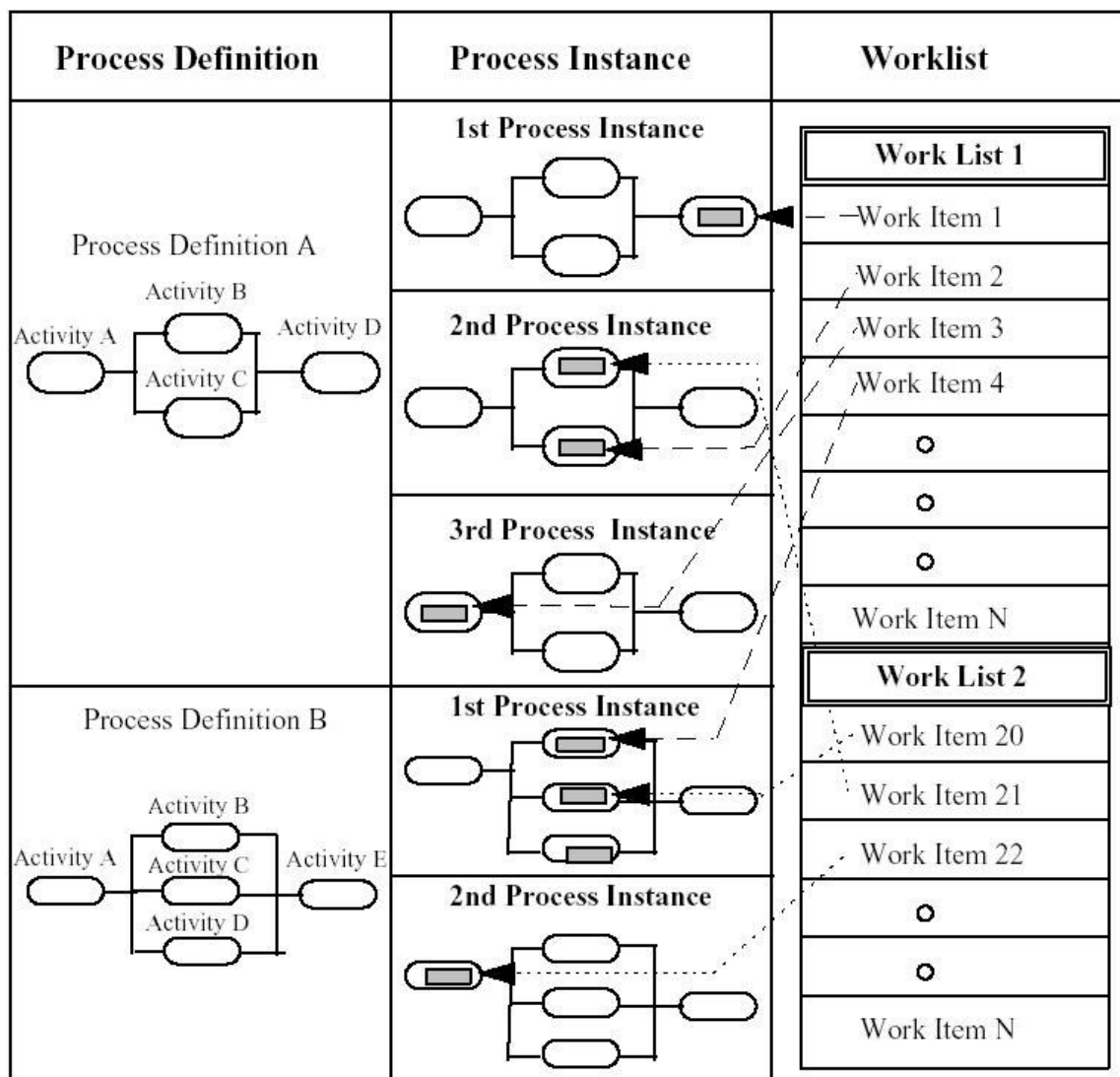


Figure 5.9 Relations between Workflow Definition, Instance, Work item and Work list

As it can be seen from the figure, each different template of processes are represented as work lists. Every work list has many work items which are the instances of the process templates. Access rights can be defined for both work items and work lists (WfMC, 1999).

#### 5.2.4.4 Client Application Activity Inbox

**Client Application** [X]

Home

Workflow List

**Work Pool**

- Activities
  - Inbox (5)**
  - Outbox
- Messages
  - Inbox (2)
  - Outbox
- Documents / Forms

History

Personal

[Log Off](#)

**Search**

Workflow

Activity Group

Name

Attribute

Document

**DEUCSE Work Flow**  
Participant Portal

Figure 5.10 Client Application Work Pool Activity Inbox Search

The user may have lots of activities in their work pool. These activities can be accessed via Inbox part by using an advanced search screen. The user can filter the activities by workflow, activity group, name, document or form name and bounded attributes if exist.

**Client Application** X

Home

Workflow List

**Work Pool**

Activities

Inbox (5)

Outbox

Messages

Inbox (2)

Outbox

Documents / Forms

History

Personal

[Log Off](#)

**Search**

+

**Activities**

- Workflow1 (118 items)
- Workflow2 (13 items)
- Workflow5 (4 items; **2 new**; **1 overdue**)
 

Activity1	serkana	01/04/2005	24 days left
Activity3	gunduza	03/03/2005	10 days left
Activity1	serkana	01/04/2005	Expired
Activity2	gunduza	01/02/2005	1 day left
- Workflow11 (6 items; **1 new**)
- Workflow17 (18 items; **2 expired**)
- Workflow5 (7 items; **2 new**)

**DEUCSE Work Flow**  
Participant Portal

Figure 5.11 Client Application Work Pool Activity Inbox

After searching over activities, the result list can be viewed in the same screen. The user interface should provide readability thus the new activities, activities which are already expired or will nearly be expired can be shown by the participants easily. They can be marked with different color. The activities may be grouped by workflow name or activity group name that they belong to.



#### 5.2.4.5 Client Application Activity Details

**Client Application** X

Home

Workflow List

**Work Pool**

Activities

**Inbox (5)**

Outbox

Messages

Inbox (2)

Outbox

Documents / Forms

History

Personal

[Log Off](#)

**Inbox**

**General Information**

**Workflow Group 1 – Workflow 1** Initiated by **gunduza** at 21/02/2005 12:12

**Activity Group 1 – Activity1**

Activity owners: Attachers Due date: 24/02/2005

**Tasks**

☐ Call the center and check new records

☐ Attach necessary document \*

**Decisions**

☐ Send attached document to manager

☐ Send attached document to supervisor

**Documents** [Attach New](#)

No workflow documents

**Forms**

No workflow forms

**Complete** **Close**

**DEUCSE Work Flow**  
Participant Portal

Figure 5.12 Client Application Activity Detail

**5.2.4.5.1 Client Application Activity Tasks.** Before the participant completes the activity, he/she should select the tasks which have been completed. Mandatory tasks should be checked.

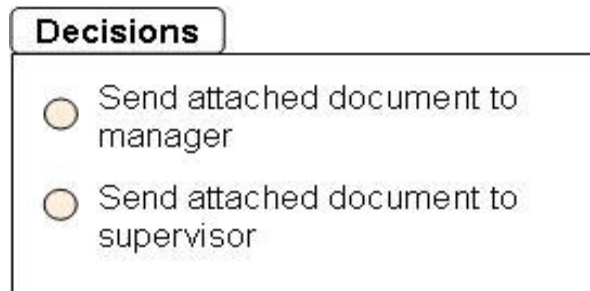
**Tasks**

☐ Call the center and check new records

☐ Attach necessary document \*

Figure 5.13 Client Application Activity Detail Tasks

*5.2.4.5.2 Client Application Activity Decisions.* Before the participant completes the activity, he/she may give some decisions which have been completed. Mandatory decision groups should be checked.



**Decisions**

☐ Send attached document to manager

☐ Send attached document to supervisor

Figure 5.14 Client Application Activity Detail Decisions

*5.2.4.5.3 Client Application Activity Documents.* The participant can view all workflow or activity related documents in the activity detail screen. The documents can be read-only or writable according to the access rights defined during workflow definition. The documents may also have some attributes / properties which may route the workflow. The participants may also view and / or update these attributes.



**Documents** [Attach New](#)

	<a href="#">Doc1</a>	R/W
	<a href="#">Doc2</a>	R/O

Figure 5.15 Client Application Activity Detail Documents

**Documents**

Documents					
➔	<a href="#">Doc1</a>	R/W	Excel file	01/01/2005 10:12	<a href="#">View</a>
	<a href="#">Doc2</a>	R/O	Word file	04/01/2005 10:39	<a href="#">View</a>

[Doc1](#)

**Document Attributes**

Limit	<input type="text" value="700"/>
First Approval Date	<input type="text" value="14.03.2005 12:00"/>
Author	<input type="text" value="James Corona"/>
Priority	<input type="text" value="High"/>

**DEUCSE Work Flow**  
Participant Portal

Figure 5.16 Client Application Activity Detail Document Attributes Dialog

The document attribute values can determine which way the workflow processes on.

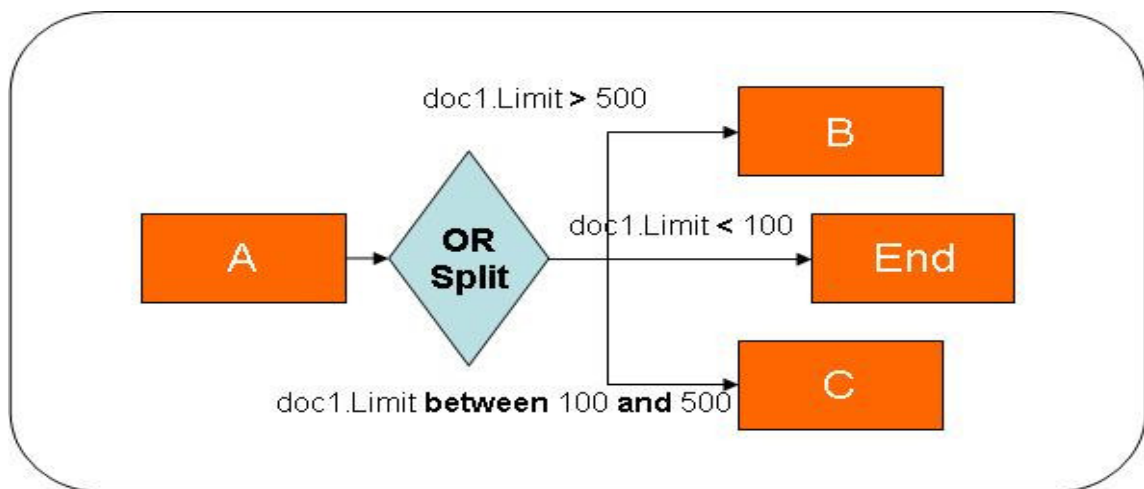


Figure 5.17 Data Flow in Workflows with Document Attributes

Date	Description	TL
05.12.2004	Bahçelievler - Efes (Taksi)	5500000
05.12.2004	HAVAŞ (Efes - ADB)	8000000
05.12.2004	HAVAŞ (Atatürk - Taksim)	7500000
05.12.2004	Taksim - M.Köy (Taksi)	6500000
07.12.2004	K.Çamlica - Üsküdar (Taksi)	6000000
09.12.2004	K.Çamlica - Üsküdar (Taksi)	4000000
09.12.2004	Beşiktaş - M.Köy	4000000
08.12.2004	Vapur	1000000
09.12.2004	Vapur	1000000
10.12.2004	Akbi	5000000
11.12.2004	Halk Otobüsü	2000000
12.12.2004	Akbi	10000000
13.12.2004	Taksi (K.Çamlica - M.köy)	15000000
15.12.2004	Halk Otobüsü	2000000
17.12.2004	Onur AIR - Gidiş Dönüş	138000000
17.12.2004	Akbi	10000000
16.12.2004	Taksi (Altunizade - M.köy)	12500000
18.12.2004	Taksi	14000000
21.12.2004	Jeton	10000000
21.12.2004	K.Çamlica - M.Köy	13000000
22.12.2004	Jeton	1000000
22.12.2004	Jeton (2 adet)	2000000
22.12.2004	Halk Otobüsü	2000000
23.12.2004	Jeton	1000000
23.12.2004	Halk Otobüsü	2000000
24.12.2004	Jeton	1000000
25.12.2004	Akbi	6000000
25.12.2004	Akbi Doldurma	5000000
25.12.2004	Kuru Temizleyici (2 defa)	18000000
24.12.2004	Halk Otobüsü	2000000
27.12.2004	Akbi	10000000
?	Sabun	3450000
?	Jeton	3000000
29.12.2004	T.Kağıdı	4500000
30.12.2004	Akbi	10000000
30.12.2004	Akbi	5000000
30.12.2004	Taksi (K.Çamlica - Kadıköy)	6500000
30.12.2004	HAVAŞ (ADB - Karabağlar)	8000000
30.12.2004	Taksi (Karabağlar - Bahçelievler)	5100000
30.12.2004	HAVAŞ (Bakırköy - Havalimanı)	2500000

Figure 5.18 Client Application Activity Detail Document View

Workflow systems can also integrate with any Office component via scripts. In this case, the connector formula can call the method probably by passing some parameters. The script returns the sum of all expense detail records to compare with the defined values to manage the route.

As it can be seen from the Figure 5.19, a script which calculates sum of expenses returns the total expense by calculating it from an Excel file. Then the result (total expense) directly routes the workflow process.

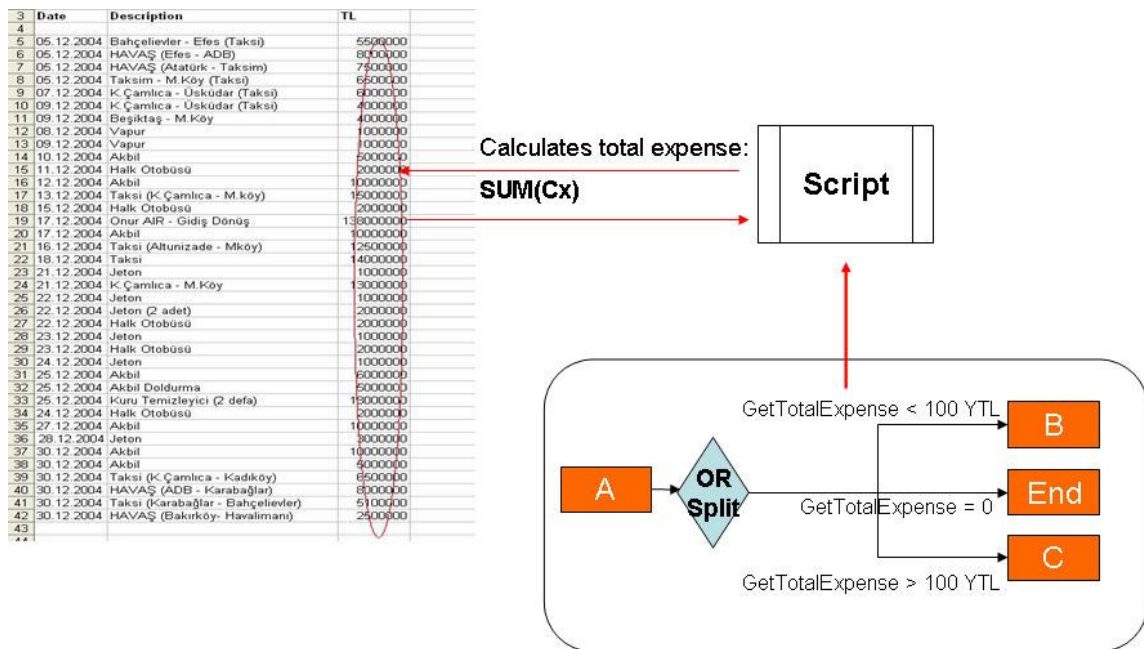


Figure 5.19 Client Application Activity Detail Document Integration Example

**5.2.4.5.4 Client Application Activity Forms.** Forms are special documents which are attached to workflows / activities. Not only forms may be read-only but also their field's visibility may be set according to access rights defined during workflow definition. Form field values can also be used in workflow routing as document attributes can.



Figure 5.20 Client Application Activity Detail Forms

#### 5.2.4.6 Client Application Activity Outbox

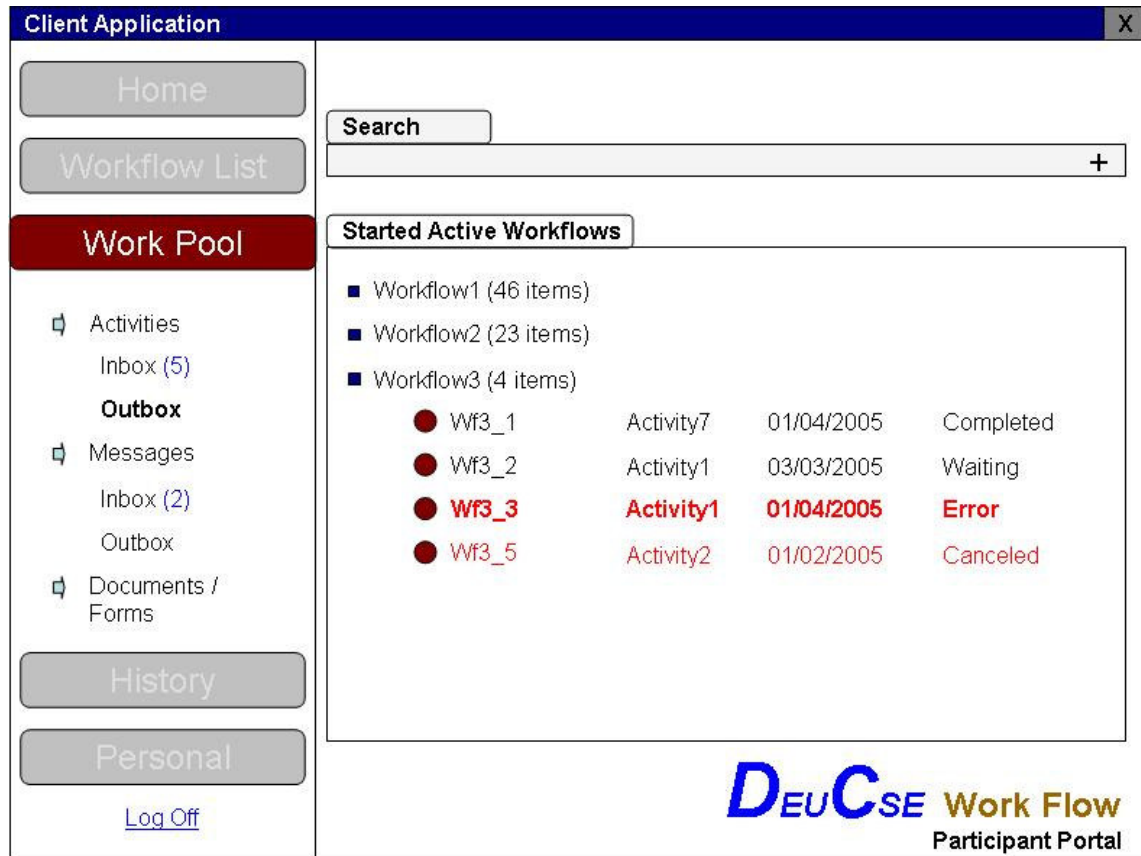


Figure 5.21 Client Application Work Pool Activity Outbox

Workflow participants can track the active workflows which they already initiated via Outbox part of client application. The workflow templates which have initiation access for the logged user are listed. Each template have the instance list so that the users can see the last status of each initiated workflows in one line. Each line has the following information:

Table 5.2 Initiated Workflow List Information

Field	Description
Workflow Code	The code of workflow instance

Last / Current Activity Name	The name of last / current activity
Last / Current Activity Start Date	The start date of last / current activity
Workflow Status	The current status of whole workflow

Each workflow line can open a dialog that is listing all completed activities as it can be seen from Figure 5.22.

Activity History

Workflow Group1  
Workflow 3 – Wf3\_1  
Start Date: 01/04/2005

Activities **Completed**

Name	Start	End	Status
■ Activity 1	01/04/2005 12:03	01/04/2005 17:00	Approved
■ <b>Activity 2</b>	<b>01/04/2005 17:00</b>	<b>02/04/2005 15:00</b>	<b>Rejected</b>
■ Activity 1	02/04/2005 15:00	02/04/2005 16:30	Approved
■ Activity 2	02/04/2005 16:30	02/04/2005 16:59	Approved
■ Activity 3	02/04/2005 16:59	04/04/2005 10:28	Approved
■ Activity 4	04/04/2005 10:28	05/04/2005 14:44	Completed
■ Activity 5	05/04/2005 14:44	08/04/2005 08:23	Approved
■ Activity 6	08/04/2005 08:23	08/04/2005 09:58	Completed
■ <u>Activity 7</u>	08/04/2005 09:58	08/04/2005 13:07	Approved

**DEUCSE Work Flow**  
Participant Portal

Figure 5.22 Client Application Work Pool Activity History Dialog

Table 5.3 Activity History List Information

Field	Description
Activity Name	The name of activity
Activity Start Date	The start date of activity

Activity End Date	The end date of activity
Activity Status	The status of the activity

#### 5.1.3.7 Client Application Activity Messages

Messages part can be similar to common e-mail programs such as Microsoft Outlook. It may be possible to integrate with existing mail programs instead of developing it. By using the benefits of Outlook, users can receive and send e-mails, search on and sort existing messages, archive and / or delete old items.

Inbox part should display the messages which have been sent to the logged workflow participant while output part of Messages part can display the sent messages by that user. Following two figures show the general design for that part.

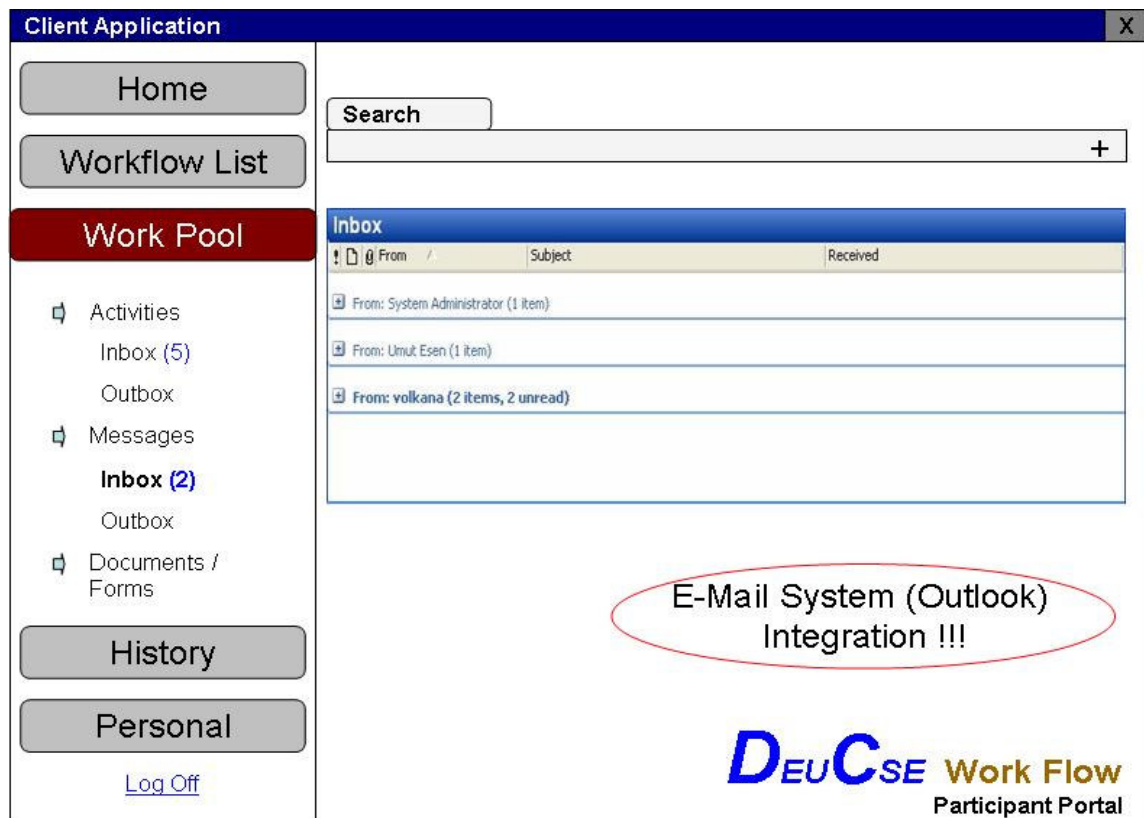


Figure 5.23 Client Application Work Pool Messages Inbox



The messages in Inbox can be sent by three different type of workflow participant:

Table 5.4 Inbox Message Types

Field	Description
Workflow Participant (Activity Owners)	The activity owners can send messages to other participants via the activity screen if they have SendMessage access right.
System Administrators	System administrators can send messages via Administration Portal
System	System can send messages in lots of cases such as notification of activity expiration, workflow initiation / cancellation, activity delegation, etc.

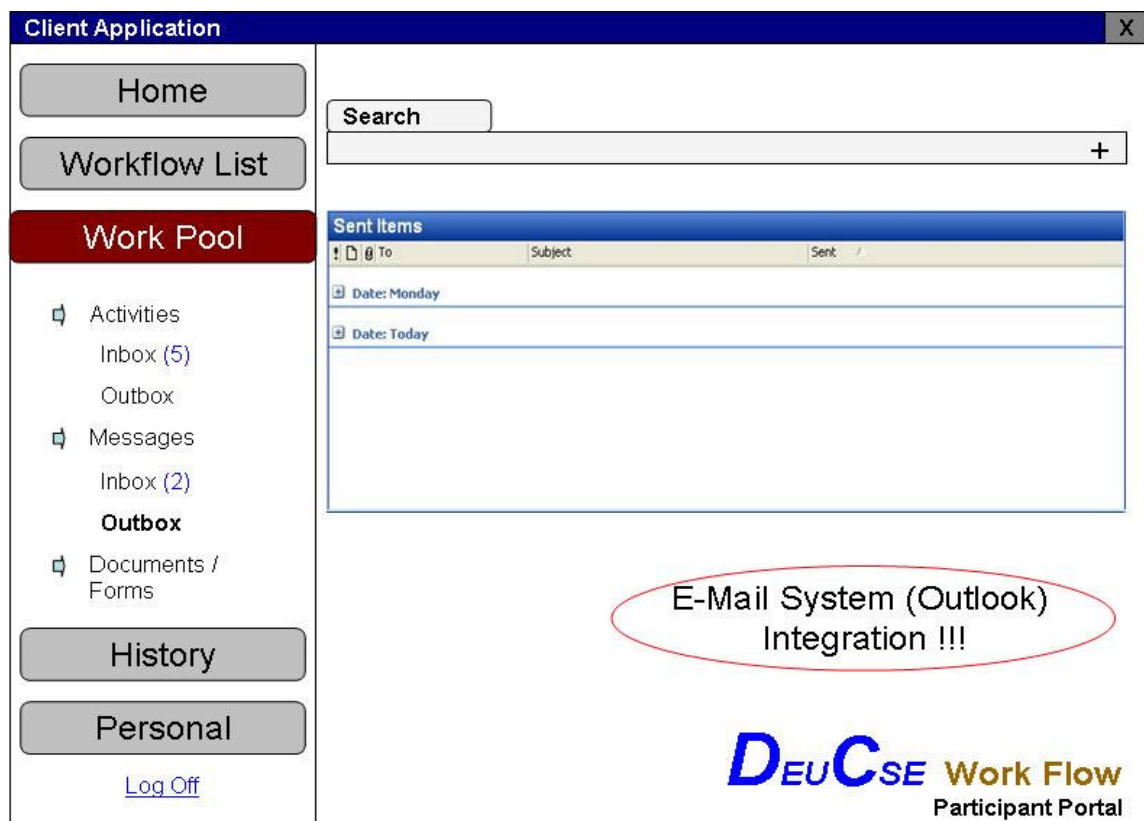


Figure 5.24 Client Application Work Pool Messages Outbox (Sent Items)

The messages in Outbox can be sent by two different type of workflow participant:

Table 5.5 Inbox Message Types

Field	Description
Workflow Participant (Activity Owner)	The logged workflow participant can send the message to whom he / she wants
System	System can send messages in lots of cases such as activity completion / cancellation / delegation, workflow initiation / cancellation, etc.

#### 5.1.3.8 Client Application Activity Documents / Forms Search

**Client Application** [X]

Home

Workflow List

**Work Pool**

- Activities
  - Inbox (5)
  - Outbox
- Messages
  - Inbox (2)
  - Outbox
- Documents / Forms**
- History
- Personal
- [Log Off](#)

**Search**

Workflow Name

Activity Name

Document ☐ Form ☐

Document Name

**DEUCSE Work Flow**  
Participant Portal

Figure 5.25 Client Application Work Pool Documents & Forms Search

If the users request viewing documents and / or forms in active workflows, they can search them individually from Documents / Forms part instead of dealing with activities part.

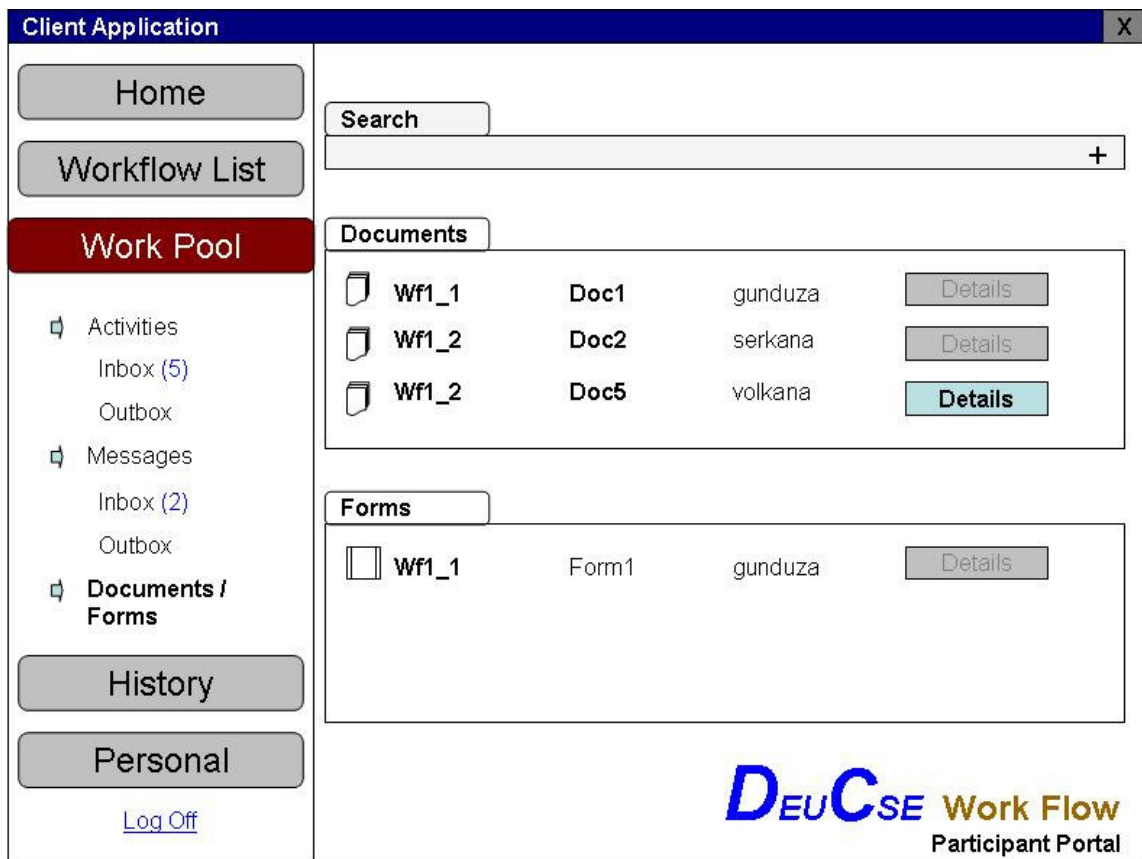


Figure 5.26 Client Application Work Pool Documents & Forms

Table 5.6 Documents / Forms List Information

Field	Description
Workflow Instance Code	The code for the Workflow Instance to which the template is attached
Document / Form Template Name	The name for document / form template
Last person who modified	The username of last person who modified the

	document / form
--	-----------------

The document / form details can be viewed by clicking Details button. If that button is disabled, it means the document / form is hidden for the user. (These documents may not be shown in the list, too)

When the “Details” button is clicked, the Document / Activity detail dialog appears. The users can view the documents, document attributes or forms via this dialog.

#### 5.1.3.9 Client Application History Tracking

**Client Application** [X]

Home

Workflow List

Work Pool

**History**

Personal

[Log Off](#)

**Search**

Workflow ☐ Activity ☐ Document ☐ Form ☐

Workflow Name

Activity Name

User

Document

Form

Search Clear

**DEUCSE Work Flow**  
Participant Portal

Figure 5.27 Client Application History Search

The users can also request to view old workflow information. Only the workflows which they are involved in can be searched.

**Client Application** X

Home

Workflow List

Work Pool

**History**

Personal

[Log Off](#)

Search

+

**Workflows**

Workflow	Start	End	Status
■ Workflow1	01/04/2005	10/04/2005	Completed
■ Workflow2	03/03/2005	17/03/2005	Waiting
■ Workflow3	<b>01/04/2005</b>	<b>02/04/2005</b>	<b>Error</b>

**DEUCSE Work Flow**  
Participant Portal

Figure 5.28 Client Application History

When the workflow is clicked, the Activity History dialog can appear. If the searched item is document or form, the Detail screen of related item will be opened. It may be possible to view all activity information by clicking on result record if the searched item is activity.

### 5.1.3.10 Client Application Personal Information

The screenshot displays the 'Client Application' window with a sidebar on the left containing navigation buttons: Home, Workflow List, Work Pool, History, and Personal (highlighted in red). Below the 'Personal' button is a 'Log Off' link. The main content area is divided into two sections: 'Configuration' and 'User Calendar'.

**Configuration**

- ☐ Out of office Alternate User
- ☐ Show custom information messages on Home Page
- ☐ Archive Completed workflow  Month  later information

**User Calendar**

July / 2002

1 09:00-18:00	2 09:00-18:00	3 09:00-18:00	4 09:00-18:00	5 09:00-18:00	6 09:00-18:00	7 09:00-18:00
8 09:00-18:00	9 09:00-18:00	10 09:00-18:00	11 09:00-18:00	12 09:00-18:00	13 09:00-18:00	14 09:00-18:00
15 09:00-18:00	16 09:00-18:00	17 09:00-18:00	18 09:00-18:00	19 09:00-18:00	20 09:00-18:00	21 09:00-18:00
22 09:00-18:00	23 09:00-18:00	24 09:00-18:00	25 09:00-18:00	26 09:00-18:00	27 09:00-18:00	28 09:00-18:00
29 09:00-18:00	30 09:00-18:00	31 09:00-18:00				

DEUCSE Work Flow Participant Portal

Figure 5.29 Client Application Personal Information

In Personal part of DEUCSE Work Flow application, the user can

- set out of office flag and determine alternate user for the works
- display custom Information messages
- archive old workflow information
- view is / her personal work calendar

When the user will be out of office, he / she should set the flag and choose an alternate user (or user group). If the user seems as out of office, he can not initiate any workflows, perform any activities and send any messages. To be able to use all client

application, the Out of office flag should be removed from the same screen. Some other workflow participants and also selected alternate users The Out of office information

If “Show custom information messages on Home Page” check box is checked, some custom messages which may be defined by the system administrator will appear on Home Page. Password expiration notification, number of pending activities messages are some examples to custom messages.

User can set the archiving time for old workflow information. After a workflow is completed, the system can hold that workflow in Work Pool till the chosen time period is over. After that time, all the workflow items are hold in history.

## **CHAPTER SIX**

### **WORKFLOW USE CASE: CUSTOMER CONTRACTS**

#### **6. Introduction**

The best way to show how workflow usage affects the business process quality and speed and how it presents a common infrastructure to development team for the future use is discussing on some real use case examples.

In this chapter, a real-life case is explained to show the benefits of workflows. It demonstrates the design, development and change request steps for a customer contract processing application; the instance system is a recent system for a production company that is not designed as a workflow system; so for that case it is tried to be proved that workflows would accelerate these processes and gets life easier for the business.

For the example, the use case scenario, table and model design of the current systems, user interface design, proposed models and other related information are given based on software engineering methodology and documentation standards.

#### **6.1 Use Case: Contract**

In this case, the company prepares some contracts with some customers. Contracts include a start date and an end date, customer code, some business-related fields to be filled in, and a contract type which is used only for representing the type information of the contract. Some contracts can be designed as templates; it means the users can create contracts by directly copying these templates.

A contract should be first created and then started. If business conditions are met then it can be ended by automatically or manually. They can be cancelled whenever it is



required. These user interactions can be called as actions and every action can be undone, if it is possible.

### ***6.1.1 Version 1: Basic Implementation***

According to the basic specification given above, only one SQL table can be created named “Contract”.

#### ***6.1.1.1 Table Design***

Table 6.1 Contract table design

Column name	Data type	Is NULL
ContractId	GUID	NOT NULL
ContractCode	nChar (12)	NOT NULL
ContractDescription	nVarChar (32)	NOT NULL
ContractIsTemplate	Bit	NOT NULL
ContractStatus	Char (1)	NOT NULL
ContractTemplate_ ContractId	GUID NULL	NULL
ContractType	nVarChar (32)	NOT NULL
...		

- **ContractId:**

This is the primary key of Contract table which probably is generated by system. The type is unique identifier.

- **ContractCode:**

This is the unique string code for Contract Template / Contract.

- **ContractDescription:**

This is the Contract / Contract template description

- **ContractIsTemplate:**

Both contract templates and templates are stored in the same table. Therefore this column is needed to sepearate contract templates from contract instances.

Table 6.2 ContractIsTemplate field descripiton

Value	Description
0	This definition is a Contract
1	This definition is a Contract Template

- **ContractStatus:**

ContractStatus field shows the last status of contract. Status information is bothered after the related action has been performed. For example, when the user clicks End button, the status for contract is changed from Started to Ended mode, if it is possible.

Usage of status for Contract and Contract templates works a bit different as they can be viewed from the tables below.

Table 6.3 Contract template status explanation

Action	Resulting Status	Notes
Creation	“O” Open	Each Contract template is created with Status “O”. Templates having status “O” are not usable to create Contracts. Possible actions: Confirmation, Cancellation
Cancellation	“X” Cancelled	Cancelled templates are kept just to preserve the last template status. They are read/only and not

		usable for Contract creation. Possible actions: Undo.
--	--	--

Table 6.4 Contract status explanation

Action	Resulting Status	Notes
Creation	“O” Open	Each Contract is created with Status “O”. Possible actions: Confirmation, Cancellation
Starting	“S” Started	Start date is saved to ContractStartDate if it is empty. Possible actions: Ending, Cancellation and/or Undo.
Ending	“E” Ended	End date is saved to ContractEndDate if it is empty. Possible actions: Undo.
Cancellation	“X” Cancelled	Cancelled Contracts are kept just to preserve the last data status. They are read/only Possible actions: Undo.

▪ **Contract\_ContractTemplateId:**

Because some contracts can be created from existing contract templates, they should reference the template. For that reason Contract table has a self-referencing. (Contract\_ContractTemplateId references another ContractId in the table)

Table 6.5 Contract\_ContractTemplateId field description

Entity	Description
Contract	Optional Contract template GUID

ContractTemplate	NULL
------------------	------

▪ **ContractType:**

This column includes contract type information. Contract type may be classified according to the customer type (e.g. SuperMarket, Market, Canteen contract types ...) It may be static string or an enumeration value.

#### *6.1.1.2 Contract / Contract Template Function Design*

Contract template processing allows users to perform three actions: Create, Cancel and Undo Cancel. Therefore three corresponding business service methods should be created. They access to database via Data Access Layer.

Table 6.6 Contract template model design explanation

<b>UI Element</b>	<b>BS Method</b>	<b>DA Method</b>	<b>Parameters</b>
Create button	CreateContractTemplate(c)	CREATE	ContractIsTemplate = 1 ContractStatus = 'O'
Cancel button	CancelContractTemplate(c)	UPDATE	ContractIsTemplate = 1 ContractStatus = 'X'
Undo Cancel button	UndoCancelContractTemplate(c)	UPDATE	ContractIsTemplate = 1 ContractStatus = 'O'

Contract processing allows users to perform seven actions: Create, Start, End, Cancel, Undo Start, Undo End and Undo Cancel. For each action, necessary business service methods should be created. They access to database via Data Access Layer.

Table 6.7 Contract model design explanation

UI Element	BS Method	DA Method	Parameters
Create button	CreateContract (c)	CREATE	ContractIsTemplate = 0 ContractStatus = 'O'
Start button	StartContract (c)	UPDATE	ContractIsTemplate = 0 ContractStatus = 'S'
Undo Start button	UndoStartContract(c)	UPDATE	ContractIsTemplate = 0 ContractStatus = 'O'
End button	EndContract (c)	UPDATE	ContractIsTemplate = 0 ContractStatus = 'E'
Undo End button	UndoEndContract(c)	UPDATE	ContractIsTemplate = 0 ContractStatus = 'O' or ContractStatus = 'S'
Cancel button	CancelContract (c)	UPDATE	ContractIsTemplate = 0 ContractStatus = 'X'
Undo Cancel button	UndoCancelContract(c)	UPDATE	ContractIsTemplate = 0 ContractStatus = 'O'

### 6.1.1.3 Contract / Contract Template User Interface Design

According to these specifications, only one main UI is enough. (Contract / Contract Template Definition screen)

#### 6.1.1.4 First Version Development Cost

For that case, three team members play a role during the whole implementation. Their cost (budge & time) varies according to the complexity of business requirements; for that case system development phase takes a bit more time than system design phase.

Table 6.8 Development cost of first Contract version

Software Engineering Phase	# of Staff	# of Days
System Design	1	1,5n
System Development (with Feedbacks)	1	2n
System Testing & Debugging	1	n

#### 6.1.2 Version 2: Change Request in Contracts

In the new version of the application, there are three main change requests:

- Period definition requirement rather than Contract start date and end date definition is needed.
- Contract should be available to predefined groups (e.g. role) of users. This group can be defined first by the administrator.
- A new action called “Contract Confirmation” is needed for the new version: Confirmation is allowed by only a restricted group (e.g. role) of users.

##### 6.1.2.1 Table Design: New tables & modification in existing tables

Therefore, one possibility is to create two new tables; one called “ContractType” and another called “ContractTypeRole”. Additionally, “Contract” table should also be

modified by changing the ContractType column and adding two new columns to provide period enhancement.

“ContractType” table can be used to handle Contracts based on the role of logged user by being referenced another table; “ContractTypeRole”. It also decides whether contract confirmation has an approval mechanism or not.

Table 6.9 New table: ContractType

Column name	Data type	Description
ContractTypeId	GUID	NOT NULL
ContractTypeCode	nChar (12)	NOT NULL
ContractTypeDescription	nVarChar (32)	NOT NULL
ContractType IsConfirmationRequested	Bit	NOT NULL
...		

- **ContractTypeId:**

This is the primary key of ContractType table which probably is generated by system. The type is uniqueidentifier.

- **ContractTypeCode:**

This is the unique string code for Contract Type.

- **ContractTypeDescription:**

This is the Contract Type description

- **ContractTypeIsConfirmationRequested:**

This column defines whether the contract confirmation has to be approved or not by a defined supervisor(s).

Table 6.10 ContractTypeIsConfirmationRequested field description

Value	Description
0	Supervisor confirmation is not required
1	Supervisor (or other authorized personnel) confirmation is required

“ContractTypeRole” table sets up basic access rights to Contracts and Contract templates by referencing to ContractType and Role tables.

Table 6.11 New table: ContractTypeRole

Column name	Data type	Description
ContractTypeRoleId	GUID	NOT NULL
ContractTypeRole_ ContractTypeId	GUID	NOT NULL
ContractTypeRole_ RoleId	GUID	NOT NULL
ContractTypeRole IsConfirmationAllowed	Bit	NOT NULL
...		

- **ContractTypeRoleId:**

This is the primary key of ContractTypeRole table which probably is generated by system. The type is uniqueidentifier.

- **ContractTypeRole\_ContractTypeId:**

It is a foreign key that references to table ContractType



- **ContractTypeRole\_ RoleId:**

It is a foreign key that references to table Role

- **ContractTypeRoleIsConfirmationAllowed:**

This column defines the contract confirmation approver. The role for whom confirmation allowed could only be allowed to confirm contracts.

Table 6.12 ContractTypeRoleIsConfirmationAllowed field description

Value	Description
0	The role does not have rights to confirm contracts where confirmation is requested
1	The role has rights to confirm contracts where confirmation is requested

“Contract” table should be updated by adding three more fields related to the new requirements.

Table 6.13 New Table: Contract table new version

Column name	Data type	IS NULL
ContractId	GUID	NOT NULL
ContractCode	nChar (12)	NOT NULL
ContractDescription	nVarChar (32)	NOT NULL
ContractIsTemplate	Bit	NOT NULL
ContractStatus	Char (1)	NOT NULL
ContractTemplate_ ContractId	GUID NULL	NULL
<b>Contract_ContractTypeId</b>	<b>GUID</b>	<b>NOT NULL</b>
<b>ContractPeriodUnit</b>	<b>Char (1)</b>	<b>NOT NULL</b>
<b>ContractPeriodDuration</b>	<b>SmallInt</b>	<b>NOT NULL</b>

...	...	...
-----	-----	-----

- **Contract\_ContractTypeId:**

This field is a foreign key to ContractType table; contract access rights which are based on the roles are handled by this column.

- **ContractPeriodUnit:**

It represents time unit for contracts. All the supported units are listed in Table 6.2.

Table 6.14 ContractPeriodUnit field description

Time unit	Description
0	Unused
1	Second
2	Minute
3	Hour
4	Day
5	Week
6	Month
7	Year

- **ContractPeriodDuration:**

Period duration in above units. Positive values allowed only. For example, the contracts with 3 years period, has Year unit and 3 value as a duration.

#### 6.1.2.2 Contract / Contract Template Status Explanation New Version

Table 6.15 Contract template status new version

Action	Resulting	Notes
--------	-----------	-------

	Status	
Creation	“O” Open	Each Contract template is created with Status “O”. Templates having status “O” are not usable to create Contracts. Possible actions: Confirmation, Cancellation
Confirmation	“C” Confirmed	<b>Template having status “C” is suitable for Contract creation. Template data are read/only in this state.</b> <b>Possible actions: Cancellation, Undo.</b>
Cancellation	“X” Cancelled	Cancelled templates are kept just to preserve the last template status. They are read/only and not usable for Contract creation. Possible actions: Undo.

Table 6.16 Contract Status New Version

Action	Resulting Status	Notes
Creation	“O” Open	Each Contract is created with Status “O”. Possible actions: Confirmation, Cancellation
Confirmation	“W” Waiting for confirmation or “C” Confirmed	<b>The Waiting state is created based on the ContractType settings. After confirmation by responsible user (see ContractTypeRole table) the Contract state becomes “C”.</b> <b>If no confirmation is necessary or if the contract is prepared directly by the user having rights to confirm it, the Contract is switched directly to “C” state.</b> <b>Possible actions: Cancellation, Starting, Undo.</b>
Starting	“S” Started	Start date is saved to ContractStartDate if it is

		empty. Possible actions: Ending, Cancellation and/or Undo.
Ending	“E” Ended	End date is saved to ContractEndDate if it is empty. Possible actions: Undo.
Cancellation	“X” Cancelled	Cancelled Contracts are kept just to preserve the last data status. They are read/only Possible actions: Undo.

### 6.1.2.3 Contract / Contract Template Model Design New Version

Table 6.17 Contract template model design new version

UI Element	BS Method	DA Method	Notes
Create button	CreateContractTemplate(c)	CREATE	ContractIsTemplate = 1 ContractStatus = ‘O’
<b>Confirm button</b>	<b>ConfirmContractTemplate (c)</b>	<b>UPDATE</b>	<b>ContractIsTemplate = 1</b> <b>ContractTemplateStatus = ‘C’</b>
<b>Undo Confirm button</b>	<b>UndoConfirmContractTemplate (c)</b>	<b>UPDATE</b>	<b>ContractIsTemplate = 1</b> <b>ContractTemplateStatus = ‘O’</b>
Cancel button	CancelContractTemplate(c)	UPDATE	ContractIsTemplate = 1 ContractStatus = ‘X’
Undo Cancel button	UndoCancelContractTemplate(c)	UPDATE	ContractIsTemplate = 1 ContractStatus = ‘O’

Table 6.18 Contract model design new version

UI Element	BS Method	SQL	Parameter
Create button	CreateContract (c)	CREATE	ContractIsTemplate = 0 ContractStatus = 'O'
<b>Confirm button</b>	<b>ConfirmContract (c)</b>	<b>UPDATE</b>	<b>ContractIsTemplate = 0</b> <b>ContractStatus = 'C'</b> <b>or</b> <b>ContractStatus = 'W'</b>
<b>Undo Confirm button</b>	<b>UndoConfirmContract(c)</b>	<b>UPDATE</b>	<b>ContractIsTemplate = 0</b> <b>ContractStatus = 'O'</b>
Start button	StartContract (c)	UPDATE	ContractIsTemplate = 0 ContractStatus = 'S'
Undo Start button	UndoStartContract(c)	UPDATE	ContractIsTemplate = 0 <b>ContractStatus = 'C'</b>
End button	EndContract (c)	UPDATE	ContractIsTemplate = 0 ContractStatus = 'E'
Undo End button	UndoEndContract(c)	UPDATE	ContractIsTemplate = 0 <b>ContractStatus = 'C'</b> <b>or</b> <b>ContractStatus = 'W'</b> or ContractStatus = 'S' (business requirements)
Cancel button	CancelContract (c)	UPDATE	ContractIsTemplate = 0 ContractStatus = 'X'
Undo Cancel button	UndoCancelContract(c)	UPDATE	ContractIsTemplate = 0 ContractStatus = 'O'

#### *6.1.2.4 Contract / Contract Template User Interface Design New version*

New business requirements needs creation of a new entity UI (Contract Type definition) and an update to an existing UI (Contract / Contract Template definition screen)

#### *6.1.2.5 New Version Development Cost*

Table 6.19 Development cost of new Contract version

<b>Software Engineering Phase</b>	<b># of Staff</b>	<b># of Days</b>
System Design	1	1,5n
System Development (with Feedbacks)	1	3n
System Testing & Debugging	1	2n

### *6.1.3 Version 3: Change Request in Contracts*

After a period, a new change request is appeared about messaging. Some people should be notified by the information of contracts which are waiting for confirmation. Because it is expected that the new change should be performed as quickest as possible; the easiest way is to implement the messaging hard-coded where it is needed in the system.

#### *6.1.3.1 Table Design: Modification in Contract table*

Contract table needs one more column: ContractConfirm\_RoleId GUID NULL.

Table 6.20 New Table: Contract table new version

Column name	Data type	IS NULL
ContractId	GUID	NOT NULL
ContractCode	nChar (12)	NOT NULL
ContractDescription	nVarChar (32)	NOT NULL
ContractIsTemplate	Bit	NOT NULL
ContractStatus	Char (1)	NOT NULL
ContractTemplate_ ContractId	GUID	NULL
Contract_ ContractTypeId	GUID	NOT NULL
ContractPeriodUnit	Char (1)	NOT NULL
ContractPeriodDuration	SmallInt	NOT NULL
<b>ContractConfirm_ RoleId</b>	<b>GUID</b>	<b>NULL</b>
...	...	...

▪ **ContractConfirm\_ RoleId:**

This field is be used to generate a notification message for contracts waiting for confirmation.

This column should contain PositionId in following status:

Table 6.21 Contract model design new version

Status	Notes
“O” Open	No RoleId (GUID NULL)
“W” Waiting	Role which is allowed to confirm the contract
“C” Confirmed	Role which really confirmed the contract
“S” Started	Role which really confirmed the contract
“E” Ended	Role which really confirmed the contract
“X” Cancel	Does not change RoleId
Undo	Change the RoleId to the original value

### 6.1.3.2 Contract / Contract Template Model Design New Version

Table 6.22 Contract model design new version

UI Element	BS Method	SQL	Parameter
Create button	CreateContract (c)	CREATE	ContractIsTemplate = 0 ContractStatus = 'O' <b>ContractConfirm_RoleId</b> = <i>NULL</i>
Confirm button	ConfirmContract (c)	UPDATE	ContractIsTemplate = 0 ContractStatus = 'C' ContractConfirm_RoleId = <i>RoleWhoConfirmed</i> or ContractStatus = 'W' <b>ContractConfirm_RoleId</b> = <i>RoleWhoWillConfirm</i>
Undo Confirm button	UndoConfirmContract(c)	UPDATE	ContractIsTemplate = 0 ContractStatus = 'O' <b>ContractConfirm_RoleId</b> = <i>NULL</i>
Start button	StartContract (c)	UPDATE	ContractIsTemplate = 0 ContractStatus = 'S' <b>ContractConfirm_RoleId</b> = <i>RoleWhoConfirmed</i>
Undo Start button	UndoStartContract(c)	UPDATE	ContractIsTemplate = 0 ContractStatus = 'C' <b>ContractConfirm_RoleId</b> = <i>RoleWhoConfirmed</i>
End button	EndContract (c)	UPDATE	ContractIsTemplate = 0



			ContractStatus = 'E' <b>ContractConfirm_RoleId = <i>RoleWhoConfirmed</i></b>
Undo End button	UndoEndContract(c)	UPDATE	ContractIsTemplate = 0 ContractStatus = 'C' <b>ContractConfirm_RoleId = <i>RoleWhoConfirmed</i></b> <b>or</b> ContractStatus = 'W' <b>ContractConfirm_RoleId = <i>RoleWhoWillConfirm</i></b> <b>or</b> ContractStatus = 'S' <b>ContractConfirm_RoleId = <i>RoleWhoConfirmed</i></b> <b>(business requirements)</b>
Cancel button	CancelContract (c)	UPDATE	ContractIsTemplate = 0 ContractStatus = 'X'
Undo Cancel button	UndoCancelContract(c)	UPDATE	ContractIsTemplate = 0 ContractStatus = 'O' <b>ContractConfirm_RoleId : DOES NOT CHANGE</b>

### 6.1.3.3 Contract / Contract Template User Interface Design New version

The Role may be displayed in Contract screen.

#### 6.1.3.4 New Version Development Cost

Table 6.23 Development cost of new Contract version

Software Engineering Phase	# of Staff	# of Days
System Design	1	1n
System Development (with Feedbacks)	1	2n
System Testing & Debugging	1	2n

#### 6.1.4 Contracts with a Workflow System

As it can be understood from the lifecycle of contract development, a small improvement in business requirements affects the whole system, gets it more complex and also increases the cost of the company (or vendor). The number of tables, the number of fields in these tables, the number of stored procedures, the LOC (line of codes) has to be increased due to the new business specification.

It is important to mention that all new requirements are related to the workflow concept. Contract has a period definition with the new version, and a workflow already has an advanced timing. Suggested new action; “contract confirmation” has to be approved by a predefined static supervisors; at the other hand workflows have more comprehensive and intelligent approval mechanisms. And in contracts; there is a template – instance relation as in the workflows.

Although some enhancement is applied, after a time new requirements can also be defined for the customer contract process such:

- Timing for each actions (Confirmation period, start period, end period, ...)
- Approval mechanism and access right definitions for each action.

- Business related fields access right definition
- Action version history tracking
- Different notification messaging for different actions

All these requirements are generic ones which are related with workflow concepts. They can be available and common for any other activities of the business, too. Therefore a workflow infrastructure should be preferred instead of the usage of different applications due to meet the business requirements.

The whole object model which also represents DB design can be used. All the contracts are defined as workflows and each action belonging to contract processing are the activities of these workflows. Two different types of workflow can be designed to define whole contract processes. One is a template workflow and another can be for standalone workflow. The electronic form or application path which is used for business flow should also be referenced by these workflow definitions.

#### *6.1.4.1 Contract Template Workflow*

Table 6.24 Contract template workflow

Workflow Template Code	WFT1
Workflow Template Name	ContractTemplate1
Workflow Template Group	ContractGroup
Workflow E-Form / Application Path	Contract E-Form
Workflow Duration	1 Year

Table 6.25 Contract template workflow activities

	<b>Activity-1</b>	<b>Activity-2</b>
<b>Code</b>	A1WFT1	A2WFT1

<b>Name</b>	Contract Template Creation	Contract Template Confirmation
<b>E-Form</b>	WFT1 EF	A1WFT1 EF
<b>Owner</b>	Creator	Confirmation Supervisor
<b>Access Rights</b>	Create	Confirm, Undo, Cancel

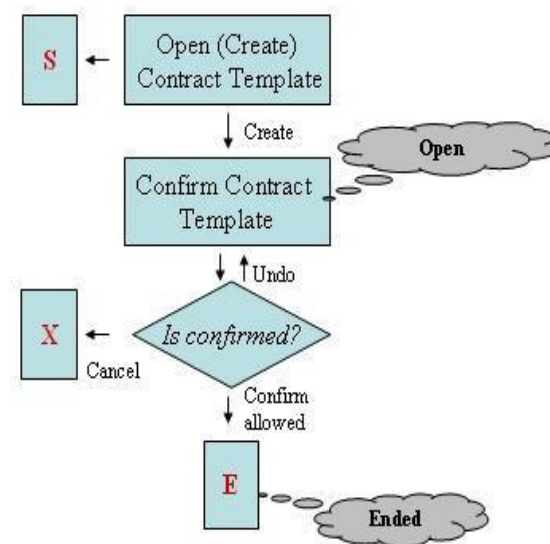


Figure 6.1. Contract Template Workflow

#### 6.1.4.2 Contract Workflow

Table 6.26 Contract workflow

Workflow Code	WF1
Workflow Name	Contract1
Workflow Template	WFT1
Workflow E-Form	Contract E-Form
Workflow Duration	1 Year

Table 6.27 Contract workflow activities

	<b>Activity-1</b>	<b>Activity-2</b>	<b>Activity-3</b>	<b>Activity-4</b>	<b>Activity-5</b>
<b>Code</b>	A1WF1	A2WF1	A2WF3	A2WF4	A2WF5
<b>Name</b>	Contract Template Creation	Contract Confirmation	Contract Confirmation Approval	Contract Starting	Contract Ending
<b>E-Form</b>	WFT EF	A1WF1 EF	A2WF1 EF	A3WF1 EF	A4WF1 EF
<b>Owner</b>	Creator	Confirmation Supervisor	Confirmation Approval Supervisor	Starter	Ender
<b>Access Rights</b>	Create	Confirm, Undo, Cancel	Confirm, Undo, Cancel	Start, Undo, Cancel	End, Undo, Cancel

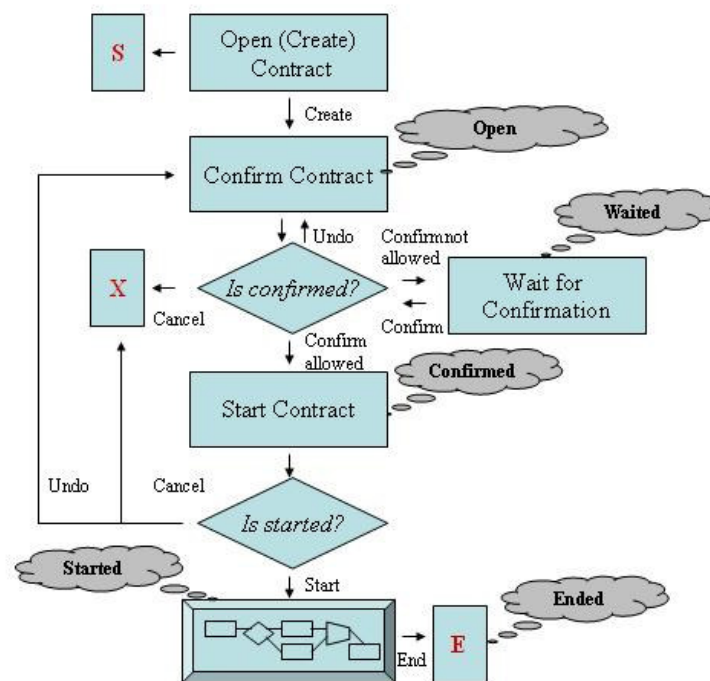


Figure 6.2. Contract Workflow

Workflow engine gets the whole activity information with the user actions and tries to evaluate it. Client calls the BS method to do this: `GoToNextActivity`. If the activity is “Contract Confirmation” activity and the user clicks “OK” button, it means the activity is demanded to be confirmed. So the engine tries to determine whether the user can go to next step or wait in “Waited” status so that the activity is sent to another user for confirmation. The engine can also cancel the activity or workflow during that evaluation process according to the defined business conditions.

Table 6.28 Workflow model design

UI Element	BS Method
OK / Save / Undo / Jump button	<code>GoToNextActivity(a)</code>
Cancel button	<code>CancelWorkflow(a)</code>

By using a workflow system, all business is covered by the electronic form(s), documents or third party applications which are attached to the activities during the workflow definition. The approval mechanism, access rights, the definition for durations and notifications and actions such as canceling, undoing operations are independent from the business and covered by workflow system itself.

**CHAPTER SEVEN**  
**A WORKFLOW SYSTEM PROPOSAL**  
**FOR COMPUTER ENGINEERING DEPARTMENT OF**  
**DOKUZ EYLUL UNIVERSITY**

## **7. Introduction**

In this chapter, a workflow-based online web application is proposed for Computer Engineering Department of Dokuz Eylul University which will apply for a quality accreditation processing at the beginning of 2006. A complex workflow system with all components which are described in the previous sections is not offered in that case because all the business processes included in the department are easy to implement and not needing a complex architecture. More complex processes are usually included with in other departments of Engineering.

The department will apply to The Engineering Evaluation Board called MÜDEK for the accreditation which was founded in 2002 in Ankara.

### **7.1 What is MÜDEK?**

The mission of MÜDEK is defined as to promote and enhance the engineering education by the accreditation of engineering programs, resulting in better educated and qualified engineers in order to advance the welfare of the society. (MÜDEK, 2004)

The main objectives of MÜDEK can be listed as it follows:

- Evaluation of programs leading to a first level “engineering degree”, administered by MDK faculties.
- Selection and training of program evaluators.



- Providing information and training to program administrators (deans and program chairs) and academic staff on program evaluation.
- Reviewing and updating program evaluation criteria and methods.

MÜDEK is an independent, non-governmental platform consisting of eight members with the following composition:

- One representative of TMMOB,
- One representative of Turkish Society for Quality (Türk Kalite Derneği – KalDer),
- Two representatives of industry, and
- Four representatives of academia.

The term of service of MÜDEK members is two years and limited to three consecutive terms. A group of MÜDEK members is renewed autonomously at the end of each term. MÜDEK membership is a voluntary service. Current deans of MDK faculties cannot serve as MÜDEK members.

MÜDEK evaluation of engineering programs intends to determine whether a given program satisfies a set of criteria or not, therefore it is not a process of ranking these programs but rather it is a process of individual accreditations.

The evaluation process of programs for an institution starts with the submission of a self-evaluation report to MÜDEK prepared by the institution according to a format set by MÜDEK. This report is examined by an evaluation team assigned by MÜDEK specific to the institution requesting evaluation of its programs.

A 3–day on–site visit is performed by the evaluation team to institution, these are the purpose of that visit:

- Resolving unclear and/or unreported issues in the self–study report,
- Meeting academic staff, students, university administration, support personnel, graduates of programs, representatives employing the graduates of programs, and any other pertinent constituencies of the programs, and
- Visiting educational facilities like classrooms, laboratories, libraries, computational facilities, supporting departments, and facilities used by the students to socialize and to realize cultural activities.

## **7.2 General Criteria For Basic Level Programs**

Criteria used in MÜDEK evaluations aim to assure the quality of engineering education as well as to promote a continuous and sustainable system of improvement in engineering programs satisfying the needs of their constituencies. Institutions seeking evaluation of their engineering programs have the responsibility of demonstrating that each such program meets these criteria.

- Students
- Program Educational Objectives
- Program Outcomes and Assessments
- Professional Component of the Curriculum
- Academic Staff
- Facilities
- Institutional Support and Financial Resources
- Program Specific Criteria

### **7.2.1 Students**

The quality and performance of the students and graduates are important considerations in the evaluation of an engineering program. The institution must

evaluate, advise, and monitor students to determine its success in meeting program objectives. (ABET, 2002)

The institution must have and enforce policies for the acceptance of transfer students and for the validation of courses taken for credit elsewhere. The institution must also have and enforce procedures to assure that all students meet all program requirements.

### ***7.2.2 Program Educational Objectives***

Each engineering program for which an institution seeks accreditation or reaccreditation must have in place. (ABET, 2002)

- Detailed published educational objectives that are consistent with the mission of the institution and these criteria
- A process based on the needs of the program's various constituencies in which the objectives are determined and periodically evaluated
- A curriculum and processes that ensure the achievement of these objectives
- A system of ongoing evaluation that demonstrates achievement of these objectives and uses the results to improve the effectiveness of the program.

### ***7.2.3 Program Outcomes and Assessment***

Engineering programs (ABET, 2002) must demonstrate that their graduates have:

- An ability to apply knowledge of mathematics, science, and engineering
- An ability to design and conduct experiments, as well as to analyze and interpret data
- An ability to design a system, component, or process to meet desired needs
- An ability to function on multi-disciplinary teams
- An ability to identify, formulate, and solve engineering problems

- An understanding of professional and ethical responsibility
- An ability to communicate effectively
- The broad education necessary to understand the impact of engineering solutions in a global and societal context
- A recognition of the need for, and an ability to engage in life-long learning
- A knowledge of contemporary issues
- An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

#### ***7.2.4 Professional Component***

The professional component requirements specify subject areas appropriate to engineering but do not prescribe specific courses. The engineering faculty must assure that the program curriculum devotes adequate attention and time to each component, consistent with the objectives of the program and institution. Students must be prepared for engineering practice through the curriculum culminating in a major design experience based on the knowledge and skills acquired in earlier course work and incorporating engineering standards and realistic constraints that include most of the following considerations: economic; environmental; sustainability; manufacturability; ethical; health and safety; social; and political. . (ABET, 2002)

The professional component must include:

- One year of a combination of college level mathematics and basic sciences (some with experimental experience) appropriate to the discipline
- One and one-half years of engineering topics, consisting of engineering sciences and engineering design appropriate to the student's field of study
- A general education component that complements the technical content of the curriculum and is consistent with the program and institution objectives.

### ***7.2.5 Faculty***

The faculty is the heart of any educational program. The faculty must be of sufficient number; and must have the competencies to cover all of the curricular areas of the program. There must be sufficient faculty to accommodate adequate levels of student-faculty interaction, student advising and counseling, university service activities, professional development, and interactions with industrial and professional practitioners, as well as employers of students. (ABET, 2002)

### ***7.2.6 Facilities***

Classrooms, laboratories, and associated equipment must be adequate to accomplish the program objectives and provide an atmosphere conducive to learning. Appropriate facilities must be available to foster faculty-student interaction and to create a climate that encourages professional development and professional activities. Programs must provide opportunities for students to learn the use of modern engineering tools. Computing and information infrastructures must be in place to support the scholarly activities of the students and faculty and the educational objectives of the institution. . (ABET, 2002)

### ***7.2.7 Institutional Support and Financial Resources***

Institutional support, financial resources, and constructive leadership must be adequate to assure the quality and continuity of the engineering program. Resources must be sufficient to attract, retain, and provide for the continued professional development of a well-qualified faculty. Resources also must be sufficient to acquire, maintain, and operate facilities and equipment appropriate for the engineering program. In addition, support personnel and institutional services must be adequate to meet program needs. (ABET, 2002)

### ***7.2.8 Program Criteria***

Each program must satisfy applicable Program Criteria (if any). Program Criteria provide the specificity needed for interpretation of the basic level criteria as applicable to a given discipline. Requirements stipulated in the Program Criteria are limited to the areas of curricular topics and faculty qualifications. If a program, by virtue of its title, becomes subject to two or more sets of Program Criteria, then that program must satisfy each set of Program Criteria; however, overlapping requirements need to be satisfied only once. (ABET, 2002)

#### ***7.2.8.1 Program Criteria For Electrical, Computer, And Similarly Named Engineering Programs***

These program criteria apply to engineering programs which include electrical, electronic, computer, or similar modifiers in their titles. The structure of the curriculum must provide both breadth and depth across the range of engineering topics implied by the title of the program. (ABET, 2002)

The program must demonstrate that graduates have:

- Knowledge of probability and statistics, including applications appropriate to the program name and objectives; and
- Knowledge of mathematics through differential and integral calculus, basic sciences, computer science,
- And engineering sciences necessary to analyze and design complex electrical and electronic devices, software, and systems containing hardware and software components, as appropriate to program objectives.

Programs containing the modifier “electrical” in the title must also demonstrate that graduates have knowledge of advanced mathematics, typically including differential

equations, linear algebra, complex variables, and discrete mathematics. Programs containing the modifier “computer” in the title must also demonstrate that graduates have knowledge of discrete mathematics. (ABET, 2002)

### 7.3 A Proposal for MÜDEK Preparation: DEUCSE Online Web Portal

The department of Computer Engineering of Dokuz Eylul University has already an Internet address that the academy units and the students are using. The web site include the courses list, the people working in the department, announcements about the events and activities, access to web mail and library database. And all of these parts except Web mail are accessible to any user who has an Internet Access from their side.



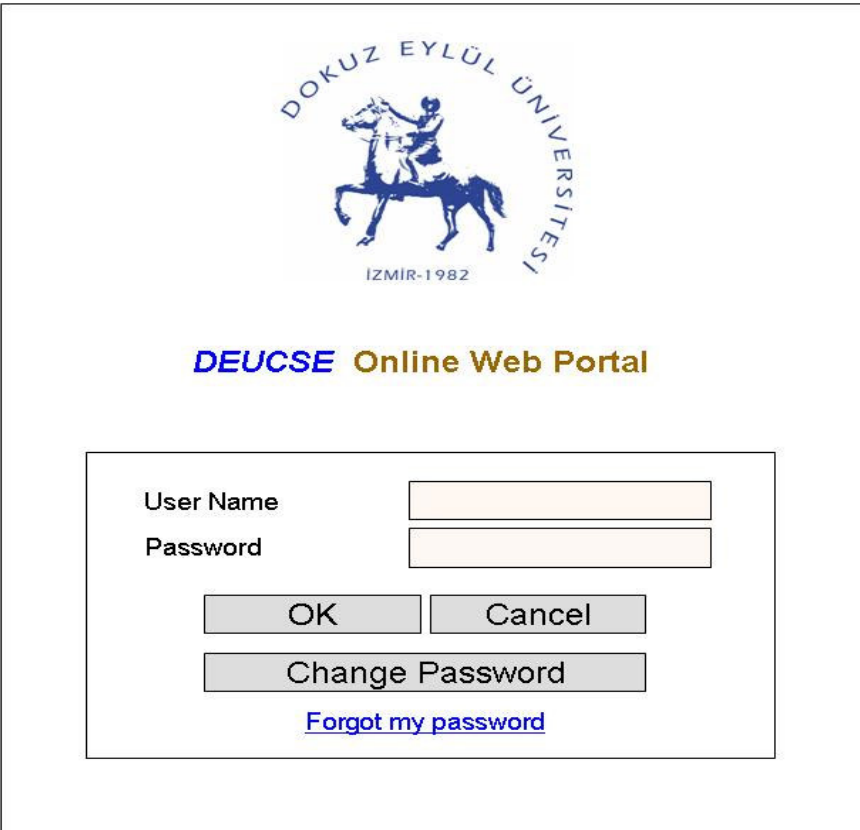
Figure 7.1 Home page of Computer Engineering Department of Dokuz Eylul University

The enhancement about MÜDEK Preparation can be designed mostly for internal use. But it doesn't mean that the application should not be developed as a Web

application. Because not only the internal staff but also the companies, firms, institutes and graduates would be the members of the portal, a web portal application is more applicable. The users should have account information in order to access that secure web sites via the official site of the department.

### 7.3.1 Login

When the users try to access Online Web Portal, a login screen would appear. User should enter his / her user name and password to authenticate to the system.



DOKUZ EYLÜL ÜNİVERSİTESİ

İZMİR-1982

**DEUCSE Online Web Portal**

User Name

Password

OK Cancel

Change Password

[Forgot my password](#)

Figure 7.2 Home page of Computer Engineering Department of Dokuz Eylul University

Some security considerations can be implemented during the login operation including blocking account in multiple wrong password entries, forcing user to change the password, etc.



### 7.3.2 Home Page

When the user logs in, Home Page would appear. The users can log out from the portal manually or according to the security restrictions they are logged out due to the time expiration in a predefined time period.

Users can access to any part of Portal via a frame menu on the left side. This menu should be accessible from each pages of the portal.

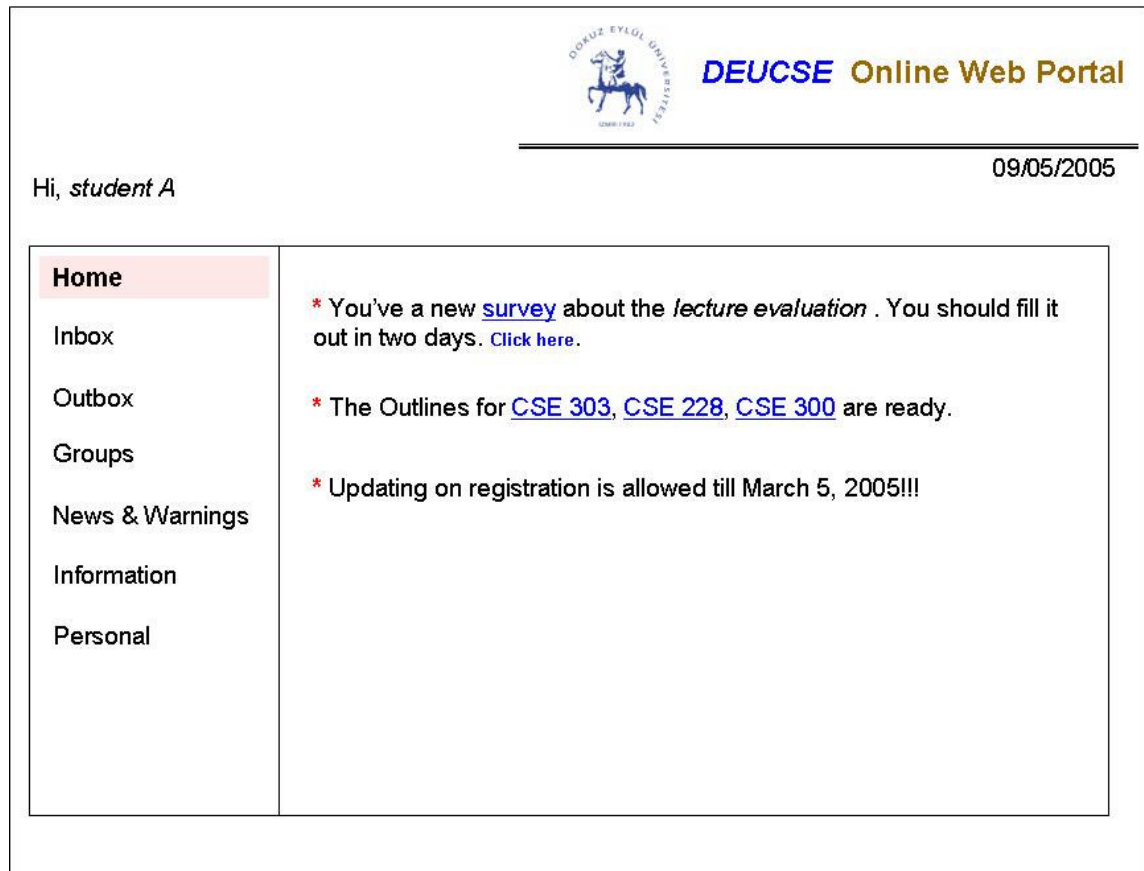


Figure 7.3 DEUCSE Online Web Portal: Home

At home page, important notifications and warnings should be displayed. Some of them can be listed as it follows:

- New Survey alert
- Survey expiration alert
- Survey approval alert
- New meeting alert
- New event alert
- New book added into library
- Reserved book released
- New document alert
- Updated / deleted document alert
- Exam / lab study / assignment alert
- Exam result alert


The warnings and announcements can be viewed on Home Page only for a defined period. (For example 6 hours). After the period expiration or if it is verified that the user already viewed them, they can be removed from the page automatically.

### ***7.3.3 Inbox***

In Inbox page, the pending works (activities) for the logged user are listed. If the user views or completes one of the pending activities, then it could be removed from the list.

There may be two main types of activities that the users deal with:

- Surveys
- Kind of approval operations


**DEUCSE Online Web Portal**

---

Hi, *student A*
09/05/2005

Home

**Inbox**

Outbox

Groups

News & Warnings

Information

Personal

From	Subject	Received
Ulasb	New Survey	07/05/2005 12:17
Alpk	Meeting Request	07/05/2005 16:10
Yalcinc	Meeting Request	07/05/2005 15:12
Yalcinc	Student Survey Approval	07/05/2005 15:12

Figure 7.4 DEUCSE Online Web Portal: Inbox

#### 7.3.3.1 Surveys

Surveys (or questionnaires) are important to gather some information or opinions from the users about any subject; evaluate them to increase the quality and efficiency of educational processes; so they are useful to meet the general criteria that MÜDEK requires.

Surveys can be assigned to user groups. At least five different types of groups are needed in the system for the surveys:

- All
- Student

- AcademicUnit
- Graduates
- Company

Each survey should have a period definition. It is the duration of survey starting from the sent date.

The questions in the survey may be defined as multiple-choice, single-choice or no-choice questions. In multiple or single-choice questions, the users can also put some reviews.

What is your own *personal* yearly income, before taxes?

- ☐ Under \$30,000
- ☐ \$30-\$39,999
- ☐ \$40-\$49,999
- ☐ \$50-\$59,999
- ☐ \$60-\$69,999
- ☐ \$70-\$79,999
- ☐ \$80-\$89,999
- ☐ \$90-\$99,999
- ☐ \$100-\$150,000
- ☐ Over \$150,000
- ☐ Other (Please Specify)

Figure 7.5 Single-Choice Question

What types of products did you purchase on the Internet?  
Please check all that you bought:

- ☐ Software
- ☐ Books or magazines
- ☐ Computer hardware
- ☐ Music, CDs, recordings
- ☐ Videos, DVDs
- ☐ Home Electronics
- ☐ Travel (airlines, car rentals, hotels)
- ☐ Clothing
- ☐ Flowers
- ☐ Tickets (concert, movies, etc.)
- ☐ Services (insurance, legal)
- ☐ Other items
- ☐ Other (Please Specify)

Figure 7.6 Multiple-Choice Question

What is your zip code?

Figure 7.7 No-Choice Question

### 7.3.3.2 Approval operations

System has some approval mechanisms while educational processes are performed by the administrators / users. These approval mechanisms can be listed as it follows:

- Survey Approval
- Library System Request Approval
- Facility System Request Approval
- Meeting Request Approval
- Meeting Conclusion Approval
- User Management System Request Approval

*7.3.3.2.1 Survey Approval.* System administrators can define some surveys within an approval mechanism. During the design process, the survey can be configured with an integration of approval mechanism by setting the related flag to true and by choosing the approver(s). If an instance of such kind of survey definition is completed by the user, it falls into the inbox of the approver(s) as an activity. Approver opens and views it. When it is rejected, it means that survey should not be evaluated in any reports or systems except the audit / history tracking systems.

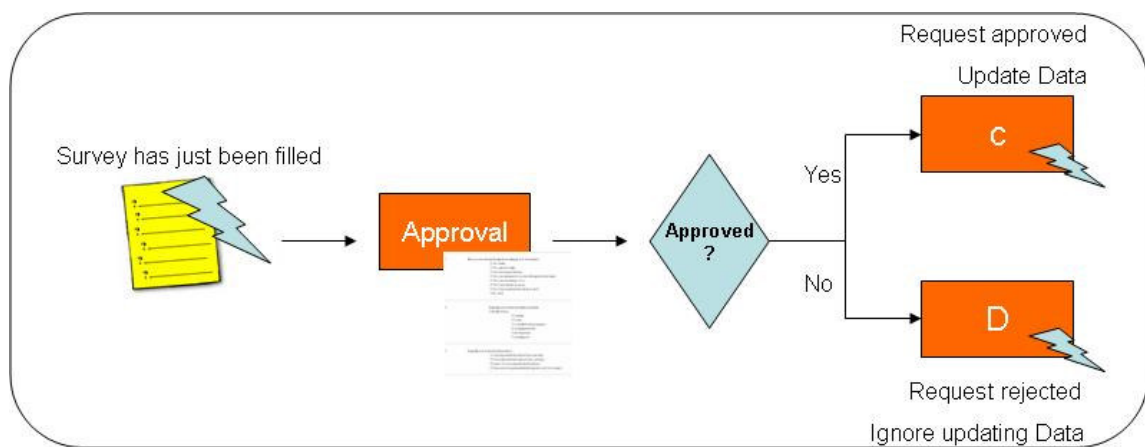


Figure 7.8 Workflow: Survey Approval

The approvers should not be aware of the survey owner identity. This can be configured via the administration console settings.

*7.3.3.2.2 Library System Request Approval.* By using Library Information System which will be described later, some requests can be sent to responsible people in order to be approved.

These requests can especially be used when a new resource will be added into the system or special cases just occurred during the borrowing operation.

System administrators can define some basic approval mechanisms to meet these requests. If a user makes a request about the library information system, it falls into the

inbox of the approver(s) as an activity. Approver opens and views it. When it is rejected, it means that the requester should not perform any operation so library system will not be populated with the request data.

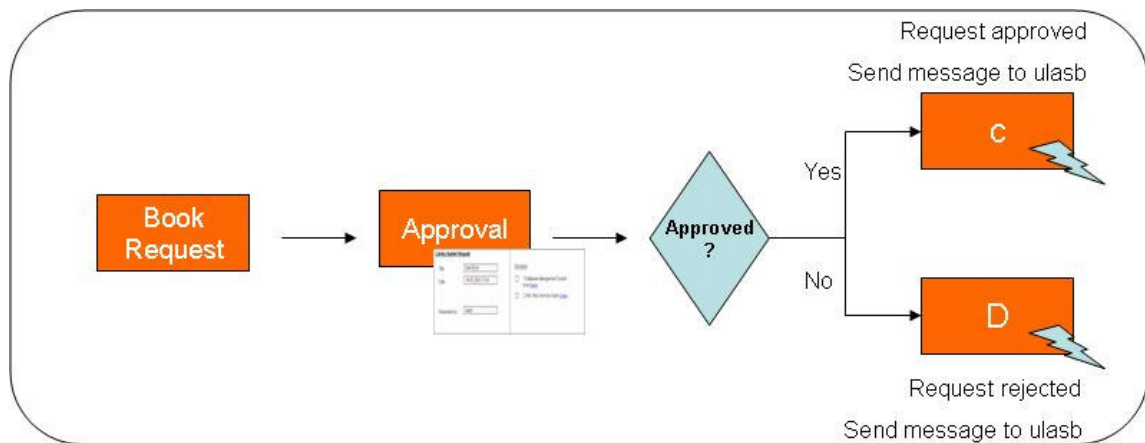


Figure 7.9 Workflow: Library System – Book Request Approval

As it is shown in the figures, the user can request for more than one resource in an approval process. The check-boxes may be read/write so the supervisor can approve both of them or one of them. If none of them is clicked, it means the request is fully rejected.

Library System Request	
Title	<input type="text" value="New Book"/>
Date	<input type="text" value="14.05.2005 17:04"/>
Requested by	<input type="text" value="ulasb"/>
<div>Decisions</div> <div> <input type="checkbox"/> 1 Database Management System book <a href="#">Details</a> </div> <div> <input type="checkbox"/> 2 XML Web Services Audio <a href="#">Details</a> </div>	

Figure 7.10 Library System Book Request Form

*7.3.3.2.3 Facility System Request Approval.* Facility Information System which also will be described later allows users to fill request forms which are sent to the supervisors in order to be approved by them.

These requests can especially be used when new equipment will be added into the system or special cases just occurred during the borrowing operation.

The process is same as the process Library Information System uses. System administrators can define some basic approval mechanisms to meet these requests. If a user makes a request about the facility information system, it falls into the inbox of the approver(s) as an activity. Approver opens and views it. When it is rejected, it means that the requester should not perform any operation so facility system will not be populated with the request data.

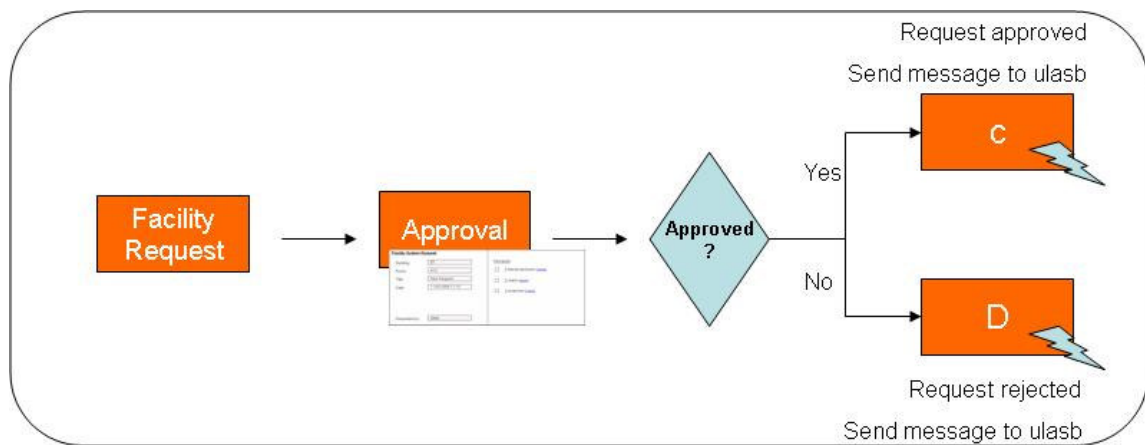


Figure 7.11 Workflow: Facility System Request Approval

The user can request for more than one equipment in an approval process. The checkboxes may be read/write so the supervisor can approve both of them or one of them. Supervisor can also be allowed to edit number of each equipment. (For example, the number of chairs can be decreased by one and then the form can be approved.) If none of them is clicked, it means the request is fully rejected.



Facility System Request	
Building	<input type="text" value="B1"/>
Room	<input type="text" value="A12"/>
Title	<input type="text" value="New Request"/>
Date	<input type="text" value="11.05.2005 11:12"/>
Requested by	<input type="text" value="ulasb"/>

Decisions	
<input type="checkbox"/>	<u>2</u> blackboard pens <a href="#">Details</a>
<input type="checkbox"/>	<u>2</u> chairs <a href="#">Details</a>
<input type="checkbox"/>	<u>1</u> projection <a href="#">Details</a>

Figure 7.12 Facility System Request Form

**7.3.3.2.4 Meeting Request Approval.** In organizations, meetings are the most important vehicle for human communication. Some users can request some meetings and these requests may be approved by the defined supervisors.

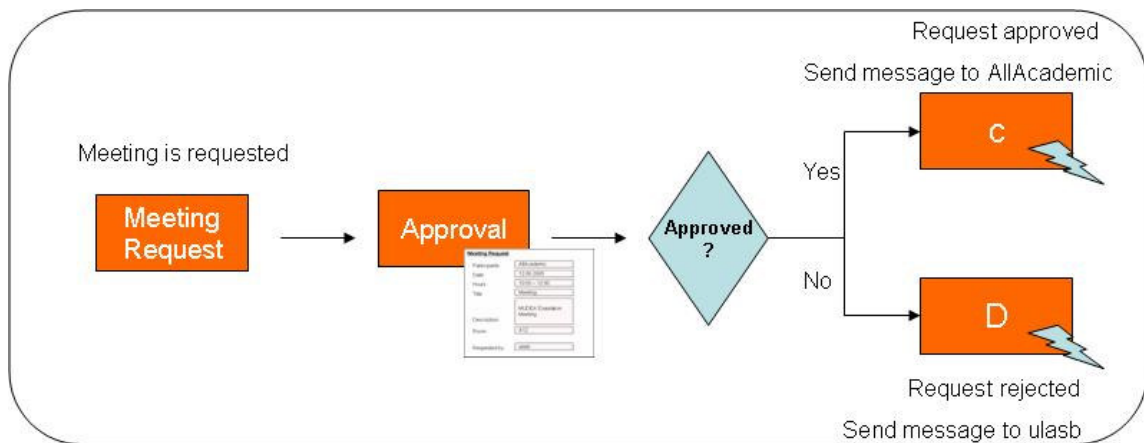


Figure 7.13 Workflow: Meeting Request Approval

By using User Management Console, the user can define the meeting and then send it to the supervisor. If the meeting request is accepted by the supervisor a static message is sent to all the participants who had been declared during the design of request.

Meeting Request	
Participants	AllAcademic
Date	12.06.2005
Hours	10:00 – 12:00
Title	Meeting
Description	MUDEK Evaluation Meeting
Room	A12
Requested by	ulasb

Figure 7.14 Meeting Request Form

After the meeting request is sent to all invited users, another workflow mechanism can be processed. Each invited user can approve or reject the meeting request. Then business logic can be applied such that if the number of accepted requests is less than half of the all participants, then the meeting request would be ignored and particular users should be aware of that. As it can be seen from the figure, if at least 2 of 3 users does not accept the meeting request, that process fails and messages about the meeting cancellation are sent to the users.

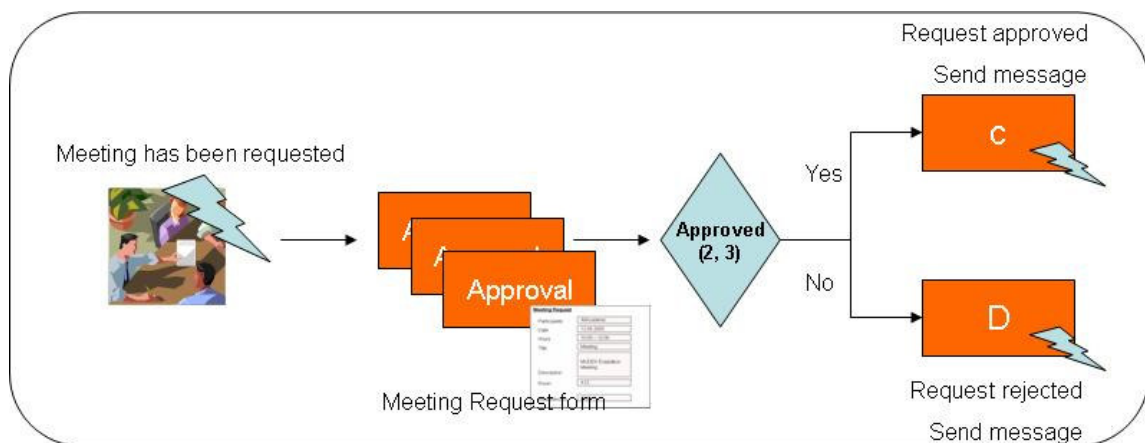


Figure 7.15 Meeting Request Form

*7.3.3.2.5 Meeting Conclusion Approval.* Meetings are the social acts of assembling for some common purposes. In any kind of meeting, the participants argue on the issues, proposals and any thoughts concerning with each meeting subject who has been planned before and according to the discussion, some decisions are given at the end. The meeting documentation should be prepared during the event and after the end of meeting the decisions should be saved into the database by the responsible user.

The meeting decisions may be processed by an approval mechanism. The meeting information such as participants, date, title and decisions are sent to the supervisor. When the supervisor views it, it is possible to approve all decisions or some of them. If none of decisions are approved, it means all meeting decisions are totally rejected.

Some decisions can get new works started or have warning messages sent for some users. For example, if a decision includes a facility system request, after it is approved by the supervisor, the particular user can view that decision as a new job in his Inbox.

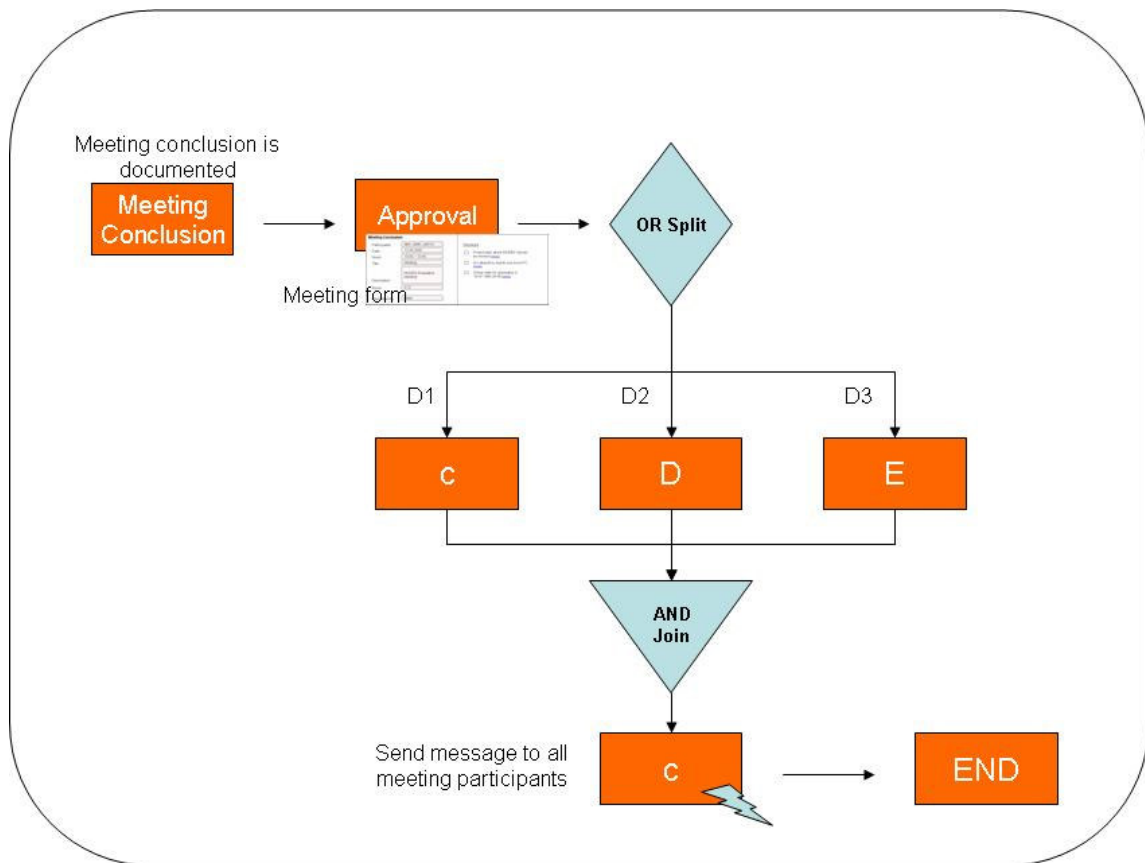


Figure 7.16 Workflow: Meeting Conclusion

Meeting Conclusion	
Participants	alpk; ulasb; yalcinc;
Date	12.06.2005
Hours	10:00 – 12:00
Title	Meeting
Description	MUDEK Evalution Meeting
Room	A12
Requested by	ulasb
<div>Decisions</div> <div> <input type="checkbox"/> Project plan about MUDEK should be revised <a href="#">Details</a> </div> <div> <input type="checkbox"/> AI Labarotory needs one more PC <a href="#">Details</a> </div> <div> <input type="checkbox"/> Dinner date for graduates is 14.07.1980 20:00 <a href="#">Details</a> </div>	

Figure 7.17 Meeting Conclusion Form

**7.3.3.2.6 User Management System Request Approval.** An approval process may be needed when some changes are performed on user management database. Some examples to these changes are insertion, deletion, modification of user information and calendar.

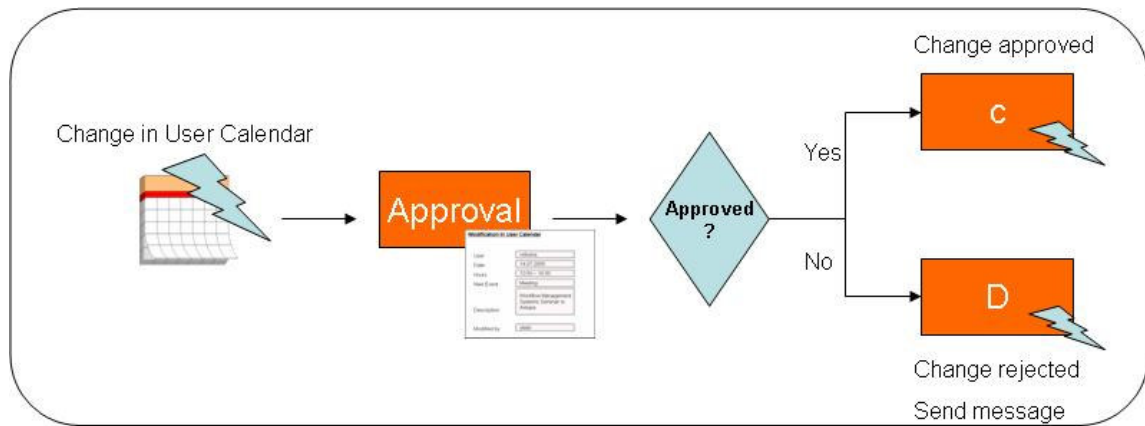


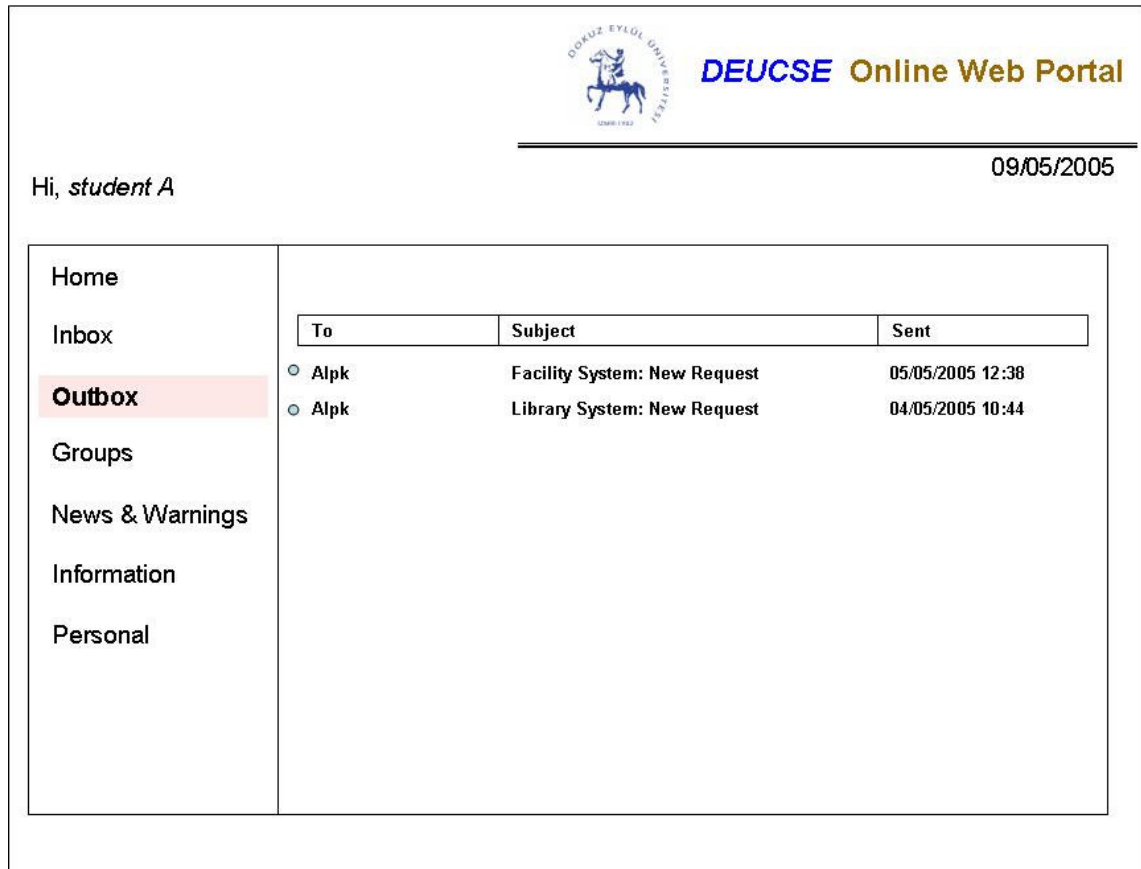
Figure 7.18 Workflow: Modification In User Calendar

<b><u>Modification In User Calendar</u></b>	
User	volkana
Date	14.07.2005
Hours	10:00 – 18:00
New Event	Meeting
Description	Workflow Management Systems Seminar in Ankara
Modified by	ulasb

Figure 7.19 Modifications in User Calendar Workflow Parameters

### 7.3.4 Outbox

In Outbox page, the users can track the status of activities which they once started somehow. The activities may be started manually by the users or automatically fired after some operations completed.



Hi, *student A*

09/05/2005

To	Subject	Sent
Alpk	Facility System: New Request	05/05/2005 12:38
Alpk	Library System: New Request	04/05/2005 10:44

Figure 7.20 DEUCSE Online Web Portal: Outbox

The outbox activities can be listed as it follows:


- Facility System Requests
- Library System Requests
- User Management Requests
- Survey Requests

### 7.3.5 Groups Page

In Groups page, the users can view all the messages of the groups which they once subscribed to. These groups can be created by the system administrators by adding existing users.

System administrators can create the messaging groups for each course in the department, researches, graduates, events and activities etc. When the user logs into the system, he/she can only access to the groups in which they are membered.

If it is allowed, the users can post new messages to the groups. The messages can be directly listed or should be approved by the moderators at first. The method for posted message displaying depends on the group settings.


**DEUCSE Online Web Portal**

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Hi, *student A*
09/05/2005

**Home**

**Inbox**

**Outbox**

**Groups**

CSE 303 (1)

CSE 300 (2)

CSE 228 (4)

CSE 306

**News & Warnings**

**Information**

**Personal**

[New Post](#)   [Delete](#)   [Next 5 messages](#)

From	Subject	Received
Administrator	Welcome to CSE 303 Group!	09/05/2005 12:17

Figure 7.21 DEUCSE Online Web Portal: Groups

The groups settings can be reached via Groups page. Creating new groups page or updating settings of groups are provided by restricted number of users who have necessary access rights for such operations.

### 7.3.6 News & Warnings Page

In this page, all the news and warnings history can be viewed. It may be possible to see the details of warnings such as why and by whom they are fired, the dates and other related information.

**DEUCSE Online Web Portal**

Hi, *student A* 09/05/2005

<p>Home</p> <p>Inbox</p> <p>Outbox</p> <p>Groups</p> <p><b>News &amp; Warnings</b></p> <p>Information</p> <p>Personal</p>	<table style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 50%; background-color: #f8d7da; padding: 5px;">News</th> <th style="width: 50%; background-color: #f8d7da; padding: 5px;">Warnings</th> </tr> <tr> <td style="padding: 5px; vertical-align: top;"> <p>* Call for proposals to join the <a href="#">DEU Festival of Culture</a>, arts and sports.</p> <p>* Telephone numbers that we have been using at the Presidency of DEU was <a href="#">changed</a></p> <p style="text-align: right;"><a href="#">More news</a></p> </td> <td style="padding: 5px; vertical-align: top;"> <p>* You've a new <a href="#">survey</a> about the <i>lecture evaluation</i> . You should fill it out in two days. <a href="#">Click here</a>.</p> <p>* The Outlines for <a href="#">CSE 303</a>, <a href="#">CSE 228</a>, <a href="#">CSE 300</a> are ready.</p> <p>* Updating on registration is allowed till March 5, 2005!!!</p> </td> </tr> </table>	News	Warnings	<p>* Call for proposals to join the <a href="#">DEU Festival of Culture</a>, arts and sports.</p> <p>* Telephone numbers that we have been using at the Presidency of DEU was <a href="#">changed</a></p> <p style="text-align: right;"><a href="#">More news</a></p>	<p>* You've a new <a href="#">survey</a> about the <i>lecture evaluation</i> . You should fill it out in two days. <a href="#">Click here</a>.</p> <p>* The Outlines for <a href="#">CSE 303</a>, <a href="#">CSE 228</a>, <a href="#">CSE 300</a> are ready.</p> <p>* Updating on registration is allowed till March 5, 2005!!!</p>
News	Warnings				
<p>* Call for proposals to join the <a href="#">DEU Festival of Culture</a>, arts and sports.</p> <p>* Telephone numbers that we have been using at the Presidency of DEU was <a href="#">changed</a></p> <p style="text-align: right;"><a href="#">More news</a></p>	<p>* You've a new <a href="#">survey</a> about the <i>lecture evaluation</i> . You should fill it out in two days. <a href="#">Click here</a>.</p> <p>* The Outlines for <a href="#">CSE 303</a>, <a href="#">CSE 228</a>, <a href="#">CSE 300</a> are ready.</p> <p>* Updating on registration is allowed till March 5, 2005!!!</p>				

Figure 7.22 DEUCSE Online Web Portal: News & Warnings



### 7.3.7 Personal Page

In Personal page, the logged user can view his / her general information, access to lessons and transcript database. If exists, the users' calendar information could also be displayed on that page.



Hi, *volkana* 09/05/2005

<ul style="list-style-type: none"> <li>Home</li> <li>Inbox</li> <li>Outbox</li> <li>Groups</li> <li>News &amp; Warnings</li> <li>Information</li> <li><b>Personal</b></li> </ul>	 <p>2002900128</p> <p><b>Name</b> Volkan</p> <p><b>Surname</b> Abur</p> <p><b>Program</b> Mastering</p> <p><b>Term</b> Thesis</p> <p><b>Consultant</b> Prof.Dr. Alp R. Kut</p> <p><b>Web</b></p> <p><a href="#">Lessons</a></p> <p><a href="#">History</a></p> <p><a href="#">FBE Personal Link</a></p>
--	--

Figure 7.23 DEUCSE Online Web Portal: Personal

### 7.3.8 Information Page

In Information Page, the users can access to some applications which are used by the system administrators. All of these applications should have some access rights thus only restricted users can manipulate on them. These applications can be grouped into six main categories:

- Library System
- Facility System
- Electronic Document System
- Reporting System
- Workflow Definition System
- User Management System

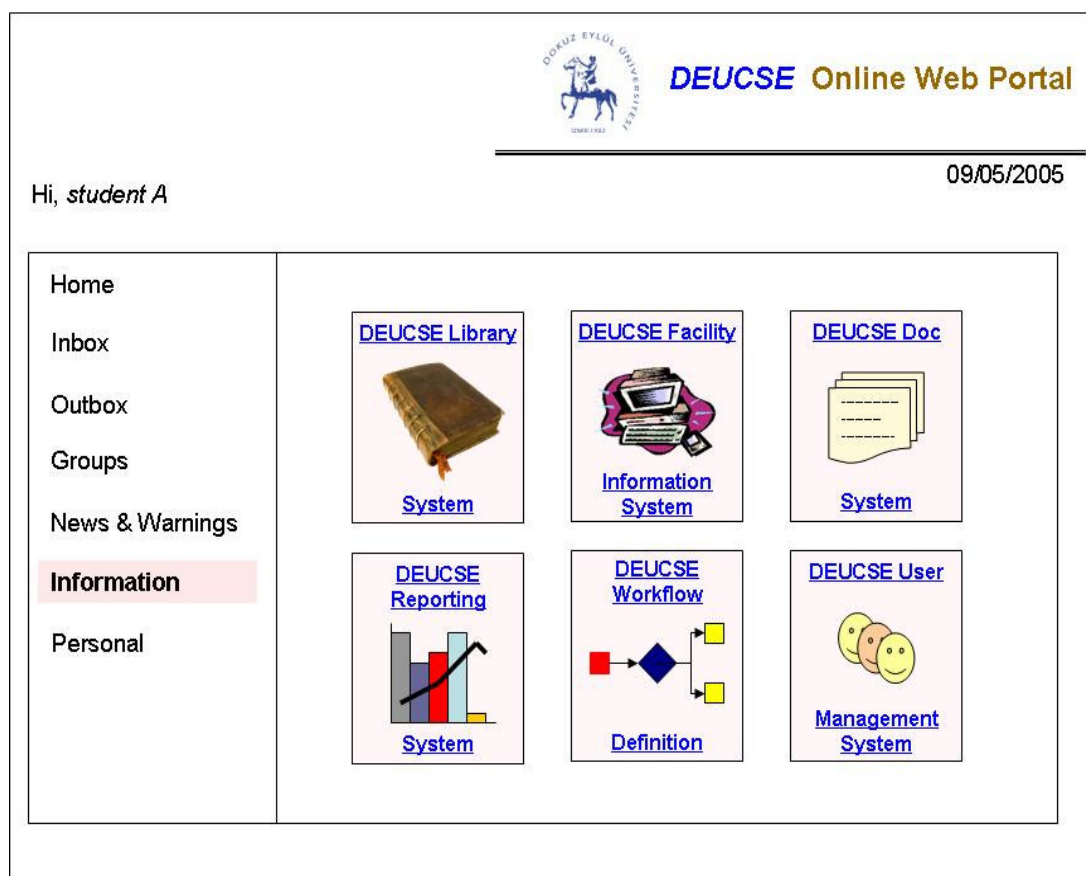


Figure 7.24 DEUCSE Online Web Portal: Information

#### 7.3.8.1 Library System Integration

Library System provides the management of all non-electronic resources such as books, papers, articles, magazines, videos, audios, thesis studies, course materials etc.

It is recommended that the system is integrated with Online Portal System. Logged portal users can access the library system according to their defined access rights.

The access rights for Library System can be defined as it follows:

- ACCESS\_LIS\_SEARCH
  - ACCESS\_LIS\_SEARCHGENERAL
  - ACCESS\_LIS\_SEARCHBOOK
  - ACCESS\_LIS\_SEARCHMAGAZINE
  - ACCESS\_LIS\_SEARCHARTICLE
  - ACCESS\_LIS\_SEARCHVIDEO
  - ACCESS\_LIS\_SEARCHAUDIO
  - ACCESS\_LIS\_SEARCHACADEMIC
- ACCESS\_LIS\_INSERT
- ACCESS\_LIS\_UPDATE
- ACCESS\_LIS\_DELETE
- ACCESS\_LIS\_STARTWORKFLOW

When a new resource is added to the library system or the copies of an existing resource are needed, first an approval mechanism can be processed. If the new book insertion operation is approved by the defined user, then the resource can be stored in Library Information System and also physically placed in the library. If the copy operation of a thesis study is also approved then the operation is allowed.

The users who are having ACCESS\_LIS\_STARTWORKFLOW right are allowed to define and start a workflow about LIS. For example, if a student wants to borrow a book

for a 10 week period instead of the defined common period (for example 3 days) then this operation should be approved by a responsible user.

### 7.3.8.2 Facility Information System Integration

As its name suggests, Facility Information System deals with all information about facilities the department have. An easy navigator application can be developed for that system. The requirements of the facilities, properties, timing of labs, classes, the configurations and any details of any equipment in the facilities can be accessed, created and updated by using this system.

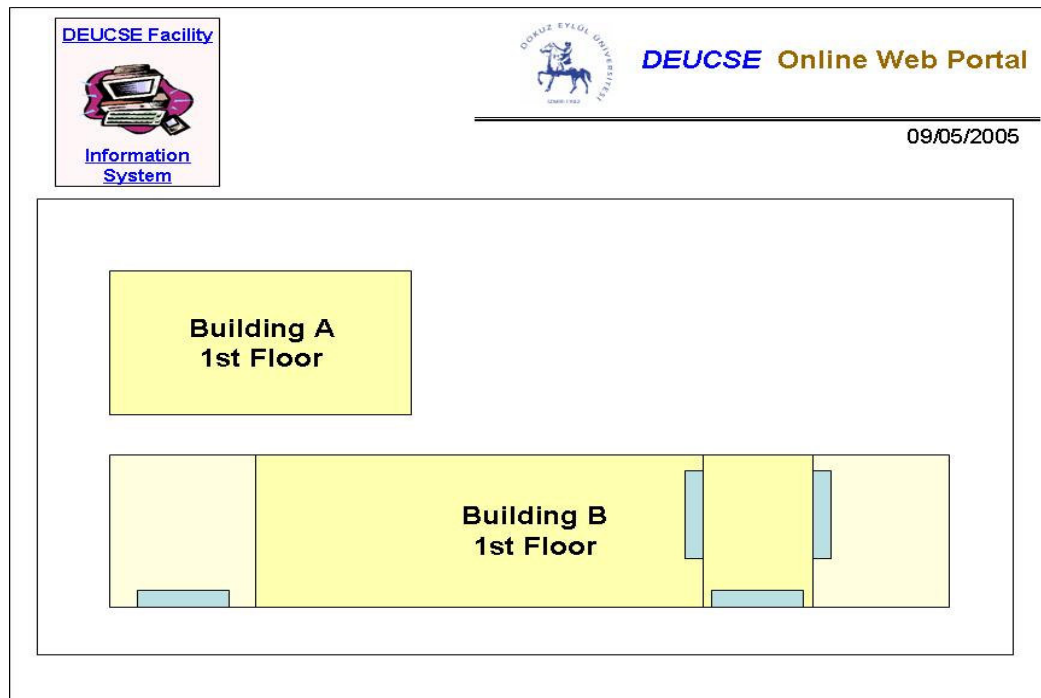


Figure 7.25 DEUCSE Online Web Portal: Facility System General Map

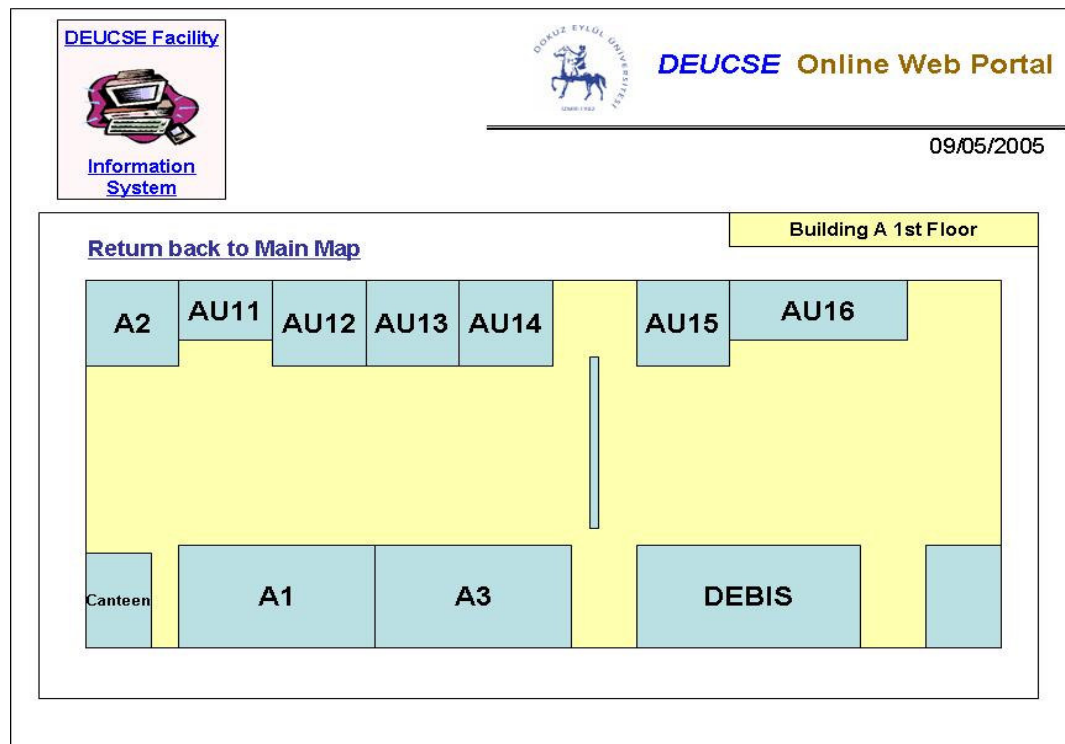


Figure 7.26 DEUCSE Online Web Portal: Facility System Building Map

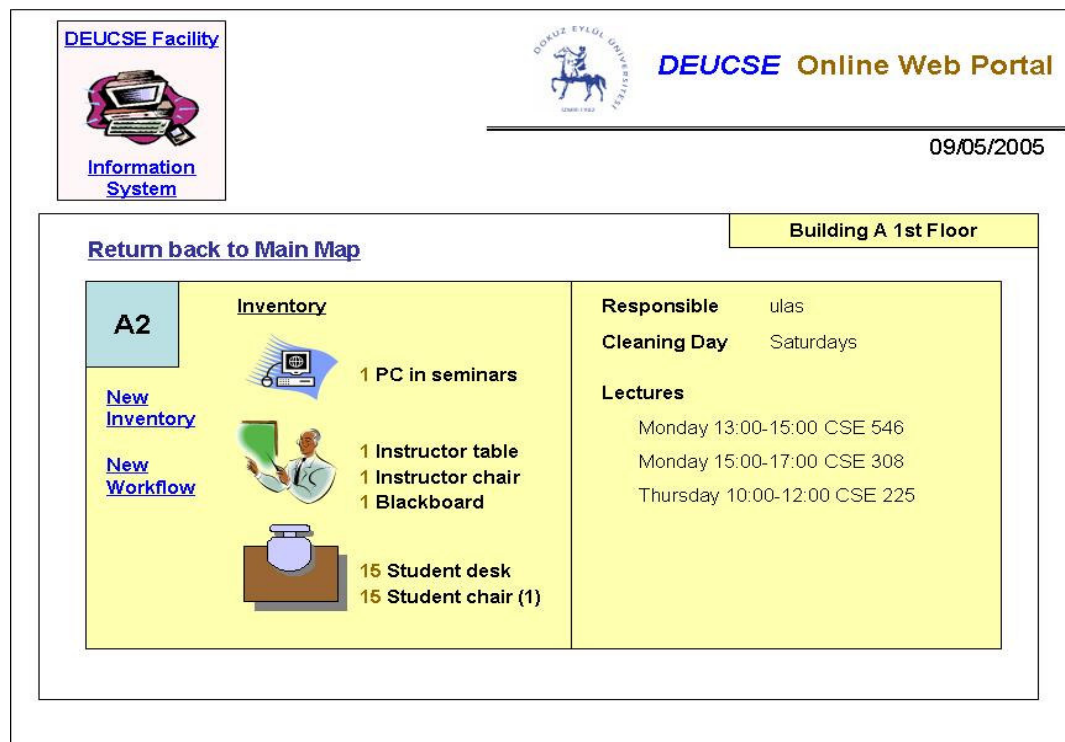


Figure 7.27 DEUCSE Online Web Portal: Facility System Room Map

### *7.3.8.3 Document System Integration*

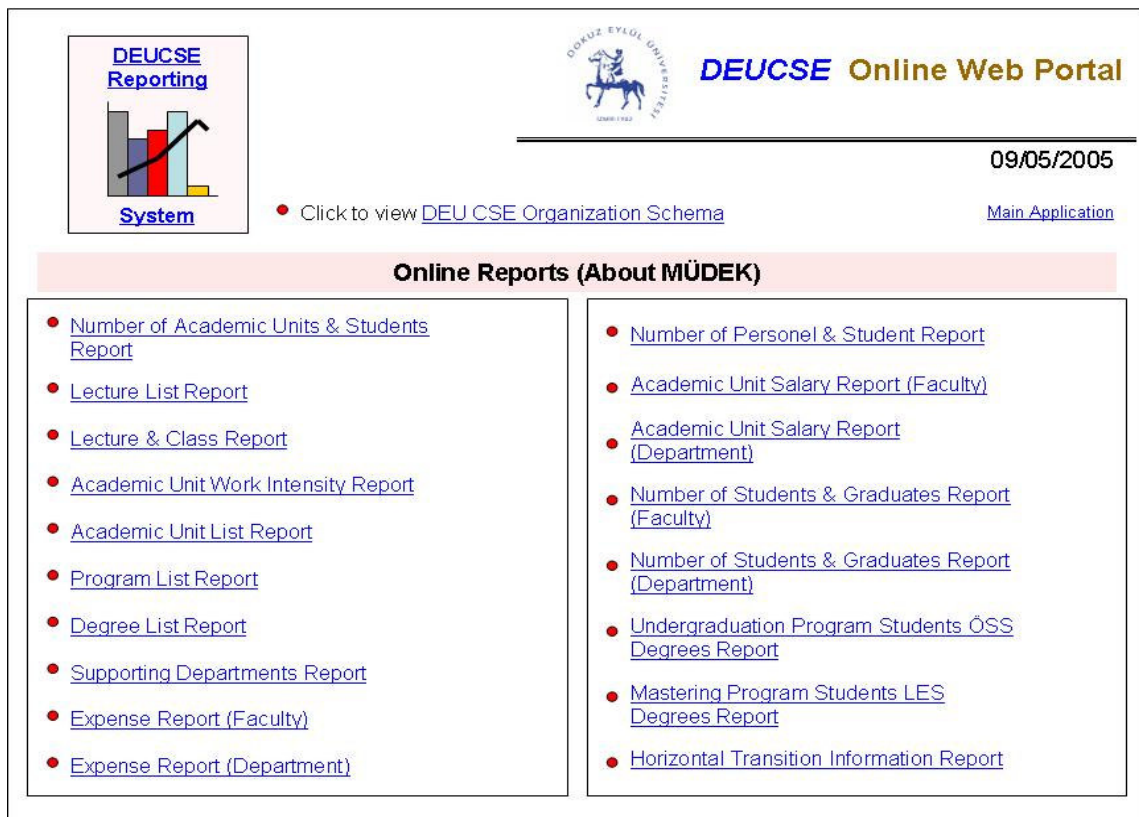
Document Information System provides the management of all electronic resources such as books, papers, articles, magazines, videos, audios, thesis studies, course materials etc.

That system should be integrated with Online Portal System. Logged portal users can access the document system according to their defined access rights. The access rights for Document Information System can be defined as it follows:

- ACCESS\_DIS\_SEARCH
  - ACCESS\_DIS\_SEARCHGENERAL
  - ACCESS\_DIS\_SEARCHBOOK
  - ACCESS\_DIS\_SEARCHMAGAZINE
  - ACCESS\_DIS\_SEARCHARTICLE
  - ACCESS\_DIS\_SEARCHVIDEO
  - ACCESS\_DIS\_SEARCHAUDIO
  - ACCESS\_DIS\_SEARCHACADEMIC
  
- ACCESS\_DIS\_INSERT
- ACCESS\_DIS\_DOWNLOAD
- ACCESS\_DIS\_UPLOAD
- ACCESS\_DIS\_INSERT
- ACCESS\_DIS\_UPDATE
- ACCESS\_DIS\_UPDATEDOCUMENT
- ACCESS\_DIS\_DELETE
- ACCESS\_DIS\_STARTWORKFLOW

When a new electronic document is added to the Document Information System or an existing one is updated, an approval mechanism can be processed.

#### 7.3.8.4 Reports



**DEUCSE Reporting System**

**DEUCSE Online Web Portal**

09/05/2005

[Click to view DEUCSE Organization Schema](#) [Main Application](#)

### Online Reports (About MÜDEK)

- [Number of Academic Units & Students Report](#)
- [Lecture List Report](#)
- [Lecture & Class Report](#)
- [Academic Unit Work Intensity Report](#)
- [Academic Unit List Report](#)
- [Program List Report](#)
- [Degree List Report](#)
- [Supporting Departments Report](#)
- [Expense Report \(Faculty\)](#)
- [Expense Report \(Department\)](#)
- [Number of Personnel & Student Report](#)
- [Academic Unit Salary Report \(Faculty\)](#)
- [Academic Unit Salary Report \(Department\)](#)
- [Number of Students & Graduates Report \(Faculty\)](#)
- [Number of Students & Graduates Report \(Department\)](#)
- [Undergraduation Program Students ÖSS Degrees Report](#)
- [Mastering Program Students LES Degrees Report](#)
- [Horizontal Transition Information Report](#)

Figure 7.28 DEUCSE Online Web Portal: Reporting System Report List





The courses can be categorized into four part according to the lecture content.

- 1: Mathematic and Base Science
- 2: Commercial & Technical Subjects
- 3: Common Education
- 4: Other

*7.3.8.4.3 Lecture & Class Report.* This report lists all courses of the department with the class information. (MÜDEK, 2004)

Table 7.3 Lecture & Class Report

Course Code	Course Name	Number of Classes	Avg Size of Class	Type of Course			
				Class	Lab	Prob. Hour	Other
CSE306	Database Management Systems	1	60	60%	20%	20%	-

*7.3.8.4.4 Academic Unit Work Intensity Report.* This report shows work intensity of all academic units for each course they give.

Table 7.4 Academic Unit Work Intensity Report

Name / Surname	FT or PT	Course Code / Hours / Term / Year	Activity		
			Teaching	Research	Other
Alp R. Kut	FT	CSE 306 / 3+0+0 / 1 / 2005	60%	20%	20%


*7.3.8.4.5 Academic Unit List Report.* This report lists all academic units with some experience-related statistic information. (MÜDEK, 2004)

Table 7.5 Academic Unit List Report

Name / Surname	Title	FT or PT	1	Graduate	Experience			Level		
					2	3	4	5	6	7
Alp R. Kut	Prof	FT		Ege						

*7.3.8.4.6 Degree List Report.* This report includes all the degrees that the program uses in transcripts. (MÜDEK, 2004)

Table 7.6 Degree List Report

Degree	Type		Degree	Name on Transcript
	1st	2nd		

*7.3.8.4.7 Supporting Departments Report.* This report includes supporting departments list. (MÜDEK, 2004)

Table 7.7 Supporting Departments Report

Name of Department	# of Academic Units (FT)	# of Academic Units (PT)	Research Assistants
1.			
2.			
3.			
4.			
5.			

*7.3.8.4.8 Expense Report.* This report shows all expense information of the program for each course they give. (MÜDEK, 2004)

Table 7.8 Expense Report

Year	1 (Current – 1)	2 (Current – 2)	3 (Current)
Expense			
Charge			
200			
300			
400			

600			
700			
Circulating Capital			
Student Fee			
Other			

*7.3.8.4.9 Number of Personel & Students Report.* This report lists the number of each academic staff which is the members of the department / program. (MÜDEK, 2004)

Table 7.9 Number of Personel & Student Report

	#		TZE	Rate to PhD
	Full Time	Part Time		
Manager				
PhD				
Instructors				
Research Assistants				
Technical				
Other Managerial				
Other				
Registered UG Students				
Registered Mastering Students				

*7.3.8.4.10 Academic Unit Salary Reports.* These reports include statistic information about academic unit salaries. MÜDEK needs two types of salary/fee reports one for faculty and one for each related programs. (MÜDEK, 2004)

Table 7.10 Academic Unit Salary Report (Faculty)

	Professor	Asst. Professor	Res.Ass. Professor	Instructor	Research Assistant
Number	42	40	38	46	64
Highest Salary	2500	2200	1800	1000	900
Average Salary					
Lowest Salary					

Table 7.11 Academic Unit Salary Report (Programs)

Program		Professor	Asst.Prof.	Res.Ass.Prof	Instructor
	Number				
	Highest				
	Average				
	Lowest				
	Number				
	Highest				
	Average				
	Lowest				

*7.3.8.4.11 Under Graduating Program Students ÖSS Degrees Report.* This report shows number of students and graduates for current and previous years. (MÜDEK, 2004)

Table 7.12 Number of Students & Graduates Report

Academic	Year				UG	Master	# of Graduates		
Year	1.	2.	3.	4.	Total	Total	UG	Master	PhD

Current									

*7.3.8.4.12 Under Graduating Program Students ÖSS Degrees Report.* This report lists statistic information about ÖSS Examination Results of the students for current and some previous academic years. (MÜDEK, 2004)

Table 7.13 Undergraduating Program Students ÖSS Degrees Report

Academic Year	ÖSS Result		%		# of Registered Students
	Lowest	Highest	Lowest	Highest	

*7.3.8.4.13 Mastering Program Students LES Degrees Report.* This report lists statistic information about LES Examination Results for current and some previous academic years. (MÜDEK, 2004)

Table 7.14 Mastering Program Students LES Degrees Report

Academic Year	LES Result		Undergraduating Program Average		# of Registered Students
	Lowest	Highest	Lowest	Highest	
2004 – 2005	44	77.5	2.02	4.00	188

*7.3.8.4.14 Number of Horizontally Passing Students Report.* This report lists the number of horizontally passing students within recent academic years. (MÜDEK, 2004)

Table 7.15 Number of Horizontally Passing Students Report

Academic Year	# of the Horizontally Passing Students
2004 – 2005	4

#### *7.3.8.5 Basic Workflow Definition System*

The workflows which are created by the system or the participants can be defined by using Basic Workflow Definition System. This system may be designed and developed similar to the proposed Workflow Definition System which has been described in Chapter 4.

### 7.3.8.6 User Management System

The User Management System (UMS) allows the administrators to add, modify, deactivate and activate users, roles, and events. This system provides access rights to any resources and functions.

In Computer Engineering department of Dokuz Eylul University, some people will probably role on administration and / or usage of DEUCSE Online Web Portal. A user can have more than one role and some access rights.

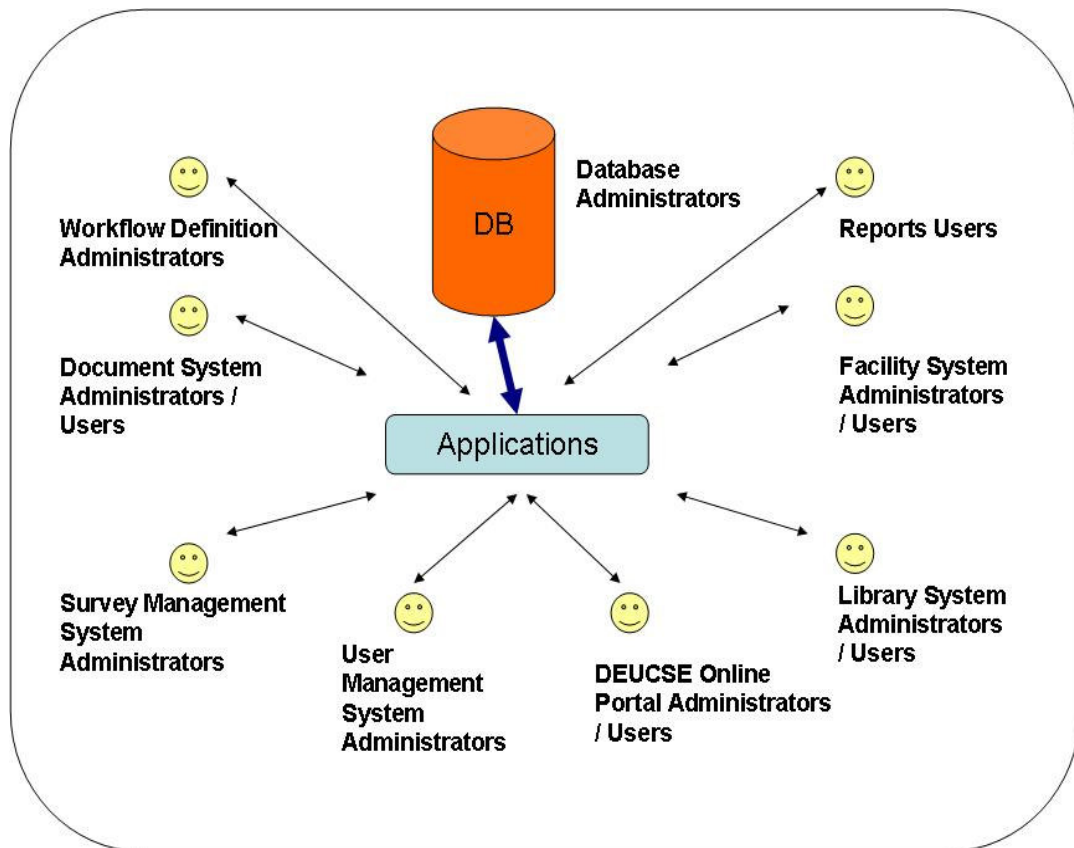


Figure 7.29 DEUCSE Online Web Portal Users



A relationship exists between each of the components within the User Management System. For example, users are created and grouped into roles or the users can also be assigned to specific workgroups.

There may be some main elements defined in User Management System. They can be listed as it follows:

- Region
- Department
- User
- User – Department Relation
- Role
- User – Role Relation
- Workgroup
- Calendar Type
- Event



Figure 7.30 DEUCSE Online Web Portal: User Management

*7.3.8.6.1 Region.* A region is an area with one or more common characteristics or features, which give it a measure of homogeneity and make it different from surrounding areas. It should include any departments, groups or standalone users defined in the system.

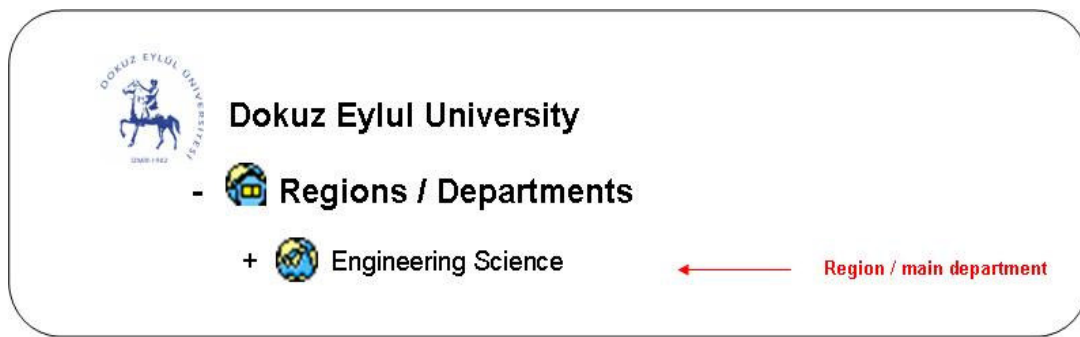


Figure 7.31 User Management: Region

The system administrator can create new regions, update or remove existing regions if they aren't used by another process in the system.

**7.3.8.6.2 Department.** A department is the basic organizational unit in a higher education institution, and is responsible for the academic functions in a field of study. In the other words, a specialized division of a large organization can be called as department, too.

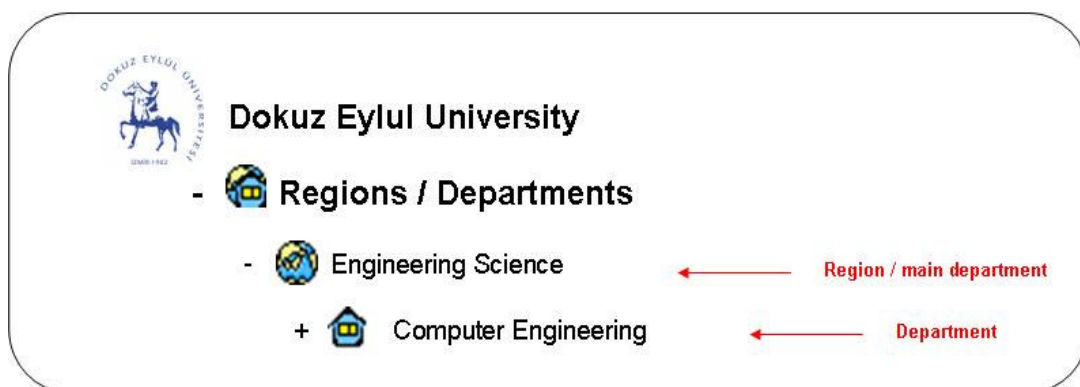


Figure 7.32 User Management: Department (Collapsed)

Four main entities can be viewed under the expanded department. All main staff about user management is performed by manipulating these entities:

- Users
- User – Department relations

- User – Role relations
- Workgroups

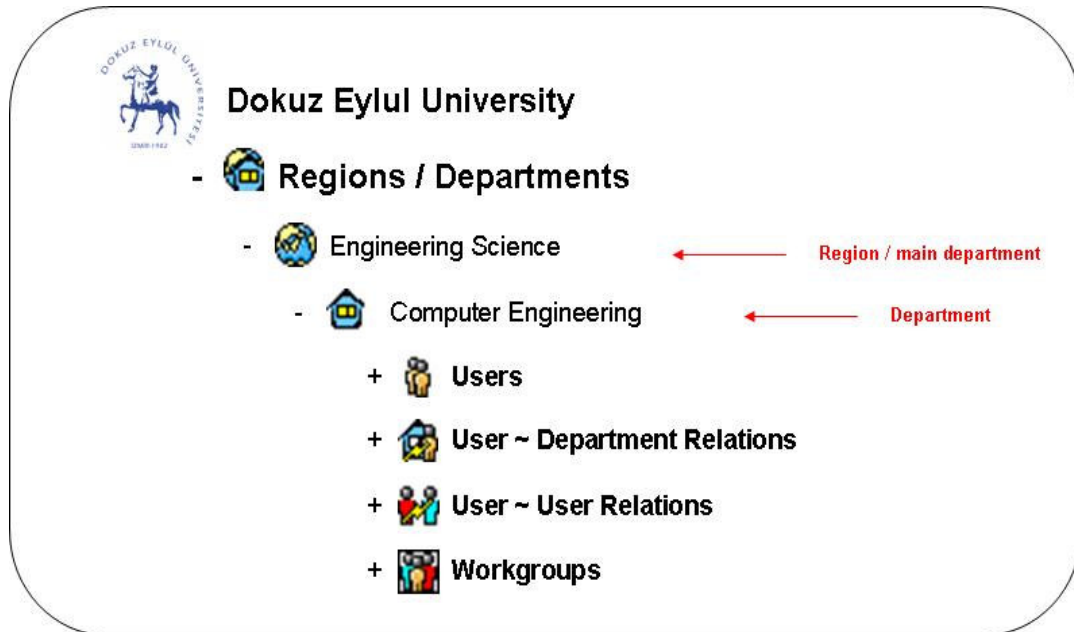


Figure 7.33 User Management: Department (Expanded)

The system administrator can create new departments into the regions, update or remove existing ones if they aren't used by another process in the system.

**7.3.8.6.3 User & Role.** User means a person or entity with an authorized access. The word 'user' can also be known as visitor, participant, actor, searcher, employee, customer, and client in a system.

Roles are system-designed job functions to which individual users are grouped. Roles allow a system administrator to limit an individual's access only to defined resources relevant to their function in an organization.

Limiting a user's access to a resource by enabling or disabling their ability to execute, read, update, create, delete, customize or activate a particular resource.

The users in the system can be grouped into five main roles.

- Academic Unit
- Other Academic Staff
- Students
- Graduates
- Non Academic Units

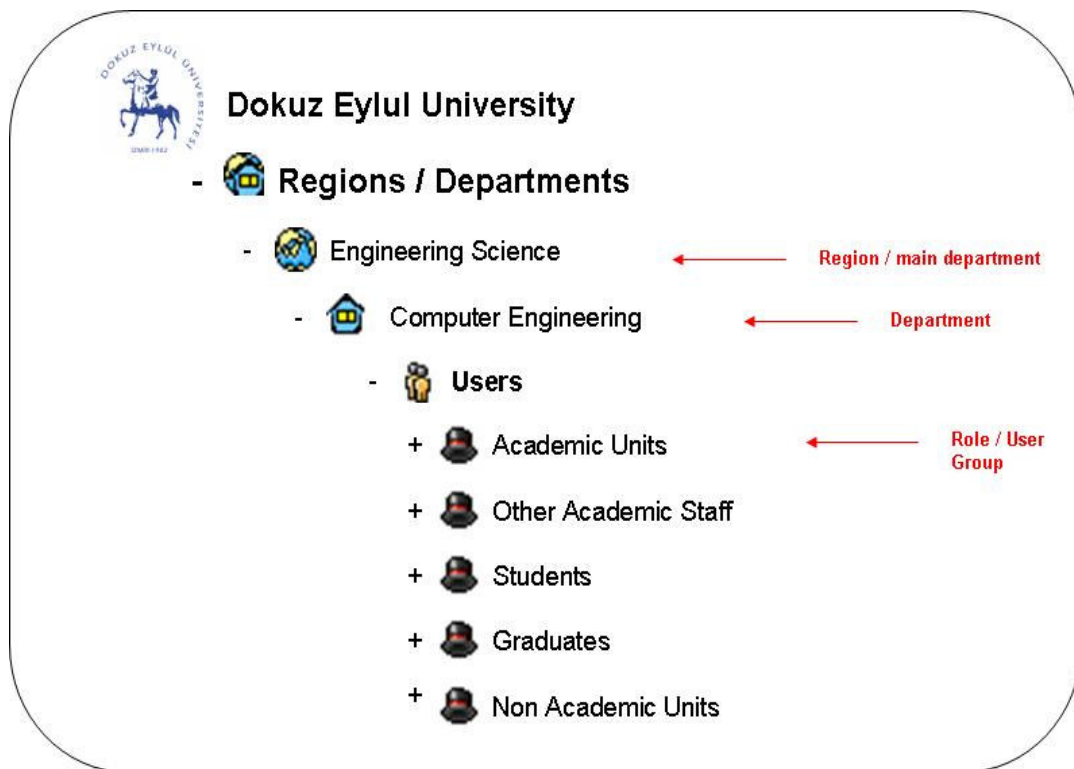


Figure 7.34 User Management: Users (Expanded)

Any sub roles can also be created belonging to these main roles according to the business requirements.

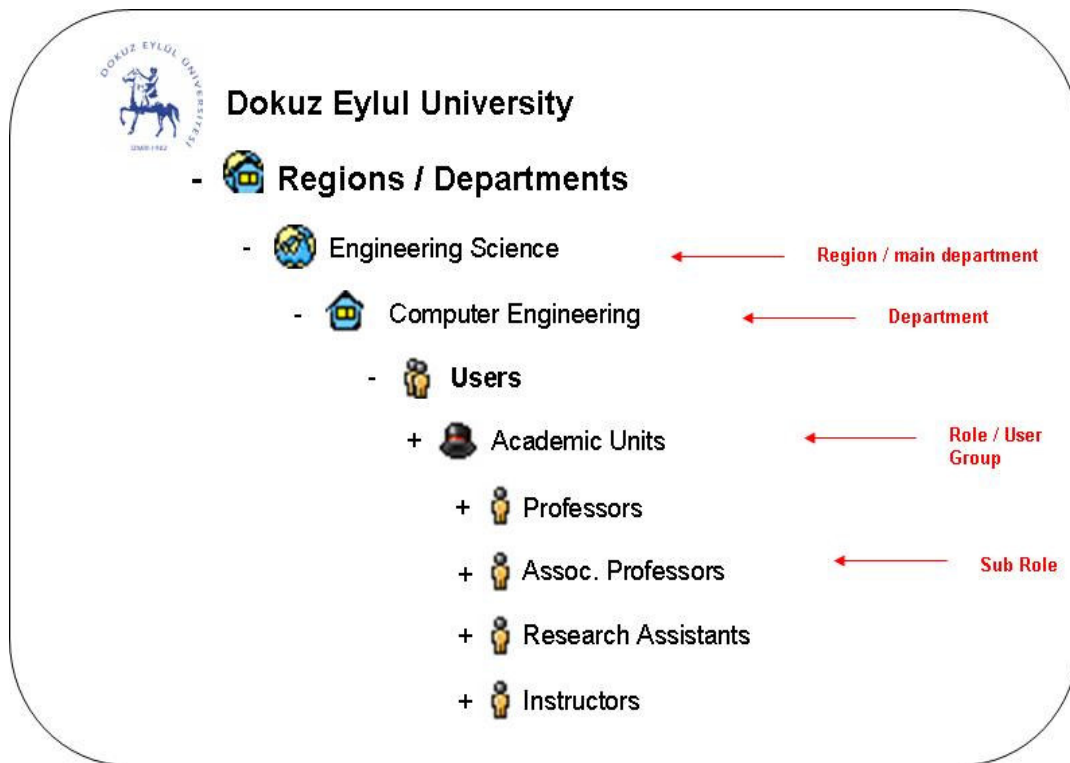


Figure 7.35 User Management: Role / Sub Role (User Group)

The general properties and functions about a selected user are shown in the list below:

- Name, surname
- E-mail, phone, fax, address information
- Username, password setting
- Region of the user
- Department of the user
- Role(s) of the user
- Group(s) of the user
- Calendar information
- Activating / deactivating user

The system administrator can create new users / roles, update or remove existing users / roles if they aren't used by another process in the system.

**7.3.8.6.4 User – Department Relation.** This type of relation is used to represent the relations among users and departments. For example, “The user Y is the manager of the department X” sentence shows that manager is a user-department relation binding a user to a department.

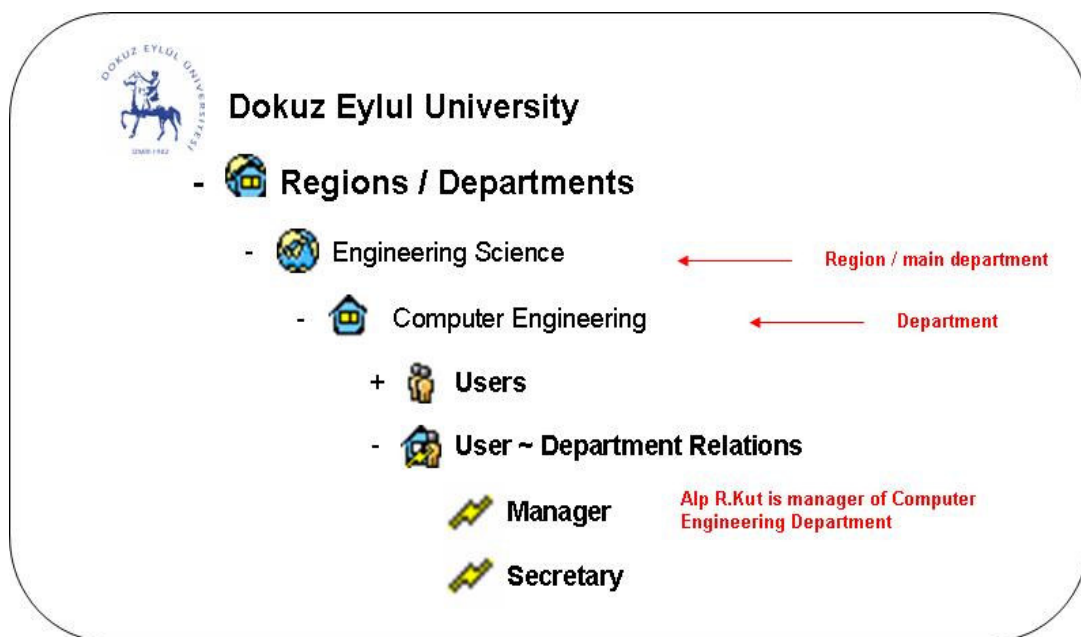


Figure 7.36 User Management: User ~ Department Relations

The system administrator can create new user-department relations, update or remove them if they aren't used by another process in the system.

**7.3.8.6.5 User – Role Relation.** This type of relation is used to represent the relations between users. For example, “The user Y is the secretary of the user X” sentence shows that secretary is a user-role relation between two users.

The system administrator can create new user-role relations, update or remove them if they aren't used by another process in the system.

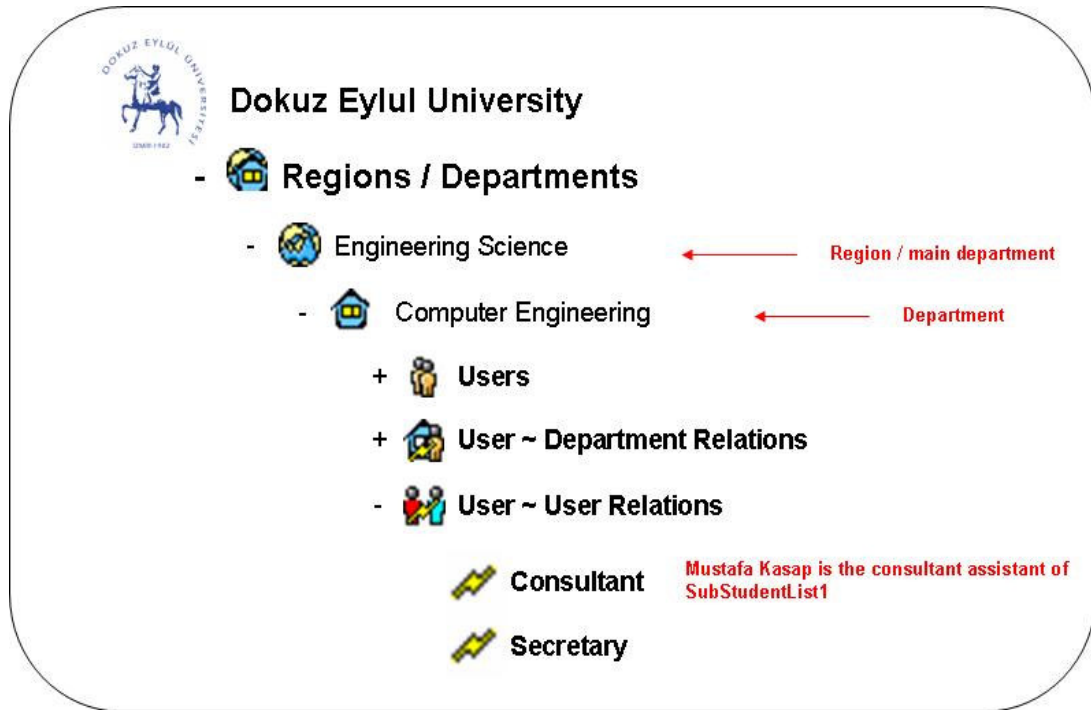


Figure 7.37 User Management: User ~ User Relations

**7.3.8.6.6 Workgroup.** A workgroup is a team of people engaged in a cooperative task. Any group of people working toward a common goal can be represented by workgroups.

Some messages, warnings or alerts can be directly sent by using workgroup name instead of adding users individually as recipients.

The workgroup definitions can also be used in order to set workflow / activity owners of defined workflows.

The system administrator can create new workgroups, add / remove users to / from existing workgroups or remove them if they aren't used by another process in the system.

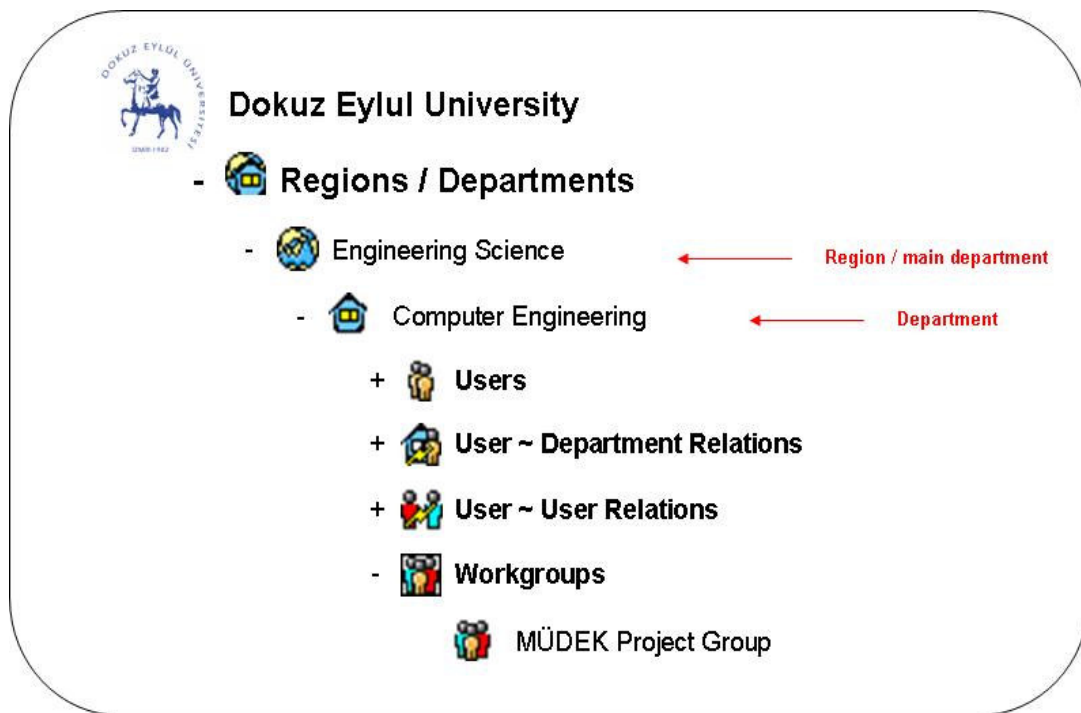


Figure 7.38 User Management: Workgroups

*7.3.8.6.7 Time Management.* Each user in the system should have calendar information in order to manage the time in the whole system. Calendar represents a list or register of events.

An event is an organization or activity which occurs at a particular place during a particular interval of time. Events should have at least one participant and by using user and calendar information, some users can be assigned to some events.





When the user selects a month and a year, the days appear as in calendar format; the weekends, holidays and the days whose importance has already been set by the administrators can be viewed on that calendar.

When new meeting or event is created, a workflow can be initiated. It is configured by the creator so while some meetings may not require an approval process, some meetings may require.

## **CHAPTER EIGHT**

### **CONCLUSION**

The most important issue for a company management is managing the flow of work such that the work is done at the right time by the best available person. If the user does his / her work by following the procedures, the business is processed more effectively, costs of company are lowered and thus the service to the customers would be generally better. A workflow system can be suggested to increase the quality and speed of the business due to the procurement of such kind of satisfaction. Usage of any workflow-based solution will be good for any business, good for the customers, and good for the users.

In a business which uses a workflow system, work doesn't get lost, the managers can focus on staff and business issues, the procedures are formally documented and followed exactly, ensuring that the work is performed in the way planned by management, meeting all business and regulatory requirements. All the resources can be tracked by using document management concept with the workflow system. The best participant (person or machine / application / process) is assigned to do each case, and the most important cases are assigned first. Users don't waste time choosing which item to work on. And all the workflow system can be watched and reported so that it would be easier and flexible to make decisions over the whole business. Workflow systems gets routing of all processes and approval mechanisms faster and easier.

A workflow based solution is also effective for software engineering disciplines and future development. Analysis and design step of business processes provide the system analysts to get benefit from any software engineering tool and methodology. At the other hand, workflow systems are scalable and designed easily integrated to any systems. Therefore the future needs of any business can be handled by some little enhancement of existing workflow system. New electronic forms, document templates or user functions

which are designed according to the system design documentation can respond to the all new requests.

In the thesis, a Web Portal is designed and proposed for development phase to improve the quality and speed of most important educational processes and activities performed in Computer Engineering Department of Dokuz Eylul University. This whole application system serves to increase the educational quality of the department according to Engineering Evaluation board's (MÜDEK) needs. The facility requirements, meeting requests, evaluation of meeting conclusions, defining and performing questionnaires / surveys, approval of activities, messaging and collaboration among all academic and non-academic units can be available with that system.

This system provides users to access any information system such that Library, Facility, User Management and Document Information Systems; organize and manage system users; define some electronic forms, basic approval mechanisms and workflows for some processes and view online reports which Engineering Evaluation Board needs from accrediting programs.

Workflow based processes are helpful especially in reporting, decision making processes and accreditation evaluation of the department the workflow system will show how internal resources of the department are working effectively on the time.

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