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**An Introduction to
Workflow Management Systems**

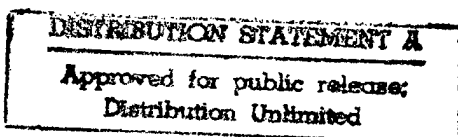
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**Models for Action Project:
Developing Practical Approaches to Electronic Records Management and Preservation**

**Center for Technology in Government
University at Albany--SUNY
State Archives and Records Administration**

November 1997

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Preface

This document provides an introduction to Workflow Management Systems. The first section concentrates on a functional review of these systems: definitions, typical features, benefits, tradeoffs, process selection, and success factors for implementation. The second section provides a technical overview: a method for categorizing workflow products, the state of the market, and emerging standards.

With over 70 vendors¹ offering significant workflow products, a variety of approaches to workflow management can be expected. The ideas presented in this paper, therefore, do not apply across the board to all products but rather represent a framework for understanding workflow management concepts. Heavy reliance was placed on James Kobiellus' book *Workflow Strategies*² and on the Workflow Management Coalition's *Workflow Reference Model*³ to provide sense and structure to this broad topic.

I. Functional Overview

What is Workflow?

Workflow can be described simply as the movement of documents and tasks through a business process. Workflow can be a sequential progression of work activities or a complex set of processes each taking place concurrently, eventually impacting each other according to a set of rules, routes, and roles.

A number of process-modeling techniques are available to define the detailed routing and processing requirements of a typical workflow. An example of one such method, called the Decision-chain process model, is shown in figure 1. This technique uses milestones and decision points to map out the process. In figure 2, the Event-flow process model depicts the process as a chain of manual and automatic events and allows for the inclusion of considerable detail.

¹ *IW*, August 18th, 1997. Vol. 6 Iss. 11 p. 23

² James G. Kobiellus, *Workflow Strategies* (IDG Books Worldwide, Inc., 1997)

³ David Hollingsworth, *The Workflow Management Coalition Reference Model* (The Workflow Management Coalition, 1994) Available at <http://www.aiai.ed.ac.uk:80/project/wfmc/DOCS/refmodel/rmv1-16.html>

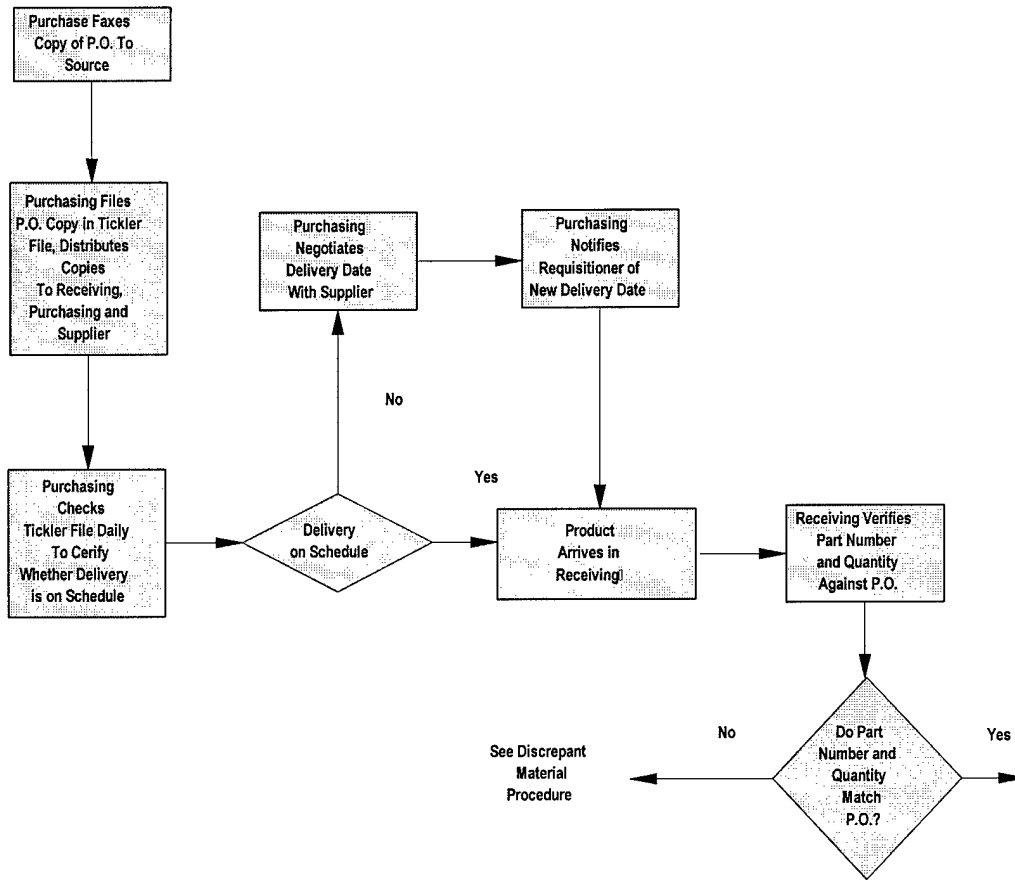


Figure 1. Decision-chain Process Model ⁴

Simulation, Prototyping and Piloting: Some systems allow workflow simulation or create prototype and/or pilot versions of a particular workflow before it goes into production.

⁴ James G. Kobiulus, *Workflow Strategies*, 52.

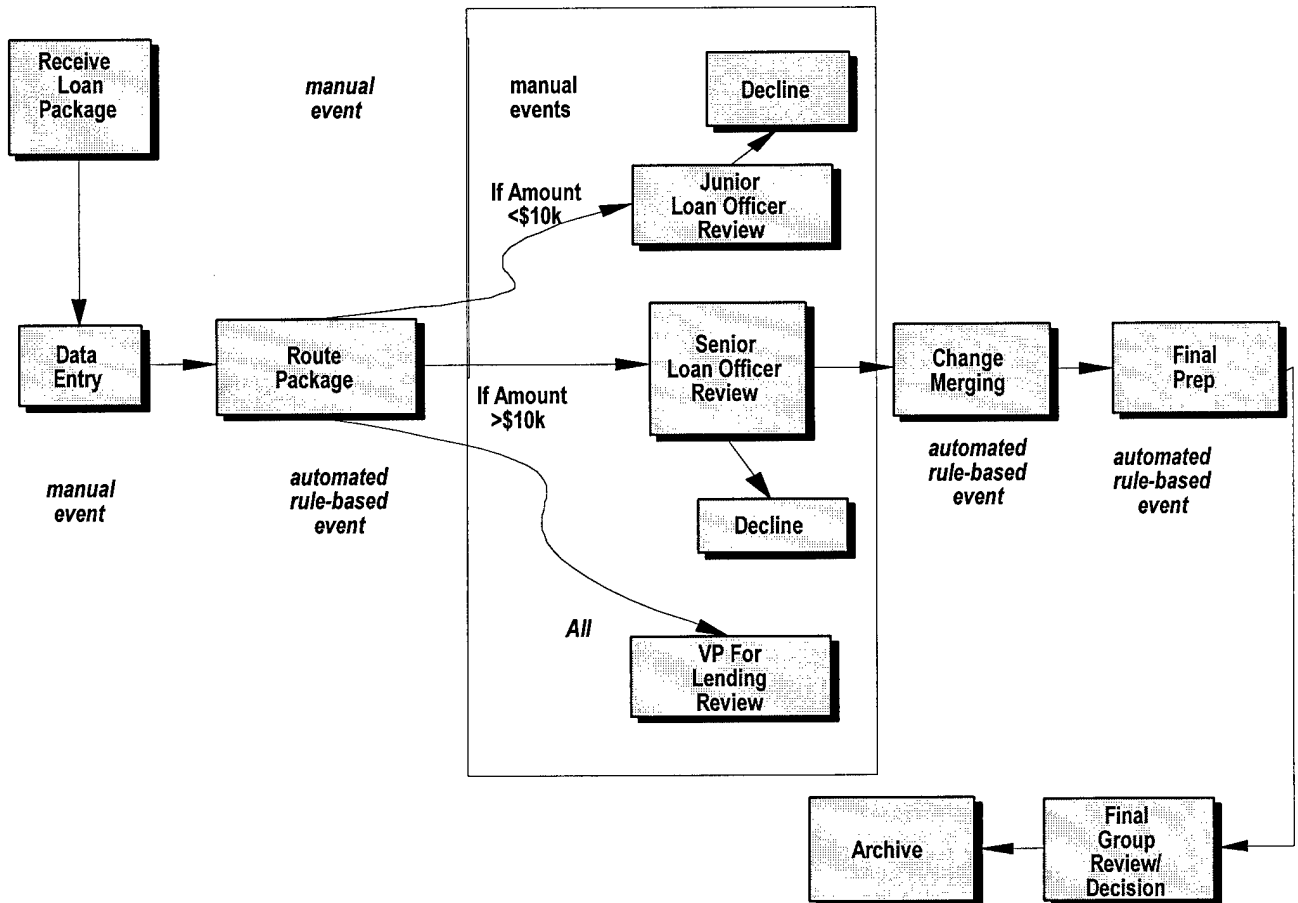


Figure 2. Event-flow Process Model⁵

Workflow Management Systems

Workflow Management Systems allow organizations to *define* and *control* the various activities associated with a business process. In addition, many management systems also allow a business the opportunity to *measure* and *analyze* the execution of the process so that **continuous improvements** can be made. Such improvements may be short-term (e.g., reallocation of tasks to better balance the workload at any point in time) or long-term (e.g., redefining portions of the workflow process to avoid bottlenecks in the future). Most workflow systems also *integrate* with other systems used by the organization: document management systems, databases, e-mail, office automation products, Geographic Information Systems, production applications, etc. This integration provides structure to a process which employs a number of otherwise independent systems. It can also provide a method (such as a project folder) for organizing documents from diverse sources.

⁵ James G. Kobiellus, *Workflow Strategies*, 53.

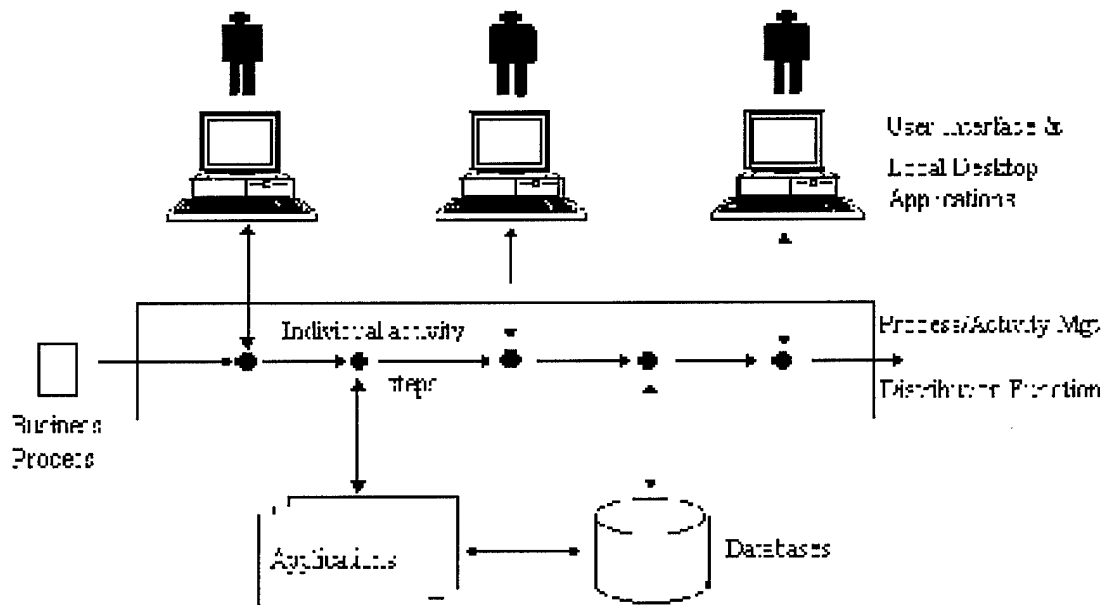


Figure 3. The Workflow Management Coalition Diagram of Process Flow Across Applications

Typical Features

Listed below are some typical features associated with many Workflow Management Systems.

- **Process Definition Tool:** A graphical or textual tool for defining the business process. Each activity within the process is associated with a person or a computer application. Rules are created to determine how the activities progress across the workflow and which controls are in place to govern each activity. Some workflow systems allow dynamic changes to the business process by selected people with administrative clearance.
- **Simulation, Prototyping and Piloting:** Some systems allow workflow simulation or create prototype and/or pilot versions of a particular workflow so that it can be tried and tested on a limited basis before it goes into production.
- **Task Initiation & Control:** The business process defined above is initiated and the appropriate human and IT resources are scheduled and/or engaged to complete each activity as the process progresses.
- **Rules Based Decision Making:** Rules are created for each step to determine how workflow-related data is to be processed, routed, tracked, and controlled. As an example, one rule might generate email notifications when a condition has been met. Another rule might implement conditional routing of documents and tasks based on the content of fields. Still another might invoke a particular application to view data.
- **Document Routing:** In simple systems, this might be accomplished by passing a file or folder from one recipient to another (e.g., an email attachment). In more sophisticated systems, it would be accomplished by checking the documents in an out of a central

repository. Both systems might allow for redlining of the documents so that each person in the process can add their own comments without affecting the original document.

- **Invocation of Applications to View and Manipulate Data:** Word-processors, spreadsheets, GIS systems, production applications, etc. can be invoked to allow workers to create, update, and view data and documents.
- **Worklists:** These allow each worker to quickly identify their *current tasks* along with such things as due date, goal date, priority, etc. In some systems, *anticipated workload* can be displayed as well. These systems analyze where jobs are in the workflow and how long each step should take, and then estimate when various tasks will reach an individual's desk.
- **Task Automation:** Computerized tasks can be automatically invoked. This might include such things as letter writing, email notices, or execution of production applications. Task automation often requires customization of the basic workflow product.
- **Event Notification:** Staff and/or managers can be notified when certain milestones occur, when workload increases, etc.
- **Distribution (Routing) Lists for Messages/Mail:** Distribution lists can be created for sending ad-hoc messages among the staff.
- **Process Monitoring:** The system can provide valuable information on current workload, future workload, bottlenecks (current or potential), turn-around time, missed deadlines, etc.
- **Access to Information over the World Wide Web:** Some systems provide Web interfacing modules in order to provide workflow information to remote customers, suppliers, collaborators, or staff.
- **Tracking and Logging of Activities:** Information about each step can be logged. This might include such things as start and completion times, person(s) assigned to the task, and key status fields. This information might later be used to analyze the process or to provide evidence that certain tasks were in fact completed.
- **Administration and Security:** A number of functions are usually provided to identify the participants and their respective privileges as well as to administer routines associated with any application (e.g., file back-ups, archiving of logs).

Benefits

The introduction of workflow management tools should be seen as an opportunity to improve both the underlying business process and the existing organizational structure. Many benefits can be accrued if the workflow management system is implemented as part of a broader business solution.

Opportunities for Organizational Change: Workflow Management Systems can help agencies and departments achieve the organizational changes necessary to operate effectively in today's world. These changes might include the move to a *flatter organizational structure* and *greater team orientation*. Since activity steps, roles, and rules are built into the system, less intervention should be needed to manage the business process. In addition, improved communications provided by notifications, document sharing, and an improved understanding of the process itself can lead to increased collaboration among team members

and/or across teams and business units. Workflow management systems tend to unify people with diverse skills into a more cohesive unit.

Workflow definition tools also allow for the *separation of IT from workflow management*. This puts the business process immediately and directly under the control of the people using the system.

Opportunities for Process Change: Since workflow systems force organizations to examine and define their business processes, it is the ideal time to consider *business process reengineering*. In fact, it is essential that an underlying process be analyzed and improved prior to workflow system implementation in order to avoid further embedding of bad practices. James Kobielus suggests that an organization optimize a process with any of three goals in mind: “minimizing process time, maximizing value-added process content, or maximizing flexibility at the initial point of customer contact.”⁶ He provides some guidelines for achieving each of these:

- To minimize process time
 - ◊ reduce the number of participants in a process
 - ◊ reduce the maximum completion time of each task (automate tasks, notify staff of approaching due dates)
 - ◊ reduce time to transfer work between tasks
 - ◊ reduce maximum queuing time for any one project (prioritize items that have been awaiting action for a long time)
 - ◊ increase the number of tasks running in parallel
- To maximize value added content (i.e. improve the quality of your product or reduce its price)
 - ◊ apply standard workflow routes, roles, and rules automatically to each new case; deviate from the standard only when certain predefined thresholds are crossed (exceeds dollar limit) or certain flags are raised (customer complaint)
 - ◊ provide participants with immediate, on-line access to all information bases
 - ◊ enable continual tracking and notification
 - ◊ eliminate costs associated with paper documentation (scan and index as soon as it enters the workflow)
- To maximize flexibility (i.e. more fully address customer needs) at the initial point of contact
 - ◊ provide multiple access options
 - ◊ capture customer data only once
 - ◊ support distributed transaction processing (“one-stop-shopping” for multiple transactions)
 - ◊ enable ad-hoc flexible work-flow by allowing the first point of contact with the customer to tailor the process to the customer’s needs

Just as important as reengineering is workflow management’s support for *continuous business process improvement*. Systems which log information about how the defined

⁶ James G. Kobielus, *Workflow Strategies*, 39.

process is actually working in practice provide valuable insights into areas which might be better tuned. Since business people can define workflow without IT involvement, there is more likelihood that process changes will occur.

Improved/Increased Access to Information: Workflow management systems build corporate knowledge. “*Workflow takes the business intelligence that comes from experience and embeds it ...*”⁷ Process information that may have been scattered among various staff members is now combined and available to all employees. This is especially useful to newer employees who may have limited understanding of a more complex business operation.

“Workflow environments encourage knowledge workers to add greater structure - in the form of routing lists, receipt notifications, version controls, (and procedures)...”⁸ Staff are now more likely to provide information to other members of the team. *For any particular project or job, more information about both the history and the current status of the process* is now available for any staff member to view.

Improved Security & Reliability: Workflow management “provides secure storage and access to a consistent set of all of the data related to a service.”⁹ Workflow management unites data from many different applications and provides this data with organization and integrity. Using mechanisms such as role privileges (determines who can access and/or change information), process control (e.g. a document may need management approval before moving on to the next step), version control, and system back-ups, the data becomes more reliable.

Trade-Offs

Investments in workflow tools will not solve underlying problems in the business process if the tool is simply used to automate existing bad processes. In fact, problems can accelerate as bad processes are hard-wired and flexibility is removed. Issues to consider before implementing any workflow system include the following:

Worker Resistance: Human-factor issues represent the greatest obstacle to the acceptance of workflow applications in more than 50 percent of cases, according to Thomas Kolopoulos in his book *The Workflow Imperative*.¹⁰ Many workers will see workflow management as a mechanism for removing their decision-making power or will see it as an instrument of downsizing. Others will resent being monitored and feel that the system is an invasion of their privacy. Still others will miss the interpersonal give-and-take which might now be replaced by an automated system.

⁷ *IW*, August 18th, 1997. Vol. 6 Iss. 11, 23.

⁸ James G. Kobiulus, *Workflow Strategies*, 28.

⁹ *Intergaph Asset and Information Management*, Ch. 4, 3.

¹⁰ Thomas Koulopoulos, *The Workflow Imperative*, 40-41.

Overmanagement: Workflow processes can be defined at any level of detail. A system which attempts to dictate and monitor every detail of the process may be excessive and incur unnecessary overhead as well as worker resistance.

Loss of Flexibility: Some business processes require workers to remain flexible and use personal judgment. These are generally not good candidates for workflow management.

Technical Implementation Costs: Workflow management systems can be complex, requiring a variety of resources to implement and manage. Cost considerations include development and maintenance of the network, the purchase price of the workflow software products, application development and implementation, and customization of the product.

Costs of Defining Complex Processes: The business process itself may be difficult to define and even more difficult to reengineer. Success depends on management and staff commitment and can be expected to take a considerable amount of time. A reliable workflow definition requires a detailed understanding of the underlying business process.

Creation of New Work: Managing the business aspects of the system as well as the technical aspects of the system will create additional work which must be offset by anticipated savings or benefits.

Choosing the Right Process

Processes which will benefit most from managed workflow are those that will find advantage in a defined or controlled process as well as profit from the integration of that process across coordinated systems. Typical candidates are those processes which are document intensive, include lots of hand-offs among participants, and require high process integrity. However, simple and/or ad-hoc processes can also benefit from managed workflow if they are implemented with a corresponding simple and flexible workflow management system.

The following criteria for spotting processes which might benefit from workflow management have been suggested by James G. Kobiulus in *Workflow Strategies*.¹¹

- **Speed:** Prolonged processes are often the first to get attention when looking at workflow solutions. Complaints from customers, suppliers and managers (“Why does this take so long?”) often provide the incentive for improvement.
- **Cost:** Costs to be aware of include high labor costs and frequent routing of simple tasks to high-priced personnel.
- **Accuracy:** Danger signals might include complaints about process integrity as well as problems pertaining to accurate record keeping.
- **Quality:** Is the quality of the end-product inconsistent?
- **Customer Satisfaction:** Does the process generate a steady stream of complaints or citizen confusion?
- **Flexibility:** Rigid procedures will usually benefit from allowing some sort of employee override, as long as the staff is required to explain and justify their actions.

¹¹ James G. Kobiulus, *Workflow Strategies*, 20-21.

Once candidates for process reengineering are identified, priority can be given to those solutions which will most positively impact the organization. One method is to prioritize an organization's critical success factors (perhaps from the above list) and then obtain consensus on which projects will address the highest ranked items.

Success Factors

Intergraph's publication, *Intergraph Asset and Information Management*¹², and James Kobielus' book, *Workflow Strategies*¹³, each outline a number of recommended practices for implementing successful workflow management systems. Among these are the following:

Focus on Business Objectives: Spend some time studying the organization and determine which potential workflow management benefits are most important to overall success. Choose projects which support core objectives.

Focus First on Projects that are Well Understood: For initial implementations, choose projects with clearly understood process activities.

Use Metrics: Take baseline measurements so that expected benefits can be quantified. Once implemented, track these metrics in order to spot favorable or unfavorable trends. Examples of metrics include: length of cycle, labor hours to complete the process, length of worklist queues, number of errors, time used to access data, and revenues generated.

Obtain Support of Upper Management: A quantifiable business justification is most persuasive in obtaining senior management support. It is important that this support be available and visible for the long-haul (planning, implementing, and refining) and not just for project approval.

Obtain Support of Staff: The staff must be involved in the redesign process and understand that the new process will fail without their commitment. Reassure staff that the new process will automate mundane tasks in order to free up their time for more productive work. Although more structure is being added to the process, critical tasks will still be dependent on employee knowledge and effort. Staff should also know that they will receive adequate training and will be given enough time to learn the system before benefits are expected to accrue.

Integrate with Current Systems & New Systems: Many of the advantages of workflow management systems are the result of its integration with existing systems already being used in the business process. The purpose of workflow is to integrate these systems and add integrity to the process. In addition, many of the goals of workflow reengineering can only be obtained as a result of new systems being implemented along with workflow management. These might include document management systems, enhanced transaction applications, or Internet/Intranet access.

Implement in Phases: Start with a small first-phase with just a few users and/or a limited number of activities. In later phases, expand the number of users quickly and expand the system's functionality (but do not expand both in one phase).

¹² *Intergraph Asset and Information Management*, Ch. 4, 5, and 6.

¹³ James G. Kobielus, *Workflow Strategies*, Ch. 1 and 2.

Seek a Scalable Solution: Although an organization might wish to start small, it is important to be able to grow with whatever technical solution is chosen. Plan for the long term.

II. Technical Overview

Four Categories of Workflow

The boundaries for the categories in this section are inspired by James G. Kobiellus as described in his book *Workflow Strategies*.

Workflow applications are generally divided into four broad categories, mainly distinguished by the transport mechanism used to route the work items. These are:

1. Production Workflow Systems
2. Messaging-based Workflow Systems
3. Web-based Workflow Systems
4. Suite-based Workflow Systems

Production Workflow Systems

Introduction

These systems make up the traditional part of the market. They have evolved from the first systems on the market, FileNet and ViewStar. They are sometimes referred to as *filestore-based systems*, *document-image processing systems*, and *forms management systems*. These systems route *folders* consisting of one or more forms or different types of documents through the organization. They typically store documents in a central repository and provide check-in, check-out, and version control for those documents.

Advantages

They generally support more features and functions than messaging-based tools, allow greater customization, and run in a wider range of network and computing environments. Since some of the products in this category have been around for a long time, there usually is expertise available from a number of sources.

Disadvantages

These systems are generally more expensive than other systems. They usually require expensive application development and integration services from an external consultant. They are sometimes not open, and might be dependent on certain machine platforms.

Background and functionality

Workflow systems are similar in their desire and need to reduce the volume of back-office paperwork in daily operations. Systems in this category are based on the idea that an organization should only have to touch a paper document once, when it is received by the organization and scanned into electronic form. Thereafter, it is routed through the work processes needed to finish the treatment of the document (such as making a decision,

calculating the tax for a citizen, or any other work-process that the organization focuses operations around).

The core capabilities supported in most of today's production workflow solutions are: image management, database management, document management, forms management, object management, product data management, project management, computer-aided software engineering (CASE), electronic messaging, directory services, Internet/Intranet services, and electronic commerce services.

This category is closely aligned to the Workflow Management Coalition (WfMC's) Reference Model as mentioned in the section on standards.

Messaging-based Workflow Systems

Introduction

This category, sometimes called *administrative workflow systems*, comprises the lower-end segment of the market. The products contained herein are stand-alone tools that route documents over existing email systems. This category started with the FormFlow product, and products in this category primarily route electronic forms and file attachments.

Advantages

Because messaging is based on an existing email system, products in this category are usually low-cost. They support rapid definition and activation of simple business processes, usually of a sequential or parallel nature. The implementation and use of the products are designed to work with a minimum of training and customization.

Disadvantages

Systems in this category are not as comprehensive and flexible as systems in the production workflow systems category. Systems in the messaging-based workflow category typically lack document-image processing and management capabilities. Some government organizations do not yet have email systems that can be used with workflow applications.

Background and functionality

Messaging-based workflow systems are designed to support typical ad-hoc business processes: a workflow with minimal preplanning, few participants, and simple routing rules that are being redefined from day-to-day depending on what works.

These systems provide such capabilities as sequential routing, cycle back to originator, and rule-based message management. Messaging-based workflow systems can be split into three parts: electronic messaging technologies, forms management, and database management. Electronic messaging is done via the email system. The people comprising the process use the email system to route forms and messages between each other. The forms are usually created with a standalone tool, and these forms are sent between people, allowing them to change and update fields. When a form has reached its end-point, where the process is done with it, it is written to the database.

Web-based Workflow Systems

Introduction

These systems are on the leading edge of workflow application development. Utilizing the popularity gained by the WWW, these systems utilize this same environment to implement workflow capabilities. Systems in this category utilize Web clients and servers to deliver their functionality.

Advantages

Many organizations already have some of the technology and networking capabilities needed to implement these systems. Thanks to the extent and proliferation of the WWW, these workflow products facilitate telecommuting and other flexible work arrangements. Because there is no need to develop an underlying network structure, it is readily expandable.

Disadvantages

The level of skill needed to develop and deploy the work process is higher than for messaging-based systems, and end-users can not be expected to develop forms or Java applications, necessary elements of Web-based workflow systems. The security of these systems is sometimes more at issue. Especially when the global Internet is used to transport documents and forms. Another disadvantage is that no standards have yet been developed specifically for this workflow category.

Background and functionality

The difference between web-based workflow systems and the two categories already described is the narrowly circumscribed, industry-standard Internet platform on which they operate. Whereas the other three categories of workflow products operate over application infrastructures that incorporate a wide range of protocols and application services, web-based workflow only requires:

- WWW Internets/Intranets/Extranets
- Web servers (serving the HTML pages and Java applets)
- Web browsers (on the users desktop)
- Workflow engines (determines routing and processing of work items)

Suite-based Workflow Systems

Introduction

Products in this category offer a suite of integrated office applications such as word processor, spreadsheet, presentation, and electronic mail. In suite-based workflow systems, all the applications are somewhat integrated with the electronic mail system. This integration is often accomplished through a *send* or *add routing slip* command in the menu structure of the non-electronic mail applications.

Advantages

Suite-based workflow applications can be bought off the shelf, and some of them require few changes during implementation. In some cases they can be implemented without support from 3rd party consultants.

Disadvantages

Some suite-based workflow applications (such as Lotus Notes) are criticized for being high maintenance driven, requiring a high system administrator to user ratio. The low-end types of these applications might be too unstructured to facilitate the creation of a structured workflow environment.

Background and functionality

Suite-based workflow products are designed to allow users to route individual desktop application files instead of folders of documents and forms. Products in this category are characterized by their support for unplanned actions, one-time actions, and ad-hoc processes. Products in this category can be split into two sub-categories; office application suites and groupware application environments. Suite-based workflow products are very similar to the messaging-based workflow products in their use of electronic mail as the routing vehicle.

Endnote on Categories

There is no single best category of workflow systems. The right system depends on the nature of the processes to be supported with a workflow tool. Different tools support varying levels of structure. Whereas suite-based workflow systems might support ad-hoc interpersonal data sharing, production workflow systems are better at supporting rigid and well-defined work processes. The other categories can be represented as somewhere in between these two on the scale of structure.

The State of the Market

This section outlines the names of vendors and their products sorted by the four categories. In some cases a "∞" is inserted in the "product name" column. This means that the vendor's products can be classified as belonging in more than one category. The vendor names and products are from James G. Kobielus' *Workflow Strategies*.¹⁴

Leading Vendors in Production Workflow Systems

Vendor Name	Product Name(s)	Background
Action Technologies Inc.	∞ Action Workflow System	One of the first vendors on the market.
Autodesk Inc.	Autodesk WorkCenter	Focuses on a niche of production workflow called <i>product data management</i> . Some of their products are CAD (Computer Assisted Design) products with workflow capabilities
BanTec Inc.	Flexus FloWare	Flexus FloWare is one of the top products based on revenue measures.

¹⁴ James G. Kobielus, *Workflow Strategies*, Ch. 7, 8, 9, and 10.

FileNet Corp.	∞ WorkFlo Business System FileNet: WorkGroup FileNet Visual WorkFlo	The pioneer, and undisputed market leader.
IA Corp.	Object-oriented Workflow	Leading vendor of enterprise-wide multimedia workflow solutions.
IBM/Lotus Development Corp.	∞ ImagePlus FlowMark Lotus Notes: Document Imaging	Only NY-headquartered company.
InConcert, Inc.	InConcert	Have broad range of products, formerly known as Xsoft.
Keyfile Corp	∞ Keyfile Enterprise Edition	
ViewStar Corp.	ViewStar	Runs on broad range of platforms
Wang Laboratories Inc.	Open/Image Open/Workflow	

Leading Vendors in the Messaging-based Workflow Market

Vendor Name	Product Name(s)	Background
Banyan Systems Inc.	∞ BeyondMail	
FileNet Corp.	∞	
IBM/Lotus Development Corp.	∞ Lotus Forms FormTalk	
JetForm Corp.	∞ Jetform Design Jetform Filler	Canadian headquartered company
Keyfile Corp.	∞ Keyflow	
Microsoft Corp.	∞ Electronic Forms Designer	
Novell Inc.	∞ InForms InForms Designer InForms Filler	

Leading Vendors in the Web-based Workflow Market

Vendor Name	Product Name(s)	Background
Action Technologies Inc.	∞ Action Workflow Metro	
Banyan Systems Inc.	∞	Listed here because they have announced plans to move into this category
Documentum, Inc.	Enterprise Document Management System (EDMS)	
JetForm Corp.	∞ Web Connectivity Pak	
Novell Inc.	∞ GroupWise Web Access	
Open Text Corp.	Livelihood Intranet	
Ultimus Inc.	Ultimus	

Leading Vendors in the Suite-based Workflow Market

Vendor Name	Product Name(s)	Background
Digital Equipment Corp.	LinkWorks TeamLinks	
IBM/Lotus Development Corp.	∞ Notes NotesFlow SmartSuite	
Microsoft Corp.	∞ Microsoft Office Exchange	Already in use in many agencies
Novell Inc.	∞ GroupWise Ensemble	

The Future

All the vendors featured in this section are considered leaders in the field for some reason or other. There are a number of other vendors that might be better suited for specific application needs. The vendors named in this section should not be used as a short-list for selection, but rather as a starting point for exploration. A list of additional Workflow products can be found at <http://www.wis.cs.utwente.nl:8080/~joosten/workflow.sites.html>. It is to be expected that many of the vendors in the market will not survive the next decade of

competition, and the selection of a vendor and partner for development is therefore very important.

Emerging Standards

Workflow Management Coalition

The Workflow Management Coalition (WfMC's) Reference Model defines a generalized target architecture driving the development of most production workflow solutions, whether or not their vendors plan to implement all the WfMC's standard technical interfaces. The goal of the model is to provide a standard for interoperability among the major workflow subsystems. It is hoped that over time, commercial products will include APIs which adhere to these standards.

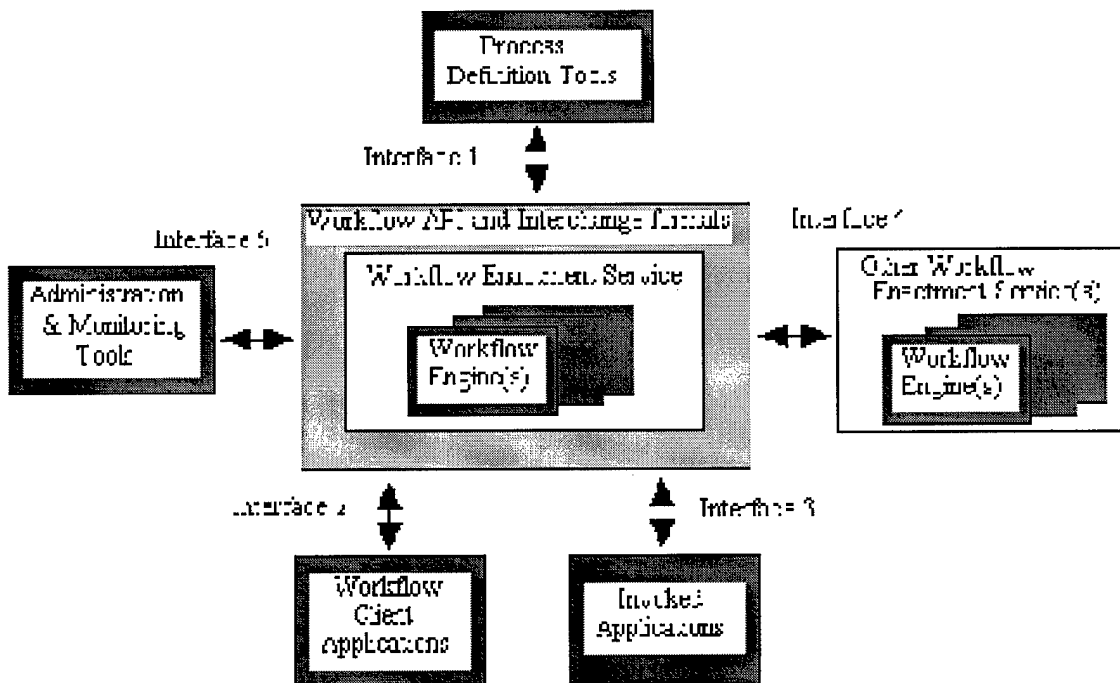


Figure 4. The Workflow Management Coalition Reference Model

More in-depth information about this model can be found at <http://www.aiai.ed.ac.uk/project/wfmc/DOCS/refmodel/rmv1-16.html>. The model focuses on the five interfaces between the workflow enactment service and the tools.

Microsoft and MAPI

Microsoft's MAPI Workflow Framework is largely complementary to WfMC's model. It was created in consultation with the WfMC and other vendors. It defines APIs, message classes, and conversational dynamics needed for client applications to request and track workflow-engine services in the MAPI messaging environment.