



Sistemi ICT per il Business Networking

Workflow Management Systems (WfMS)

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Work Flow Management

- The **automation** of processes involving
 - combinations of **human** and **machine-based activities**, particularly those involving interaction with IT applications and tools
 - passing **documents**, **information** or **tasks** between participants according to a defined set of rules to achieve, or contribute to, an overall business goal
- Whilst workflow may be **manually organised**, in practice most workflow is normally organised within the context of an **IT system** to provide computerised support for the procedural automation

Workflow and BPR

- **Workflow** is often associated with **Business Process Re-engineering**
- **BPR**: the assessment, analysis, modeling, definition and subsequent operational implementation of the **core business processes** of an organization (or other business entity)
- **Not all BPR activities** result in workflow implementations
 - Advantages: **workflow technology** is often an appropriate solution as it provides **separation** of the business procedure logic and its IT operational support, enabling **subsequent changes** to be incorporated into the procedural rules defining the business process
- Conversely, **not all workflow implementations** necessarily form part of a BPR exercise

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Workflow Management System (WfMS)

- A **Workflow Management System** provides procedural automation of a business process by management of the sequence of work activities and the invocation of appropriate human and/or IT resources associated with the various activity steps
- An individual business process may have a **life cycle** ranging from minutes to days (or even months)
- May use a **wide variety of IT and communications infrastructure**
- May operate in an environment ranging **from small local workgroup to inter-enterprise**

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Workflow Management Coalition

- All work flow management products have some **common characteristics**
- **WFM Coalition**: a grouping of companies who have joined together **to address the lack of standards to enable different WFM products to work together**
 - to achieve a level of interoperability through the use of **common standards** for various functions
 - to identify these **functional areas** and develop appropriate specifications for implementation in workflow products
- **Interoperability** between **heterogeneous workflow products**

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WFMC Reference Model

- The WFMC Reference Model thus takes a **broad view** of workflow management, which is intended to accommodate the variety of implementation techniques, operational environments, and technologies
- Despite this variety, all WFM systems exhibit certain **common characteristics**, which provide a basis for developing integration and interoperability capability between different products
- The **Reference Model** describes a common model for the construction of workflow systems and identifies how it may be related to various alternative implementation approaches

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Aims of WfMC Reference Model

- A **common vocabulary** for describing the business process and various aspects of the supporting technologies to facilitate automation
- A **functional description** of the necessary **key software components** in a workflow management system and how they would interact (in a **"technology neutral"** manner)
- The definition, in functional [or abstract] terms, of the **interface between various key software components** that would facilitate exchange of information in a standardised way, thus enabling interoperability between different products

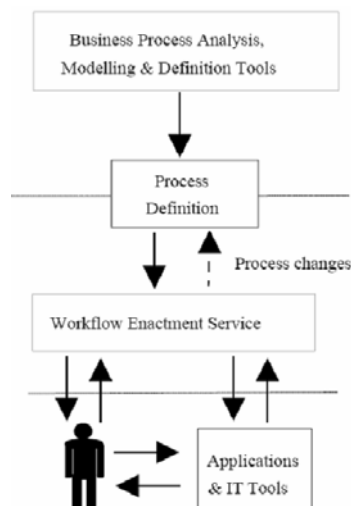
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Functional areas for WfMS

- **Build-time functions:** **defining**, and possibly **modeling**, the workflow process and its constituent activities
- **Run-time control functions:** **managing** the workflow processes in an operational environment and **sequencing** the various activities to be handled as part of each process
- **Run-time interactions** with **human** users and IT **application tools** for processing the various activity steps



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Build-time functions

- A **business process** is translated from the real world into a formal, computer processable definition by the use of one or more analysis, modeling and system definition techniques
- **Result**: a computerized definition of a business process (process model, a process template, process metadata, or a process definition)
 - Comprises a number of **discrete activity steps**, with associated **computer and/or human operations and rules** governing the **progression of the process** through the various activity steps
 - May be expressed in **textual or graphical** form or in a **formal language** notation

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Run-time Process Control Functions

- **At run-time** the process definition is interpreted by software which is responsible for
 - **creating** and **controlling** operational instances of the process
 - **scheduling** the various activities steps within the process
- Core component: **workflow "engine"** responsible for process creation & deletion, control of the activity scheduling within an operational process and interaction with application tools or human resources
 - Typically **distributed** across a number of computer platforms to cope with processes which operate over a wide geographic basis

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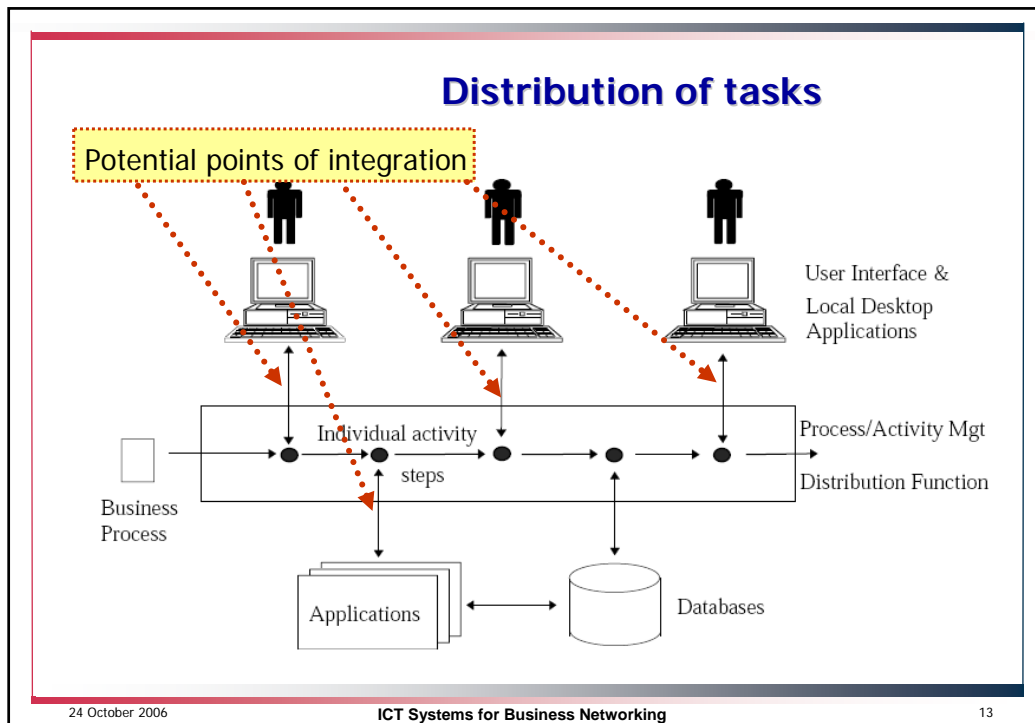
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Run-time Activity Interactions

- Individual **activities**
 - **human operations**
 - often realized **in conjunction with** the use of a particular IT tool
 - **information processing operations** requiring a particular application program to operate on some defined information
- **Invoking** application tools and pass the appropriate data
- There are several benefits in having a **standardized** framework for supporting this type of interaction

Distribution

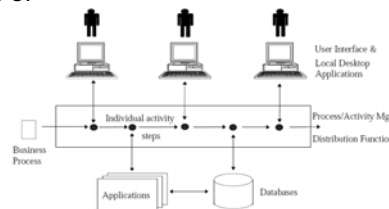
- **Distribute tasks and information** between participants
- The distribution function may operate at **a variety of levels** (workgroup to inter-organization) depending upon the scope of the workflows
- A variety of underlying **communications mechanisms** (electronic mail, messaging passing, distributed object technology, etc.)



- ### Workflow areas
- **Document Management:** managing the **lifecycle of electronic documents** distributed within an organization
 - **Electronic mail** systems have workflow functionality to add **routing** commands to define a sequence of recipients for particular types of mail items in response to some form of identified business procedure
 - **Transaction-based applications:** separation between the business procedure logic and the invocation of the various application tools required **to support individual activities** within the business process
 - **Project Support Software:** workflow functionality within the project environment for "**transferring**" **development tasks** between individuals and **routing information** between individuals to support these tasks
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Coverage of WfMC specifications

- The full range of interfaces being defined by the WFM Coalition covers
 - specifications for **process definition data** and its interchange
 - interfaces to support **interaction** with a variety of IT application types
 - interfaces to support **interaction** with user interface desktop functions
 - interfaces to provide **system monitoring** and **metric functions** to facilitate the management of composite workflow application environments
 - interfaces to support **interoperability** between different workflow enactment systems

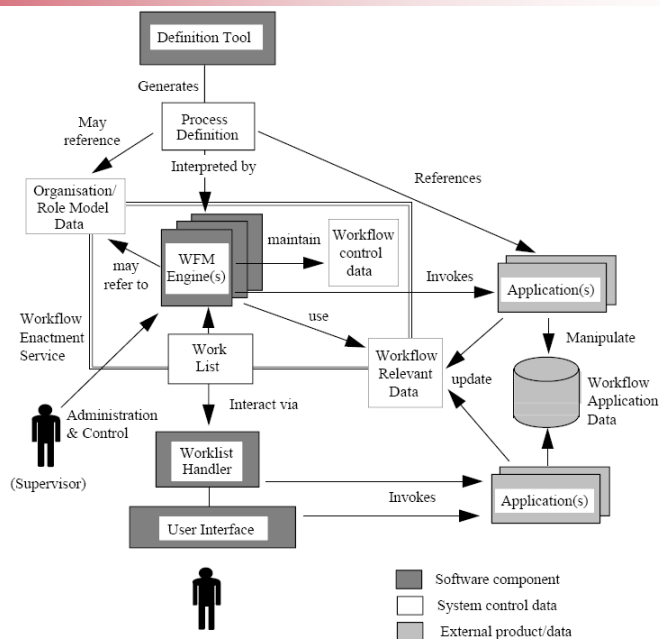


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Main functional components of a generic workflow system



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Generic workflow system

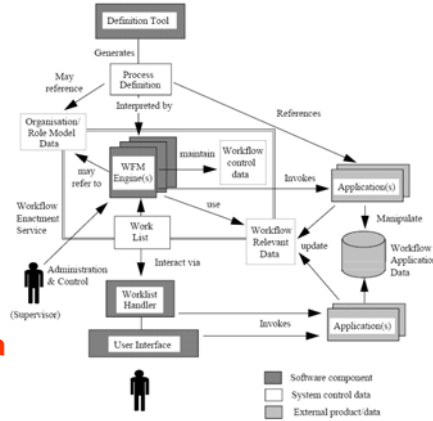
- Three types of component:
 - software components** which provide support for various functions within the workflow system
 - various types of **system definition and control data** which are used by one or more software components
 - applications and application databases** which are not part of the workflow product, but which may be invoked by it as part of the total workflow system

The diagram illustrates the architecture of a Generic Workflow System. It shows the following components and their interactions:

- Definition Tool** (Software component) generates the **Process Definition** (System control data).
- The **Process Definition** is **Interpreted by** the **WFM Engine(s)** (Software component).
- The **WFM Engine(s)** **maintain** **Workflow control data** (System control data) and **may refer to** **Organisation/ Role Model Data** (System control data).
- The **WFM Engine(s)** **use** the **Work List** (System control data) and **Workflow Relevant Data** (System control data).
- The **Work List** **Interacts via** the **Worklist Handler** (System control data) with the **User Interface** (Software component).
- The **User Interface** is used by the **Supervisor** (External product data).
- The **Worklist Handler** **Interacts via** **Workflow Relevant Data** with **Application(s)** (Software component).
- The **Workflow Relevant Data** is **updated** by **Application(s)** and **Workflow Application Data** (System control data).
- The **Application(s)** **manipulate** **Workflow Application Data** and **invoke** **Application(s)** (Software component).

Legend:

- Software component (Grey box)
- System control data (White box)
- External product data (Grey box with black border)



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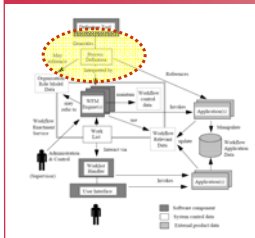
[illegible]

- Used **to create the process description** in a **computer processable form**
- May be based on a **formal process definition language**
- The definition tool may **be supplied as**
 - part of a specific workflow product
 - part of a business process analysis product
 - there must be a **compatible interchange format** to transfer the process definitions to/from the run-time workflow software

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Process Definition

- contains **all necessary information** about the process to enable it to be executed by the workflow enactment software
 - **starting and completion conditions**
 - constituent **activities**
 - **user tasks**
 - references to **applications** which may to be invoked
 - definition of any workflow **relevant data** which may need to be referenced
- Es. BPML, BPEL, BPN, XPD, ...


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Organisation/Role model

- contains information concerning **organisational structure** and **roles** within the organisation
- The process definition to be specified **in terms of organisational entities and role functions** associated with particular activities or information objects, rather than specific participants

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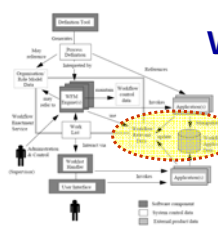


The diagram illustrates the Workflow Enactment Service architecture. It shows a central 'Workflow Enactment Service' box (highlighted with a yellow dashed border) connected to various components. On the left, a 'User' icon is connected to 'User Interface' and 'User Services' boxes. On the right, 'Application Tools' and 'Application Data' boxes are connected to the central service. A legend at the bottom right identifies three types of data: 'Software component' (represented by a box with a grid), 'System-related data' (represented by a box with a grid and a small circle), and 'External product data' (represented by a box with a grid and a small circle).

Workflow Enactment Service

- **interprets** the process description and
- **controls** the instantiation of processes and sequencing of activities
 - adding work items to the user **work lists** and
 - invoking **application tools** as necessary
- One or more **co-operating workflow management engines**

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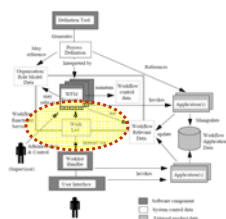


The diagram illustrates the Workflow Relevant Data and Application Data architecture. It shows a central 'Workflow Enactment Service' box (highlighted with a yellow dashed border) connected to various components. On the left, a 'User' icon is connected to 'User Interface' and 'User Services' boxes. On the right, 'Application Tools' and 'Application Data' boxes are connected to the central service. A legend at the bottom right identifies three types of data: 'Software component' (represented by a box with a grid), 'System-related data' (represented by a box with a grid and a small circle), and 'External product data' (represented by a box with a grid and a small circle).

Workflow Relevant Data and Application Data

- Data are **generated** or **updated** by workflow application programs
- **Relevant data** (also known as "case data"): application data accessible to the workflow engine
- **Application data**: manipulated directly (and only) by the invoked applications

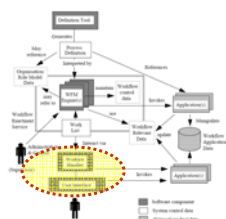
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Worklists

- Where user interactions are necessary within the process execution, the workflow engine(s) **place items on to worklists** for attention by the worklist handler, which manages the **interactions with the workflow participants**
- The worklist may be **visible to the user**, who has the responsibility of **selecting individual items** of work from the list and progressing them independently, with the worklist being used to indicate **task completions**

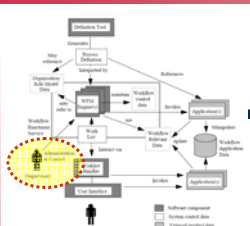
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Worklist Handler & User Interface

- Software component that manages the **interaction between workflow participants and the workflow enactment service**
- **Responsible** for progressing work requiring user attention
- Controlling the **allocation of work** amongst a set of users to provide **facilities** such as load balancing and work reassignment
- The **User Interface** (shown as a separate software component) is responsible for the look and feel of the user dialogue and control of the local interface with the user

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Supervisory Operations

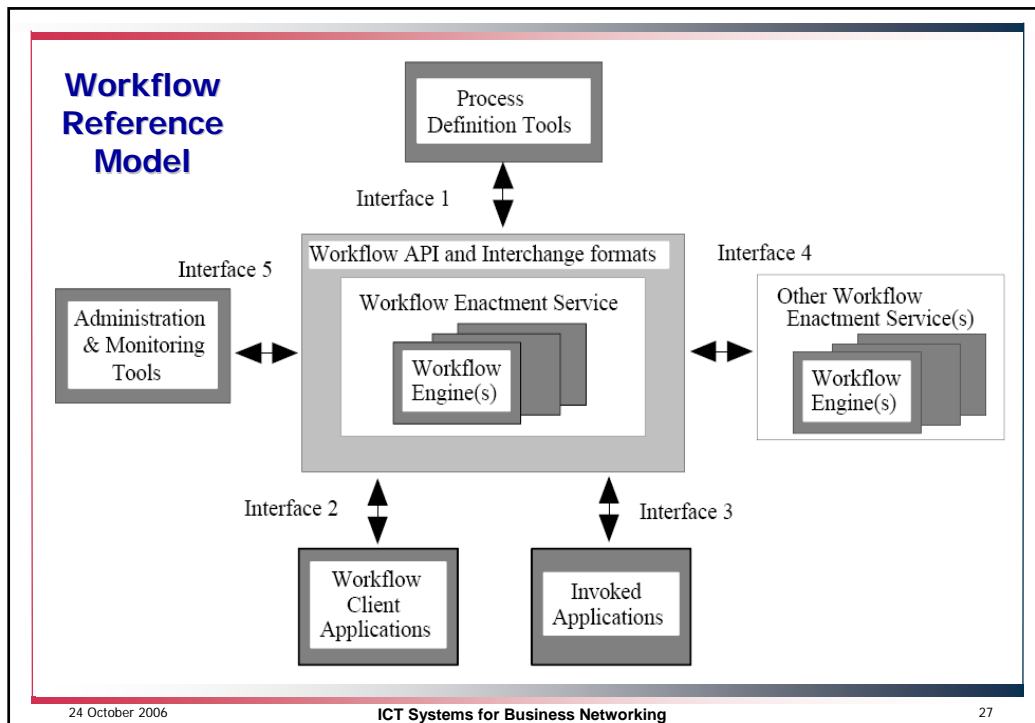
- Within a workflow system there are a number of **supervisory functions**
 - to alter work allocation rules
 - to identify participants for specific organisational roles within a process
 - to track alerts for **missed deadlines** or other forms of event
 - to trace the history of a particular process instance
 - to enquire about work throughput or other statistics
 - ...

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Workflow Reference Model

- **Generic** workflow application structure
 - 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 levels of capability within each of these generic components
- **To achieve interoperability** between different workflow products → a **standardised set of interfaces and data interchange formats** between such components is necessary

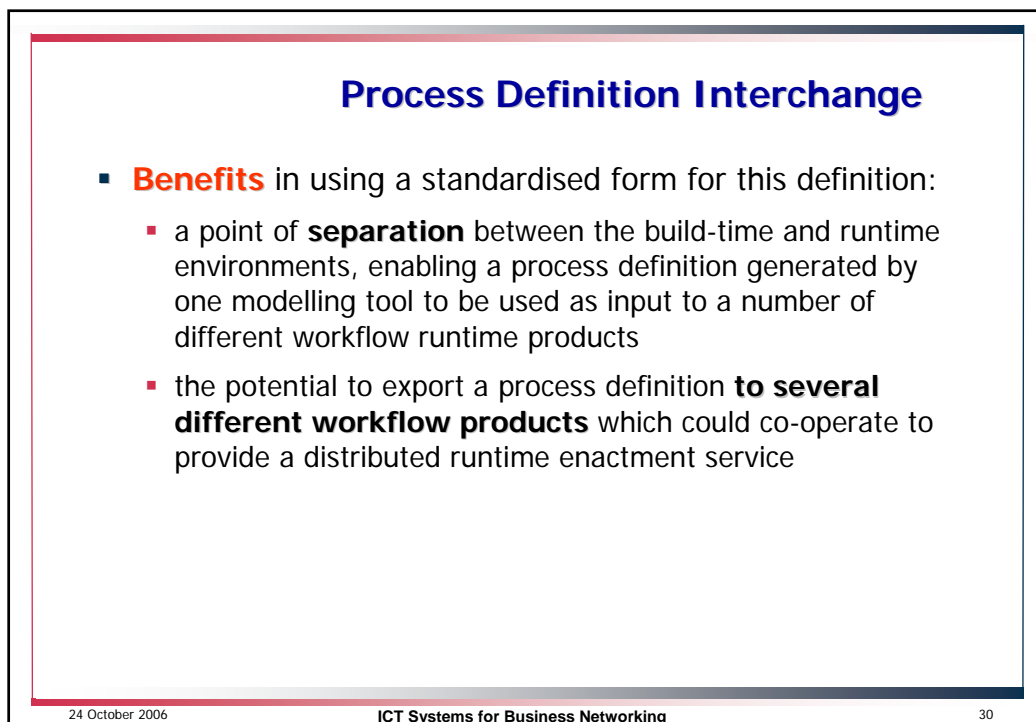
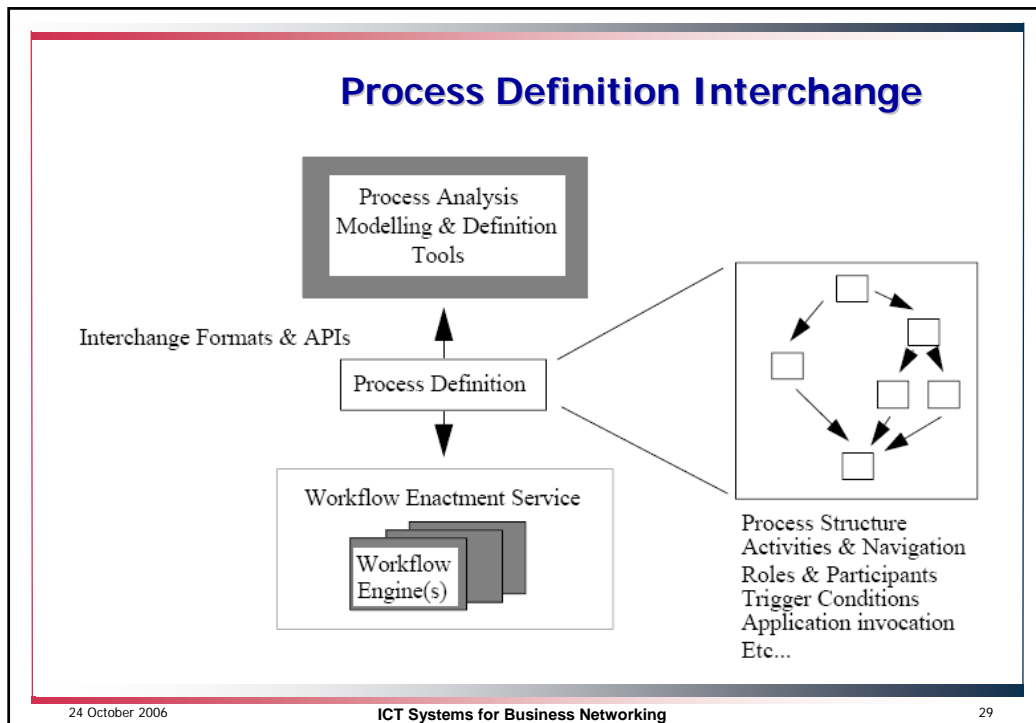
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Process Definition Tools

- Used to **analyse, model, describe** and **document** a business process
 - from the informal ("pencil and paper") to sophisticated and highly formalised
- The final **output** from process modelling and design activity: a **process definition** which can be interpreted at runtime by the workflow engine(s) within the enactment service
- **Process definition interface**: between the modelling and definition tools and the runtime workflow management software
 - may support the exchange of a complete process definition or a subset - for example a set of process definition changes or the attributes of a particular activity within the process definition

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Process definition entities with attributes

- **Workflow Type Definition** (process name, Version number, start and termination conditions, security, audit or other control data)
- **Activity** (name, type, pre- and post- conditions, other scheduling constraints)
- **Transition Conditions** (flow or execution conditions)
- **Workflow relevant data** (data name and types)
- **Role** (name and organisational entity)
- **Invoked Application** (generic type or name, execution parameters, location or access path)

Workflow Enactment Services

- The **run-time environment** in which process instantiation and activation occurs, utilising **one or more workflow management engines**, responsible for
 - **interpreting** process definitions,
 - **creating, managing and executing** workflow instances
 - **interacting** with the external resources necessary to process the various activities
- A **logical separation** between the process and activity control logic (the workflow enactment service) and the application tools and end user tasks (i.e. the processing associated with each activity)

Workflow Enactment Services

- **Interaction with external resources:**
 - **Client application interface:** interaction with a worklist handler
 - **Activation of application tools** may be under the control of the worklist handler or the end-user
 - **Invoked application interface**, which enables the workflow engine to directly activate a specific tool to undertake a particular activity
 - Typically be a server-based application with no user interface
- Where a particular activity uses **a tool which requires end-user interaction** it would normally be invoked **via the worklist interface** to provide more flexibility for user task scheduling

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Workflow engine

- Responsible for the **runtime control environment** for workflow instances within an enactment service
 - **interpretation** of the process definition
 - **control** of process instances (creation, activation, suspension, ...)
 - **navigation** between process activities (sequential or parallel operations, deadline, interpretation of workflow relevant data, ...)
 - **sign-on** and **sign-off** of specific participants
 - **identification of work items** for user attention
 - **maintenance** of control data and relevant data
 - **invoke** external applications and link any workflow relevant data
 - **supervisory** actions for control, administration and audit purposes

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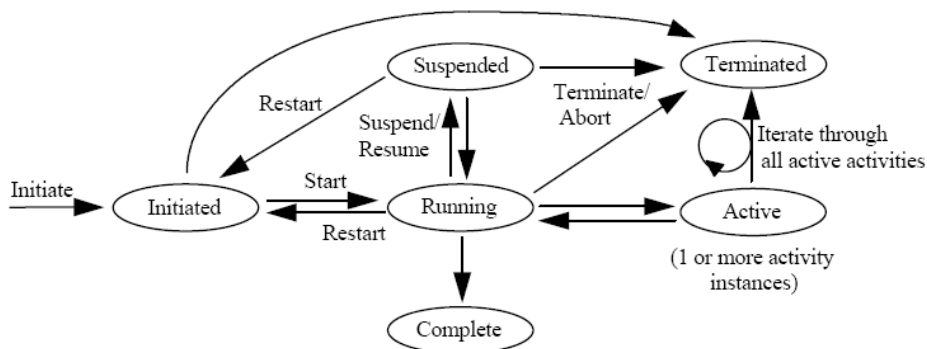
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States for process instances

- **Initiated:** a process instance has been created, including any associated process state data and workflow relevant data, but the process has not (yet) fulfilled the conditions to cause it to start execution
- **Running:** the process instance has started execution and any of its activities may be started (once any appropriate activity start conditions have been met)
- **Active:** one or more of its activities has been started
- **Suspended:** the process instance is quiescent and no activities are started until the process has returned to the running state (via a resume command)
- **Completed:** the process instance has fulfilled the conditions for completion
- **Terminated:** the execution of the process instance has been stopped before its normal completion

State transitions for a process instances



States for activity instances

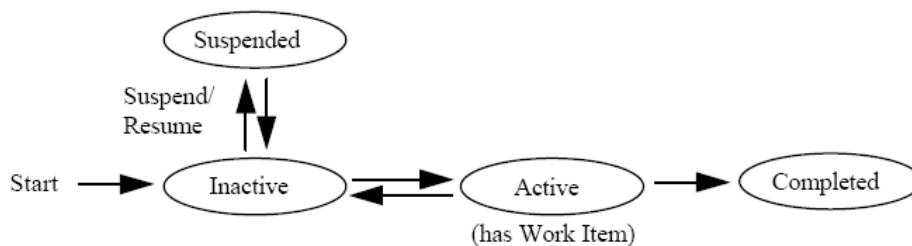
- **Inactive:** the activity within the process instance has been created but has not yet been activated (because activity entry conditions have not been met)
- **Active:** a work item has been created and assigned to the activity instance for processing
- **Suspended:** the activity instance is quiescent and will not be allocated a work item until returned to the active state
- **Completed:** execution of the activity instance has completed (and any post-activity transition conditions will be evaluated)

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State transitions for activity instances



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Workflow data

- **Workflow Control Data:** internal data that is managed by the workflow management system and/or workflow engine in order to identify the state of individual process or activity instances and may support other internal status information
- **Workflow Relevant Data:** used by a workflow management system to determine particular transition conditions and may affect the choice of the next activity to be executed
 - Accessible to workflow applications for operations on the data
- **Workflow Application Data:** application specific and not accessible by the workflow management system
 - Relevant only to the applications or user tasks executed during the workflow

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Data Interchange

- Required to support interworking within
 - **worklist handler** (interface 2)
 - workflow relevant data may be embedded in the work item and extracted from the worklist for presentation to the user or for linkage to a particular application tool
 - **invoked application** (interface 3)
 - the data interchange will depend upon the nature of the application invocation interface and may require the invocation service to embed the data within a specific application protocol
 - **workflow engine interchange** (interface 4)
 - where the different systems support different application data interchange approaches, the use of a **gateway** function will be necessary to map between the two schemes and, possibly, handle name resolution

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Workflow Client Applications

- **Worklist**: the queue of work items assigned to a particular user (or, possibly, group of common users) by the workflow engine. **Accessible** to
 - the **workflow engine** for the purposes of assigning work items
 - the **worklist handler** for the purpose of retrieving work items for presentation to the user for processing
- **Activation** of individual work items may be under the control of the workflow client application or the end-user
- Applications invoked from the worklist handler are predominantly **local** to that environment
- A worklist handler might potentially **interact with several different** Wf engines and several different enactment services

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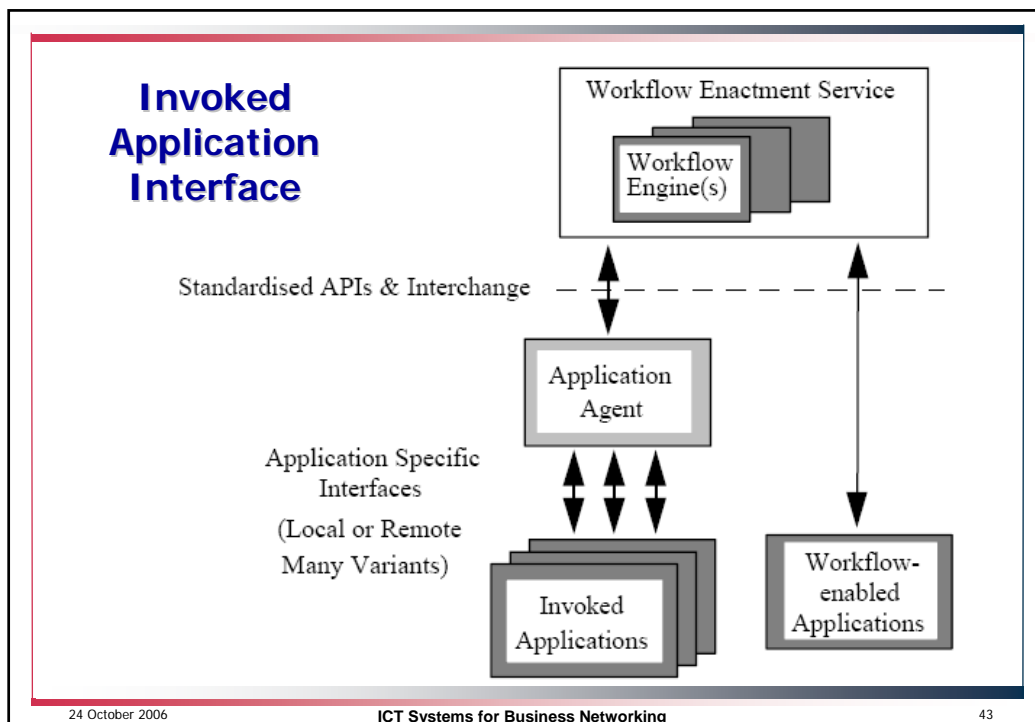
Invoked Applications

- Any particular WFM implementation **does not have sufficient logic** to understand how to invoke **all potential applications** which might exist in an heterogeneous product environment
- Some implementations use the concept of a "**Application Agent**" to contain this variety of operation invocation behind a standard interface into the workflow enactment service

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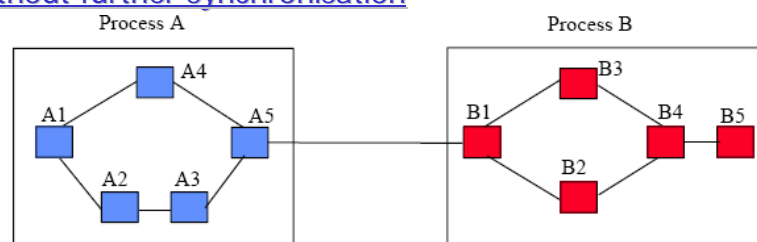
Workflow Interoperability

- Workflow products are **diverse** in nature ranging from those used for more ad-hoc routing of tasks or data to those aimed at highly regularised production processes
- **The work of the Coalition** has therefore focussed on developing a variety of **interoperability scenarios** which can operate at a number of levels from simple task passing through to full workflow application interoperability with complete interchange of process definition, workflow relevant data and a common look and feel
 - **Realistic** target in the near term: the ability to transfer parts of a process for runtime support on a different enactment service

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Scenario 1 - Connected Discrete (Chained)

- A **connection point** within process A to connect to another point within process B
 - The connection points can be **anywhere** within the processes
- **Transfer of a single item of work** (a process instance or activity) between the two workflow environments, which then operates independently in the second environment without further synchronisation



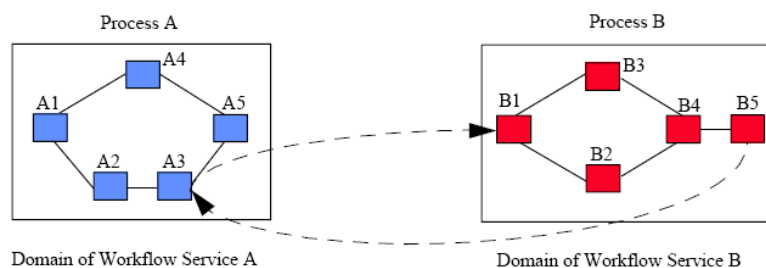
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Scenario 2 - Hierarchical (Nested Subprocesses)

- A process executed in a particular workflow domain can be completely **encapsulated** as a single task within a (superior) process executed in a different workflow domain
- **Hierarchic relationship** between the superior process and the encapsulated process
- Across **several levels**, forming a set of nested sub-processes



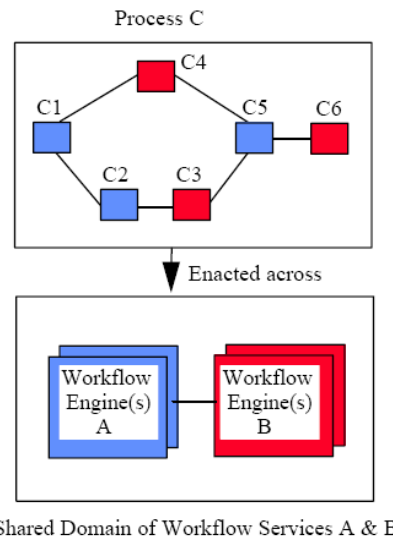
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Scenario 3 - Connected Indiscrete (Peer-to-Peer)

- **Fully mixed environment**
- Activities which may be executed across multiple workflow services, forming a **shared domain**
- The process progresses **transparently** from task to task, without any specific actions by users or administrators, with interactions between the individual workflow engines taking place as necessary
- Workflow relevant and application **data** may also be passed between the various heterogeneous engines



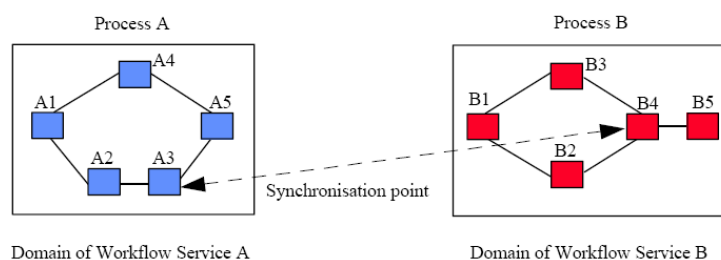
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Scenario 4 - Parallel Synchronised

- This model allows **two processes to operate independently**, possibly across separate enactment services, but requires that **synchronisation points** exist between the two processes
- once the processes each reach **a predefined point** within their respective execution sequences, a common event is generated

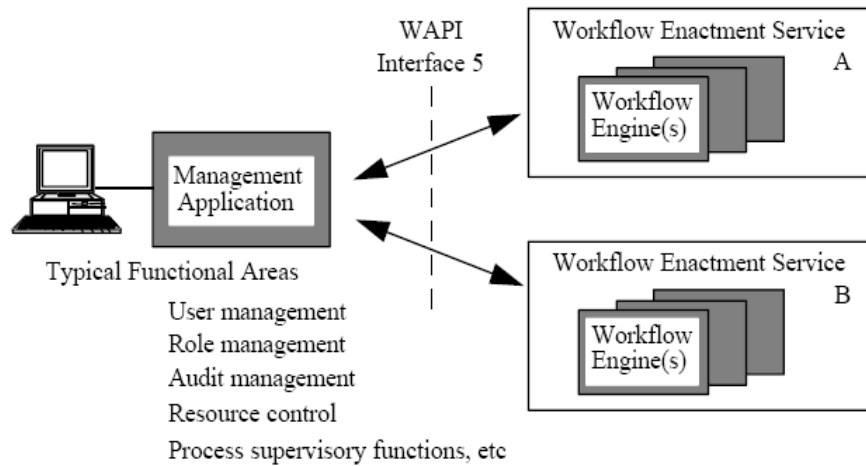


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Systems Administration



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Systems Administration

- User Management operations
 - establishment/deletion/suspension/amendment of **privileges** of users or workgroups
- Role Management operations
 - define/delete/amend **role**
- Audit Management operations
 - query/print/start new/delete **audit trail** or event log, ...
- ...

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Systems Administration

- Process Supervisory Functions
 - changing the **operational status** of a process definition and/or its extant process instances
 - enabling or disabling particular **versions** of a process definition
 - **changing the state** of activity instances of a specified type
 - **termination** of all process instances
- Process Status Functions
 - Fetching **details** of process instances or activity instances, filtered as specified

References

- Workflow Management Coalition - **The Workflow Reference Model**