Ch5 Functions and Architecture of Workflow Systems

1. Role of WFMS
2. A Reference Model
3. Storage and Exchange of Data
4. Required Technical Infrastructure
5. Current Generation of Workflow Products
6. Adaptive Workflow
7. Workflow Management Trends

5.1 Role of WFMS

- how can we realize the desired business process using information technology?
- The information system must be structured in such a way that it can respond to possible future changes.
- Information systems must meet a number of requirements:
  - Information systems must be set up in such a way that the structure of the business processes is clearly reflected in them.
  - There should be an integrated approach, which also encompasses non computerized tasks.
  - Information systems must be set up in such a way that the structure of the business processes can be modified easily.
  - It is important that the performance of a business process can be tracked properly so that any problems can be discovered at an early stage.
  - The allocation of work to people is a point of particular interest.

5.1 Role of WFMS

- How information systems are traditionally structured
  - the process management has been hidden inside the information system.
- Separation of management and execution

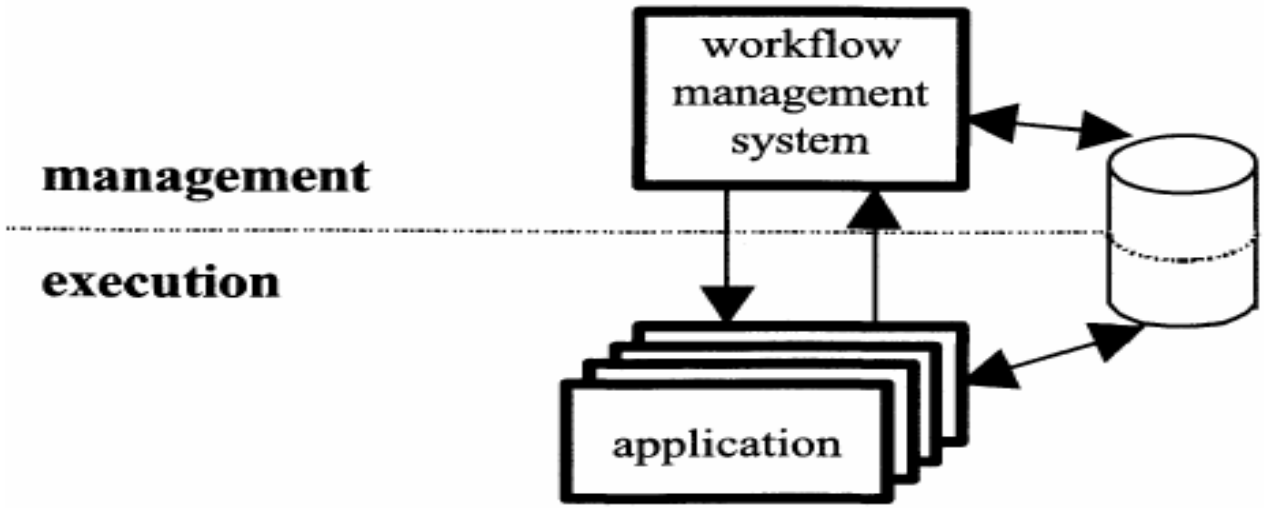

Figure 5.1
The separation between logistics and execution

5.1 Role of WFMS

- Separation of management and execution
  - WFMS ensures that no steps are skipped, that they are carried out in the correct order, that tasks can be performed in parallel where possible, that the correct applications are called in to support a task, and so on.
  - Apart from the structure of the business process, the management system actually has no application-specific characteristics. TManagement may only consult the case attributes in order to wake routing decisions. changing the case attributes is regarded as part of execution rather than management.
  - It is the task of the management system to bring the work to the right person or application at the right time so that the tasks for a specific case can be carried out.

5.1 Role of WFMS

- Advantages of separating management from applications:
  - It enables us to achieve uniform management functionality and to isolate this from the rest of the system.
  - Applications no longer require any management functionality, and hence are simpler and completely independent of their context or place in the business process.
  - The management layer makes it possible to integrate wide-ranging applications.
  - At the management level, the business process is identifiable and the state of a particular case within it is easy to establish.

5.1 Role of WFMS

- Given that the process management functionality should, in principle, be widely applicable rather than intended for a specific application, it becomes attractive to use generic software: workflow management systems(WFMS).

5.2 A Reference Model

- *Workflow Management Coalition* (WFMC) 1993
- *Workflow reference model:* the architecture of a workflow management system, in which the main components and the associated interfaces are summarized.

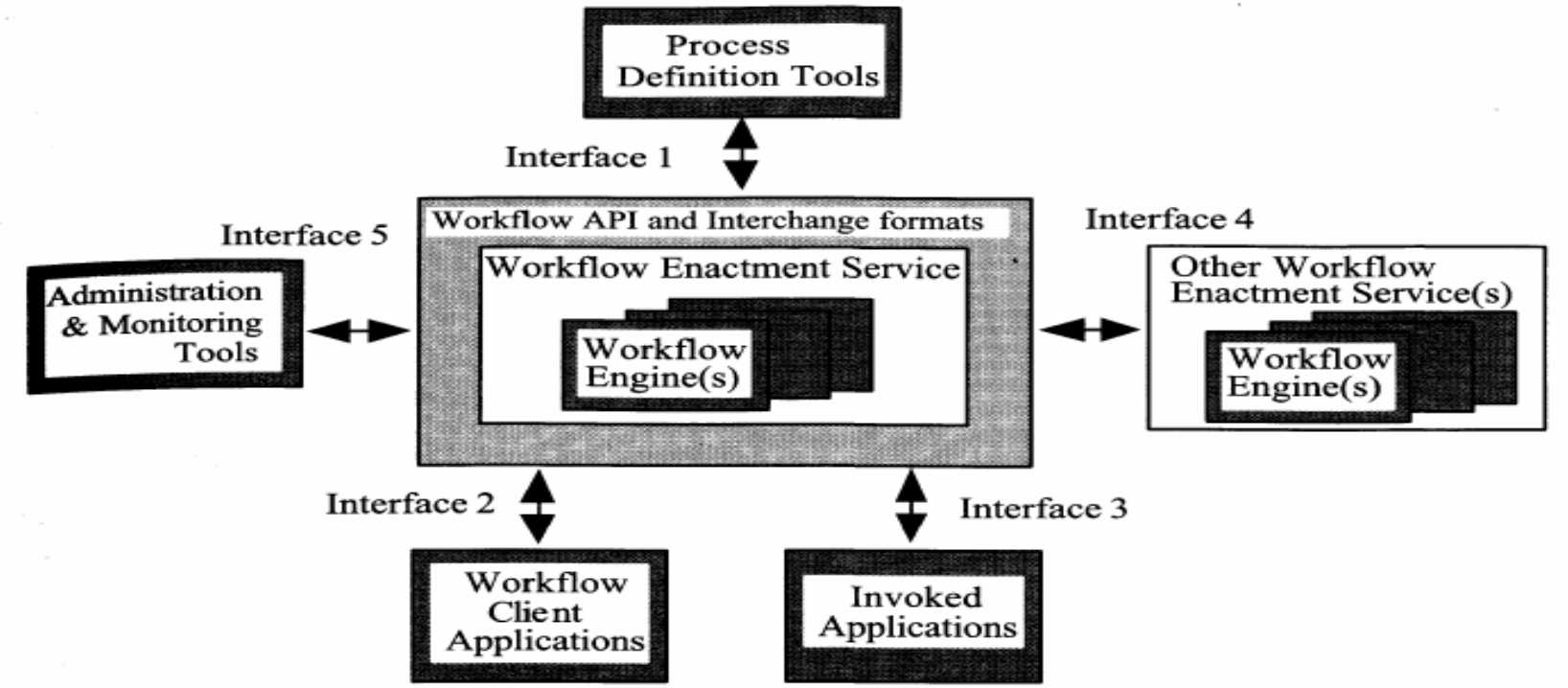

Figure 5.2
The Workflow Management Coalition's reference model (© WFMC)

5.2 A Reference Model

- Workflow enactment service
  - The so-called *workflow enactment service* is the heart of a workflow system.
  - the enactment service may consist of several *workflow engines.* the user will not notice when a workflow system is using more than one engine.

5.2 A Reference Model

- The duties of a workflow engine include:
  - creating new cases and removing completed ones;
  - routing cases, using the interpretation of the appropriate process definition;
  - managing case attributes;
  - submitting work items to the correct resources (employees), based upon resource classification;
  - managing and handling triggers;
  - starting up application software during the execution of an activity;
  - recording historical data;
  - providing a summary of the workflow; and
  - monitoring the consistency of the workflow.
- The workflow engines are therefore the "core" of the workflow system,

5.2 A Reference Model

- Process definition tools
  - In principle, we thus can differentiate between three types of tools: (1) *process definition tools,* (2) *resource classification tools,* and (3) *analysis tools.*
  - In many WFMSs, processes are formulated in a different way. Nevertheless in most cases it is easy to map the used routing constructs onto Petri net elements.
  - The basic functionality of the process definition tool
    - the ability to establish process definitions (name, description, date version, components, and so on);
    - the ability to model sequential, parallel, selective, and iterative routing by means of such graphic components as the AND-split, AND-join, OR-split and OR-join;
    - version management support (after all, there may be several versions of the same process);
    - the definition of case attributes used in the process;
    - task specification; and
    - the checking of the (syntactical) correctness of a process definition and the tracing of any omissions or inconsistencies.

5.2 A Reference Model

- The basic functionality of the process definition tool

  Characteristics for each task:

  - the name and description of the task;
  - task information—in other words, any instructions and supporting information for the employee performing the task;
  - the requirements with respect to the resource carrying out the task;
  - the task's routing characteristics (AND-split, AND-join,OR-split, OR-join);
  - the specification of any triggers required;
  - instructions for the workflow engine;
  - the applications that may be started, plus the conditions and order in which this should be done;
  - a specification of the case attributes that are used and adjusted by the application; and
  - decision rules that determine the subsequent tasks based upon the case attributes, when there is an OR-split or mixed OR/AND-split.

5.2 A Reference Model

- The resource classification tool
  - a list of the resource classes, often subdivided into roles (based upon qualifications, functions, and skills) and organizational units (based upon arrangement into teams, branches, and/or departments);
  - any specific characteristics of a resource class; and
  - the relationship between the various resource classes (for example, a hierarchy of roles or organizational units).
- The analysis tool
  - semantic correctness
  - performance simulation

5.2 A Reference Model

- **Workflow client applications**
  - Each employee has a *worklist* (also known as in-tray or in-basket). The workflow engine uses this worklist to show which work items need to be carried out.
  - basic function
    - the presentation of the work items that may be performed by an employee;
    - the provision of relevant properties of a work item, such as case and task information;
    - the ability to sort and select, based upon these properties;
    - the provision of state information pertaining to the state of the work flow engine;
    - the starting of a task for a specific case when a work item is selected;
    - the ability to report the completion of an activity

5.2 A Reference Model

- **The standard worklist handler**
  - Basic Functions
  - Adjust the layout and content of the window
  - shows the state of a case graphically.
- **The integrated worklist handler**
  - Basic Functions
  - Security and quality assurance
  - *Batch processing*
  - *Chained processing*

5.2 A Reference Model

- **Invoked applications**
  - The performance of a task may result in the starting up of one or more applications. They are not the part of the WFMS
  - Applications are started by the workflow engine in order to perform a specific task.
  - The application may make use of a particular case-attribute value. The case's identification is frequently used to find the appropriate information in the database.
  - The application may change the case-attribute values. These modified attributes are often used to decide the routing of the case.
  - Two Kinds: Interactive application & Fully automatic application

5.2 A Reference Model

- **Other workflow enactment services**
  - Engine Integration
  - workflow interoperability *(Interface 4)*
- **Administration and monitoring tools**
  - The operational management tool
    - addition or removal of staff
    - input/revision of an employee's details
    - implementation of new workflow definitions; and
    - reconfiguration of the workflow system
    - inspection of the logistical state of a case; and
    - manipulation of the logistical state of a case due to problems and exceptional circumstances.
    - provide ad hoc solutions to problems resulting from system faults and bottlenecks in the process.

5.2 A Reference Model

- **The recording and reporting tool:** Many aspects can be recorded and stored during the performance of a workflow. The following interesting *performance indicators* may be distilled from the data:
  - average completion time for a case;
  - average waiting time and processing time (possibly subdivided per task);
  - percentage of cases completed within a fixed standard period; and
  - average level of resource capacity utilization.
- integrated report generator; *data mining, data warehousing,* and *OLAP* (on-line analytical processing); historical data can be used in analyzing a workflow

5.2 A Reference Model

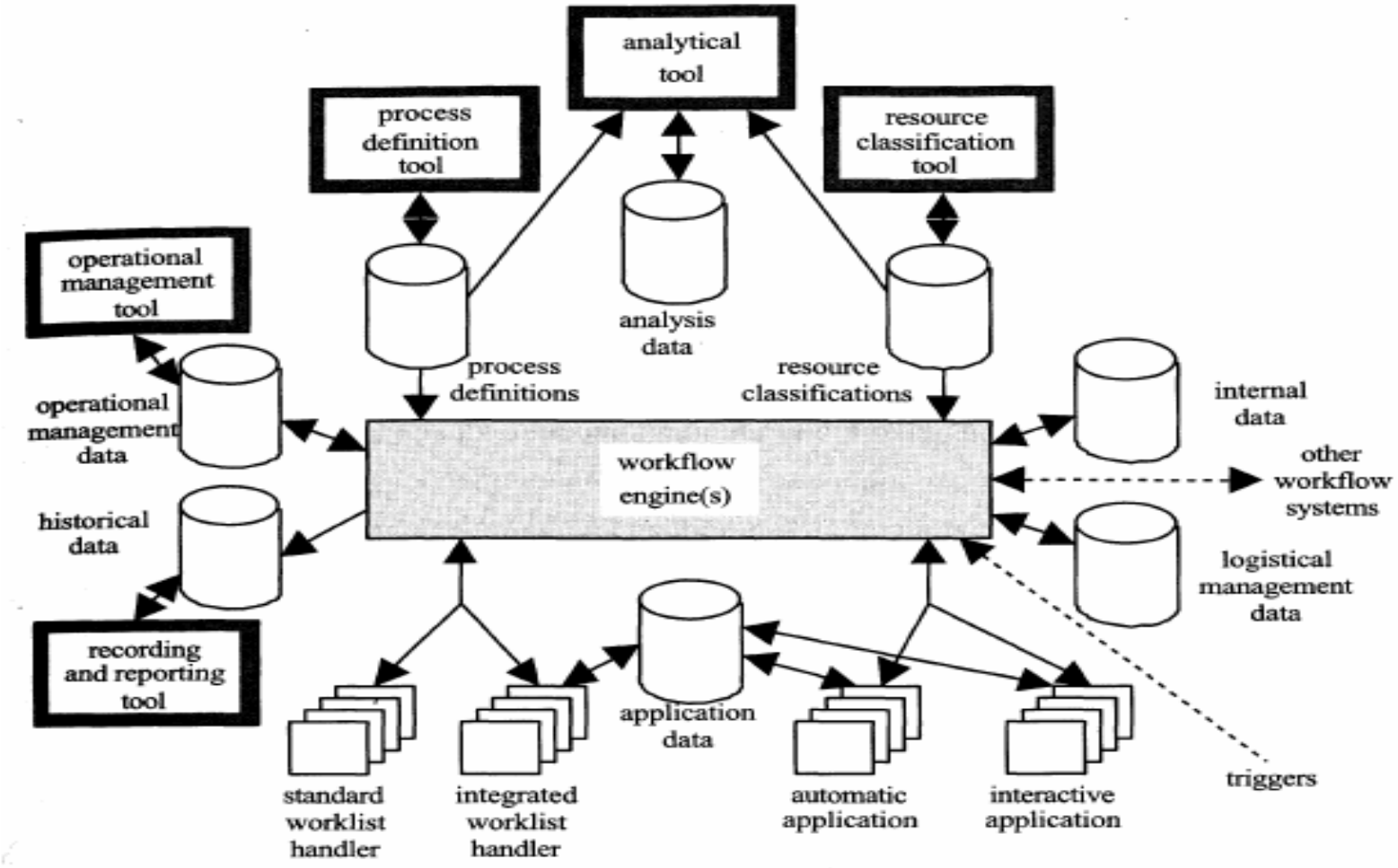

Figure 5.4
The various components of a workflow system

5.2 A Reference Model

- **Roles of people involved**
  - 4 types of users: *The Workflow Designer, The Administrator, The Process Analyst, The Employee*
  - *Others: manager, database designers/programmers* and *application designers/programmers*

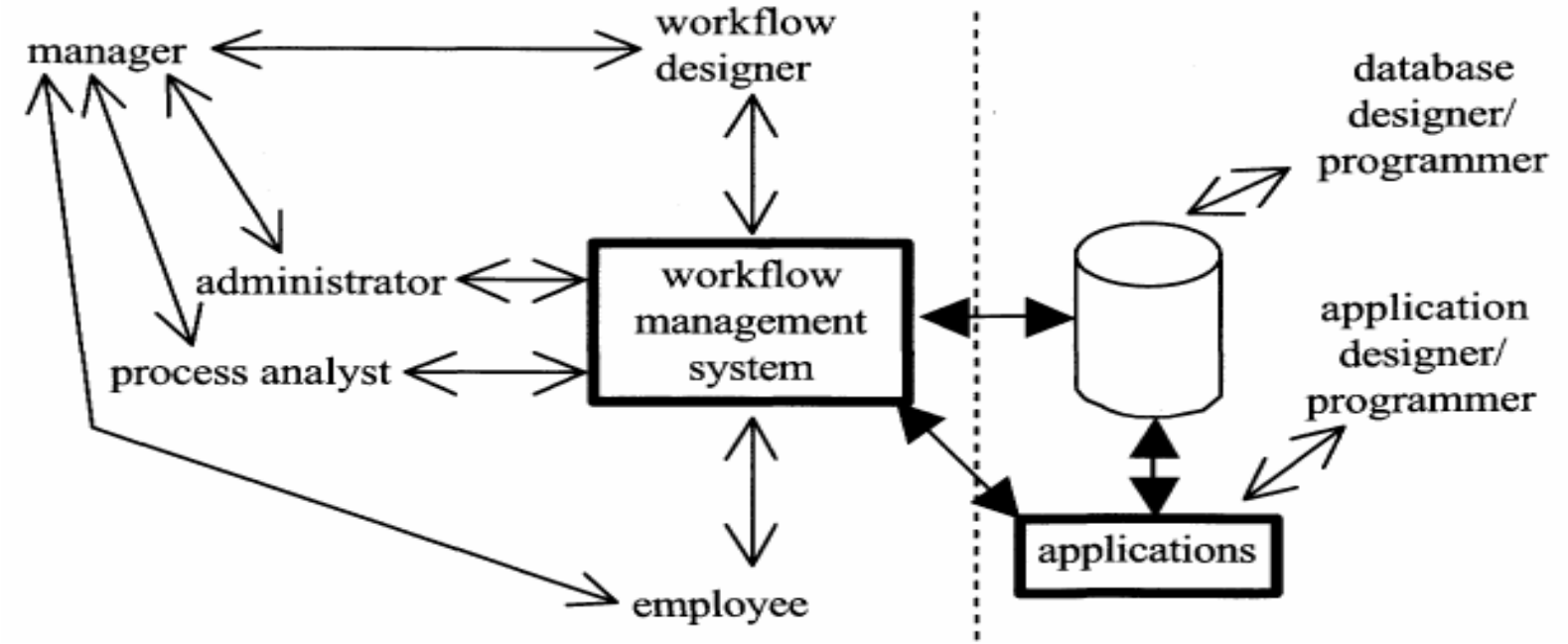

Figure 5.5
The users of a workflow management system

5.3 Storage and Exchange of Data

- **Data in a workflow system**
  - In most cases the workflow management system and the applications make use of the same database system.
  - Data Types:
    - Process definitions
    - Resource classifications
    - Analysis data
    - Operational management data
    - Historical data
    - Application data
    - Internal data
    - Logistical management data

5.3 Storage and Exchange of Data

- **Interfacing problems**
  - *Interface 1 (process definition tools).*
  - *Interface 2 (workflow client applications).*
  - *Interface 3 (invoked applications).*
  - *Interface 4 (other workflow enactment services).*
  - *Interface 5 (administration and monitoring tools).*

  - little progress has been made thus far in agreeing on standards for Interfaces 3 and 5.

5.3 Storage and Exchange of Data

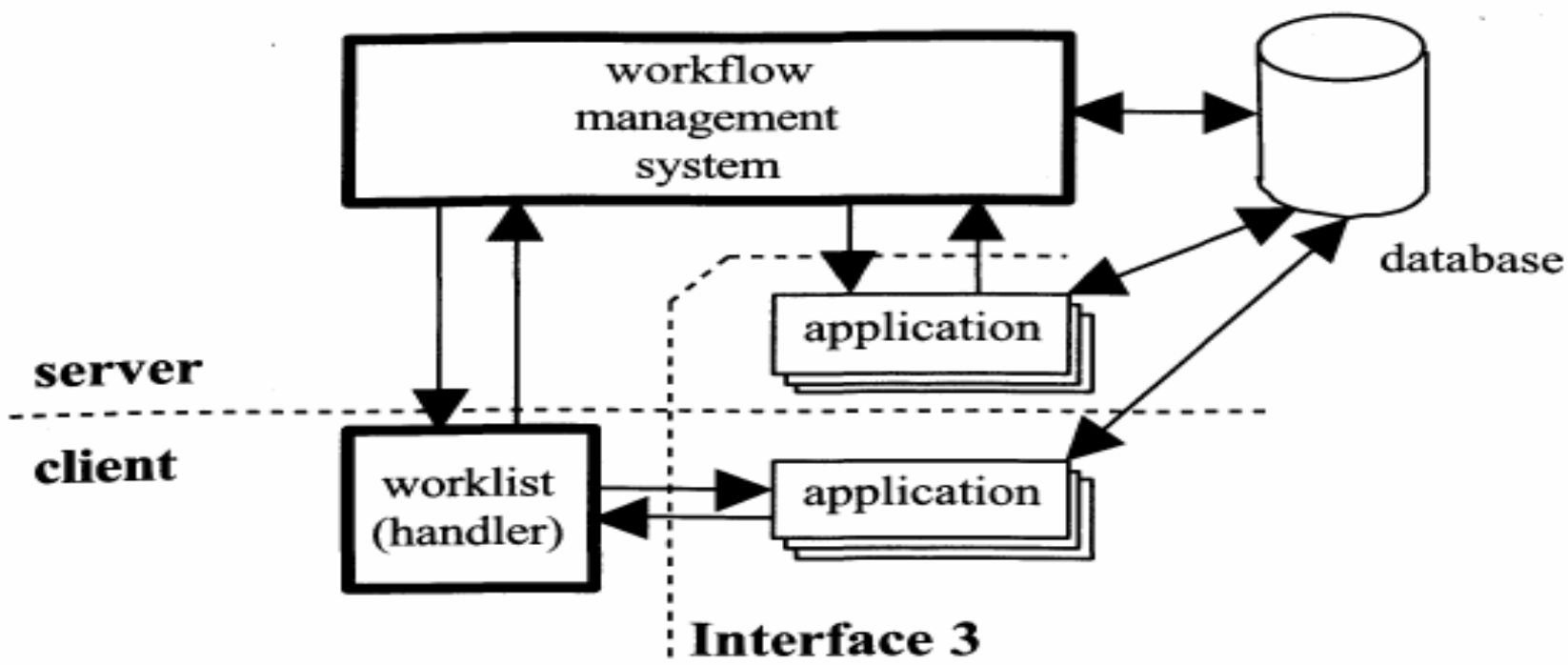

Figure 5.7
Potential problems around Interface 3

- To solve such problems effectively, it is vital that the engine, the database, the worklist handler, and the application all regard a task (or a part of a task) as a *common logical unit of work* (LUW).

5.3 Storage and Exchange of Data

- several interoperability standards for the exchanging information between workflow products have been proposed.
  - specifications for workflow modeling and workflow description (i.e., design-time): Interface 1
    - WPDL, PIF, PSL, UML, Petri Net (ISO), IDEF0
    - XPDL, BPEL, BPEL4People
  - specifications for run-time interoperability: Interface 2,3,4. 4 is more important.
    - WfMC: TC-1012, TC-1018, TC-1023
    - SWAP: *Simple Workflow Access Protocol*
    - The jointFlow standard is formed by a set of IDL specifications.
  - the standards are at a rather technical level and do not really deal with issues at a business level.

5.4 Required Technical Infrastructure

- **Required Technical Infrastructure**
  - Hardware
  - OS
  - Network Software: TCP/IP
  - DBMS:Usually the applications and the WFMS use the same database system.
  - Applications: The case attributes can be exchanged through a WAPI or the database.
  - WFMS

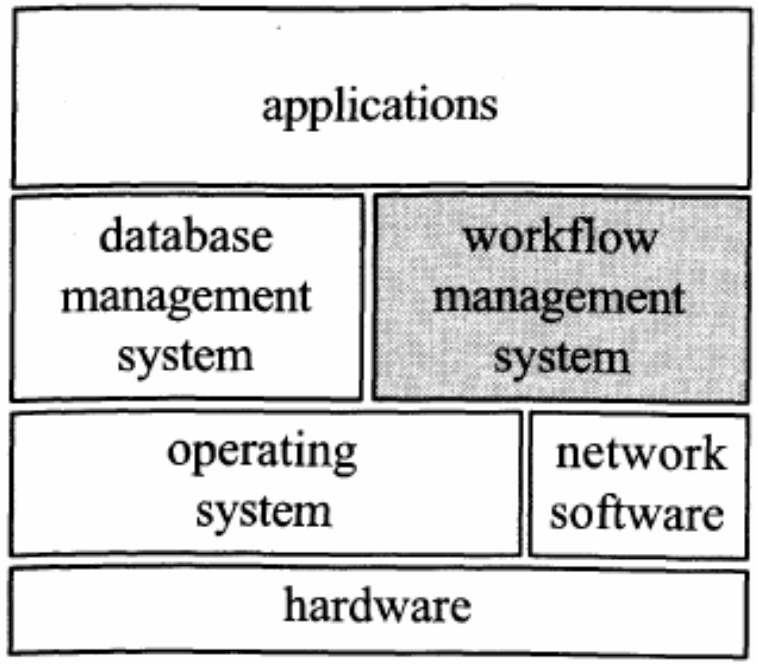

Figure 5.8
A summary of the technical components

5.5 Current Generation of Workflow Products

- Until 2000, about 200 suppliers
- most ERP-systems such as SAP, Baan, and JD Edwards have a workflow engine incorporated.

ActionWorkflow	Action Technologies Inc.
Computron Workflow	Computron
COSA	Ley GmbH
CSE/WorkFlow	CSE
Documetrix Workflow	Universal Systems Inc.
FloWare	BancTec-Plexus
FLOWBuilder	PowerCerv
FlowMark/MQ Series Workflow	IBM
FormFlow	Delrina
HICOS	Empirica
InConcert	TIBCO/InConcert
Income	Promatis
JetForm Server	JetForm Corporation
KI Shell	UES Inc.
NAVIGATOR 2000/Workflow	I. Levy & Associates
Open Workflow	Wang
OPEN IMAGE	SNS Systems
PowerFlow	Optika Imaging Systems Inc.
Process Weaver	Cap Gemini Innovation
SAP Business Workflow	SAPAG
Staffware	Staffware
TeamWARE	TeamWARE
Ultimus	Ultimus
Verve	Verve Inc.
ViewStar	ViewStar
Visual WorkFlo	FileNet Corp.
WebFlow	Cap Gemini Innovation
Workflow Factory	Delphi Consulting Group
WorkFLOW SQL	Optical Image Technology Inc.
WorkParty	Siemens Nixdorf IS -AG
WorkVision	IA Corporation

Figure 5.9
A number of workflow management systems and their suppliers

5.5 Current Generation of Workflow Products

- **Staffware**
  - one of the most widespread WFMSs in the world.
  - components:
    - *Graphical Workflow Definer (GWD)*
    - *Graphical Form Designer (GFD)*
    - *Work Queue Manager (WQM)*
    - *Staffware Server (SS)*
    - *Staffware Administration Managers (SAM)*
    - *Audit Trail (AT)*

5.5 Current Generation of Workflow Products

- **Staffware—Process Definition and its tool**

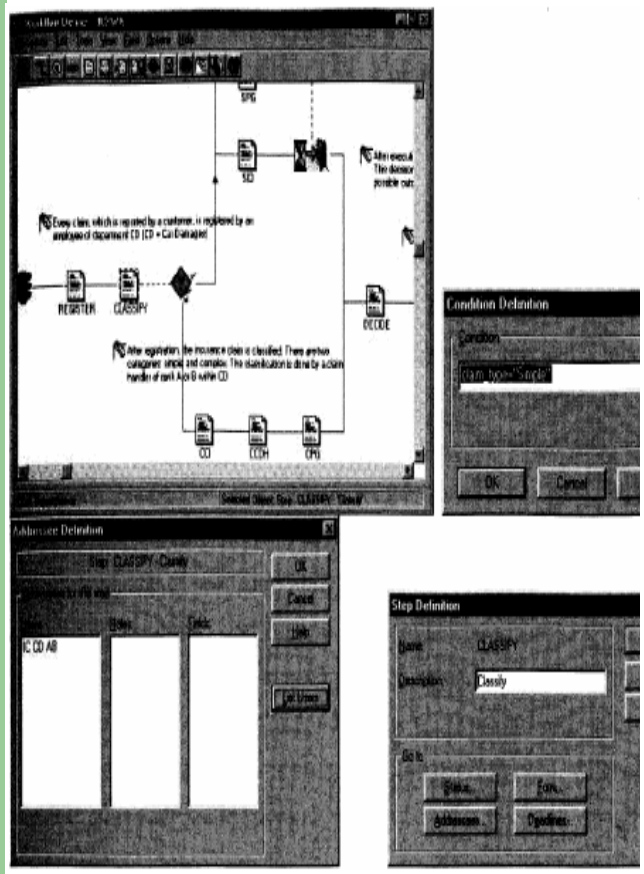

Figure 5.10
The graphical Workflow Definer (GWD): The design tool of Staffware

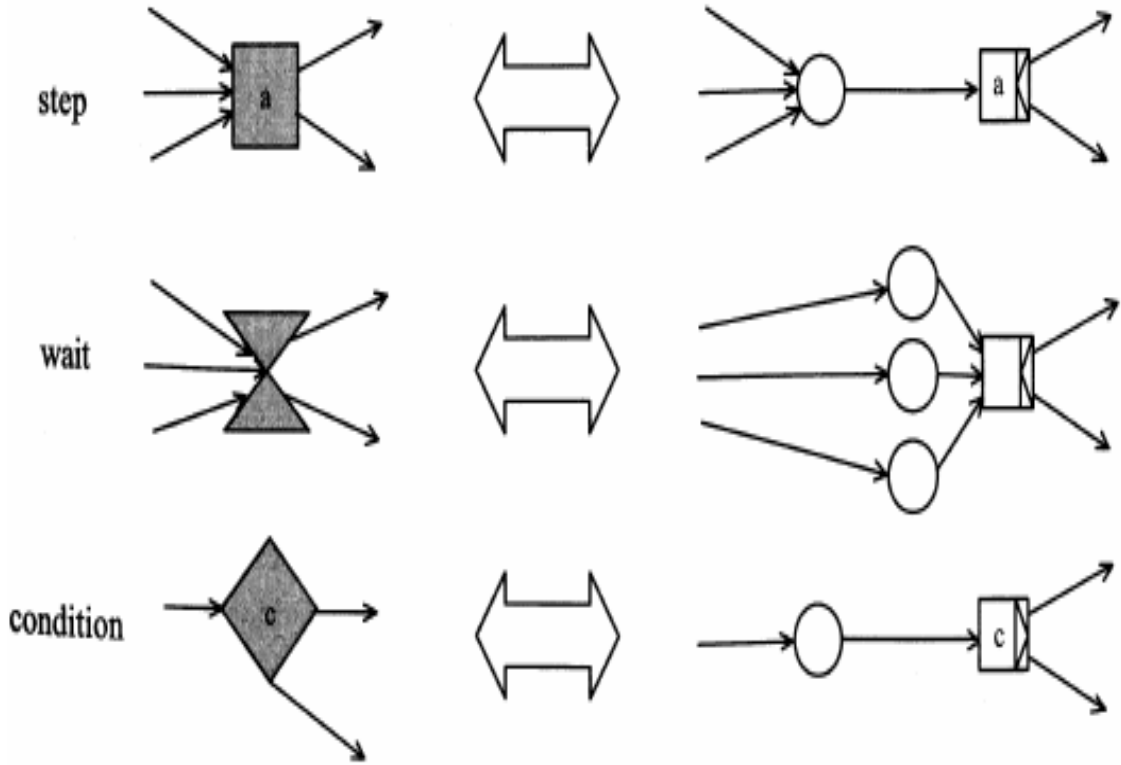

Figure 5.11
The semantics of some of the Staffware constructs (left) expressed in Petri nets (right)

5.5 Current Generation of Workflow Products

- Staffware
  - One of the core differences is the fact that the notion of states, that is, a concept similar to places, is not supported by Staffware.
  - several constructs that can be modeled in terms of Petri nets cannot be modeled in Staffware, such as implicit choices, milestones, and other non-free-choice constructs.

5.5 Current Generation of Workflow Products

- Staffware—Client Application
  - Staffware does not offer a tool for organizational modeling. Instead Staffware uses the concept of the *work queue.*
  - A user can be a member of many work queues and a work queue can be associated with many users.
  - Work items can be put into one or more work queues.
  - While the user is processing the work item, the work item remains locked for all other members of the group.

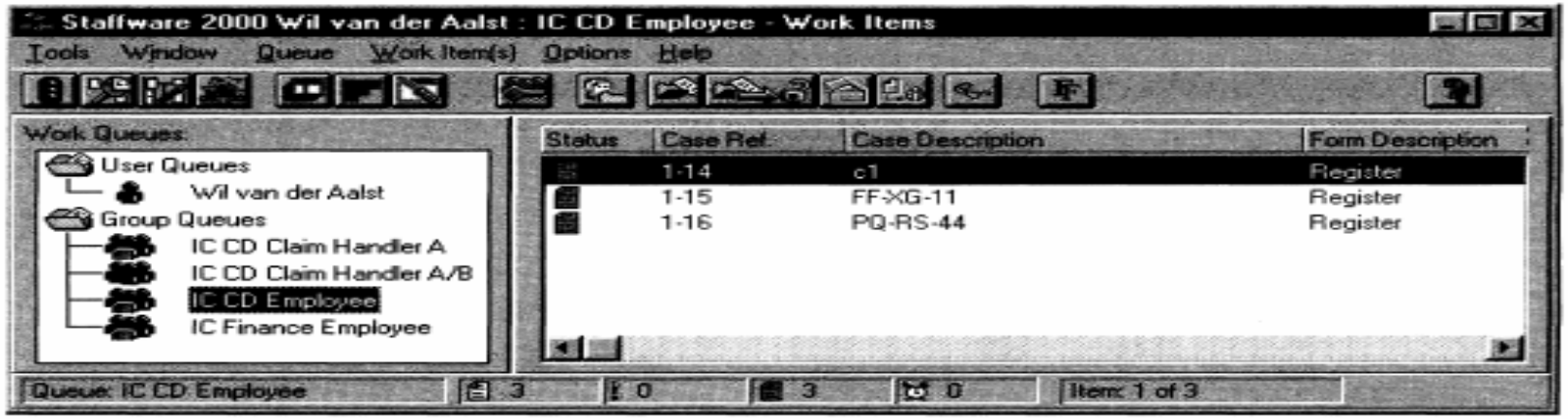

Figure 5.13
The Work Queue Manager (WQM) of Staffware

5.5 Current Generation of Workflow Products

- Staffware—Other Tools

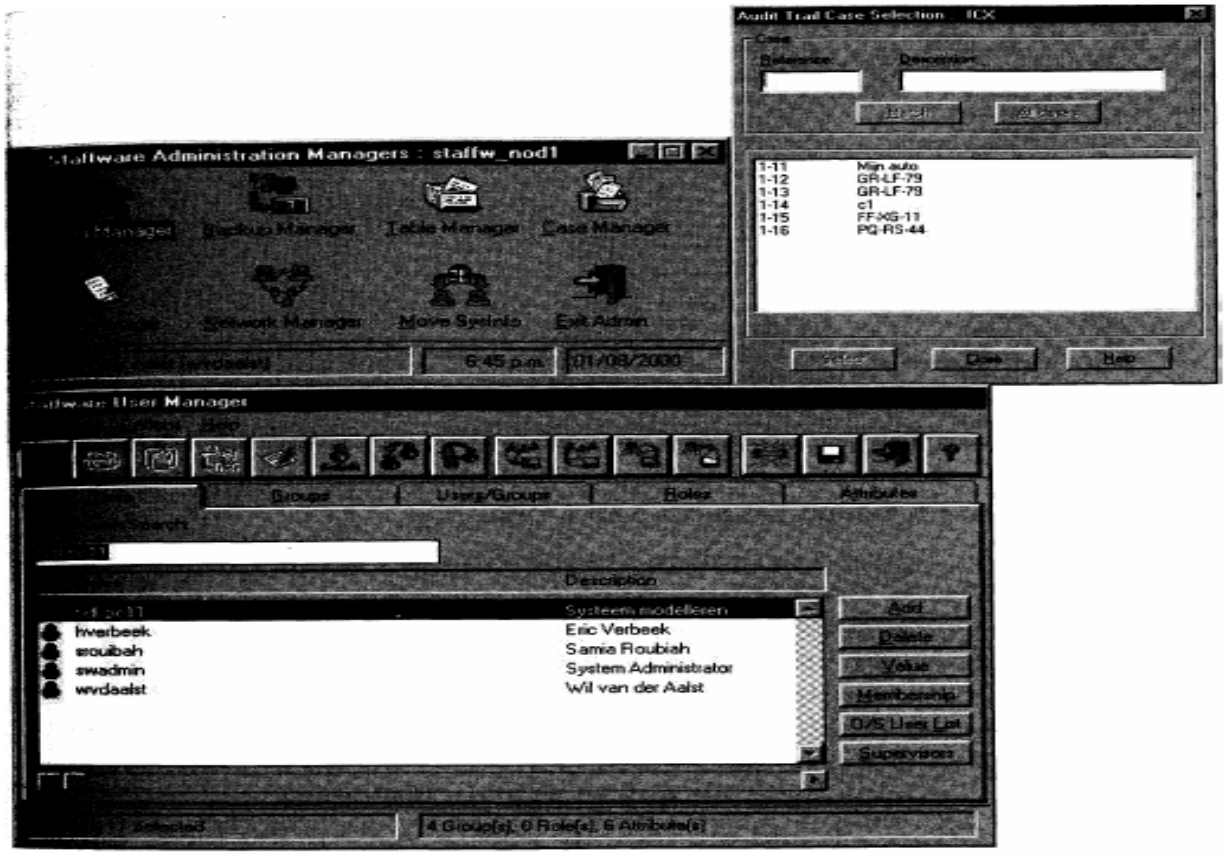

Figure 5.14
The Audit Trail and the User Manager (one of the Staffware Administration Managers tools)

5.5 Current Generation of Workflow Products

- COSA
  - It is a workflow management system based upon Petri nets. COSA can be described as a traditional WFMS that closely follows the WFMC reference model.
  - components:
    - 1. COSA Network Editor (CONE)
    - 2. COSA User Editor (COUE)
    - 3. COSA MemoBox (COMB)
    - 4. COSA Networkstate Displayer (COND)
    - 5. COSA Runtime Server (CORS)
    - 6. COSA Simulator (COSI)
    - 7. COSA Administrator (COAD)

5.5 Current Generation of Workflow Products

- COSA--Tools

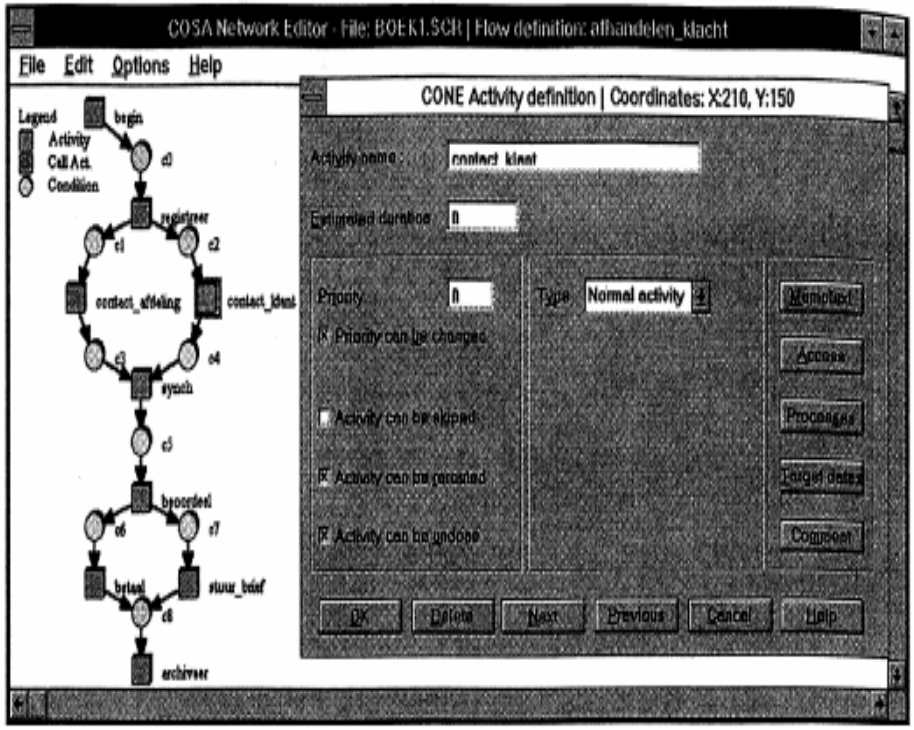

Figure 5.15
A COSA process definition produced with CONE

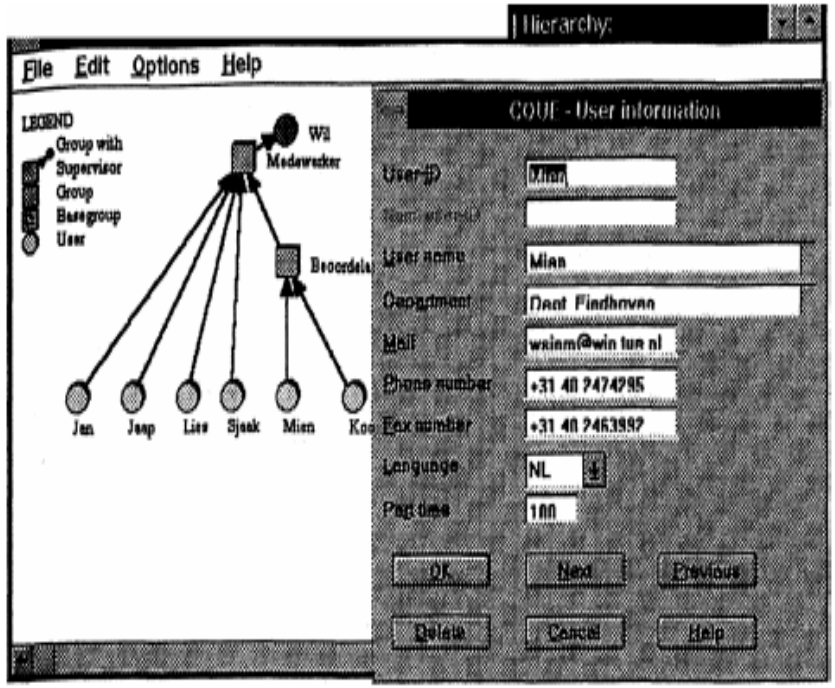

Figure 5.16
A subdivision into roles produced by COUE

5.5 Current Generation of Workflow Products

- ActionWorkflow
  - Focuses upon supporting processes in which communication between people and/or parties plays a major role.
  - components:
    - 1. ActionWorkflow Process Builder
    - 2. ActionWorkflow Process Manager
    - 3. Action DocRoute
    - 4. Action Metro
  - ActionWorkflow differs in many respects from standard WFMS

5.5 Current Generation of Workflow Products

- **Analysis tools**
  - **Woflan** *Woflan* (WorkFLow Analyzer) is a tool that analyzes workflow process definitions specified in terms of Petri nets.
  - ExSpect *ExSpect* (Executable Simulation Tool) is a full-fledged simulation tool based on Petri nets.
    - ExSpect can also be used to simulate production processes, transportation networks, software components, embedded systems, etc.
    - ExSpect can download workflow processes from workflow management systems such as COSA and BPR tools such as Protos.

5.5 Current Generation of Workflow Products

- BPR Tools
  - Protos, ARIS
  - BusinessSpecs, Income, Meta Workflow Analyzer

5.5 Current Generation of Workflow Products

- Selecting a workflow management system
  - The *shortlist* should preferably contain about five systems
  - One way to gain a good impression of a workflow management system quickly is to work through a *sample process* chosen *in advance.*
  - a possible sample process: p191 Figure 5.22

5.6 Adaptive Workflow

- **Workflow management and CSCW**
  - workflow management systems have problems dealing with *changes.*
  - different fields of support for collaborative work:
    - unstructured, information centric approaches: CSCW
    - structured, process-centric approaches : workflow

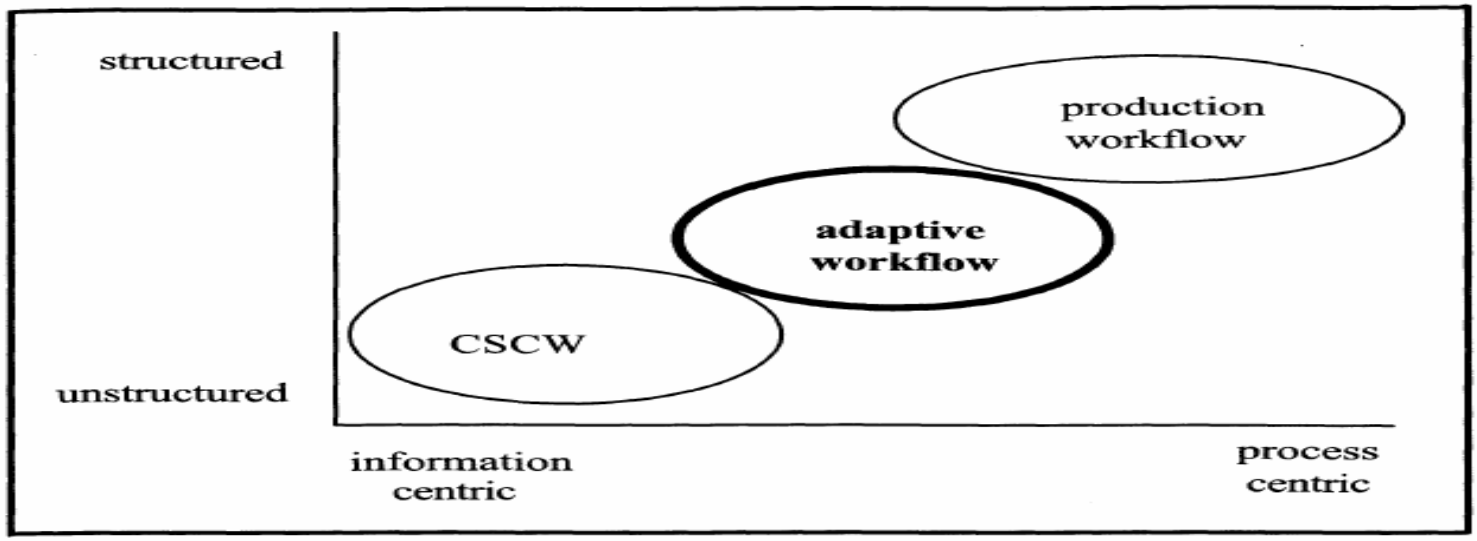

Figure 5.23
The collaborative work spectrum

5.6 Adaptive Workflow

- **Workflow management and CSCW**
  - *Adaptive workflow* aims at providing process support like normal workflow systems do, but in such a way that the system is able to deal with certain changes.
  - Typical issues related to adaptive workflow:
    - *Correctness*
    - *Dynamic change*
    - *Management information*

5.6 Adaptive Workflow

- **Classification of change**
  - Some of the perspectives relevant for change
    - process perspective: tasks are added or deleted or their ordering is changed,
    - resource perspective: resources are classified in a different way or new classes are introduced,
    - control perspective: changing the way resources are allocated to processes and tasks,
    - task perspective: upgrading or downgrading tasks, and
    - system perspective: changes to the infrastructure or the configuration of the engines in the enactment service.
  - For workflow management systems, the process perspective is dominant.

5.6 Adaptive Workflow

- **Classification of change**
  - **classify change based on the scope or impact of it**
    - **Individual (ad hoc) changes**
    - **Structural (evolutionary) changes**
  - **3 different ways in which a workflow can be changed:**
    - **the process definition is extended**
    - **tasks are replaced by other tasks**
    - **tasks in the process are reordered**
  - **For structural changes there are 3 alternatives**
    - **restart**
    - **proceed**
    - **transfer**

5.6 Adaptive Workflow

- **InConcert**
  - Few commercial systems provide support for adaptive workflow. Only for individual change there are some systems available.
  - two unique features of InConcert
    - "workflow design by discovery"
    - supports a notion of class hierarchies that enables one InConcert object to inherit functionality of another InConcert object
  - Client tools: Process Designer, Task User Interface Designer, Work Group Manager, Process Manager, Document Organizer, Task Organizer.
  - The modeling language used by InConcert corresponds to a subclass of Petri nets: AMG.

5.6 Adaptive Workflow

- **InConcert**
  - InConcert associates a unique process definition to each individual case
  - several ways to create a new workflow instance:
    - Instantiate an existing workflow process definition
    - Instantiate a customized version of an existing workflow process definition
    - Instantiate an ad hoc workflow process by specifying a sequence of tasks and users.
    - Instantiate a so-called "free routing process"
  - "workflow design by discovery“ : The routing of any completed workflow instance can be used to create a new template.
  - 3 types of classes: process classes, task classes, and document classes.

5.7 Workflow Management Trends

① modeling;
② analysis;
③ planning;
④ transaction management;
⑤ interoperability;
⑥ Internet/Intranet; and
⑦ logistical management.

⑧ Distributed WFMS: SOA/BPEL Workflow, Grid Workflow, P2P Workflow
⑨ Temporal Workflow