1998

CPA's guide to workflow management

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Kent Information Services

Graves
Hill
Allen

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AICPA

AICPA Top Technology Series

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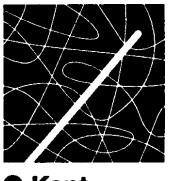

● Kent
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Title:

THE CPA'S GUIDE TO WORKFLOW MANAGEMENT

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Acknowledgements

We would like to thank the following individuals and organizations who contributed their knowledge, skills, and time to the creation of ***The CPA's Guide to Workflow Management***:

Scott Stillisano, Webmaster and graphic designer, who is responsible for page layout and design for Kent Information Services, Inc., publications.

Penny Graves and Christa Stalnaker, who coordinate fulfillment and shipping of Kent Information Services, Inc., products.

Marge Cataldo, M.A., editor, who authors and edits various Kent Information Services, Inc., publications.

Steve Cembrinski, vice president of operations for New York Central Mutual Fire Insurance Company, and Jeff Garn, Carroll Riggin, and Dick Thomas of Moen Incorporated, who generously shared his expertise and experiences.

The following workflow software vendors, who allowed us to adapt and reprint case studies and ancillary information: Microsoft, JetForm, FileNET, Staffware, PeopleSoft, Action Technologies, and InterTech.

The Workflow Management Coalition, who allowed us to reprint the *Workflow Reference Model* as Appendix A.

March 31, 1998
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Chapter One
The Business Context of Workflow Management

Business process redesign, continuous quality improvement, just-in-time methodology, customer service orientation–these are the terms used regularly by those issuing the call for companies to revamp their operations. With their roots in the changes of the downsizing and acquiring 1980s, and the improving and reorganizing 1990s, the early years of the 21st century will likely see a dominant trend for businesses all over the world to completely overhaul the way they do their work. In large enterprises, the move has already begun, and the smaller companies who deal with these corporate giants are either complying with new processes and technologies such as electronic data interchange (EDI) and electronic commerce, or they're losing business.

As the momentum builds, it is probable that your company or one of your clients will find itself undertaking an analysis of how it does what it does. Maybe the process will be initiated from within, in an effort to be more profitable and competitive. Perhaps the impetus will come from outside, as a response to a particular business condition or trading partner requirement. Either way, as a financial professional with responsibilities for technology management, you will certainly be in the thick of it. This book will give you the background and concepts necessary for you to competently participate in such a process and evaluate the technologies available for automating a company's workflow.

Business Process Redesign

Business Process Redesign (BPR) is arguably the most prominent technique used today to analyze how a company makes products or provides services and how it could do so better, faster, and at a lower cost. The primary line of business is not the only area a BPR study targets–administrative and support functions come under close scrutiny as well. The technique is known by a wide array of synonyms, some of which are: Business Process Reengineering, Business Process Restructuring, Business Reengineering, Business Systems Engineering, and Business Process Improvement. While the catch phrases and industry-specific terminologies differ, the core concept of BPR remains the same–looking at the tasks and processes necessary to run the company and accomplish its objectives.

A business process can be defined as a group of tasks that are related and are accomplished in the service of a business outcome. In many cases, that outcome is a work product, like a product or service for either an external customer or an internal one. A grouping of related business processes forms a business system, which is the structure through which most things happen in companies today. Marketing, technical support, and billing are examples of familiar corporate functions that can be viewed as business systems. Of course, business systems are very likely to be automated–we even apply terms like "computer systems" to business systems when they closely match the business processes being automated. So, any process that seeks to refine business processes and business systems will certainly impact an organization's computer information systems.

Evolution of Organizational Information Systems

Almost every business process imaginable today relies in some way on computer information systems. Cutting a paycheck, issuing a purchase order, clearing a shipment, compiling an inventory list, even hiring an employee–these are all processes that would be difficult to complete in most businesses without the aid of specialized computer software. And each of us has a handful of horror stories about the times when the computer system that was supposed to be supporting the process actually brought it to a complete halt. Even more common are the daily accommodations we make to our information systems, mumbling things to clients, co-workers, and customers like, "I'm sorry, the software just won't print the report sorted that way," or "the computer won't let me issue that refund."

Information industry experts point out over and over how the technology seems to be running the show, and that employee efficiency and response to customer requests may not be improved one bit by a large and expensive computer system. As Australian systems expert Stanley Ritchie puts it: "The value for a business in using information technology lies in the rational use of that technology by adapting it to fit the goals of the organization and its workforce." Business process redesign and workflow management are being used by companies that wish to get the most value out of their information systems by making sure the business processes being automated are efficient, and that the systems allow employees to do tasks in flexible and effective ways.

The Flow of Work

If you bring to mind any common business process in your office, you can easily trace the workflow associated with it. Let's take a purchase order, for example. You might retrieve a copy of the purchase order form, sit with an office supply catalog, and select a few line items to purchase. Or, you might ask your office assistant to complete the order form for you and place it in your inbox for your signature. After signing at the bottom of the form to indicate that you approve this expenditure from your budget, you forward the PO via interoffice mail to your vice president, whose signature is also required. The vice president signs the form and sends it to the company's purchasing agent, who places the order via telephone and initials the form to show that the order has been made. Then, she tears off the top copy of the form for her files and returns the bottom copy to you via interoffice mail. Your office assistant files the copy in the pending file, so that it can be easily retrieved and matched against the shipping list when the carton arrives. At least for now, the flow of work is suspended.

This workflow might not seem like such a big effort, until you consider that there are one hundred other professionals in your company initiating the same process every day, five days a week, fifty-two weeks a year. That's 26,000 purchase orders a year, and we've only considered the lifecycle of one administrative form in the company. If you critically analyzed this process, you could probably identify several steps that could be streamlined or eliminated. At the very least, you could certainly eliminate at least one step–let's say that you decide that the form will be three-part rather than two-part, and that you will keep a copy of your own purchase orders rather than have one sent back to you from the purchasing agent. Just making this one, small, seemingly

insignificant change would result in 26,000 fewer independent steps being performed by the purchasing agent's office staff. And, we haven't even considered the possibility of computer automation yet. This is the power of viewing a business process as a flow of work, and this is the crux of workflow management.

Just like in all new fields, the terminology of workflow management is rapidly evolving and not quite as precise as one might wish. Take, for instance, the term workflow itself. Ultimus, a software firm, defines workflow as "any task performed in series or in parallel by two or more members of a workgroup to reach a common goal" (**http://www.ultimus1.com/ultwf/ultwf.htm**). Seems simple enough, yes? Well, information systems consultant Vic Lilley adds another layer of complexity when he states, "Workflow is software that automates business processes to a greater extent than conventional data processing by integrating additional features like e-mail, word processing, imaging, alarms, audit trails, internet technology, etc." (**http://www.netcomuk.co.uk/~vlilley/workflowrep.html**). Here, the term workflow is being used to describe the software used to automate the workflow, not just the flow of work.

Academic computer scientists Mohan Kamath and Krithi Ramamritham take a much broader approach, using the combined term "workflow management" when they say, "Adopting a process-centric approach, workflow management is emerging as a technique for modeling, executing and monitoring such applications" (**http://www.ccs-cs.umass.edu/~kamath/nsf-wf.html**). Here, the researchers are speaking of applications such as databases, office automation, and computer graphics. They define workflow management as the technique that can plan and implement the efficient use of these other systems. They place the emphasis on process, rather than data, to convey that the focus of workflow management is the flow of the tasks and

business outcomes, not the particular word processing files or spreadsheets created by computer software applications.

The Workflow and Reengineering International Association is trying to integrate many related concepts into its oversight of workflow management systems. In its very broad charter and mission statements, WARIA presents its goals as: "to identify and clarify issues that are common to all users of workflow and those who are in the process of reengineering their organizations;" and "to make sense of what's happening at the intersection of Business Process Reengineering, Workflow and Electronic Commerce" (**http://www.waria.com**). In line with its ambitious mandate, WARIA's Web site provides over 100 books and a variety of papers and conference descriptions to help people become familiar with these related fields.

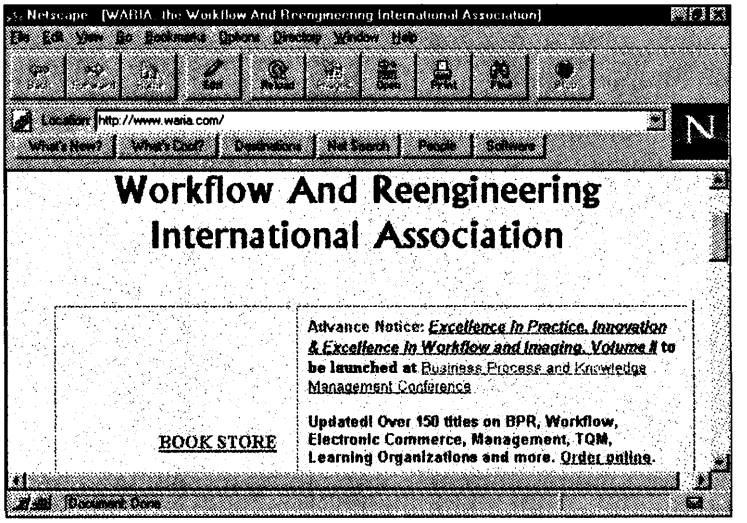


Figure 1.1 *Workflow and Reengineering International Association's Web site, source of educational resources on workflow management and related topics.*

As these related but widely differing definitions indicate, workflow management is considered both a very specific and a very generic technique, and everything in between. It is sometimes used synonymously with BPR, or, even more

confusingly, is considered either the layer of analysis above BPR or the one below it. Some people use the term to refer to workflow software only, making it a technology-specific concept that applies to a particular category of software products such as groupware. Others will make even smaller distinctions, treating workflow software and groupware products, such as *Lotus Notes*, as two entirely different kinds of applications.

Trend Toward Standardization

As the workflow management field develops, we will see a standardization of definitions and a lexicon of commonly accepted terms that most people will find decipherable. In addition, various professional associations are beginning efforts to create industry standards for the software used to analyze and automate workflows. One such organization is the Workflow Management Coalition (**http://www.aiim.org/wfmc/**). The Workflow Management Coalition is an ANSI (American National Standards Institute) organization, which is supporting significant efforts to create technical guidelines for the development of workflow systems and standards to ensure that applications from various software producers will integrate smoothly. These standards have recently been adopted by many of the leading software manufacturers.

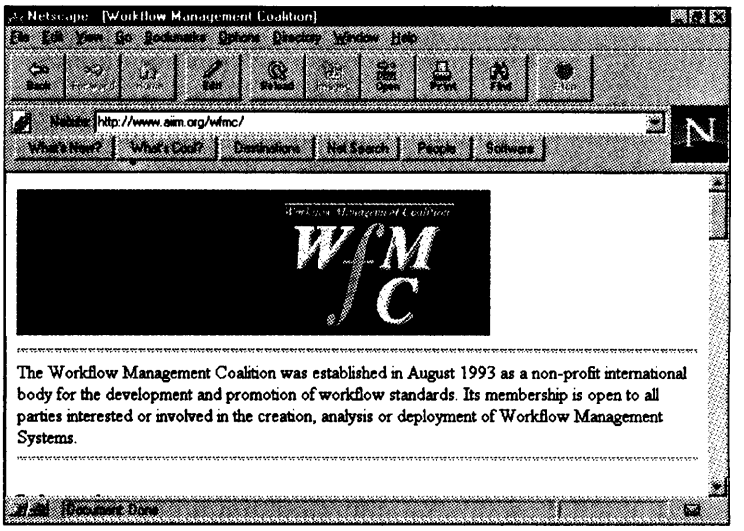


Figure 1.2 *Workflow Management Coalition members are working to create standards for workflow software.*

The Workflow Management Coalition has published a very important document, called the *Workflow Reference Model*, that proposes standards for workflow software to ensure that various packages operate together in businesses that use more than one package. In this document, the Coalition presents a strong argument for the need for standardization, stating that, "There are currently estimated to be in excess of a hundred different workflow (and related) products in the market, focused on different aspects of functionality and data/application integration. The development of interworking standards will allow application choice of 'best of breed' products for individual aspects of a workflow implementation" (Section 2.5, p. 18). The entire *Workflow Reference Model* document is reprinted in this text as Appendix A for your convenience.

Companion documents to the *Workflow Reference Model* define a set of five "interfaces" among various components of workflow systems. Simply speaking, the interfaces provide for information, which in this case is instances of automated business processes, to flow between components of workflow software from different

vendors. For the purposes of creating these interfaces, the model divides workflow management software functions into groups. These groups of functions can be a useful way to compare various workflow management software. We will discuss the functional components of workflow software in more detail in Chapter Seven; however, the following example will give you an idea of the importance of standards.

If you are implementing a large workflow system, your organization will probably choose a product from the "integrated" workflow management software category (categories of workflow software are discussed in Chapter Six). In this category of software, vendors market both planning programs and the programs that automate the flow of work. Let's imagine that your organization selects the *ActionWorkflow Process Builder* tool profiled in Chapter Six to conduct the analysis and documentation of flows of work. After hundreds, maybe thousands, of hours of work, your organization has identified the business processes it wishes to automate, analyzed the processes to determine how they could be conducted more efficiently, and documented the new workflows in the *Process Builder* tool to create graphical maps of the flows of work and definitions of the participants in the business processes.

At this point, you are ready to launch the workflow management system by translating these documented workflows into the workflow automaton software. If you select a workflow automation program from Action Technologies, Inc., the makers of the *ActionWorkflow Process Builder* tool, the transition will be smooth. If, however, you select a workflow management software package from another vendor, it will be important for you to determine that the workflow definitions you have already built can easily be translated to that vendor's software. And this is where standards apply–if both vendors have agreed to develop

software in compliance with the standards for Interface 1, the information from the process definition software will flow smoothly into the workflow automation software. Interface 1 is the interaction point between process definition functions and workflow automation functions, as envisioned in the *Workflow Reference Model.*

As more and more workflow management software incorporates World Wide Web functionality, standards will become increasingly important. A recent article published at the *Network World Fusion* Web site begins like this: "You can thank the Internet for reviving workflow" (***http://www.nwfusion.com/news/0420workflow.html***). In this article and many other industry analyses, experts are discussing how Web communication alleviates many of the network problems that organizations previously encountered when implementing workflow systems. Due to the nature of workflow software, workflow management systems must be developed on local area networks or wide-area networks, as discussed in more detail in Chapter Six. And, for companies that have only one location, this criterion presents very few difficulties. However, organizations with far-flung regional offices and highly mobile staffs encounter many more problems. Workflow vendors are just beginning to respond to these issues by introducing workflow modules that can communicate information via the Internet using the World Wide Web. As organizations turn to corporate intranets to provide information to employees no matter where their location, the demand for Web-based workflow tools will increase, and the number of software choices will also increase.

In addition to supporting software interoperability, it is important for professionals who deal with workflow management systems to understand one another when discussing this subject. Toward this goal, the Workflow Management Coalition also has developed a

Terminology & Glossary document that, as its name suggests, presents an extensive list of terms associated with workflow and BPR and establishes standardized definitions for them. The terms used in the *Workflow Reference Model* are drawn from the *Terminology & Glossary,* and the many software vendors that are members of the Workflow Management Coalition make an effort to use the terms in their standard forms. If you will be responsible for conducting the software selection and project planning activities discussed in Chapters Six and Seven, you should be familiar with the contents of the *Terminology & Glossary* in addition to the *Workflow Reference Model.*

Until standard terms become more established, we can make some arbitrary distinctions for the purposes of this book and your introduction to the subject. In the chapters that follow, we'll use the term "workflow" to describe the steps and tasks involved in a business process or business system. The analysis, revision, and ongoing maintenance of workflow will be called "workflow management." If the analysis of workflow uses approaches specific to BPR, we'll use that term. The many hundreds of software packages available for analyzing, modeling, and automating the flow of work in a company will be called "workflow management" software. We'll use this as a general term, realizing that almost any program could be called workflow software in a networked environment. When we are describing software that belongs to a category that has another name in the information industry, such as document image processing applications or tax preparation software, we'll make you aware of that category term as well.

The Role of the Financial Professional

In many organizations, especially smaller offices and mid-sized companies, the CPA, CFO, or accounting manager serves as a general business manager and information services expert. (If you are running your own accounting firm, you are the systems expert by default!) In addition, accountants are entering technology consulting in increasing numbers. In his inaugural address to the AICPA in late 1996, the president Robert Mednick stressed the important roles that CPAs can play in advising clients on the selection of technology for their needs and building procedures for its effective use. You can find many documents addressing the role of information technology in the accounting professional at the AICPA Online Web site at **http://www.aicpa.org**.

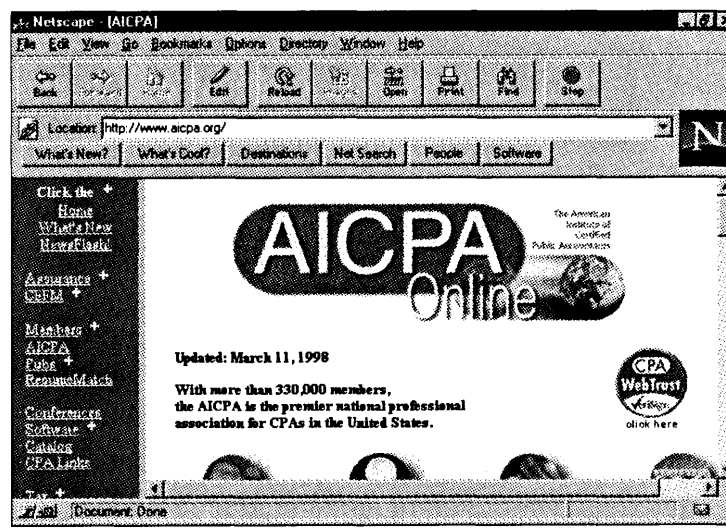


Figure 1.3 *AICPA Online Web site, source of information on how technology is affecting the accounting profession.*

Accountants are often also responsible for specific analysis and management tasks in information systems projects. Audits and quality assurance reviews are commonly the responsibility of the CPA, who is often also the operations, administrative, or

accounting manager leading the systems analysis and development project.

While you may not be asked to write the programming code or perform the database analysis for a workflow system, you will certainly need to be familiar with the techniques of BPR and workflow management and the various kinds of software used to implement streamlining strategies. If you work for a larger company, you may sit on a workflow management project team, or be asked to lead a BPR project. If you are employed by, or own, a smaller firm, you might choose to build a workflow system for your own business operations. And, when clients ask for advice on how to evaluate and select workflow management software, you will want to be prepared to guide their decisions.

Using this Book

In this text, we present a set of chapters that, first, provide case studies and summaries describing workflow projects in service-industry organizations and, second, describe in more detail some of the issues encountered by service firms when implementing workflow technology (Chapters Two and Three). The second set of such chapters takes the same approach to manufacturing-sector organizations, first presenting a set of case studies and summaries (Chapter Four) and then discussing the issues involved (Chapter Five). Chapter Six takes a look at tools that small businesses can use to explore workflow management techniques. You might be surprised to find that software you are already using on your office network may have sophisticated workflow automation capabilities. Chapter Seven is intended to introduce you to a full-blown systems development environment, a milieu you will encounter when participating on a workflow

management team in a large company. You'll become acquainted with project management methodology and how workflow management and BPR projects are undertaken in large companies. In Chapter Eight, you'll be exposed to a wide range of additional resources for learning more about workflow management and learn where to find resources for researching and keeping up-to-date in this rapidly evolving field.

Chapter Two
Managing Workflow in Service Industries: Case Studies

In order to improve workflow efficiency, there is really no good substitute for close observation and analysis of the business processes of your particular company, firm, or organization (or a client's company, firm, or organization). However, some of the issues companies confront when seeking to redesign and automate their workflows recur again and again. To help you consider how a workflow management project might affect your (or a client's) organization, this chapter and Chapter Four present case studies in service and manufacturing industries, respectively. Although the experiences of these organizations do not encapsulate every issue, question, or complication that could affect a workflow project, they represent some of what you can expect. These stories, and the advice offered by the managers interviewed and the vendors who consulted with them on building systems, will help you become more confident in undertaking your own project, or in helping a client analyze and evaluate workflow software options.

The New York Central Mutual Fire Insurance Company

New York Central Mutual Fire Insurance Company, currently the largest regional provider of auto insurance in New York State, holds a century-long tradition as a regional carrier of homeowner, small business, and automobile insurance. Headquartered in Edmeston, New York, the company maintains offices in Amsterdam and Sherbourne, NY, as well as a subsidiary claims adjustment company in Buffalo. Sales are conducted through a network of more than 900 independent, professional agents who communicate through an Insurance Value Added Network Service (IVANS). With an annual revenue in excess of $350 million, the company has enjoyed dramatic growth over the past decade and now has approximately 500,000 policies in force.

Figure 2.1 *New York Central Mutual's Web site provides background on a growing company.*

Growth Necessitates Workflow Redesign

Through the early 1990s, New York Central Mutual settled claims the old-fashioned way, using a hands-on, paper-based business system. The company handled about 80,000 new claims per year, and although the average claim file contained 24 pages, more complex claims often grew to several hundred pages. With the manual methods, when a claim came in, the original paper file was pulled from the file room and put on an examiner's desk along with the incoming document. Each day, employees had to sort their mail, prioritize work, sift through the paper file, and decide how to settle a claim.

The company's burgeoning success in the early 1990s highlighted the flaws in the paper-based system, which bogged down under the sheer weight of paper necessary to do business. Examiners, who typically handle a caseload of 200 files, spent hours each morning deciding where to stack incoming documents before they could turn to the process of actually settling a claim. Accurately prioritizing, locating, and storing claims information became something of a nightmare. "Too many documents were misfiled or misplaced," said Steve Cembrinski, vice president of operations, who joined the company in 1984. "Under the paper system, employees kept separate files that listed all the missing documents needed to settle a claim, but, sometimes, people would lose the 'Can't Find' files. It became a kind of joke. Just the process of keeping files updated was taking up almost 30% of an employee's time."

Answering customer inquiries in a timely manner also became a problem. To address a policyholder's question, an examiner would have to physically locate the correct file, then track down information that was either being handled by another caseworker or, worse, had been misplaced. Responding to customers' concerns interfered with daily operations for the examiner and,

because of the time it took to answer questions, too often left the customer unsatisfied. Furthermore, file retention and space considerations were an issue. The claims department file room contained about five million documents, with the number rapidly increasing. Under the paper-based system, the company eventually would have faced the cost of adding file storage space.

Another drawback in the paper-based system was the company's growing inability to meet state regulations. The claims process is highly regulated by a state agency, with mandated time periods and conditions on the accuracy of settlements. "We were falling behind on medical claims," Cembrinski said, "and had to pay a two-percent penalty each time we failed to meet a target date. This issue, which was a combination of staff and workload, was a problem we definitely needed to solve."

To deal with the rapid growth in the number of policies administered by the company–and therefore in the number of claims to be serviced daily–New York Central Mutual initially added staff, but Cembrinski and the other managers realized that the claims process itself needed to be refined. By 1991, Steve Cembrinski began researching work management techniques and document-imaging technology to find a way to better manage business growth. Three years later, in June 1994, a new workflow and document-imaging system, created by FileNET, went online in the claims area of the home office.

Creating Management Goals

In designing a new workflow system, New York Central Mutual's overarching goal was to give the claims adjusters better tools to deal with claims in a timely fashion. Additional benefits would include: more efficient handling of both state regulations and internal deadlines; improved employee morale and customer satisfaction; and a decreased file storage burden.

Management, led by Steve Cembrinski, sought to design a claims processing system that would allow examiners to share documents without impeding the flow of work. In any insurance policy, whether automobile, home, or medical, several types of claims are involved–for example, an auto policy may contain claims in the areas of medical, property damage, and liability. While many insurance companies assign one individual to handle every aspect of a claim, New York Central Mutual believes it is in the customer's best interest to create specialty areas. "We have people who are specifically responsible for settling medical claims, for example," said Cembrinski. "Because that's all they do, they become familiar with medical issues, the types of questions to ask, and the kind of results to expect. They can form relationships with doctors and hospitals and become experts in a specific area. By allowing our people to specialize, we feel we get the best resolution to the problem for our policyholders."

But this practice of having multiple examiners work on a single policy complicated workflow under the old, manual system. Cembrinski was committed to finding a way to let examiners from different specialty areas work on a case simultaneously. This led him to investigate document imaging systems. "With most imaging systems, you have ten or so types of documents," noted Cembrinski. "In our case, we have 800+ different document types, and each holds different priority based on internal and external regulations. We have to prioritize and age each of the documents. Getting people the work they needed to see in a timely fashion was an important goal that could not be reached with any paper-based system."

Analyzing the Old System and Researching the New

Once the shortcomings of the old system were identified, the first step toward redesigning the workflows was to form a project team. According to Steve Cembrinski, having a clearly-defined, committed leader was vital to the success of the project. "I was the vision keeper," he said. "If you move into a project like this, you have to have one person who can maintain a hands-on relationship through the entire process and who can pay close attention for a long period of time. When one person is dedicated to the project, it is less likely the ship will stray from course. We wanted a variety of individuals on our team, but we found it was a good idea to maintain constancy of leadership within the project team."

Cembrinski surrounded himself with both "quality members" from the claims community, who had credibility with their managers, and information systems specialists. In January 1993, a team of 10 claims department employees and internal IS professionals evaluated the company's business processes, with an eye toward redesigning the claims system using document imaging technology. Cembrinski believed it was essential to have intended users involved in every aspect of the analysis. "It's absolutely key to have the employee's involvement in the process from the beginning," he noted. "After all, it is their eight-hour day on that system. They know it best. And, they have to ultimately buy into any new system, or it won't work."

Over a period of two months, the team looked at which process steps could be changed, eliminated, or combined. "We spent a solid week in which I went through the department with the claims people and learned specifically each of the jobs out there," said Cembrinski. "They taught me the process, and they looked closely at the details of the system they knew. We analyzed each job type. We took various types of occurrences

and tried to detail the steps involved in processing, asking questions like, 'What happens to that paper? Who else needs to look at it?' We did that for every type of claim."

To better visualize and reorganize steps, the team hung sheets of paper on the walls detailing the settlement process for particular types of claims. "Since we were creating a proposal to convince the senior managers," Cembrinski said, "We kept asking the question, 'With a new system, what officially can we gain?' We found that a significant number of steps in the claims process could be saved–which meant time would be saved."

In a formal proposal, Cembrinski presented the team's findings to senior management, and the project received approval in September 1993. The next step was to research vendors. He attended a seminar hosted by FileNET on imaging systems, but the project team also looked closely at several other vendors. By conducting site visits and viewing demonstrations, the team narrowed its choices to three vendors. According to Cembrinski, FileNET was chosen on the basis of four criteria: (1) price; (2) service; (3) product; and (4) "gut feeling."

Some of the key factors in the selection of FileNET included: system functionality, a developed customer base, and FileNET's understanding of the high volume transaction processing required by an insurance company. Although the system was "probably the most expensive," Cembrinski said the project team especially liked the type of long-term relationship it could form with FileNET. Before choosing a vendor, team members had to decide how much responsibility for the new system the company could expect to take on. Should New York Central Mutual enter into a long-term relationship and become dependent on a vendor for any upgrades or future customizing of the claims processing system? Or should it form a short-term relationship and request a

transfer of skills that would allow it to take charge of customization and support in-house? To answer these questions, the team had to be honest about what the claims employees wanted and what the IS professionals could handle. Because the company's roster included a number of highly-trained IS people, the team decided to outsource a lot of the initial application development and provide training so the company could assume upgrades to the system. "We wanted to build at least 10% of this system ourselves," Cembrinski said, "so we could be responsible for maintaining and upgrading it. FileNET helped us do that."

Implementing the System: Learning by Degrees

Only nine months after choosing FileNET, the company saw the first phase of its claims processing system go online. Since replacing paper with desktop PCs was a "cultural change," as Cembrinski commented, the company decided to implement slowly. The home office claims department has 250 employees and is divided into eight territories for auto and two territories for property claims processing. One territory went online at a time. "We implemented them to a point where we felt the system was 80% developed," Cembrinski said, "then went back to the drawing board based on valuable feedback we got from users. Once we got everyone in one territory online, we did a benchmark analysis. Every two months we brought on subsequent territories, so it took almost two years to bring everyone onto the system."

By staggering the implementation scheme, the company, working with FileNET, was able to recognize right away that it would need more storage and higher-level servers than the designers had anticipated. Therefore, the system was brought up to par shortly after subsequent territories were brought online.

By concentrating on one territory of users at a time, the project team also was able to emphasize the importance of training. Many of the examiners felt like "old dogs learning new tricks," Cembrinski said. Some individuals, particularly those 50-60 years of age who'd had little contact with personal computers, were worried about depending upon PCs as a vital work tool. "We had to figure out the best way to train them on the PC first–and then on the workflow system–so they could feel comfortable and perform their jobs," Cembrinski said. An in-house team of technology experts spent a few days on PC training before dealing with the workflow system, but soon they realized the employees needed more time and attention. As they rolled out implementation, the training process was refined. "Fortunately, the employees were receptive," Cembrinski said. "After we got the bugs ironed out, they indicated they didn't want to go back to the paper system."

The FileNET System

The FileNET *WorkFlo* application chosen by New York Central Mutual is used for storage, routing, and prioritization; and integrates with the company's IBM AS400 payment system. Incoming documents and claims are scanned, indexed, and written to optical disk. The documents are then categorized into 800 different types, and the *WorkFlo* software automatically matches incoming documents with claim files. The software prioritizes the documents, selects an item for an examiner to work on, and presents it to the assigned examiner's queue. A prefetch of all associated documents from optical disk to magnetic disk is done for the examiner, which speeds system response time at the workstation. This *WorkFlo* "distributor" is running throughout the day, so that as new items come in they are put in priority order and added to the examiners' work queues. When a telephone inquiry is received, the examiner can make a quick query on the status of any claim in the system.

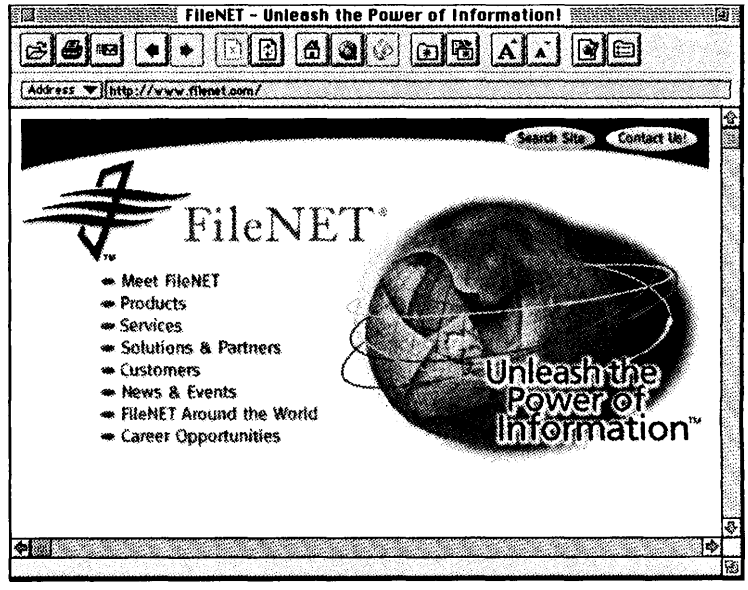


Figure 2.2
You can access information on image processing systems from the FileNET Web site.

New York Central Mutual has developed in-house software to do back-end processing tasks using the AS400, such as calculating settlement amounts, setting up for major perils and loss causes, calculating reserves, producing checks, and collecting statistical data for the company's financial needs. *Workflo* software uses the Dynamic Data Exchange screen scraping technique to get policy information from the mainframe and presents it to the examiners during the claims process.

In addition, the *Workflo* application includes letter writing and automatic faxing with 60 different letter types. A bar code is applied to each outgoing letter. The letter is committed to optical disk and a pending date is set to wait for a reply. The *Workflo* software manages the decision to send a second letter if a reply is not received. If the letter is returned in time by the claimant, it is scanned and auto-indexed by bar code, and the *Workflo* application puts it into the examiner's queue automatically. The software's ability to manage the pending and rendezvous of

incoming information with the original claim file speeds the entire claims process, removing the burden from examiners and supervisors. (Portions of this product description were adapted and excerpted from the FileNET Web site, ***http://www.filenet.com***, reprinted with permission).

Costs and Benefits

In its initial proposal, the project team estimated the cost of implementing the new system at $2.5-2.7 million–but the team aimed a little low. "The area we underestimated was installing the local area network, which we did not have before," said Cembrinski. "We knew we needed one–pretty much everyone doing business right now needs one–but we spent so much time looking at the workflow system, and trying to figure out which vendor could offer the kind of system we wanted, that we didn't look closely enough at the cost of the LAN."

After one year of use for 200+ users, Cembrinski estimated the total expense for the system was $3.5 million. But, company management believes the benefits have outweighed those costs. "We think it is paying for itself," Cembrinski said confidently. "We've been measuring it the past couple of years. In terms of things like staffing levels, the number of days it takes to settle claims, and ultimate settlement size, we're very pleased with the results."

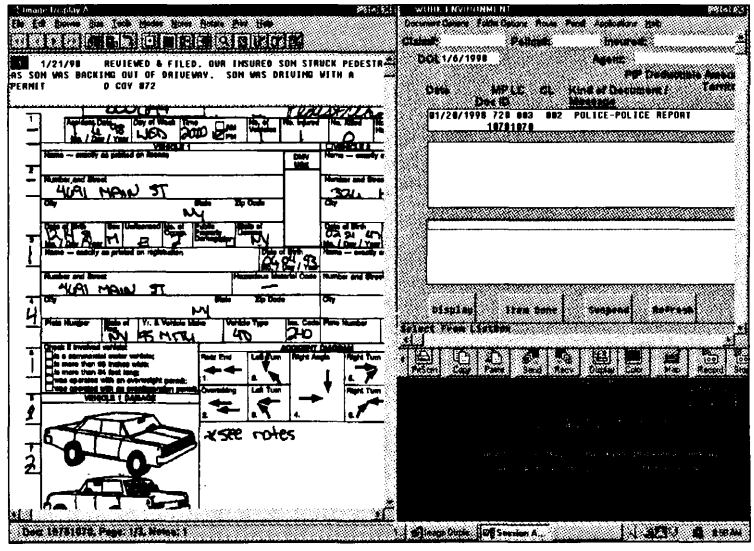


Figure 2.3
An examiner at New York Central Mutual can access both the workflow system and the IBM claims settlement system from this internal home page.

According to the company's internal evaluation, the streamlined workflow process has improved the average time it takes to settle claims by two to three days, which means the company no longer has to pay penalties for missing state-imposed deadlines. Furthermore, customer approval ratings have skyrocketed. Although no employees were let go, the system has allowed the company to reduce staff numbers by 10-15% through the process of attrition, with more payroll savings expected in the near future. Space savings are also a consideration; New York Central Mutual no longer needs a five-million document storage room, so that space has been converted to work space.

One unforeseen advantage to the automated workflow system has been its use as a tool for evaluating employees. Supervisors can track employee performance by retrieving computer data about the types of items an employee works on as well as the amount of time spent on each. However, Cembrinski said, this tool has been used with caution. "We need to be careful about how we set standards for performance," he admitted. "How we use this

kind of information is critical for employee well-being and for how they feel about their jobs."

Although pleased with the benefits provided by the workflow system, Cembrinski is already looking ahead to the next step, which may be to automate workload balancing. Currently, a workflow administrator, who oversees the queues of all employees in the system, has the responsibility to shuffle work when necessary, such as when an employee calls in sick or takes vacation time. With automated workload balancing, the system, upon receipt of a document, would automatically scan employees' workloads to determine which individual could best handle the new work. "This is still in the discussion phase," Cembrinski said, and added with a laugh, "And it will take a lot of work!"

To begin, the company would need to re-examine its workflows once again, this time focusing on how workload balancing could benefit New York Central Mutual. "Then we would have to see if we can do it with this system," said Cembrinski. "We would talk with the system developer and the claims people to determine the advantages, perhaps any disadvantages. It would basically be another business process redesign, the same kind of thing we went through in installing the workflow system."

Case Summaries

In the sections that follow, we'll look at a few broader, less detailed descriptions of how service-based organizations have implemented workflow systems. Many workflow software vendors have case studies available for prospective customers to review, in addition to white papers and position documents. To

locate these materials, you can begin your search by contacting the vendors and consultants highlighted in Chapter Eight. Although vendor materials are understandably slanted toward the company whose software is featured, case studies are an important source of information about the benefits that can be derived from implementing workflow software and the types of tasks and business processes that can be automated through workflow technologies. And, a company willing to provide educational and research materials for prospective customers is likely to be one with satisfactory customer service in other areas, like technical support and customization consulting.

Workflow by Design at Pfizer Creative Services

Pfizer Limited is the principal subsidiary in the United Kingdom of the worldwide Pfizer Company, employing some 2,850 people at its site at Sandwich, Kent. It conducts its UK operations through two marketing divisions (pharmaceutical and animal health), a manufacturing division, a research and development facility and certain service departments. The research division has its European headquarters in Sandwich on the Kent coast, where it has been a major local employer for the last 40 years. The company operates in a highly competitive sector.

Pfizer uses a mix of techniques to promote awareness and support sales, ranging from advertising, mail campaigns, distribution of leaflets and brochures, through symposia and medical conferences to exhibitions. A good proportion of the material that underpins all this promotional activity comes out of Pfizer Creative Services (PCS)–whether designing and printing sales and marketing collateral, mailshots and product packaging, building conference staging and exhibition stands, or producing videos and audio visual presentations.

"Our overall mission is to support the core sales and marketing divisions of Pfizer as well as central research, and the services we provide are all billed on a commercial basis. In essence, we operate as an internal agency," says Peter Gagette, Client Services Manager for Pfizer Creative Services. "This means we have to be every bit as competitive as external agencies. We do not have an automatic right to the Pfizer business and our internal customers are free to go elsewhere if they think they can get a better deal. So we pay keen attention to prices, quality and service."

A key element in helping PCS to deliver is the *Staffware Workflow* system which was adopted when the agency decided that it should relocate from several disparate locations on the Pfizer main site into a refurbished building a few hundred yards away. The move was partly to underline its stance as an independent operation subject to the same commercial considerations as any other supplier, and partly to get closer to the reprographics side of the operation. As a result, Creative Services had to overhaul its job control, billing, and financial accounting processes.

"We wanted a business system which would address single billing and invoicing, job progression, and improve management feedback. We also needed to be able to break down individual jobs by specific elements–how much video production, promotional advertising, mailing and so on–at the start of the job for cost estimating and then for reconciliation on completion," added Peter. "We asked our business consultant to recommend a business infrastructure. Out of this came the proposal to use *Staffware Workflow* as the backbone of the system. What we have ended up with is *Staffware* integrated with an *Oracle* database and *Forest and Trees* for extraction of management information and the accounts procedure."

A standard form using fixed choice categories was designed to front the *Staffware* system and through which all jobs must be booked in by an account manager. When a work request is entered, a job manager is assigned and the system kicks off a sequence of events, based on the design process. The job manager in turn assigns a designer, and, when accepted, the job enters the work in progress process and is tracked through to completion.

Staffware may be handling as many as 2,000 cases at any one time, ranging from a small mailing piece to complete conferences, in which several of Pfizer Creative Services' 50 staff members may be involved. "A key feature of the system is that everyone involved can view the progress of any of the jobs and how they stand against the critical path to delivery. Before *Staffware*, we relied on a T-card system, which was pretty good, but not as accessible as calling up the information on the PC screen. We can also track costs, hours estimated and used, and find out which jobs are active or non-active. Alarms are built into the system to warn of potential difficulties, such as photography not being completed in time to meet the next deadline in the design process, or delay in artwork production," says Peter.

The accounting system runs alongside and comes back into the process for reconciliation of invoices with the job, so that Pfizer Creative Services can draw up a single customer invoice. Another aspect of the *Workflow* system, which was not really considered at the outset, is the contribution that *Staffware* will make to Pfizer Creative Services' application for ISO9001 certification. *Staffware* is providing a good backbone by enforcing the process rules.

"*Staffware Workflow* has helped us to achieve our overall objectives. We know exactly what stage an individual job has reached. We have dispensed with job and time sheets. All

invoices and costs relating to a job can be captured and billed. And it helps focus on administration–something at which few designers excel!" concludes John Foat, Director of Creative Services.

This case study was adapted and reprinted with the permission of Staffware, Inc. To read more case studies and learn about Staffware's line of software and services, you can visit the company's Web site at **http://www.staffware.com**.

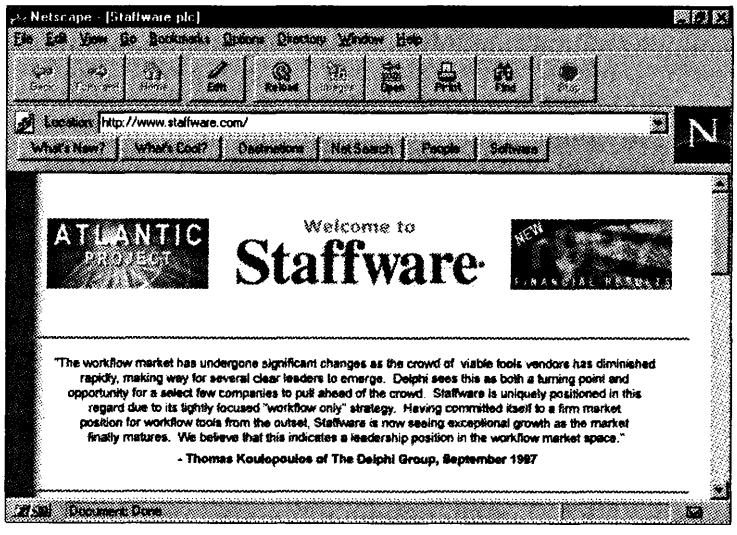


Figure 2.4 *Staffware's Web site, source of case studies and related documents on workflow systems.*

CIGNA Healthcare Insurance

CIGNA Healthcare, headquartered in Bloomfield, Connecticut is a leading provider of healthcare insurance. Staffware has partnered with CIGNA Healthcare for the past two years, providing production standard workflow automation. The use of *Staffware* in CIGNA Healthcare was based on the need to correctly handle insurance claims which are an exception to the normal process (known in the industry as "pended claims"). For instance, a claim may be received which references a diagnostic code so new that it is not in the database, or is for a healthcare

provider not registered with CIGNA. *Staffware* was the tool chosen to enable these cases to be routed quickly, to individuals with the expertise to complete the claim.

The bulk of insurance claims are handled quite efficiently on a traditional IBM mainframe environment with standard 3270 terminals. In the past, pended claims would have to be transferred to paper for resolution. With the addition of *Staffware* running under AIX, screen scraping from CL/Supersession and Brixton software to provide linkage from the screen to the UNIX environment, the exception process became automated, reducing lost claims to zero, and vastly improving the time it takes for them to be resolved.

The *Staffware* server runs on an RS6000 (Model 59H), with 640mb of memory and over 7.5gb of RAID 5 disk. The system is used to support over 6,000 *Staffware* users and the Brixton processes used to log them in from 3270 terminals. In 1995, the *Staffware* system performed over one million workflow steps in support of the business process. They also have a second system dedicated to workflow procedure development; an RS6000 (Model 570).

In order to support greater amounts of work and an increasing number of users, CIGNA moved to a multi-node *Staffware* environment based on an IBM SP/2, a system which allows RS6000 processors and their own memory and I/O subsystems to be rack-mounted. The system also includes a high-speed switch which will run TCP/IP between the systems. This operates at over 600 megabits a second as opposed to token ring hardware which is rated at 16 megabits per second. Inside the SP/2 there will be a production environment of two RS6000 (Model 59H), each with 512mb of memory and 7.5gb of RAID disk. The SP/2 also has two RS6000 (Model 39H) with 256mb of memory and 4.5gb of

disk to support the multi-node development environment. The new environment will be used to provide load distribution by allowing CIGNA Healthcare to spread its users over two nodes, rather than perform a geographical distribution which is what spurred the initial design of multi-node Staffware some years ago.

Other exciting events happening at CIGNA Healthcare in 1996 include the use of the new *EIS* development product from Staffware. Report and analysis of workflow data is critical in the need to improve the business process which continues to keep CIGNA Healthcare competitive. Currently, live and archive data from the workflow system is loaded into a DB2 database for analysis. *EIS* will provide easier and speedier access to the workflow data, while at the same time reducing the need to move the data into DB2, and then taking the reported data for conversion into graphical format.

There is also work being done to link *Staffware* on AIX directly to a new MVS/ CICS application within CIGNA Healthcare to further improve productivity. This will probably take the form of gateway code between the two architectures using IBM's MQSeries product set as the bridge from CICS to *Staffware*. CICS will be able to pass work items to *Staffware* directly for workflow processing with *Staffware* returning the item to CICS when it has been processed. (Case study adapted and reprinted with permission of Staffware Inc. **http://www.staffware.com**.)

Army and Air Force Exchange Service

Thanks to *DocuPACT*, a Microsoft *BackOffice*-based document management system from InterTech Information Management, and *ActionWorkflow*, a Microsoft *BackOffice*-based workflow system from Action Technologies, the Army and Air Force Exchange Service is processing up to 250% more invoices a day. The powerful solution, built with help from KPMG Peat Marwick,

is expected to deliver $4.5 million in savings over five years and a 100% return on investment in just 14 months.

For 102 years, the Army and Air Force Exchange Service (AAFES) has been providing high-quality merchandise and services at low prices to US military personnel and their families around the world. AAFES currently has 10,878 facilities (including 1,423 retail outlets), 8.7 million customers, and annual revenues of $6.9 billion. AAFES processes every invoice from every vendor worldwide at a facility in Dallas, TX. Until recently, accounts payable staff there were sorting, distributing, and reconciling those invoices by hand. Though they managed to process 4,000 payables a day, keeping up was a constant struggle.

Looking to improve both efficiency and productivity, AAFES engaged KPMG Peat Marwick, InterTech Information Management, and Action Technologies for help in creating a state-of-the-art document management and workflow solution. Using InterTech's *DocuPACT*, Action's *ActionWorks*, and Microsoft's *BackOffice* server applications, AAFES and its partners designed, developed, and deployed an application that routes invoice images to clerks automatically for speedy indexing and reconciliation.

AAFES is now processing as many as 10,000 invoices a day with 20 fewer clerks than before. Over time, reduced demand for file storage space and further staff attrition will save the organization even more money.

New invoices arrive by the thousands each day, but before *DocuPACT* and *ActionWorkflow*, the accounts payable team was processing them entirely by hand. "We were still caught up in the manual method of processing invoices," recalls Cathy Mosconi, FAST Team Section Chief. "Sorting the invoices, distributing them,

passing them around, it was an organizational nightmare." Though the accounts payable team managed to process 4,000 invoices a day by hand, keeping up with the influx was challenging. "If someone got sick, the whole team fell behind," says Mosconi. By early 1995, the problem had become urgent. The only answer, AAFES decided, was to automate the accounts payable process with help from document management and workflow technologies.

For help in designing its solution, AAFES turned to KPMG Peat Marwick. As it turned out, KPMG would play a pivotal role in the project from start to finish. Says Richard Green, Chief of Fast Action Support, "they helped us find the right solution for AAFES, and then worked right along with us through the entire development and deployment process."

Challenge number one was selecting enabling technologies. At the time, AAFES was migrating its networking and e-mail onto Microsoft *Windows NT* and Microsoft *Exchange*, a move that has worked out well for the organization since. "The advantages AAFES has enjoyed as a result of operating in a *Windows NT*-based environment have been, just to name a few, integrated security, central administration, and a stable platform," reports Mosconi. Given its new direction, AAFES naturally wanted to use products that were smoothly compatible with Microsoft *BackOffice* in its solution. Acting on KPMG's advice, AAFES chose *DocuPACT* and *ActionWorks.* "We were looking for products that fit into the environment we worked in, which was based on *Windows NT,*" says Mosconi. "We felt InterTech and Action Technologies fit quite seamlessly."

"We chose *DocuPACT* because it provides the best-of-breed, plug-and-play technology we were looking for," says Mosconi. "It is extremely easy to use and is more flexible than the other

systems we looked at." AAFES also liked *DocuPACT's* Universal Viewer, which allows users to annotate documents on screen.

The solution's second key component, *ActionWorkflow*, provides an open architecture for managing and streamlining mission-critical business processes. With its intuitive process mapping utility and robust work management engine, *ActionWorkflow* helps organizations build and deploy applications quickly and then run them efficiently. "What stood out about *ActionWorkflow* was how easily you could map out your workflow," says Mosconi. "It was all quite straightforward and easy to use."

AAFES and KPMG spent five months developing its new solution, which went live in November, 1996. The system employs three Dell XE Dual Pentium servers running Microsoft *Windows NT Server* and Microsoft *SQL Server*, as well as 150 client PCs running Microsoft *Windows NT Workstation*. Every morning, the AAFES mail room creates images of newly received invoices using a Kodak Imagelink 923 scanner. Accounts payable clerks then index the invoice images, validating their work in real time against data in AAFES's mainframe-based accounting system (which is linked to *DocuPACT* via Microsoft *SNA Server*). Invoices with flawed or missing information are flagged for reconciliation, a process conducted in the afternoon by the same team of clerks that handles indexing.

The new workflow system has made processing invoices a dramatically simpler and less time-consuming process for AAFES. "Once the clerks have the right information, it's just a matter of a few keystrokes," says Mosconi. That's a big part of why users are such fans of the system. "As they've become familiar with it, they're happy with the way it has streamlined the process and helped them do their jobs," Green reports.

Since implementing the new system, AAFES has taken advantage of the system's open architecture to add Internet functionality. Using Microsoft *Internet Information Server* and Microsoft *FrontPage*, AAFES created a Web-based application that allows vendors to check on the status of their invoices. The organization also plans to use *DocuPACT Web Server* and *ActionWorks Metro*, two powerful new Web-based products, to deploy future Web-based applications.

This case study was adapted and reprinted with the permission of InterTech Information Management. To read more case studies and learn about InterTech's software and services, you can visit the company's Web site at **http://www.docupact.com**.

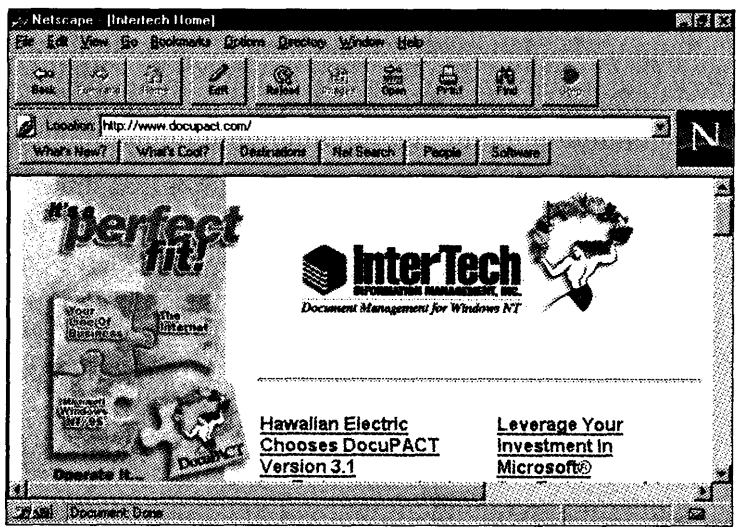


Figure 2.5 *InterTech's Web site, source of case studies and related documents on workflow systems.*

CS Columna

CS Columna Service AG, a subsidiary of Credit Suisse and the Swiss Volksbank, deals with professional pensions for national and international firms throughout Switzerland. In January 1995, with the help of reseller OBIS AG and Staffware Germany, the company went live with a *Staffware Workflow* automation system

for its pensions fund transfer department. Since then, the company has been so impressed with the business benefits Staffware has brought to this area, that it plans to adopt workflow across the entire organization.

The Staffware system, which currently deals with around 100 new cases per day, is integrated with Unisys 2200 and IBM MVS platforms and Novell *Netware* 3.12, *Microsoft Office* 4.0 and *VisualBasic V3.0* software systems. Oracle is the integrated database.

Outlining the factors which led to the adoption of workflow, Max Meili, Head of Distributed Systems at Columna, says, "We felt that just having an archive solution on its own would not be cost-effective, but together with workflow we'll be able to see a return on our investment within two years. A key requirement was a workflow system that went beyond archiving, dealing with the processes and routines associated with documentation. Out of all the systems we reviewed, *Staffware* was best suited to our particular needs."

Benefits which CS Columna has realized since implementing *Staffware* include the ability to answer customer inquiries more efficiently, with 25% fewer staff needed to deal with a 30% increase in the number of enquiries. Additionally, new cases are being processed more quickly, resource allocation has improved, and archive storage space problems have been resolved. (Case study adapted and reprinted with permission of Staffware, Inc. **http://www.staffware.com**.)

Chapter Three
Workflow Issues for Service Industries

Now that you've had a chance to read about some service companies' experiences with workflow management projects, we'll step back a moment to identify and discuss some of the issues they encountered. Of course, many workflow issues are common to both service and manufacturing companies, so any distinctions are necessarily arbitrary. However, organizations automating service-oriented tasks tend to experience more document and file storage complexities, for instance, while manufacturing companies are more likely to be concerned with inventory and supplier interactions. In this chapter, we'll look at those issues service companies most commonly grapple with, including:

- Customer service.
- Document image processing.
- Information storage.
- Employee development and evaluation.

The next set of two chapters (Chapters Three and Four) will treat manufacturing companies similarly–first presenting case information and then analyzing the issues.

Customer Service

For companies in service industries, service is indeed the name of the game. Customer service is a hot topic for managers in all sectors, and business initiatives are frequently measured by criteria such as how many more customer calls can be handled, how much inquiry turn-around time can be reduced, and how fast policy cards can be issued. Customer service is such a universal business concern that we now have an official "Customer Service Week" designated by the US Congress as the first week in October every year. The International Customer Service Association (**http://www.icsa.com**) provides a range of certifications and training programs for persons who are specializing in this new profession of monitoring and improving customer service.

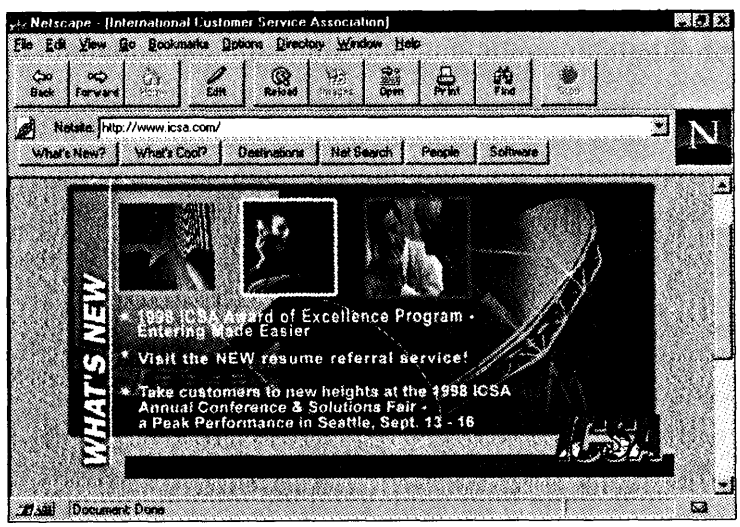


Figure 3.1 *Find information about customer service training and certification at the International Customer Service Association's Web site.*

As discussed in the Chapter Two case study, the New York Central Mutual Fire Insurance Company experienced serious customer service problems due to misplaced or unavailable paper

files. One of the company's primary goals was to improve customer service by processing claims more quickly and gaining the ability to respond to customer inquiries in a timely and informed fashion. And, as expected, the new workflow system has achieved those goals by reducing the days required to process a claim and allowing multiple examiners to work simultaneously on different aspects of a claim.

Steve Cembrinksi of New York Central Mutual said, "When our people are settling claims, for every file they open they are dealing with someone who's experiencing some level of stress, whether it be a medical crisis, an automobile accident, or the loss of property. If there's any way we can help that person minimize stress and resolve the situation as quickly and cleanly as possible, we feel we've done our job well. One reason we decided to install the new software was to give our adjusters a tool to make the customer happy, and when we presented it that way to our employees, it helped them feel better about going through the process of change."

It's not always so straightforward to identify exactly who one's customers are. The Pfizer Creative Services case summary raises an important point related to customer service–the fact that a department's customers can be either external to or internal to the organization. In this case, internal customers of the Creative Services group could acquire the same services outside Pfizer if dissatisfied with the internal creative group. Thus, Pfizer Creative Services needed a way to ensure that they could compete with outside professionals by tracking projects closely and keeping costs down.

CIGNA Healthcare faced yet another definition of the term *customer*: they process claims from health providers, who are providing services to the end consumer, who is a patient. In this

case, the insured patient is the entity paying for the company's service, which is insurance. The patient receives other services from a healthcare provider, for which the provider submits reimbursement claims to the insurance company. At any point along this line, some customer might become dissatisfied–the patient, the healthcare provider, or the processing firm through which the healthcare provider submits reimbursement requests. And, with healthcare benefits becoming an increasingly important factor as employees decide among potential employers, even corporate employers are customers of healthcare insurance companies, because they pay most or all of the insurance premiums and they want to ensure the best possible service on behalf of their employees. This example illustrates that a service company can have many customers, and many different types of customers, and that service to each of them should be a consideration when planning a workflow system.

When you evaluate important customer-service concerns in planning a workflow management project, consider all potential customers of the business processes you are automating. Ask yourself questions like: To whom do you sell the service? Who are the intermediaries in that sale? What other entities are involved in acquiring the service? Which groups internal to the organization are served? Will the system be supporting information-gathering or inquiry functions in other parts of the organization? By taking as broad a view as possible, you can ensure that all types of customers are accommodated by the newly automated flow of work.

Once you identify who your customers are, there is a range of techniques you can use to determine their needs and how you can improve service to them. For internal customers, try the following:

- Conduct interviews with representatives of all levels of the department that uses your services.
- Submit mock requests and calls to identify problem areas.
- Establish a service task force or quality team with members from each company area that uses your service.

For external customers, you can elicit feedback via more familiar, marketing-oriented techniques:

- Create a focus group session with representative customers.
- Solicit comments via response forms, e-mail, or another appropriate channel.
- Conduct a customer survey with established questions for randomly selected customers.

To learn more about the myriad techniques available for analyzing and improving your organization's customer service, start with online sources such as the *Customer Service Review*, available by subscription at **http://www.csr.co.za/**.

Figure 3.2 *Customer Service Review, an example of online resources for learning about customer service techniques and guidelines.*

Once you have identified the most pressing customer service issues facing your organization, you can feed this important information into your workflow system planning process. Don't forget to ask potential vendors and workflow system consultants for any information they may have about customer satisfaction concerns in your market sector. For instance, Staffware, the maker of one of the leading workflow management systems, has published a series of white papers that address customer service and other workflow issues in the insurance industry.

> *The consumer is inadvertently being trained to be more and more demanding. Whether it is the industry presenting a utopian view of instantaneous claims settlement, or consumer organizations being publicly severe on lapses, the burden of satisfying expectations is growing.*
>
> *Workflow clearly helps enormously. Knowing immediately the stage of a claim in a procedure reduces the work involved in responding to customer queries. In one overworked life and pension department, incoming calls were monitored and analyzed. The results revealed*

that 40% were call-backs following an inquiry where the employee has had to search paper files for the documents necessary to respond to a customer's questions. The department in this company won director-level recognition for customer service once Staffware had been implemented, providing the relevant documents at the press of a key and solving customer inquiries as they come in.

As well as being able to track the process, the processing time can be dramatically reduced. The customer service department of a general insurer reported that the time taken to process certain complex requests had been reduced from an average of four days to less than one. In an uninsured loss recovery process it was reported that the first part of the process, previously taking seven days, was being completed in one following automation with Staffware (adapted and reprinted with permission of Staffware, ***http://www.staffware.com****).*

Electronic Document Management and Document Image Processing

Electronic Document Management (EDM) is the automated control of page images, spreadsheets, word-processing documents, and complex, compound documents throughout their life cycle within an organization. Traditionally, there have been two classes of document management: (1) the management of fixed images of pages (printed material, such as books), and (2) the management of editable documents, such as word processing files and spreadsheets. Vendors are rapidly moving away from specializing in one class or another–the best management systems obviously contain elements from both traditional classes.

Vendors are now creating larger, integrated document management systems that incorporate a full range of document management functions–these systems control the creation and use of documents across platforms, applications, and company organizational units.

Many workflow systems incorporate EDM modules or interfaces with closely related Document Image Process (DIP) software. Some industry experts view workflow and DIP as sub-units of the larger category of electronic document management systems, while others consider workflow systems to be the larger category, with EDM and DIP as nested sub-units. Whatever the terminology used, it is likely that any service organization's workflow system will incorporate some elements of EDM or DIP, so it is important for you to understand the basics of EDM/DIP systems and the elements that comprise them.

The elements of a typical electronic document management system include software to perform all functions necessary to manage the document from inception to archiving. Some of the elements include the following:

- Authoring—These tools support document creation and revision.
- Storage—The heart of any EDM system is the database and search engines supporting storage and retrieval of documents.
- Library Services—These are document control mechanisms like checkin, checkout, audit trail, protection/security, and version control.
- Presentation/Distribution Services—Presentation and distribution concerns the form and manner in which users are provided with information. This is a vital feature when businesses wish to reuse information, putting it into

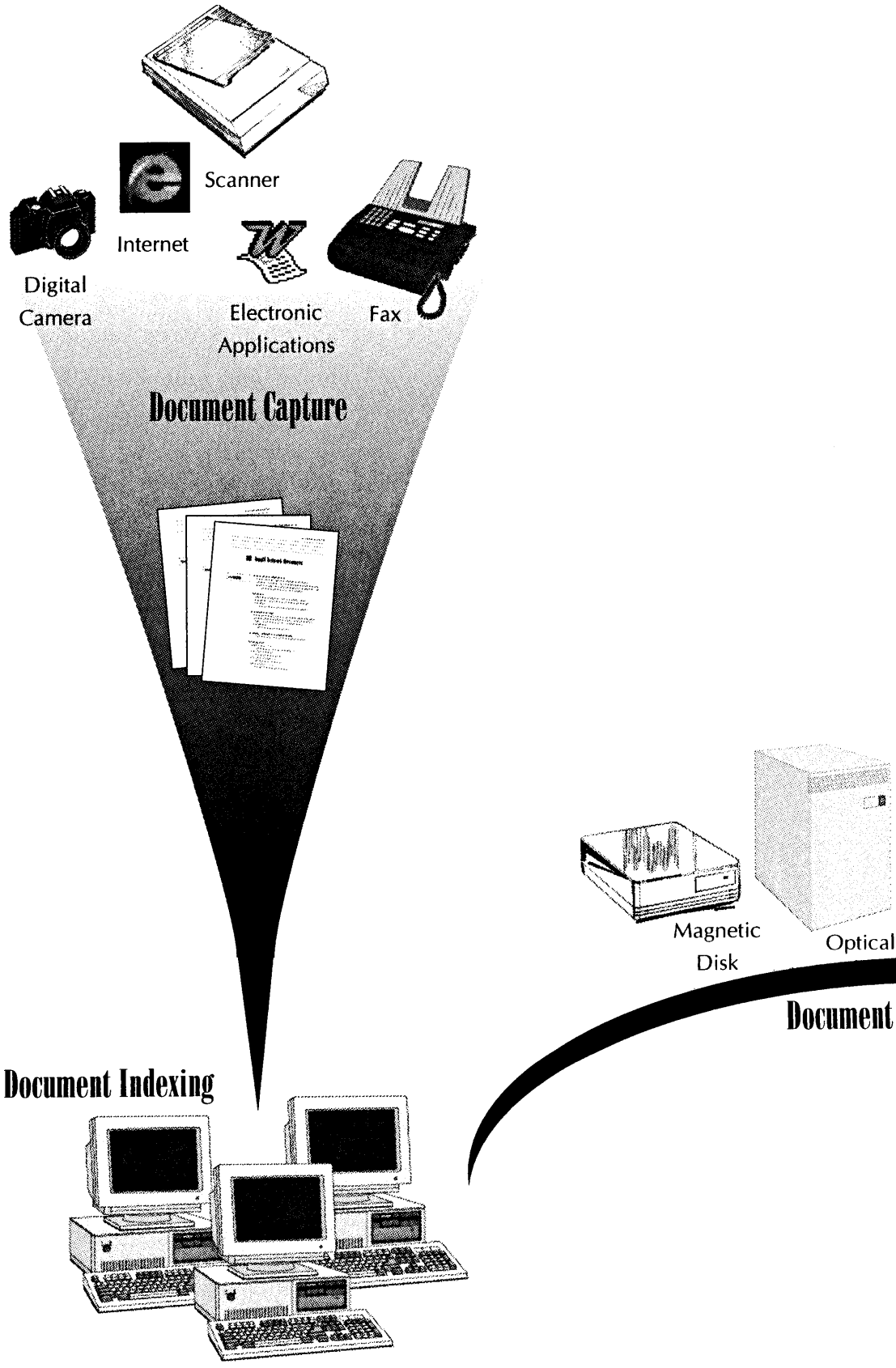
a format determined by the target market or business function.

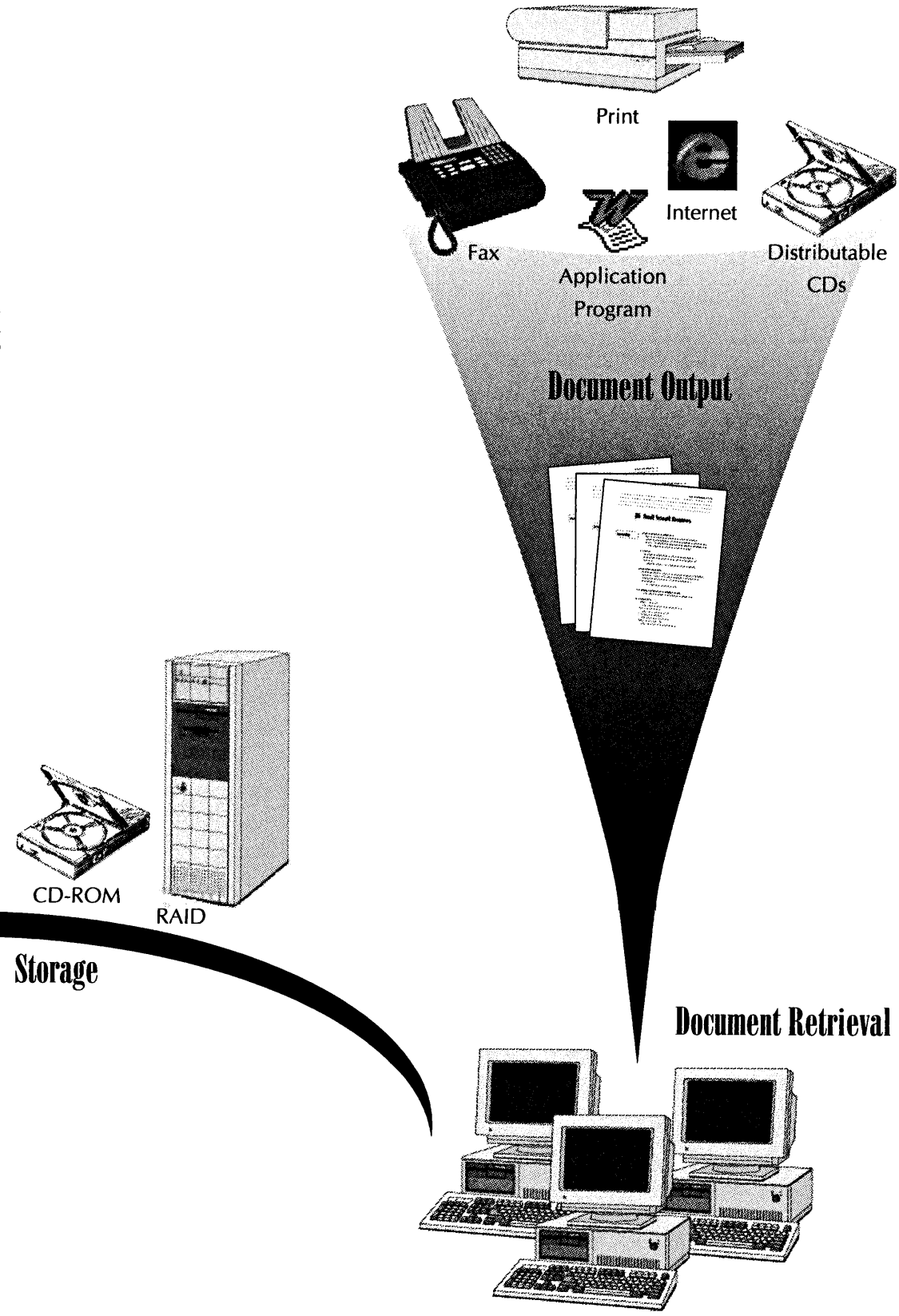
The ultimate scope of DIP is the complete management of documents throughout their life cycles from creation, to possible, eventual destruction. The contribution of technology to the capture, storage, indexing, retrieval, processing, and communication of documents is, therefore, crucial to the success of any DIP system. If your company needs to store documents for more than a few months, if those documents are referred to regularly by more than one person, if the storage of those documents requires valuable space and human resources, your organization is a good candidate for including DIP functionality in a workflow system.

The four most common components of a DIP system are listed below:

1. Capturing documents in an electronic form.
2. Indexing the documents for easy retrieval.
3. Storing the documents.
4. Retrieving and outputting the documents.

The diagram on the following pages illustrates the relationship between these components in a system that uses all four steps.


Scanner
Internet
Digital Camera
Electronic Applications
Fax
Document Capture
Magnetic Disk
Optical
Document
Document Indexing


Print
Fax
Internet
Application Program
Distributable CDs
Document Output
CD-ROM
RAID
Storage
Document Retrieval

Each workflow vendor will have a different way of integrating DIP functionality into its system or providing for your organization to add DIP modules from other vendors.

For instance, vendors PC DOCS and Action Technologies, who make DIP and workflow systems respectively, recently announced the integration of their two leading software packages. In support of this partnership, PC DOCS has joined Action Technologies' Strategic Alliance Partners Program, and Action has joined PC DOCS' Image and Workflow Workbench program. The two companies are working together to help their system integrator partners successfully implement collaborative Web-based business applications. Action Technologies' *Metro 3.0* is a Web-based workflow software suite that allows system integrators and corporate IT organizations to automate key business processes and rapidly build and deploy collaborative business applications for intranets and extranets. The *Metro* suite includes ready-to-run applications, workflow automation and application development tools, and a personal work management environment. *CyberDOCS* is a Web-enabled document management product that provides organizations with full document management functionality from a Web browser over corporate intranets, extranets, or the Internet. Both *Metro* and *CyberDOCS* are based on the Microsoft *BackOffice* server platform.

If your workflow system will rely heavily on DIP functions, you may wish to begin your search for software with companies that specifically deal in DIP software, as New York Central Mutual did when they selected FileNET. If the DIP functions represent a smaller portion of your overall system needs, you may be able to pursue an integrated approach as described above. You can begin research on appropriate systems for your organization's needs by visiting the sites of companies that make the network operating

systems on which both DIP and workflow packages run. One such source of information is Microsoft's *Document Management* Web area, at **http://www.microsoft.com/industry/docman/**.

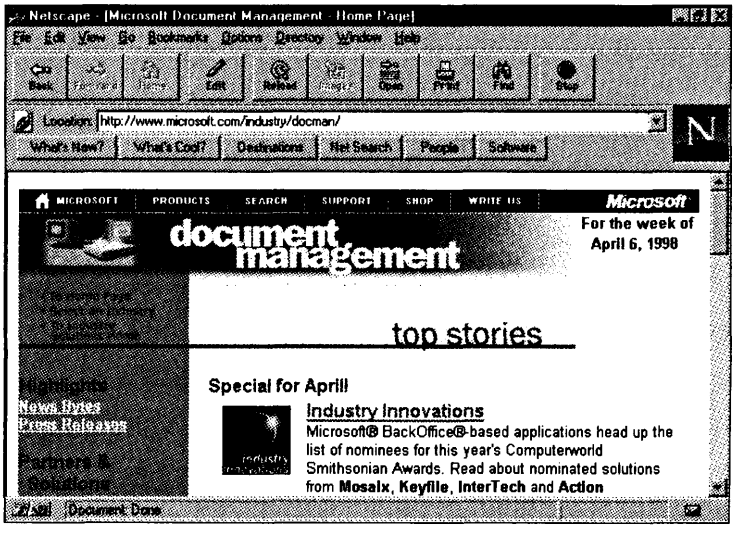


Figure 3.3 *Microsoft's Document Management Web area, source of information on integrating DIP and workflow functionality.*

Information Storage

As you'll remember from the New York Central Mutual case study, reducing costs for the physical storage of files was an important objective in implementing workflow technology. In a study commissioned by Staffware, researchers found that about 5% of businesses that implement workflow systems realize space-savings benefits.

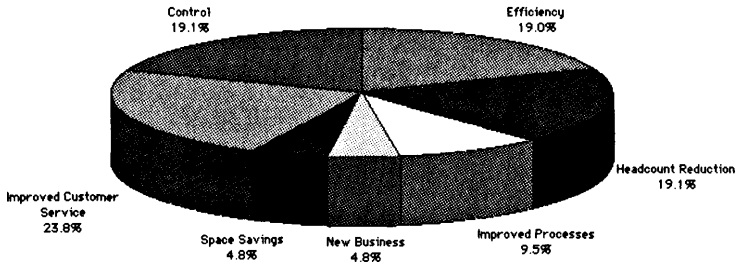


Figure 3.4
Types of benefits derived by organizations implementing workflow systems.

Certainly, the larger benefit areas on this diagram, such as improved customer service and staff reduction, are more universally experienced benefits. However, to a business that is primarily based on paper, and that spends top dollar to protect crucial paper-based information, this benefit can be substantial. Even those forward-looking companies that have made the transition from paper to some type of film information storage are required to spend considerable effort and resources managing the information storage process.

Reducing the necessary space for document storage has been an issue for a very long time; and image-processing procedures are certainly not new topics or technologies. Microfilm and microfiche technologies have been available for decades. This technology, in essence, produces a dramatically reduced photograph of the document that is stored on film. These approaches require special machines (called microreaders) to view the stored documents. If a business has an extensive microfilm or microfiche collection, it is typically necessary to employ a librarian to catalog, file, and retrieve microfilm and microfiche documents; and often appointments must be made to view these documents–obviously, this can be a time-consuming process. Where microfilm and microfiche technologies are, essentially, photographs of documents, DIP creates a digital image of the document that can be stored in any number of

ways. And, with the appropriate hardware and software, document retrieval is as simple as the click of the mouse.

As discussed above, DIP is an important element of any workflow system being considered by a business that provides services which depend on paper-based processes, such as forms, applications, claims, requests, orders, and a host of other documents. When compiling a cost-benefit analysis of workflow technology for your own or a client's organization, be sure to include the possible savings related to a reduction in the cost of storing information in physical form, whether paper or film, and instead storing it in digital form.

Employee Development and Evaluation

According to Chris Watson, President of Workflow Systems, Inc. (**http://www.workflowsystems.com**), employee-related workflow issues fall into several categories. Most importantly, he warns, companies should not view implementing a workflow system as an occasion to begin hiring untrained, unskilled personnel to handle functions previously managed by highly skilled employees. "Viewing workflow as a way to reduce personnel costs is a short-sighted perspective," says Watson. He points out that redesigning workflows and implementing workflow software should be an opportunity for a company to increase employee productivity and give employees more pride in their work. The company benefits by gaining a more agile and effective workforce that can respond to changes in the market quickly.

One problem Watson sees with many current workflow projects is that systems are designed merely to accommodate routine process steps, and exceptions present real problems. "There

should be no need for management intervention or additional programming when exceptions to the process arise," he adds. "Plan for the unexpected. Employees should be empowered to see their important roles in the business processes of the company and to make decisions based on their knowledge and experience. This is not carte blanche for employees to act without appropriate safeguards for the company. Current workflow systems incorporate tracking and reporting capabilities. Managers can review each employee's actions, providing training, or even disciplinary, action as required. In this way, workflow can be viewed as a chance to accelerate employee development and increase efficiency even in problem situations."

An analyst at Staffware adds another element to employee-related workflow issues in companies with multiple locations:

With staff in many locations the problem is obvious; instructions are issued, forms designed and staff trained. Without workflow it is hard to be sure that the processes are being followed, even where manuals and guidebooks are issued. As a solution to the problem a series of checks and audits is constructed within the workflow application to ensure that predefined rules are adhered to, ensuring that the system adds value.

Thus, workflow systems provide a convenient opportunity to improving staff members' compliance with established business processes and measuring their productivity. The case of New York Central Mutual Fire Insurance Company is a good example. Remember that New York Central Mutual found that its new workflow system did indeed increase individual employee productivity and allow supervisors to monitor how much time was spent on each claim. Remember also, though, that New York Central Mutual experienced some employee resistance to the new quantitative nature of performance measurement, and that managers have had to implement new measurements slowly to

keep employee morale high while making such a dramatic cultural shift in the organization.

Perhaps more importantly, don't forget that your employees will be just as aware as are you that staff reduction is one possible objective of the workflow system implementation. Many organizations handle this reduction slowly through attrition, but others undertake aggressive downsizing and outplacement programs to reduce the total workforce. Clear communication with employees will help the process go more smoothly, as is the case with any organizational change. If you anticipate a larger, rapid reduction in workforce, you might wish to engage a management consultant that specializes in employee communications and severance benefit administration in outplacement situations. Watson Wyatt is one such firm–there are many others.

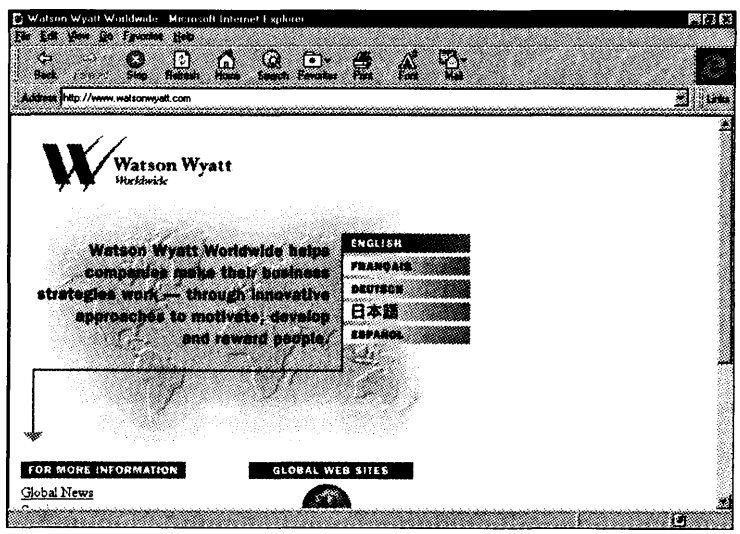


Figure 3.5 *Home page of Watson Wyatt, one of many management consulting firms that can assist in situations where major workforce changes are being made.*

An employee-related issue with more immediate impact on the success of your workflow project is system training. As described in the New York Central Mutual case study, older employees who

were not familiar with personal computing equipment were very intimidated by the new requirement that they perform nearly every aspect of their jobs with a keyboard and screen when they previously did the same tasks with pen and paper. This difficult training issue requires intervention at several levels:

1. Basic computer training for users.
2. Specific workflow system training for users.
3. Adequate trouble-shooting or help desk support for already-trained users.
4. Performance feedback on system use.

To approach the first level of training, you have a variety of options. There is a wide range of excellent books and self-study training courses available for businesspersons who need to gain a basic familiarity with personal computers and operating systems. Corporate training facilities offer classes on basic computer topics and specific software programs. Local colleges and technical schools also are potential sources of computer training. Whichever you choose, keep in mind that an employee who doesn't know how to use a personal computer is unlikely to be successful in more advanced workflow system training. If you take care of the basics first, the money your organization spends on workflow training will create more value in the form of staff efficiency.

At the second level of training, you likely will get a good deal of support from your workflow system vendor. In fact, a comprehensive training program should be one factor on which you evaluate potential vendors. As you compare training programs, look for structured curriculum modules and the presence of well-qualified instructors. And, of course, any system training should provide for hands-on experience. The best training programs will incorporate clearly defined learning

objectives and precise audience descriptions that ensure employees get the level of training appropriate for their job requirements. InConcert, a Xerox company that provides workflow software, also provides in-depth training program descriptions at its Web site (**http://www.inconcert.com**).

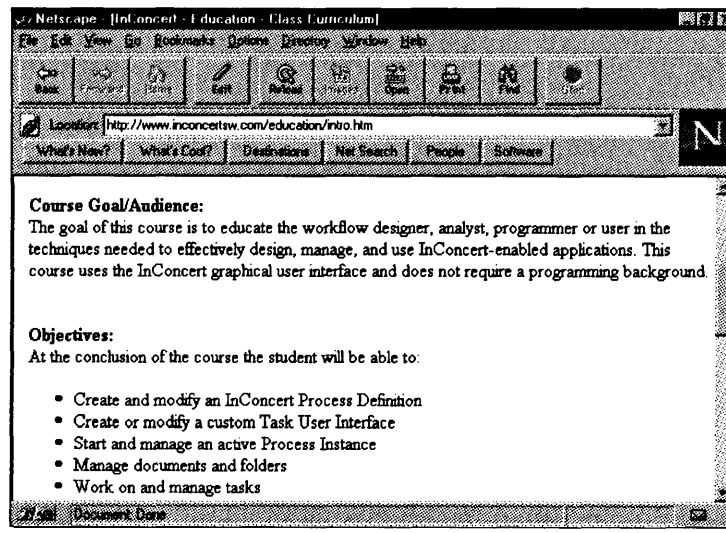


Figure 3.6 *Viewing the training program options available from workflow vendor InConcert.*

Technical support for the daily users of the workflow system goes hand-in-hand with appropriate user training. Once again, you should evaluate potential vendors closely in terms of the responsiveness of their help desk or technical support line. Look for features such as online documentation and lists of trouble-shooting tips in addition to checking the qualifications and availability of technical staff. Portfolio Technologies (**http://www.officeiq.com**), makers of *Office.IQ* workflow software, provides a series of technical tip and error code documents at its Web site, in addition to phone contact information.

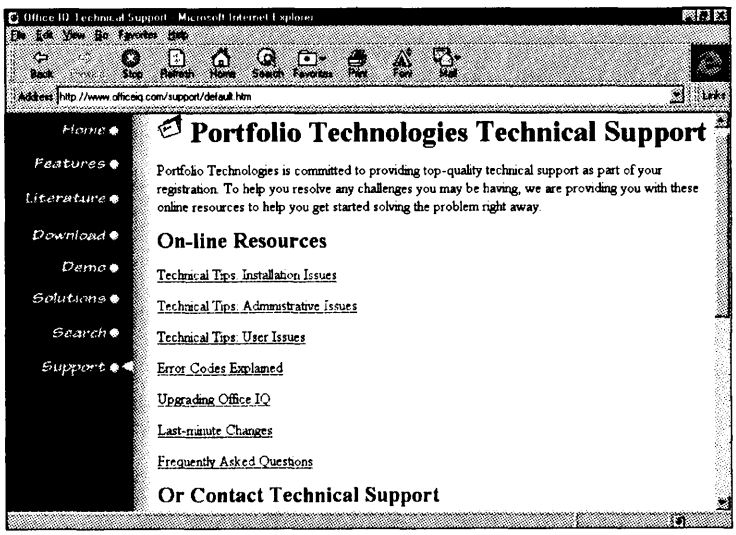


Figure 3.7 *Web page describing technical support services available from Portfolio Technologies, makers of Office.IQ.*

Another consideration is hours of availability–is it likely that you will need technical support after regular office hours? If so, inquire about 24-hour technical support, or consider making special arrangements for such support during critical periods. If your business serves customers 24 hours a day, 7 days a week, your workflow vendor had better do the same. If regular office hours are suitable, remember to plan for the impact of differing time zones.

Organizations such as the American Society for Training and Development can provide leads on where to start if you need help assessing the training and development needs of employees affected by workflow systems.

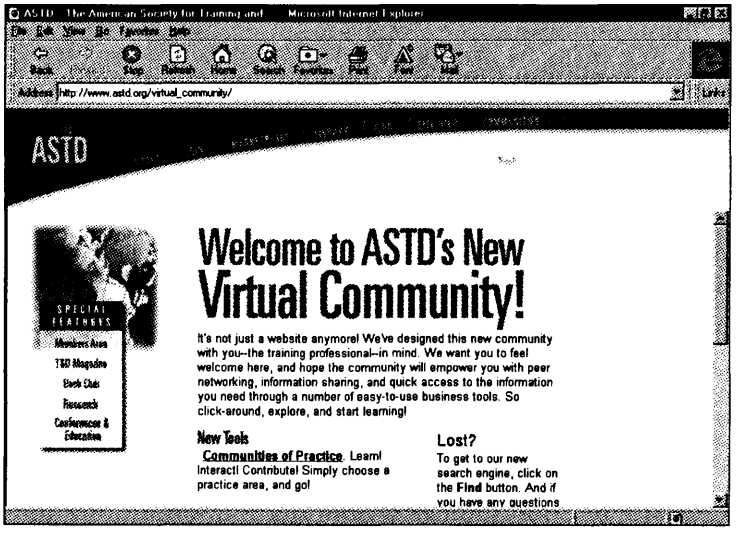


Figure 3.8 *The American Society for Training and Development, a source of resources for approaching employee training.*

Establishing new and unfamiliar metrics systems and quantitative performance measurement standards can be a challenge for any manager–especially in the throes of a workflow system implementation. To learn about the newest techniques used to modify outdated performance appraisal processes, take advantage of the Zigon Performance Group's (**http://www.zigonperf.com/performance.htm**) helpful listing of line resources. As your workflow system becomes established, and then enhanced, you can begin the important project of linking individual employee performance to organizational tactical goals.

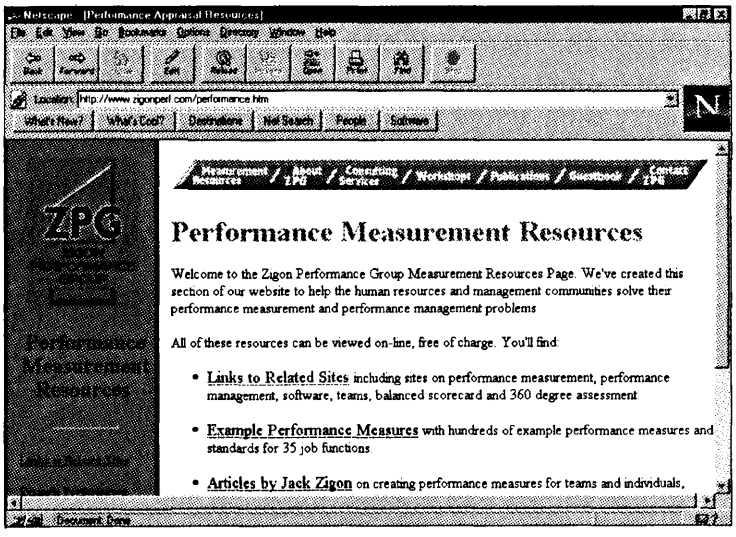


Figure 3.9 *An extensive listing of performance measurement resources is offered by Zigon Performance Group.*

Executive Summary

If your service company, or a client's, is considering implementing a workflow system, there are several issues that consistently affect service-based organizations to keep in mind. You will need to undertake a close assessment of who your customers are, both internal and external, and what kinds of service improvements they seek. You can obtain this information through a variety of information-gathering techniques, including interviews and focus groups.

If your organization provides a paper-based service, it is likely that you will be implementing a workflow system that either includes a document image processing (DIP) component or is primarily a DIP system. Thus, you will need to be familiar with image technology and how DIP systems integrate with other modules of workflow systems. You might be pleasantly surprised to discover the cost savings involved in eliminating expensive,

secured file storage areas and replacing them with digital document storage. Be sure to include these savings in your cost-benefit analysis.

The implementation of a workflow system will have both short- and long-term effects on your organization's employees. Change is hard, no matter how positive. While workflow systems don't always translate, nor should they, into a reduction in personnel costs, employees will be wary of new performance measurements and possible staff reductions. To realize optimal increases in efficiency and productivity, handle these concerns sensitively and clearly, prepared with the latest in performance management and metric techniques. You will need to closely examine the training needs of your group, from the level of basic personal computer training to system training and technical support.

Use Planning Worksheet #1 on the next page to identify which service-industry issues are likely to affect a workflow management project in your organization or a client's business.

Planning Worksheet #1:
Identifying Issues in a Service Organization

Issue	Does It Affect this Organization?	Action to be Taken to Assess Impact/Needs
Identify internal customers affected by workflow system.	❑ Yes ❑ No	
Identify external customers affected by workflow system.	❑ Yes ❑ No	
Define service expectations of customers (through interviews or focus groups).	❑ Yes ❑ No	
Establish document image processing requirements for workflow system.	❑ Yes ❑ No	
Assess the hardware requirements for workflow system.	❑ Yes ❑ No	
Evaluate effect of workflow system on staffing levels, job descriptions, and performance requirements.	❑ Yes ❑ No	
Create employee communications plan in the case of a reduction in workforce.	❑ Yes ❑ No	
Analyze training needs for employees.	❑ Yes ❑ No	

Chapter Four
Managing Workflow in Manufacturing Industries: Case Studies

In Chapter Two, we looked at a case study and several case summaries from companies operating in service industries. As discussed in Chapter Three, the issues affecting workflow management projects in those industries tend to center on customer satisfaction, information storage, and a variety of employee-related concerns. In companies whose business it is to make things, workflow management projects sometimes take a different slant. In manufacturing industries, there is a bigger emphasis on relationships with parts suppliers and product distributors. A variety of newly developed manufacturing techniques affect how work is done and how factors such as inventories are handled. And, personnel issues gain a layer of complexity when a company's workforce is comprised of workers spanning more skill and training levels–from the factory line workers who actually do the manufacturing work, to their supervisors who trouble-shoot the operation, to the white-collar administrators who staff the corporate office. This chapter presents one longer case study and three case summaries that highlight how a variety of manufacturing companies have approached the automation of the flow of work.

Moen Incorporated

Headquartered in North Olmsted, Ohio, Moen Incorporated is one of the world's largest manufacturers of plumbing products. Famous for pioneering the single-handed faucet developed by founder Al Moen in 1937, the company was purchased in 1990 by an operating company of Fortune Brands, Inc., an international consumer products corporation based in Old Greenwich, Connecticut. With subsidiary companies in Canada and Mexico, joint ventures in Taiwan and Japan, and sales and marketing offices in Hong Kong and Singapore, Moen is a multinational powerhouse in the competitive kitchen and bath plumbing industry. Since 1994, it has been the #1 brand of faucet in North America. In 1997, Moen owned 27% of the US kitchen and bath plumbing market, with #2 Delta claiming 23%. Currently, the company's 3,000 employees are working toward a common goal: to top $1 billion in profitable annual sales by the year 2000.

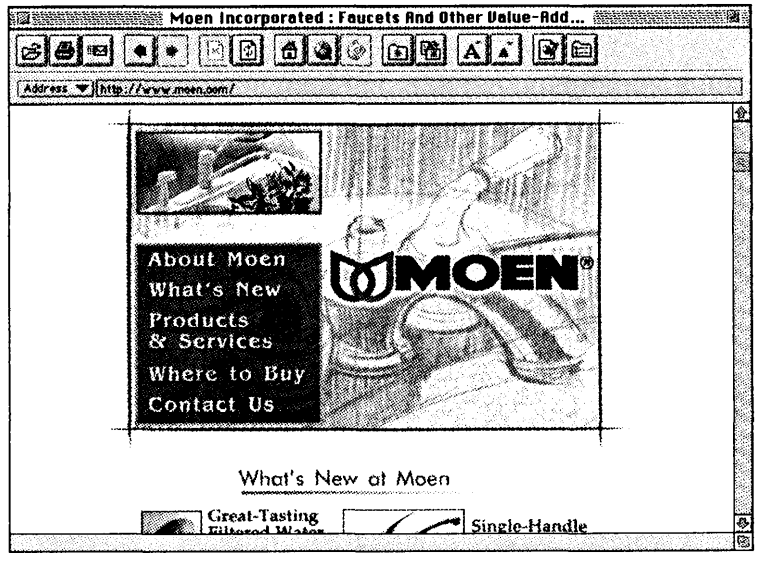


Figure 4.1 *The Internet home page of Moen, Inc.*

Staying Competitive in a Customer-Driven Industry

The kitchen and bath plumbing industry accounts for annual sales of $1.8 billion in the United States alone. Globally, this multi-billion dollar industry produces approximately 40 million faucets each year, along with billions of other products including: sinks, shower stalls, water heaters, fixtures, bath tubs, water softeners, sprinklers, valves, toilets, meters, gauges, water filtration systems, hoses, drains, pipes, aerators, and replacement parts. The industry is largely customer-driven in terms of product features and benefits, price points, style, and speed to market. The Moen New Associates Handbook describes the company's challenge in this way: "Customers require defect-free products; timely, accurate, expedient deliveries; courteous and competent service; a choice in price, style, and features; assistance with assembly, installation, repair, and replacement; informative packaging; and ease in purchasing products and services."

With well-established competitors like Delta, Kohler/Sterling, Price Pfister, and American Standard, the executives at Moen know the danger of complacency. In the mid-1990s, in order to better meet the demands of customers–primarily retail giants Home Depot, Lowes, and D.I.Y. Home Warehouse–Moen reassessed its business processes in the New Bern, North Carolina factory, the company's major North American assembly plant. To smooth and speed the ordering and inventory control processes, workflow software was installed at both the North Olmsted headquarters and the New Bern factory offices. This automated system supports changes made on the factory floor at New Bern, which is Moen's primary producer of single- and double-handle faucets and bathroom shower heads. In the spring of 1995, the plant replaced its traditional manufacturing style with a new, "pull" process.

Making the Change from "Push" to "Pull"

In 1995, in an effort to speed manufacturing, reduce inventory, and improve quality control, Moen's then-Vice President of Operations Al King instigated the BPR project. Working from the company's North Olmsted headquarters, King put together a project team that included high-level managers and representatives of the New Bern factory. Impressed by *Industry Week* magazine's assertion that top companies were implementing "lean" workflow systems, a group of Moen executives traveled to Englewood, Colorado to attend a seminar at the John Costanza Institute of Technology (JCIT), which teaches corporations how to implement Demand Flow® Technology (DFT). Developed by John R. Costanza, author of *Quantum Leap*, DFT is a mathematical-based manufacturing technique and comprehensive business strategy designed to replace Manufacturing Resource Planning and Enterprise Resource Planning systems. Through workshops, fully functioning manufacturing laboratories, and technology centers equipped with state-of-the-art computer systems that support and formalize the technology into a business strategy, JCIT clients learn to design and manage a realistic Demand Flow® business environment. Students utilize the technology centers to receive additional technical assistance to further their understanding of DFT Line Designs, Demand Based Management, Kanban, Flow Costing, and other subjects.

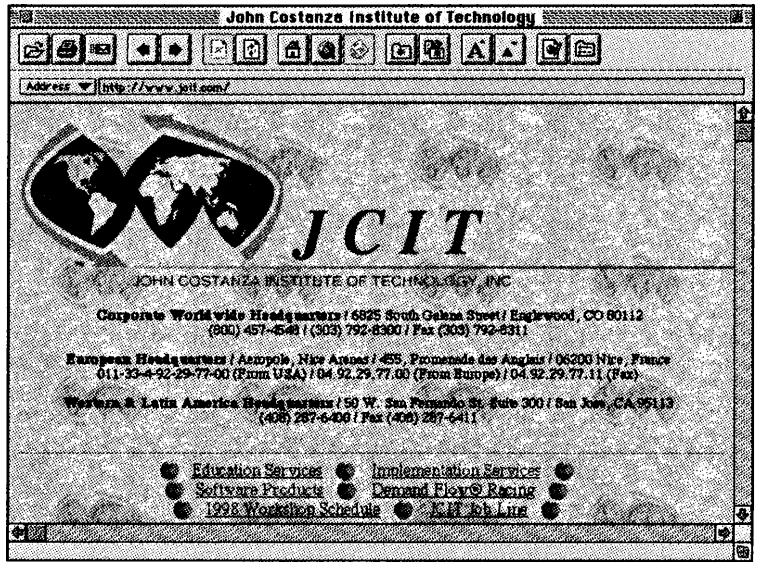


Figure 4.2 *The John Costanza Institute of Technology provides software, education, and implementation services for companies around the world.*

At JCIT, Moen's project team designed an assemble-to-demand (ATD) workflow system, based on the JCIT Demand Flow® Business Strategy. ATD is a "lean" manufacturing system, one that meets high throughput, or service, demands with very little inventory in a repetitive manufacturing environment. Under its old style of manufacturing, Moen built up large inventories by "pushing" production even before customers had ordered the products. Drawbacks to this approach included a high level of quality rejects, slow production, long lag time between receiving a customer's order and delivering product, and high taxable inventories.

The ATD process implemented in the New Bern plant was aimed at increasing yield, lowering inventory, and refining the quality of products. Designed to solve the problem of over- or under-producing, ATD systems aim to fill customer orders as they come in. Jeff Garn of Moen University, the company's training division, likened the approach to the old practice of traveling milkmen who replaced the number of empty bottles set out on a porch

with the same number of bottles filled with milk. As Garn noted, changing to an ATD system required a bi-level commitment on the part of the company: first, to technical changes that would streamline the ordering process, and second, to changes in the factory environment. Together, these changes tightened the relationship between customer demand and actual factory output.

The FlowPower® Enterprise System

Moen's first step in implementing a Demand Flow® Business Strategy was to purchase and install the JCIT *FlowPower® Enterprise System.* Running on a Novell or *Windows NT* server, *FlowPower* provides business-wide functionality to support order management, planning, manufacturing execution, inventory management, purchasing, costing, engineering change control, capacity planning, and business reporting. The fourteen modules include DFT Data Management, Mixed-Model Flow Management, Deduct Structures, Kanban Management, Flex Supplier Management, Electronic Data Interchange, Backflush Inventory, Demand-Based Management, Demand-Based Forecasting, Linearity Reporting, Flow-Based Costing®, System Administration, Order Management System, and Business Reports.

Using the *FlowPower* system, orders received in Moen's North Olmsted corporate office are automatically pushed through to the New Bern plant. When the factory's two demand planners arrive at work at 7:30 in the morning, they open the files and schedule outstanding orders for production the following day. The software scans the order and tells the demand planners what number of operations are necessary to complete each order, as well as the staffing requirements and supplies needed. With this information, the demand planners can allocate a work order to an individual business cell, or team, and assign an appropriate number of

workers, usually between five and eight, to the business cell to fulfill that day's production requirements.

Assemble-to-Demand on the Factory Floor

Inside the factory, the company also instituted major changes. Traditional factory lines were replaced with fluid business cells, which allow demand planners and material planners to better organize work assignments and control supplies. Within each cell, employees are encouraged to work as teams; rather than having one individual responsible for a single operation, each member of the cell must have mastered three or four operations within a specific work cycle. This lets employees move upstream or downstream in the manufacturing process to keep the flow of work moving smoothly. Furthermore, if an individual worker fails to keep up, or fails to identify a quality problem, the line's team leader can step in. Team leaders, who oversee only 6-15 workers at a time, are responsible for the group's efficiency and output. Team leaders report to department heads, who report to the plant manufacturing manager, who then reports to the plant manager, creating a clear and accessible chain of command.

Because the make-up of the business cell, and of the operations its members must complete, frequently change, method sheets are placed at each workstation. These Microsoft *Word* documents diagram how each of ten or so operations is to be correctly performed. A cartoon-like pictorial view reminds workers to check the product for quality by inspecting it after each assembly step.

In addition, a Kanban control system was put in place to speed the manufacturing process and better utilize space on the factory floor. Kanban control uses the levels of buffer inventories in a system to regulate production. When a buffer reaches its preset maximum level, for instance, the upstream machine is told to

stop producing that part type. A part does not move up the line until the next station is ready for it. This flow of work is accomplished through a series of communication devices, known as Kanbans. At the New Bern plant, supplies are controlled through a system of Kanban cards, which indicate when a particular stock bin needs to be refilled. Supplies coming from the warehouse are stored in small storage areas near each workstation. When a production worker pulls a Kanban card, indicating that he has opened a particular bin, the material stockers immediately know what supplies need to be replenished from the warehouse supply. The Kanban process allows sufficient time for the stockers to locate the necessary materials and deliver them to the appropriate workstation, so the production line does not have to cease.

The manufacturing process itself is precisely timed to avoid the old problem of line stoppage. Operators working on a product do not hand it over to the next work station unless a Kanban card indicates that the work station is ready for it. According to Carroll Riggin, Director of Training at the New Bern plant, this becomes a form of internal quality control. "It has smoothed efficiency tremendously," he said, "and allows our workers, who are trained to inspect for quality as they go, to catch mistakes right away."

Training: Smoothing the Way for a Cultural Change

Managers at the New Bern plant discovered that the most crucial aspect in implementing the new manufacturing and ordering system was to sell the changes to skeptical employees. Once the design was in place, Moen's trainers, led by Jeff Garn, undertook a campaign to educate workers from the front office to the factory floor about the ATD system. Classrooms were set up in North Olmsted and New Bern to teach office and factory supervisors how the new system would work.

In its first year, the ATD system was not all that Moen managers had hoped for. "Naturally, a tremendous change takes time for people to digest. What we found," said Carroll Riggin, "was that without extensive training, people deviated from the process. We realized we had to help employees understand the whole process, so they could see the importance of completing each part accurately." Riggin, whose 30-years of management experience in manufacturing environments includes stints at Sara Lee and HealthText, was brought in to oversee a massive educational campaign for employees of the New Bern plant.

In April 1997, Riggin and his team of trainers initiated a full 40-hour program for all new and current employees. "The idea is to train, or re-train, everybody who walks in the door," he said. "That goes for office personnel, management, and line workers. For more than a year now," he continued, "we've run classes continuously, one every week, starting each Sunday night and using the third shift throughout the week to educate people about company history, safety techniques, and the workings of ATD."

Like the Kanban card system, the training techniques emphasize communication. For each weekly class, five trainers work with 12-30 employees, incorporating team-building techniques in addition to practical instruction about job types and responsibilities. Riggin said a lot of time is spent talking about behavioral styles and personality types of co-workers, to give employees the skills to deal with other team members. The group also tours the entire factory, and employees become familiar with the practical application and importance of various job types. "By bringing in production managers, office personnel, and factory associates," said Riggin, "we make them more appreciative of the ATD process on the floor. This has improved the level of respect between associates, and it helps the corporate types ask better

questions and make better suggestions because they understand the process better."

To graduate from the training program, every employee must be able to certify on at least two operations, producing a good quality product in an acceptable amount of time. Students are also rated as team players. A Friday morning graduation breakfast celebrates the completion of one class cycle, and the next Sunday, the trainers start over with a fresh group.

"By March 1998, we had gone through this process with 733 of the more than 1,000 people in this factory," Riggin said, "And it has made a phenomenal difference." While the majority of employees, particularly line workers, initially groused about having to adopt the ATD system, the training procedures demonstrate the value to the company–and to its workers–of the more efficient operations. "We saw this change right in the classroom," Riggin said. "At first, a lot of folks complained about wanting to get back to the 'real world' of the factory floor, but now they've begun to understand that ATD is the real world. They are seeing ATD work, and once the workers buy into a system, it runs more smoothly," he added.

Now that more than half the factory's employees have undergone the training program, Riggin said the peer pressure that initially tempted workers to abandon ATD techniques now encourages them to adhere to the ATD system." People are actually volunteering to come to training now," Riggin said. "Everyone wants to learn to work 'smarter, not harder.'"

Measuring Results

Although ATD is still fairly new, Moen has benefited in several important ways. Orders can now be filled within four to five days, and the factory is aiming to improve that figure to three

days. "Before, we ran 65% [of the factory's full capacity] production in the plant, which went up to 72% the second year after we put in ATD," said Carroll Riggin, who noted that most of the improvement came after the extensive training program began. "The first year we used ATD," Riggin said, "There were some advantages, but the production numbers didn't really start to move until we focused on training beginning in April of '97. Since then, quality holds have improved 60%, so aside from better throughput, we know there are that many more *good* faucets going out the door."

Jeff Garn, director of Moen University, calls the ATD process a "variable" rather than a "classic" success story, citing problems with suppliers as being a major difficulty. Supply centers that have yet to convert to ATD don't always send parts on time, or miscalculate how many parts are needed to complete a certain operation. At times, production has had to slow or even halt. Garn and Riggin agree that this problem should fade as more and more vendors are certified in ATD. "We try to get all our suppliers certified ATD," Riggin said, "but it doesn't always work. Sometimes we run out of parts on the floor because a supplier didn't accurately estimate how many screws or bolts are needed in a bin, and if it's off even a little bit, it can mess up the line. Polishing this is a problem, but it's slowly getting better."

One popular advantage of the ATD system, according to Jeff Garn, is the financial incentives provided to workers. Flexing–the practice of training workers in several operations and having them move where the work is needed–is more challenging for the employees, and the higher product output provides them with financial benefits.

Overall, as Dick Thomas, the plant's IT manager, noted, Moen has enjoyed higher production figures, faster production time,

better throughput, and better material presentation with the ATD system. Because of this success, Moen is slowly incorporating ATD techniques into the Sanford, North Carolina and Elyria, Illinois pre-assembly plants.

The Next Generation in Workflow Management: SAP

The company's next step to improve workflow efficiency is a major one; currently, a planning team is ironing out the details involved in implementing an SAP (Systems, Applications, and Products in Data Processing) enterprise-wide system, which, as Jeff Garn said, will "build an integrated database" for the entire corporation. SAP systems, whether client-server or mainframe, are tailored to manage comprehensive financial, manufacturing, sales and distribution, and human resources functions essential to the operations of a particular company (**http://www.sap.com**).

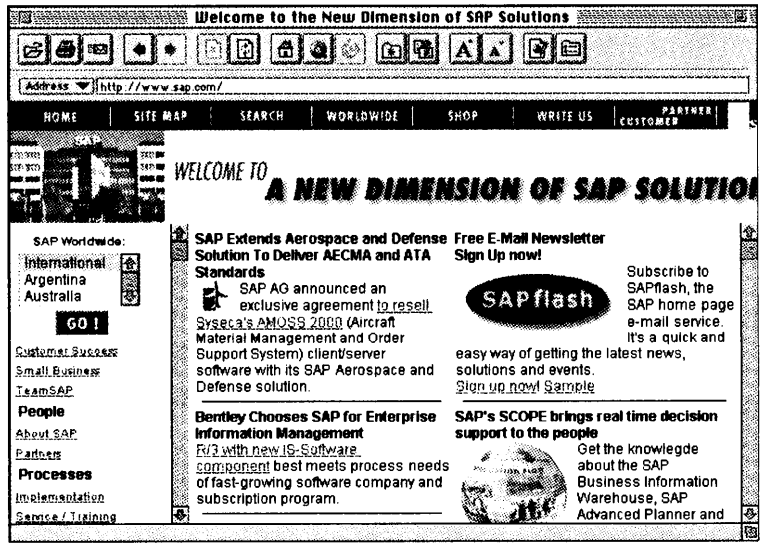


Figure 4.3 *Information about SAP enterprise systems can be found at the company's extensive WWW site.*

For a multi-national company like Moen, the attraction of SAP includes: integrated intranet/Internet technologies; the support of multiple currency exchange and the automatic handling of

country-specific import/export, tax, legal, and language requirements; and the ease of access to comprehensive customer, supplier, and ordering information from anywhere within the company. "Our customers are becoming more sophisticated," commented Garn, "and requiring us to have better control of our processes. When a customer like Home Depot calls in and wants to do an order inquiry, we need the capability to find out exactly how many faucets we have on hand at a given time, for instance. SAP is software that will allow us to do that."

Case Summaries

As in Chapter Two, we'll now turn to a set of case summaries that contain descriptions of how other manufacturing-based organizations have approached workflow management projects. Remember that many workflow software vendors have case studies available for prospective customers to review, in addition to white papers and position documents. To locate these materials, you can begin your search by contacting the vendors and consultants highlighted in Chapter Eight. Remember also that vendor materials tend to have obvious biases; however, this should not prevent you from taking advantage of the wealth of background information available from workflow industry companies.

Sabó Industria e Comercio Ltda.

Sabó Industria e Comercio Ltda., located in Brazil, is a world leader in the manufacturing of components for the automotive industry. Sabó supplies Brazilian and international markets–including the US, Europe, and Australia–with various automotive components including seals, gaskets, and hoses. Sabó employs 3,000 people in seven factory locations (three in Brazil,

three in Europe, one in Argentina) with an impressive customer list which includes General Motors, Ford, Volkswagen, and Fiat.

Global sourcing programs require that major international assemblers consolidate their purchase of auto parts in order to stay competitive and meet the assemblers' demands. They must procure these parts from a small list of manufacturers–all of which are required to be ISO9000 certified–to ensure the quality of the products that enter into the marketplace. Realizing that it was critical to their success, Sabó determined they would have to speed up their ISO9001 certification.

The research done in the seal plant during the pre-audit process showed a significant problem in the administration of engineering documentation–old paper drawings, drawings in CAD, Engineering Change Orders, etc. Because these documents were kept in twelve different locations throughout the plant, there was no way to guarantee that they would all be kept up to date.

After working with Image Pro Consultoria, a Keyfile International Distributor, and Cim Consult Automacao, a Keyfile International Reseller, Keyfile's document management and workflow solution proved to be an ideal tool. In addition to *Keyfile*'s ease of use, its out-of-the-box functionality allowed it to be implemented in the shop almost immediately. *Keyfile*'s powerful graphical workflow was also a tremendous resource for project tracking and administering engineering change orders.

Initially, 37 users were set up and trained over a three-month period. All existing paper drawings were scanned by a 33" x 47" scanner directly into *Keyfile*. *Keyfile* was then integrated with Sabó's already existing CAD software so that new drawings were electronically shared, elaborated, and then filed. The employees quickly adapted to the new system. Critical customized functions

were taught in-house to both shop and office personnel in less than a day. Due to the success of the initial installation, Sabó has purchased two more servers and 60 additional seats for the two other Brazilian plants. The number of users registered on the Keyfile system has increased to 250 people.

"*Keyfile* was instrumental in enabling us to implement, in just three months, the new organizational system for engineering documents," said Lourenço Agnello Oricchio Jr., Senior Engineering Manager of the Seal Unit. "Because of the new *Keyfile* system, we received an honorable mention from external auditors during the ISO9001 certification process. We also witnessed an increase in productivity with the project team. And, since *Keyfile* was remarkably accepted by the shop workers, we have noticed a better working relationship among the shop floor workers and our engineers." Future plans include the expansion of the Keyfile installation in the Argentine and German plants, as well as its interconnection with the three Brazilian plants. (Case study:)

To learn more about Keyfile's products and services, visit the company's Web site at **http://www.keyfile.com**. To learn more about how Microsoft supports the incorporation of specific workflow and document management software with *Windows NT* and *BackOffice*, visit the Microsoft Web site industry area on document management at **http://www.microsoft.com/industry/docman**.

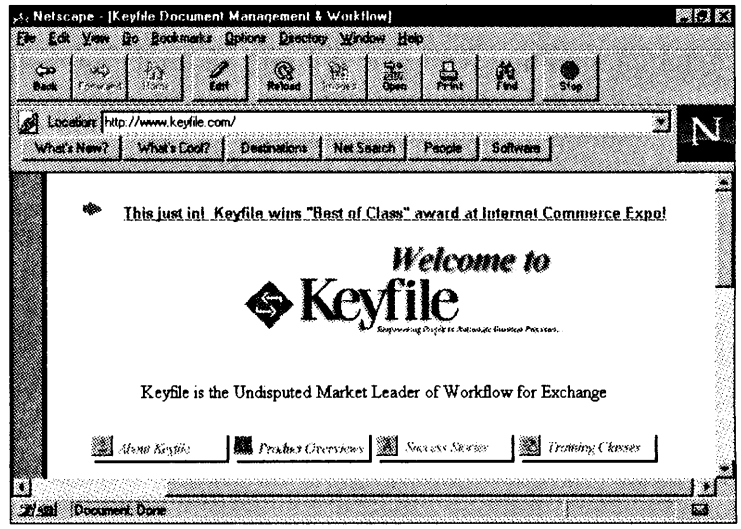


Figure 4.4 *Home page of Keyfile, makers of workflow and document management software.*

NCR

Founded in 1884, NCR (**http://www.ncr.com**) is a world leader in the production of automated teller machines, high-performance stationary bar code scanners, retail point-of-sale workstations, automated ticket dispensers, electronic payment devices, premium communications equipment, computer servers, and computer database servers.

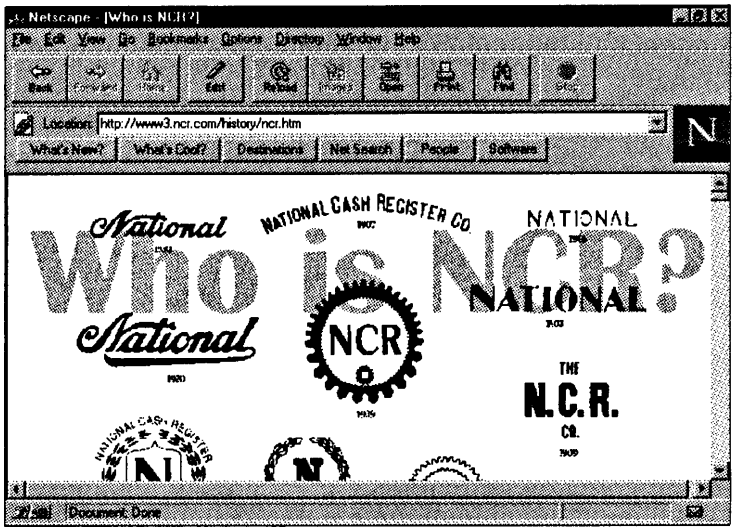


Figure 4.5
Learn more about NCR's products, long history, and business challenges at the company's Web site.

Seeking to streamline its distribution process, NCR implemented a powerful enterprise document management solution based on Microsoft *BackOffice* technologies and state-of-the-art software from FileNET Corporation, a Microsoft Certified Solution Provider. Under the new system, completed manuals are sent to Dayton, Ohio electronically in PostScript or Adobe PDF format. PostScript files are stored on an intranet server that may be accessed by any NCR employee worldwide. PDF files are housed on an external server, from which NCR customers can download manuals using any standard Web browser.

NCR's FileNET solution gives employees and customers alike "any time, any place, any format" access to technical documents. NCR can now print manuals on demand, rather than store them in expensive warehouses. Customers can also download publications immediately, rather than wait–and pay–for them to be shipped. Plus, FileNET software has also improved the quality of NCR's documentation by making it significantly easier for the company to keep documents up to date.

Recently spun off from AT&T as an independent, publicly-held company, NCR continues to embody qualities it has upheld for 113 years: strength, responsiveness, innovation, dependability, partnership, and global reach. Now a powerful Enterprise Document Management (EDM) solution is helping NCR extend those qualities to the way it distributes technical documentation. Based on state-of-the-art technologies from Microsoft Certified Solution Provider FileNET Corporation and the Microsoft BackOffice family of server applications, the new system gives NCR employees and customers alike instant, desktop access to the most up-to-date information available.

NCR is a global company with business units around the world that develop and market their own product lines. For example, the Dundee, Scotland business unit produces ATMs, while in Oiso, Japan, it's Kanji-language retail terminals. At each locale, an Information Products Publishing unit writes and designs user guides, training materials, and other documentation. In the past, master copies of completed manuals were sent to NCR's corporate offices in Dayton, Ohio, either through the mail on paper or electronically over the Internet. Then, in Dayton, the manuals were printed, warehoused, and shipped to customers as needed. However, this distribution model had several weaknesses. For one thing, it produced long delivery cycles and high storage costs. For another, it made updating documents a difficult and expensive process.

Realizing that they all faced the same problems, members of Information Products Publishing units around the world formed an ad hoc team. Their goal was to streamline NCR's document delivery procedure by deploying cutting-edge EDM software. The project team searched the market for a document management solution offering low cost, ease of maintenance, cross-platform support, comprehensive functionality, and scalability. In the end,

NCR concluded that the solution best able to meet its requirements was FileNET.

The foundation of NCR's EDM solution is Mezzanine®, an open-architecture document management engine offering power, scalability, flexibility, and extensibility. To access and manage the documents stored in Mezzanine, NCR employees use *Saros Document Manager*, a graphical and intuitive client application. FileNET @mezzanine enables users to access information in the Mezzanine repository via any standard Web browser.

The entire solution runs on two servers powered by the Microsoft Windows NT® operating system and Microsoft SQL Server™. According to Patti Leschansky, NCR's manager of electronic distribution, "we chose to run the EDM solution under Microsoft *BackOffice* technologies because of the seamless integration between Windows NT and Microsoft SQL Server, as well as between those systems and FileNET."

Today at NCR, completed manuals are saved in either PostScript or Adobe Portable Document File (PDF) format, and then sent electronically through Saros Document Manager to NCR's Dayton office. The PostScript files are stored on an intranet server that may be accessed by any NCR employee worldwide. The PDF files are housed on an external server. FileNET @mezzanine enables NCR customers to download manuals off the external server using their Web browser, and then view and print them offline.

Currently, there are more than 1,500 completed manuals on the intranet server, each running anywhere from 150 to 300 pages in length on average and containing as many as 500 discrete files. The external server presently houses more than 400 publications, and will eventually store thousands more.

FileNET products and the Microsoft *BackOffice* family combine to offer an efficient way for NCR to manage and deliver technical publications worldwide. The Dayton office can now print manuals on demand and ship them to customers within days. Customers also have the option of downloading publications immediately, rather than waiting–and paying–for them to be shipped. Plus, the FileNET solution shortens the print delivery cycle and reduces the need for storage space.

"Now our documentation can keep pace with the rate of change of our products," says David Kerr, a consulting analyst and program administrator at NCR's San Diego office. "The FileNET solution enables us to provide customers with 'any time, any place, any format' access to NCR publications with minimum cost and maximum speed."

As Kerr points out, using FileNET and Microsoft products also improves the quality of NCR's documentation by making it significantly easier for the company to keep documents up to date. "The beauty of electronic publishing is that we can truly make our manuals perfect," he says. "Whether we need to rework a grammatical error, confusing graphic, or out-of-date text, we can update our documents whenever it's needed." Leschansky sees yet another advantage to using FileNET software. "With FileNET EDM products, we can print manuals on demand," she says. "Our long-term goal is to eliminate physical masters. FileNET can take us there."

NCR's new delivery model makes it much easier for business units to share information. Employees anywhere in the world can now access the same manuals right from their desktop. And since the most current file versions are available for distribution the minute they're saved to the Mezzanine repository, both

employees and customers always get only the most up-to-date information.

Furthermore, FileNET @mezzanine is enabling NCR to be more engaged with its customers. Included on the download Web site are feedback forms. If a customer provides input about a confusing section of text, for example, the writer can rework the copy and distribute an updated manual within days, notifying the customer via e-mail. "And there's virtually no overhead cost for us to do that," says Kerr.

NCR's San Diego and Atlanta business units have found another valuable use for FileNET and Microsoft software: managing and archiving different versions of manuals and associated files before publication. Version control and multi-authoring capabilities in the FileNET products significantly streamline the publication process.

Together, FileNET and Microsoft have made a major contribution at NCR. "Our manuals and training materials are worth thousands of dollars in labor cost," says Kerr. "They're just as valuable to us as a circuit board, disk drive, or any other piece of equipment. FileNET products and the Microsoft BackOffice family give us a tremendous way to manage, control, and protect these valuable intellectual property assets." (Case study: Copyright Microsoft Corporation. All rights reserved.)

Owens Corning

Owens Corning, the world's leading manufacturer of fiberglass, is a $4.2 billion global, industry leader with more than 18,000 employees around the world. With manufacturing, sales and research facilities, including joint venture and licensee relationships, in more than 30 countries, Owens Corning

continues to expand through today's competitive, international markets.

Owens Corning recently re-engineered their global information management operations by replacing their many legacy systems, including invoicing, accounting, and other mainframe applications, with one, global system: SAP's R/3. The new system fulfilled Owens data management requirements, but they needed to augment it to meet their forms design and print output objectives. Owens philosophy was simple: whether you're printing an invoice in South Carolina or Belgium, it has to be easy to read, simple to generate, and have the same look and feel as of other similar documents.

Meeting all these objectives would have meant hiring a skilled programmer to re-program each form supplied by SAP. This would be an expensive undertaking, especially for a large company like Owens that prints 15,000 to 20,000 forms daily to 60 locations worldwide. So Owens looked for a solution that met their customization needs and integrated quickly and easily with R/3. Timing was critical, since a one-week delay in switching to R/3 would have been cost prohibitive.

Some of Owens' needs in the new forms system were that it: (1) automatically print forms in English, French, Spanish and German, and in various paper sizes, depending on where the printed statements were being sent; (2) output each print job in PDF format, and archive locally to meet legal requirements; (3) allow for dynamic changes to forms to eliminate the need for pre-printed forms; (4) integrate quickly and easily with existing printers and SAP's R/3; and, (5) reduce forms development and maintenance time.

Owens looked into a number of different forms tool sets, and chose JetForm because of JetForm's ability to really address R/3 output issues. JetForm created dynamic forms using JetForm Design, enabling the designer to organize a form into parts that conditionally appear as data is merged from R/3. Formatting attributes on the form are easily moved, changed, added or deleted without programming. Page sizes, font types, line spacing, justification, shading, logos, and sizing are all specified in the form itself, independent of the data.

Using *JetForm Central's* job management features, users can easily and quickly choose the correct form, language, or logo when they need to print. JetForm Central then merges the data from R/3 with the selected form. JetForm Central converts the merged form to the appropriate printer language and sends it to the specified printer for output as a high-quality, printed form in various formats such as PostScript, PCL, and PDF to local and remote locations.

Form files and graphics files such as company logos are stored on the server, so there's no need to download them for each print job, reducing processing time. Once JetForm Central outputs the merged form in PDF to Documentum, it's easily archived for an electronic record of all statements. John Seitz, Owens Corning's process leader for invoicing, was very pleased. "With JetForm, we have significantly reduced our development and maintenance costs while greatly improving the quality and flexibility of our document output–all without delaying our R/3 implementation."

Owens Corning is enjoying the benefits of greater forms design and output flexibility. Time-saving and cost-reducing benefits include: high-quality, professional-looking forms (JetForm Design has extensive forms processing capabilities, allowing designers to add bar codes, rotated text, and watermarks); easy and

inexpensive forms implementation and maintenance (because there's no need for programming, forms can be quickly created and maintained); flexible forms that support customers' business requirements (using a single layout set to print several variations of a single form such as an invoice) and, faster forms printing (JetForm Central print drivers are 3-5 times faster than operating system print drivers). Because the move to JetForm was so successful at Owens Corning's headquarters in Toledo, plans are under way to introduce the system to other Owens manufacturing facilities around the world. (Case study adapted and reprinted with permission of JetForm.)

To learn more about JetForm's forms processing software and its newly introduced workflow add-ons, visit the JetForm Web site at **http://www.jetform.com**.

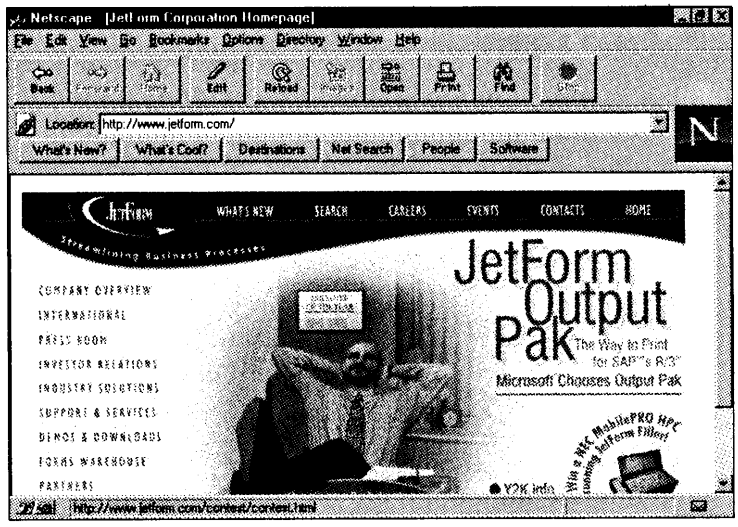


Figure 4.6 *Learn about forms processing software and its workflow aspects at JetForm's home page.*

Chapter Five
Workflow Issues for Manufacturing Industries

We examined issues common to many service-industry workflow management projects in Chapter Three, and we will do the same in this chapter for manufacturing industries. Of course, many issues, such as information storage costs, will be common to both types of organizations; however, manufacturing environments do present special circumstances, as the case scenarios in Chapter Four indicate. In this chapter, we'll review the following topics:

- Inventory, Suppliers, and Just-in-Time Techniques.
- Electronic Data Interchange.
- Training and Changing Supervisory Roles.

As in Chapter Three, this chapter concludes with a planning worksheet that will help you identify these issues in your own or a client's organization when undertaking a workflow management project.

Inventory, Suppliers, and Just-in-Time Techniques

As described in the case study in Chapter Four, Moen Incorporated experienced both physical and financial challenges when trying to deal with the inventory that their previous manufacturing process created at the New Bern plant. The plant's

reliance on "push" manufacturing techniques created a bottleneck that, ironically, both created an inventory pile-up and also lengthened the lag time between a customer's order and the company's ability to fill the order. At the other end of the manufacturing chain, where component parts must be purchased from suppliers, a similar problem was created. In order to assure that the factory line had enough parts to create the necessary products, supervisors spent considerable time and energy monitoring supplies, placing orders, and trouble-shooting when the process went awry.

Moen is certainly not unique in this predicament. Workflow systems are revolutionizing the way manufacturers accomplish critical tasks, a change driven by new manufacturing methodologies like just-in-time, assemble-to-demand, and a host of related techniques. Simply put, just-in-time techniques emphasize the efficiency of manufacturing a product and shipping it to the customer with little or no time between the steps. Developed by Japanese manufacturing experts, just-in-time, or JIT, emphasizes "producing only the necessary units in the necessary quantities at the necessary time by bringing production rates exactly in line with market demand," as described by researchers at the Curtin University School of Technology (**http://rolf.ece.curtin.edu.au/~clive/jit/jit.htm**).

Just-in-time methodologies generally share a set of common components, such as pre-established contracts with supply vendors that allow a manufacturer to order only what it needs at the time it is needed. Manufacturing consultants recommend that on-going relationships be established with suppliers who are close to assembly factories, so that transportation time is reduced. Because the business cycle of the supply company will be very dependent on the ordering and delivery cycle of the manufacturer, just-in-time techniques emphasize a collaborative

approach to supplier-manufacturer interactions, an approach that recognizes the risks a supplier will take to tune its operations this closely to a manufacturer's needs.

To learn more about how manufacturers envision and implement new factory techniques based on workflow management and other technology-based concepts, you can visit online forums for manufacturing professionals, such as the Association for Manufacturing Excellence (**http://www.trainingforum.com/ASN/AME/**) and the American Production and Inventory Control Society (**http://www.apics.org**).

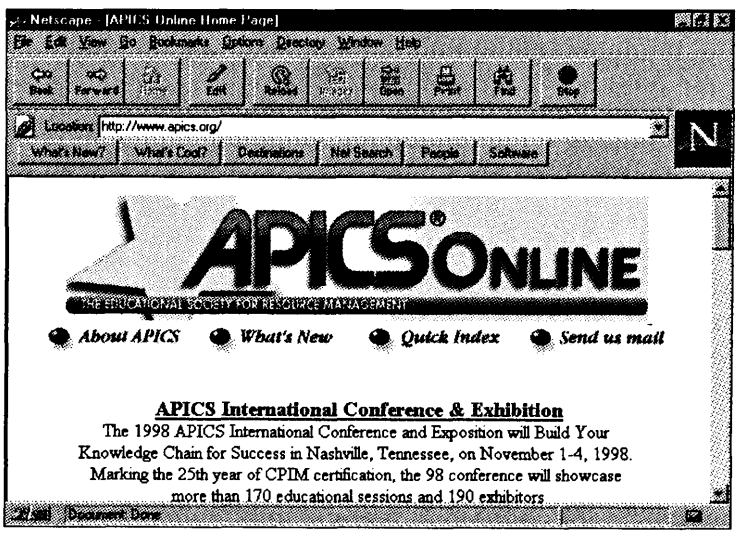


Figure 5.1
Web site of the American Production and Inventory Control Society, source of information on new manufacturing techniques and processes.

One computer-based method that became popular a few years ago for reaching these new manufacturing process goals is called Materials Resource Planning, or MRP. MRP-based systems allowed plant managers and executives to monitor supply needs, plan manufacturing lot sizes, and initiate parts orders. However, many of these systems were cumbersome to use, because the software was character-based, rather than graphical. So, it is not surprising that workflow software vendors began incorporating

similar functions into the network-based, graphical, process-oriented software packages they were developing. As a new generation of software emerges, it tends to consolidate features previously found in other free-standing packages, and that is what has happened in the manufacturing arena with workflow software. Now, the term workflow reasonably can be used to discuss any flow of work, from creating purchase order to making cars.

Electronic Data Interchange

Like document image processing, electronic data interchange (EDI) is a technology that forms the basis of certain modules of workflow systems. The three words, electronic data interchange, really say it all. EDI is a way for computers to exchange information–electronically. The millions of companies in the world store information in millions of formats, so sending information "as is" between computers is impossible unless the computers use a shared, standard format for the exchange. And that is exactly what EDI does.

EDI is a collection of data format and transmission standards that governs how information will be transmitted between separate organizations, for instance, between a manufacturer and a parts supplier conducting purchase transactions for component parts. Processes that traditionally would be carried out in several steps, involving paper tracking and data entry at each end, can be completed directly between computers. A manufacturer can automatically submit purchase orders for needed parts when the parts supply falls to a pre-determined level. The supplier can plan in advance to fill the manufacturer's orders, according to the automatically submitted orders, and can even order its own

materials via EDI. In this way, the chain a product follows, from raw materials to parts to assembly, can be managed with the newest just-in-time business techniques. And, the chain can even extend to distributors and retailers, whose systems can automatically order products when inventory reaches a threshold level.

Although EDI began in the transportation industry, where the efficient sharing of schedule, shipment, and tracking information is intrinsically necessary, the technology has now spread to many other industry segments. The Data Interchange Standards Association, Inc.'s EDI information Web page provides a clear basic description of EDI and states, "many industries, including shipping, retail and grocery, apparel manufacturing and textiles, warehousing, aerospace, chemicals, construction, automotive, electrical, electronics, utilities, finance, health care, petroleum, metals, and paper endorse EDI standards" (**http://www.disa.org**). This list will only continue to grow as the cost savings and process improvements gained through implementation of EDI technology influences enterprises to develop EDI systems to keep up with competitors and strategic business partners.

One of the biggest potential channels through which to route EDI transactions is the Internet. Two companies wishing to exchange information electronically must establish some form of inter-computer communication between their two sites. In the past, EDI systems have operated over private bulletin board systems (BBSs), dedicated telecommunications lines, and various forms of private networks. However, the Internet is the biggest, most-used network in the world, and it makes sense that companies would begin to explore how they can take advantage of the Internet's built-in advantages, like the number of various Internet service providers available and the inherent network redundancies of the Internet's web-like structure. In addition, the Internet's broad

public user base now makes it a prime channel through which to develop consumer-based transaction systems.

Thus, the fields of EDI and electronic commerce have become intimately linked. Selling products in a retail venue is one of the biggest transaction-based processes in business, and we are beginning to see innovative companies provide goods and services over the Internet via EDI-based systems. More important to workflow systems, however, is the fact that companies who conduct transactions via EDI-formatted files must incorporate the creation, routing, and communication of these transactions into the business processes automated through the workflow system. Thus, many workflow software vendors have incorporated EDI modules into their integrated packages, especially in the case of manufacturing companies.

EDI is inherently a very methodical process. One of the major benefits of EDI is that companies from around the world can exchange information quickly and cost-effectively if they adhere to a set of agreed-upon standards and a common vocabulary. Below are definitions for a few of the most commonly used terms when discussing EDI systems and system modules.

ASC X12

The term ASC X12 refers to two related entities. In 1979, the American National Standards Institute (ANSI) chartered the Accredited Standards Committee called X12 to oversee and establish standards for the exchange of business information. In this context, ASC X12 refers to the committee responsible for these standards. However, here are now many subcommittees of ASC X12 that develop standards and present them for the approval of the general ASC X12 committee membership. Thus, the EDI standards themselves are now referred to as a group as ASC X12 standards. The ASC X12 standards for electronic data

interchange are now accepted by most businesses in the US, the US Federal government, and the Canadian government.

EDIFACT

EDIFACT is an acronym for the United Nations' rules for Electronic Data Interchange For Administration, Commerce, and Transport. These rules are internationally accepted standards, directories, and guidelines for EDI. There are six regional EDIFACT boards that oversee the administration of EDIFACT rules in geographical areas; the board for North and South America is called the Pan-American EDIFACT Board (PAEB). The ASC X12 committee described above is currently working on coordinating the ASC X12 standards with these more global EDIFACT guidelines.

Data Element, Segment, and Transaction Set

A data element is a single fact or figure–the basic building block of the exchange of information. For instance, the price of one unit of a particular product would be a data element. A group of related data elements arranged one after another is called a segment. A unit price together with a number of items ordered and an extended price would represent a segment of related data elements. Segments are strung together to form transaction sets. The electronic equivalent of a printed exchange of information, the EDI transaction set will include all data elements and related exchange information that are required for transmission of one transaction between EDI partners. One example of a transaction set would be the information required to transmit an electronic purchase order.

Mapping and Translation

Mapping is a process used in building EDI systems that determines which data elements in a company's computer system correspond to the standard data elements used in the ASC X12 or EDIFACT guidelines. Developers working on EDI mapping might ask: "Which specific field in our company database represents the unit price of a product? Does this field always correspond to the unit price, or is the unit price sometimes computed from two other fields?" Once the mapping is complete, developers need to consider how the two computer systems will communicate the EDI transactions. Translation is the process used to communicate information from one computer system to another system made by a different manufacturer or running different software.

An EDI project team will typically begin by deciding which standards the system will follow, and ASC X12 or EDIFACT are the most common choices. Then, team members might consider exactly which data elements, segments, and transaction sets will be included in the EDI system. This step will involve deciding which paper processes the company wishes to automate and perhaps coordinating system development with a proposed manufacturer, supplier, or trading partner. For instance, a project team might decide to automate the purchase-order process between their own parts company and the manufacturer that assembles the parts into a finished product. Once team members know which outside company the EDI system will communicate with, they will begin the process of mapping their own company's data and deciding how translation between the two systems will be handled. Of course, in the context of a larger workflow management project, this analysis will take place within the larger task of automating many other business processes in addition to EDI transactions.

EDI transactions are structured through the standards on which they are based, so a familiarity with the different types of documents that relate to EDI standards can help you locate which standards apply to your particular system. Documents about EDI can be divided into three categories: (1) general reference books and information; (2) specific agency or industry guidelines; and (3) standards. The general references usually contain information about why companies should use EDI and how to organize an EDI project. Some documents that fall into this category are the IETF-EDI Working Group FAQ (**http://www.va.gov/publ/standard/edifaq/index.htm**); the Data Interchange Standards Association's EDI Reference Desk (**http://www.disa.org/edi/edihome.htp**); and the Unidex EDI Help Desk (**http://www.wwa.com/unidex/edi/**). In addition, there is a wide range of books and periodicals available on the subject of EDI; you can find listings of print publications at the online sites listed above or browse a selection at most libraries or bookstores. These reference documents will help you see the EDI "big picture" and understand how other companies have implemented EDI systems. They can help you orient yourself and gain background information, but they do not contain mandatory criteria or regulatory guidelines for EDI systems.

The second category of EDI documents, specific agency or industry guidelines, are published by groups that administer systems development in a particular area. For instance, the US Federal government is understandably urging large Federal contractors to build EDI systems to interface with Federal agencies. The US Department of Commerce National Institute of Standards and Technology has published an architecture document describing the conventions used in Federal procurement systems. Available at the Federal EDI site (**http://snad.ncsl.nist.gov/dartg/edi/fededi.html**), this architecture document governs all electronic transactions between Federal

suppliers and the government. Naturally, it is important and necessary for contractors wishing to do business with the government to follow the stipulations of this document. In contrast to the general reference documents described above, it is crucial to locate and follow any agency or industry guidelines that have authority over an EDI system or module you may be building.

The most important, and most specific, types of EDI documents are those in the third category, standards. Various organizations have established EDI standards for US and worldwide use, but the ones you will run into again and again are the Accredited Standards Committee X12 standards, called ASC X12 as a set. This group of very detailed, technical standards governs exactly how EDI files are built. Although companies wishing to exchange information electronically might use widely different information systems, the basic assumption of EDI is that they will create and exchange computer files that contain data in a standard form. The ASC X12 standards define this form, and any business entity wishing to do business via EDI must use them.

One nicely organized online version of the ASC X12 set of standards is provided by Premenos, a company specializing in EDI translation software (**http://www.premenos.com**). At this site, the standards are listed all together on one page as links. When following a link for, say, Standard 810, which defines the format of invoices in EDI transactions, the next page you will see is a general description of the transaction set described by the standard.

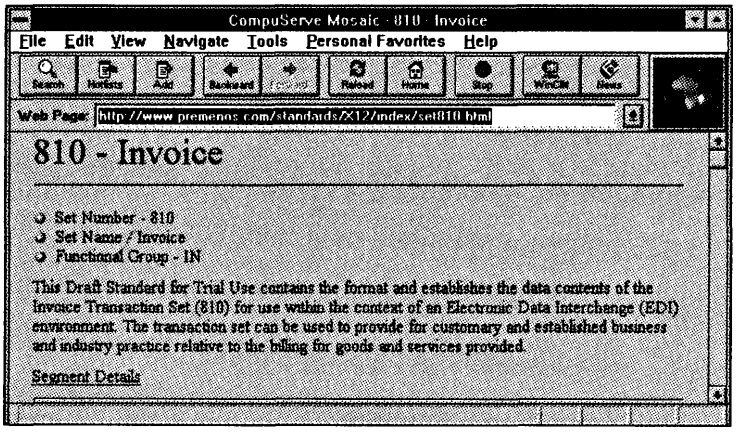


Figure 5.2 *Viewing the standard for an EDI transaction set.*

If you follow the **Segment Details** link, you will find a list of all data segments included in invoice transaction sets. (Remember that transaction sets are made up of related data segments, which are, in turn, made up of individual data elements, like unit price or order quantity). You can see from the information that this level of detail already includes a good deal of technical information that might be used by a systems analyst or programmer to develop an EDI system. For instance, the letters in the Seg column indicate how the segment will be labeled in the electronic file, and the numbers in the Max column indicate how many distinct segments with that label can appear in any given transaction set.

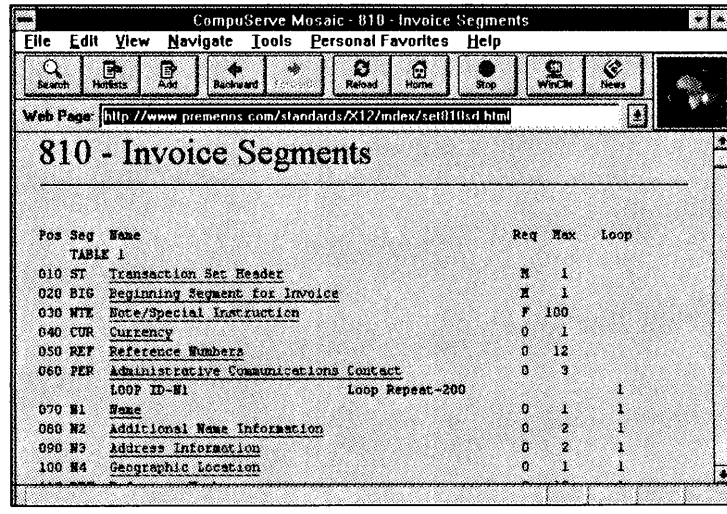


Figure 5.3 *Finding the Segment Details parameters of an EDI standard.*

Similarly, you could follow the link for any data segment from this screen to an even more detailed description of how the data elements comprising the segment should be formatted, as with the CUR segment.

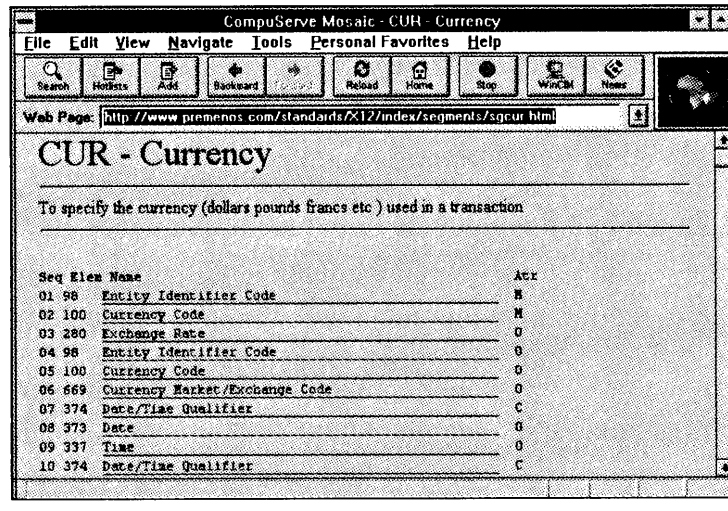


Figure 5.4 *Viewing data element details in an EDI standard.*

When approaching a workflow management project that includes an EDI module, it makes sense to approach your planning in terms of these three document categories. First, are there any general references or guidelines that could assist you in understanding what companies of a particular industry, country, or size are doing with EDI? Next, can you locate any guidelines developed by specific agencies or industry groups with authority over the company's area of business? And, lastly, what are the specific EDI standards that your system must follow to create and receive electronic transactions?

Training and Changing Supervisory Roles

As Moen Incorporated discovered, changes in technology or manufacturing processes will impact employees at every level of the production cycle. Carroll Riggin, Director of Training for the New Bern, North Carolina factory of Moen, Inc., noted, human beings tend to cling to the familiar unless convinced of a good reason to change. "When we first redesigned our production process," he said, "there was tremendous peer pressure among line workers to keep up the status quo, even though the company had invested a lot of time, sweat, and money in the new assemble-to-demand process. We found that too many people just plain didn't follow the new process as soon as a supervisor's back was turned." To counter this kind of resistance, the plant managers realized they needed to institute a factory-wide training program, which, as you read in Chapter Four, was conducted at the rate of one session each week on off-shifts. One year after Carroll Riggin was brought in to direct such a program–which already has trained nearly 70% of the plant's associates, from managers and office personnel to production workers–the factory

is running smoothly using the assemble-to-demand process, and production figures are steadily rising.

Jeff Garn, Directory of Moen University, describes how this kind of training represents not just a skill shift, but a cultural one. He points out that these kinds of business process changes require that supervisors entirely overhaul their approach to supervision. Instead of being "monitors," supervisors become "coaches." A supervisor who approaches employees as a coach will be ensuring that employees know how to respond when an exception to the automated process occurs. Coaching supervisors will spend much less time working with specific production issues and much more time working with employees, who are in turn empowered to respond to the production issues they face every day.

Several years ago, in response to these and other cultural shifts at Moen, Garn implemented a company-wide supervisory training program under the title "Supervising and Coaching at Moen." Designed to facilitate this cultural shift from supervisors at monitors to supervisors as coaches, the program emphasizes the relationships among the roles of supervising, managing, and leading and encourages supervisors to know the extent of their spheres of control and to strive to support Moen's strategic initiatives in all business processes. The Table of Contents of the training manual for this program is included on the following two pages, so you can get an idea of the types of topics covered in this kind of training effort.

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Page

Day 2

Day 3

As we discussed in Chapter Three, you can draw on the expertise of your workflow system vendor and other computer-training resources when responding to the training issues arising during workflow management projects. However, when you are required to effect a cultural change or major revision in employee and supervisory roles, you may need to undertake more development-oriented activities to support the changes in business processes. In a field closely related to training, organizational development specialists have considerable expertise in supporting this type of organizational change. There are many organizational development (OD) consultants who can assist your firm in designing and implementing effective training to support your workflow management project's new business processes and associated job responsibilities. The *Yahoo!* search site (**http://www.yahoo.com**) has a category labeled "organizational development" with hundreds of entries, as illustrated below.

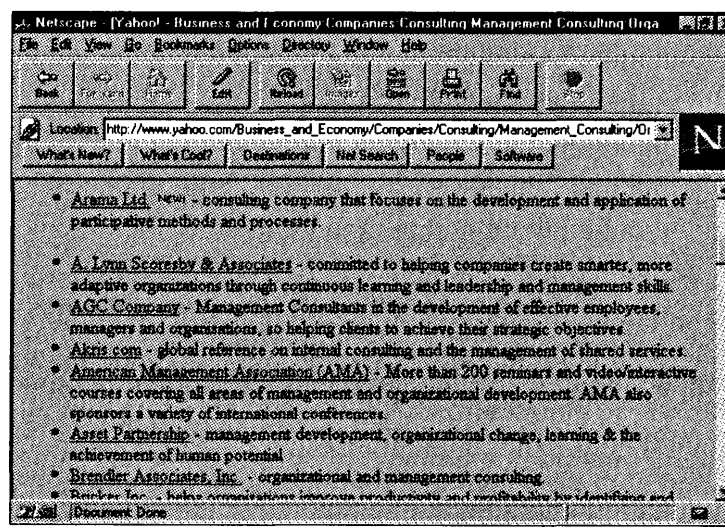


Figure 5.5 *Locating organizational development consultants at the Yahoo! search site.*

Executive Summary

When undertaking a workflow management project in a manufacturing industry, you will need to understand the effects that new manufacturing techniques have had on the way these companies do business. Just-in-time and related methodologies have substantially altered the way manufacturing companies deal with inventories and supplier relationships. A workflow system in this environment will need to incorporate ways to handle automated ordering and the complexities of supplier contracts. If transactions with suppliers, distributors, and customers are conducted via electronic data interchange (EDI), the workflow system will need to accommodate EDI-formatted files. Many workflow systems have EDI modules already incorporated for this purpose, or they can be modified to add EDI modules.

As with any significant organizational change, you will need to assess the workflow system's impact on how employees, supervisors, and other levels of managers do their jobs. In a manufacturing environment, some companies, such as Moen Incorporated, have found that it is useful to envision the supervisor's role as a coach rather than a monitor. To support a cultural shift of this type, you might want to consider getting an organizational development specialist involved. Whether or not you acquire outside consulting services, the training required to support changing roles must address not only the workflow system, but also the supervisory skills needed to effectively support the work of employees in this new manufacturing paradigm.

Use Planning Worksheet #2 on the next page to identify which service-industry issues are likely to affect a workflow management project in your organization or a client's business.

Planning Worksheet #2: Identifying Issues in a Manufacturing Organization

Issue	Does It Affect this Organization?	Action to be Taken to Assess Impact/Needs
Evaluate effects of just-in-time and other manufacturing methodologies on workflow system.	❑ Yes ❑ No	
Evaluate effects of electronic data interchange (EDI) on workflow system.	❑ Yes ❑ No	
Identify changes in supervisory roles due to workflow system.	❑ Yes ❑ No	
Analyze cultural and organizational shifts created by workflow system.	❑ Yes ❑ No	
Design training plan for supervisors and employees.	❑ Yes ❑ No	

Chapter Six
Workflow Management Tools for Smaller Businesses

Large enterprises often spend years planning for and building an automated workflow management system. As described in the case studies in Chapters Two and Four, the workflow teams can be large, the projects complex, and the costs considerable. However, across the number of business processes automated and the volume of steps that can be saved, workflow systems of this scope can be very cost-effective. And businesses of this size can easily justify the cost of developing company-wide training programs and hiring consultants to help oversee the process.

In smaller businesses, workflow management projects have a much smaller scope and are a bit more difficult to justify in terms of cost. Selecting the right hardware and software will be critical and can significantly affect the bottom line of the business. If your firm or a client's company is considering how to redesign and automate its business processes, you will probably be involved in all phases of the project, from installing the local area network to choosing the workflow software to run on it. This chapter will give you the background you need to get started on such a project. We'll look at the basics of small networks and describe the three major categories of workflow software in the following sections. Then we'll review the kinds of tools available to you for analyzing the way a small business conducts its business processes. This chapter covers the following topics:

- Small networks.
- Types of workflow software.
- Workflow analysis and planning tools.

Small Networks

Because the nature of a flow of work is from person to person, or department to department, workflow management software is designed to run on computer networks, not stand-alone computers. The vast majority of workflow software runs on the type of network called a client/server network, which is described in more detail below. As you consider how best to implement workflow management software in a small business, your first area of concern will be the network on which it will run. In the sections that follow, we will describe the basic components and functions of networks and how they work. This background information will enable you to discuss system requirements with confidence when considering various types of workflow management software.

In simplest terms, a network is a group of computers, printers, and other hardware connected together with cables so that they can communicate with one another and share data, files, and programs. Each computer, printer, and other peripheral device that is connected to the network is called a node. Networks can have a few nodes, dozens of nodes, hundreds of nodes, or even millions of nodes!

Networks of many types and sizes exist in today's business world. The two most common terms used to describe networks are (1) LAN and (2) WAN. LANs, or Local Area Networks, connect computers that are located close to one another, such as

computers located in the same office. On the other hand, WANs, or Wide Area Networks, connect computers that are separated over wide distances.

The nodes in a network are connected with both hardware and software. The hardware consists of those "hard" components and pieces of equipment that physically connect the computers together (such as cables, hubs, and the computers themselves). The software consists of the less tangible, but very important, instructions or programs that enable the hardware to communicate and exchange information in a meaningful way. The software works by establishing a common set of rules, known as protocols. In essence, protocols act as a common language that allows computers from various manufacturers running diverse software to agree on what data means and how to use it.

Whatever type of network you choose to build, and whatever network operating system it employs, you should be familiar with some specific networking terms.

The following is a list of some common small network components with a brief description of each:

- Network Interface Card (NIC)—Also called the network adapter card, this piece of hardware is the device that allows computers on the network to communicate with one another.
- Hub—This hardware component acts as a central connection point where all workstations on the network are linked to one another.
- Communication cabling—An essential element of any network, the cabling that connects the networked computers is determined by the type of network

implemented. The two most common types of cabling are twisted-pair cable and thin coax cable.

- Network topologies—The network topology is the structure of the network; more specifically, it is the location of each network element and how all elements are connected physically via the communications cabling.
- Network Operating Systems (NOS)—This system handles all of the operating system functions and bundles the various network protocols necessary to network communication.
- Client/server—Consisting of a dedicated server computer and any number of client computers (also called workstations), this type of network is a must for most workflow management software applications.
- Peer-to-peer—Unlike client/server networks, this type of network does not have a dedicated server or designated client computers. Only the simplest workflow management software applications can run on this network.

For your convenience, we have included a more in-depth discussion of small network components in Appendix C of this text.

Types of Workflow Software

Like most things in this rapidly evolving field, the terms that describe workflow software and the various categories into which we can divide the types of software are not as stable as one might wish. Many of the companies that make workflow software, or the operating systems on which the software runs, have published

white papers that define types of workflow software and, of course, why this particular company's software is the best. In this section, we have chosen generic terms to describe workflow management software in terms of its level of complexity and its relationship to software your company may already be using. Most workflow management products can be loosely placed into one of these three groupings, and the categories themselves can provide a useful framework for selecting workflow management software for your small business.

Message-Based Workflow Software

The least complex type of workflow software is based on electronic mail and message routing. Called message-based workflow, or ad-hoc workflow, this type of software simply takes advantage of already-existing routing capabilities within an organization's network. In addition to the messages themselves, this type of workflow management scheme can deliver document attachments to messages, such as worksheets, reports, and data charts. Users of the system receive workflow-related documents in their e-mail inboxes, just like all other messages received in a day. Some application programs, such as accounting systems, now include add-on software "agents," which are modules that interface with e-mail message systems to alert users to particular events, such as budget overruns or document availability.

In a slightly more complex configuration, message-based workflow software can incorporate forms, such as purchase requisitions, invoices, or employee timesheets. This added layer of functionality requires a set of rules that define what routes particular documents will take and which organizational roles will have authority to approve or implement the actions on the forms. Incorporating forms into message-based workflow systems also requires the addition to software that will accommodate the capture and printing of forms-based information.

One of the most popular platforms on which to establish a message-based workflow system is Microsoft's *Exchange*, the client portion of which comes as a standard component of the *Windows 95* and *Windows NT* operating systems. A very simple way to implement workflow automation is to install the *Windows NT* network operating system and the *Exchange* server software on an office network and use the e-mail capabilities to route and exchange documents such as reports and requests. Because e-mail messages also accommodate binary file attachments, users can also trade specialized document types such as *Excel* worksheets. To learn more about Microsoft's network and server software, visit the Operating Systems and Servers page of Microsoft's Web site at **http://www.microsoft.com/products/os.htm**.

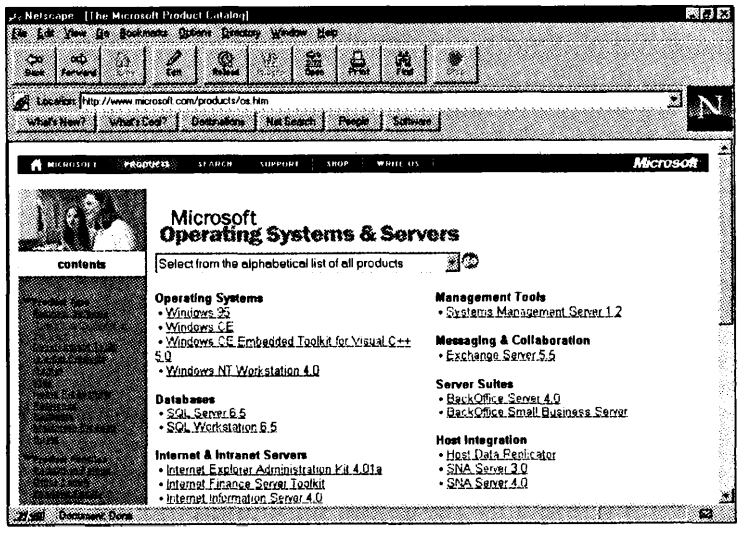


Figure 6.1 *The Operating Systems and Servers page at Microsoft's Web site, source of information about Windows NT and Exchange software.*

Another popular group of electronic messaging products on which you can build a workflow management system is the Lotus *Notes* and *Domino* family of software. These products run on an intranet platform, which is a LAN that uses the TCP/IP protocol for communication and uses Internet-type software such as a Web

server and browsers. The *Notes* program has been popular in larger corporations for some time, providing a convenient way to share documents and collaborative data. The addition of *Domino* to such a system enhances the application capabilities of the network, allowing programmers to embed small application programs, called applets, within the company's intranet. Applets run from within a user's browser software to accomplish tasks such as searches on databases or filtering of forms data. The *Domino* product provides for workflow enhancements, adding automatic routing of documents and applet functionality to the messaging functions already in place on the network. Visit the Lotus Web site Intranet Products page to view demonstrations of intranets that utilize *Notes* and *Domino* to support workflow management and shared applications on intranets (**http://www.lotus.com/home.nsf/welcome/wtw**).

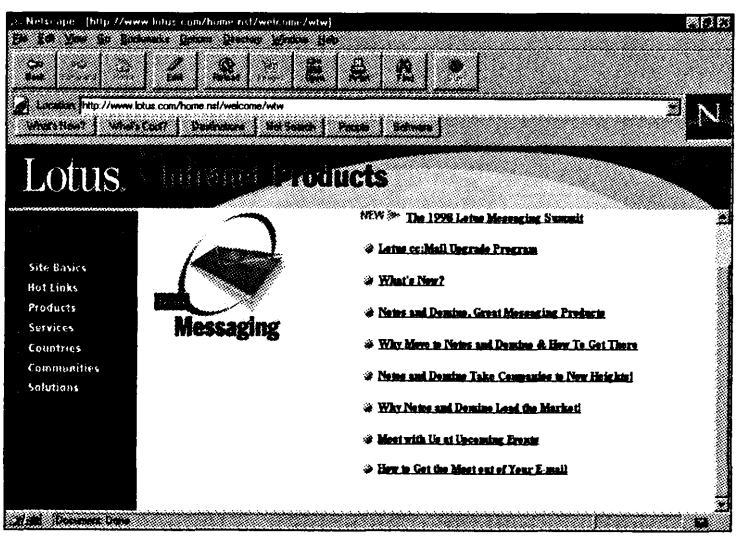


Figure 6.2 *Finding information on intranet messaging and workflow-customizable software at the Lotus Web site.*

Process-Based Workflow Software

Some application programs, although they are not specifically workflow management software, now include fairly sophisticated workflow components to support processes such as approvals, exception reporting, and alerts. High-end, network-based accounting software is a good example of this workflow software category. These programs are designed to support a particular group of organizational business processes, and the workflow functions of the software enhance the business processes by automating the routing of the work or automatically creating e-mail messages upon certain events. In the case of client/server accounting software, many also include document image processing modules and communication components that allow the software to transmit information over the Internet to remote workers or other organizations. We will use accounting packages to illustrate this category of software by describing a few popular programs.

Platinum Software's (**http://www.platsoft.com**) *Platinum SQL* includes a user-modifiable Financial Alerts module and a Customization Workbench tool that allows modification of the forms and scripts that control the flow of work in applications such as Order Entry, Cash Management, and Purchase Order. Platinum provides the Entity Relationship Diagrams that underpin the various application modules of the accounting suite, so a small business that completes an analysis of its business processes can modify the software to better conform to its newly established processes.

SAP's very popular R/3 suite is another good example of process-based workflow software. You will recall from the case study in Chapter Four that Moen Incorporated is planning to implement SAP enterprise-wide to bring the benefits of a central, integrated database and organizational workflow to the company. SAP has

an interesting viewpoint on the development and future evolution of workflow itself, noting that the best application software has always included workflow functionality and pointing out that the workflow craze has largely been fueled by the advent of BPR. SAP says about its *SAP Business Workflow* product that, "Workflow has been an essential part of the entire R/3 design from product inception. This is witnessed by the sophistication of the process definition tools, the amount of workflow functionality imbedded in each of the application modules, the architectural design for scaleability and flexibility, and the power of the infrastructure in the initial R/3 releases. All of the native elements for enterprise workflow were already a part of the R/3 product in the 2.x release structure. What was missing was the management and routing structures. These were added with the release of R/3 3.0 with the advent of the Workflow Manager and Role-Based Processing."

The SAP Web site provides extensive background information on the company's approach to business process analysis and workflow management. Most of the white papers are available in PDF (*Acrobat*) format, so make sure to download this useful utility from the Adobe site (**http://www.adobe.com**) if you haven't already. You can begin to investigate SAP's approach to workflow functionality in their accounting suite at the company's Business Process Technology page of the Web site at **http://www.sap.com/products/bpt/index.htm.**

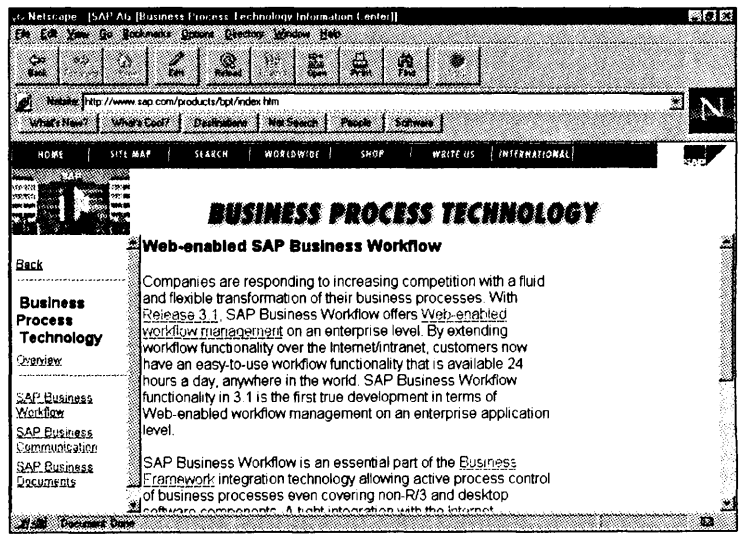


Figure 6.3 *Learning about process-based workflow in client/server accounting software at SAP's Web site.*

PeopleSoft is another major player in the client/server accounting software market, and, like most of its competitors, it has recently added a workflow module to its offerings. *PeopleSoft Workflow* can be added to the extensive suite of mix-and-match applications provided by the company, which include financials, materials management, distribution, manufacturing, and human resources. Using the Application Designer tool, a small business can create visual maps that show the steps and workflow routings of a given business process. The users of the software view these maps using a tool called Navigator to navigate through the activities they need to perform. PeopleSoft stresses the flexibility of its system, pointing out that the kinds of data collected and routed through the workflow maps can be messages from voice response systems, interactive kiosks, e-mail systems, and the Internet.

Integrated Workflow Software

The most complex and highest level of workflow software is integrated workflow software, also called collaborative workflow by some companies. These programs are developed as free-

standing workflow systems, as opposed to serving as add-on modules for specialized applications or as software agents in electronic messaging systems. Integrated workflow software is characterized by the presence of workflow analysis and redesign tools, such as the *ActionWorkflow Process Builder* software described later in this chapter. Integrated workflow systems require a great deal of customization on the part of the user organization, because the structure and rules of individual business processes must be built into the system before it can be used to accomplish routing tasks.

Most of the software profiled in the case studies in Chapters Two and Four fall into the category of integrated workflow software; the makers of some of the most popular products are FileNet and Staffware. These are packages chosen by companies that have time and money to spend on a substantial business process analysis effort and a subsequent systems development period. Implementing integrated workflow management software will usually mean that your business will need to acquire consulting services from the software company or another consulting firm and that your employees will need specialized training on the software. This is not to say that small businesses should disregard products in this software category, however. For a company that handles a high volume of standardized work, or one that does not already rely on application software that could be enhanced by the addition of a workflow module, integrated workflow software can be a cost-effective choice. For the purposes of this book, we will assume that your selection of an integrated workflow management software product will require that you undertake a larger systems development effort, and therefore we will treat this category of software in Chapter Seven, "Planning a Larger Workflow Management Project."

Workflow Analysis and Planning Tools

Before automating the business processes of any organization, it is important first to analyze them and to create some structure from which to build a workflow system. As you might expect, many vendors provide analysis and planning tools. In this section, we'll use Action Technologies, Inc.'s *ActionWorkflow Process Builder* tool to illustrate concepts basic to workflow analysis and planning. A 30-day trial version of the *Analyst Edition* of this software is available from the Action Technologies Web site at **http://www.actiontech.com**. To use it, download the program file to the **/temp** folder of your hard drive and then launch the installation routine by running the file via the **Run** command of the *Windows 95* **Start** menu. You'll want to be sure to also download the *User's Guide*, available as a PDF file which you can view and print using Adobe's *Acrobat* utility. If you do not have *Acrobat* installed on your computer, Action Technologies has provided a link for downloading the utility program through its Web site.

Upon first opening *Process Builder*, you will see a screen with four tabs: **Map**, **Data**, **Protocol**, and **Fields**. Each of these tabs contain information on the business process currently being viewed–the information is simply presented in different formats and levels of detail. For most people, the **Map** tab will present the most clearly recognizable version of a business process. The business process map is simply a graphical representation of the flow of work from role to role within an organization; the illustration below shows you how a portion of the business process called "Custom Order" appears in business process map form. This workflow might be used in a manufacturing environment when a customer orders a specially built item or one that must be modified in a non-standard manner.

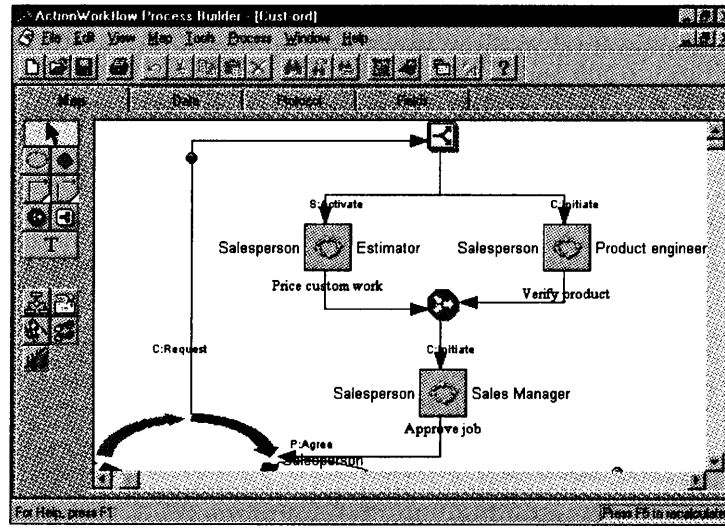
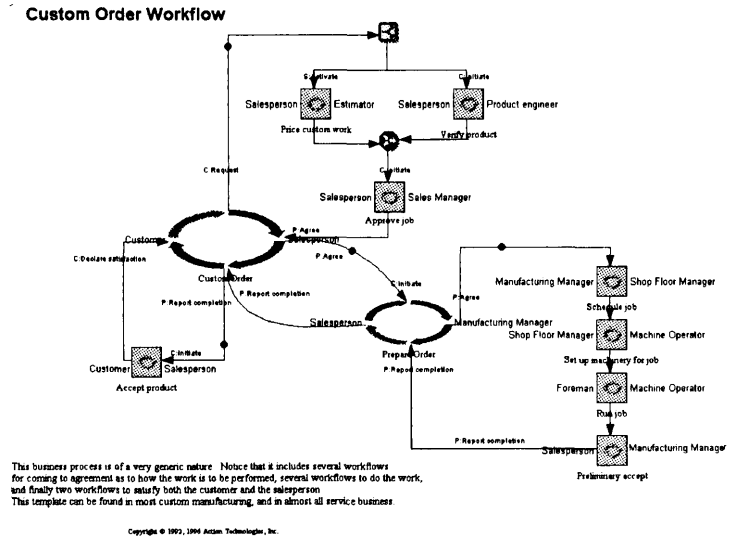


Figure 6.4 *Viewing the business process map for the Custom Order Workflow using Action Technologies' Process Builder software.*

As you can see, many of the steps in this graphical view of a workflow are represented by icons. For those of you familiar with the flow-charting techniques used in computer programming and other disciplines, the icons may look vaguely familiar. However, workflow analysis packages each tend to have a vocabulary of their own, usually based on the company's use of BPR or related techniques and perhaps on a proprietary business process analysis methodology that the company has developed. In this tool, the user can export business process maps as separate graphics files to view or print them. The full business process map is displayed below.

Figure 6.5
Full display of the Custom Order Workflow.



In the map displayed above, using *Action Workflow Process Builder*, the icons represent the following points, or process components, in a business process:

Splitter—A point at which a single item splits into two items in the flow.

Rendezvous—A point at which two previously split items join together again.

Workflow—A linked, or subordinate, workflow that can be viewed either in condensed form, as presented here, or in elaborated form in another view.

In addition to these process components, the map shows who is responsible for parts of the workflow. A participant in the workflow can be labeled as a Customer, a Performer, or an Observer. These generic labels can be translated into specific job

titles, or even specific employee names, when the workflow application is built and the workflow system launched.

Many workflow patterns have certain phases in common. For instance, a workflow that follows the generic pattern of a "request" will have the following phases: Preparation, during which a Customer (internal or external) prepares a request; Negotiation, during which the Customer and the Performer together agree on the details of the request and the date the deliverable is due; Performance, during which the Performer completes the task; and Acceptance, during which the Customer accepts the deliverable and agrees that the task is completed.

In a more complicated version of this basic request pattern, separate, subordinate workflows might be created. For instance, if an administrator requests a staffing report from a HR manager, the HR manager might need to initiate requests to various department managers to determine the current staffing level in each department. This is the point at which a link would be created to another workflow, and the product of that subordinate workflow would link back to the primary request workflow so that the task can be completed. Sometimes this subordinate workflow is called a "subprocess," to indicate that it is a partial process that contributes to the deliverable (end product) of a business process. In the Customer Order Workflow map above, one of the subprocesses is called "Price custom work," and it involves Salesperson and Estimator participants.

To use a tool such as *ActionWorkflow Process Builder* to analyze and document the business processes of your organization, you will need to learn the software well enough to be familiar with the terminology the software uses to label various business process components and to manipulate the map-making portion of the software along with establishing definitions for workflow

participants, routing, and approval steps. The *Process Builder Analyst Edition* includes wizards to help you get started on building workflows, and the *User's Guide* includes sample exercises that you can complete to become proficient with the software.

Of course, there are other, similar business process analysis tools available from many software vendors. IDEFine Ltd. markets several analysis tools, including *Business Modelling Workbench, Workflow Modeller, Workflow Simulator,* and *Workflow Generation,* a product that generates system requirements and parameters for later incorporation into workflow management software such as products marketed by FileNet. You can learn more about IDEFine's products and order a demonstration of the *Workflow Modeller* software at the company's Web site (**http://www.idefine.com**). InConcert, Inc., a division of Xerox, recently released a workflow management software that captures and documents business processes as users perform tasks. Using a proprietary methodology called "Process Design by Discovery," *InConcert Version 3.6* allows users to launch a workflow and modify the structure as the work progresses through the flow. According to the software makers, this product greatly reduces the time required for analysis of business processes before implementing workflow management software, and thus it increases the organization's return on its workflow software investment.

Executive Summary

By their nature, automated workflow management systems run on local area networks, and most require a client/server environment. Examples of client/server network operating systems are *Windows NT* and Novell's *Netware.* If your organization has an already-established LAN, you will need to ensure that the hardware infrastructure will support whichever type of workflow software you intend to implement. If you must install a LAN at the same time as workflow software, the hardware requirements of the software itself can guide your decisions.

When evaluating workflow software for your firm or a client's small business, it will help to first establish which of the three types of workflow software would best meet your needs: message-based, process-based, or integrated. If you choose an integrated workflow software package, you can use the associated planning and analysis tool to document and redesign the structure of your organization's business processes. If you choose a less sophisticated type of workflow software, you can perform the analysis of business processes using stand-alone workflow analysis tools such as *ActionWorkflow Process Builder.*

Use Planning Worksheet #3 on the next page to determine which workflow management tools will be most appropriate for your small business workflow management project.

Planning Worksheet #3:
Selecting Workflow Management Tools for a Small Business

Task	Action Steps Required
If business already has a LAN, gather the specifications and capabilities of the network.	
Determine which type of workflow software best fits the organization's needs: message-based, process-based, or integrated.	
Determine if already-used software, such as client/server accounting packages, have workflow modules available.	
If implementing message-based or process-based workflow software, select and acquire software.	
Evaluate needed expansions or improvements to LAN and implement changes.	
Select and acquire workflow analysis tool to create and document business processes.	
Translate business processes into workflow management system.	

Chapter Seven
Planning a Larger Workflow Management Project

In smaller business situations, information systems projects have easily definable scopes. As we reviewed in Chapter Six, your biggest challenge in implementing workflow management software in a smaller business probably will be selecting appropriate software and building a suitable network on which to run it. In larger companies, workflow management projects can be more complicated, simply by virtue of the number of users and variety of organizational units involved. Fortunately, information systems professionals have been using structured methodologies for building computer systems for years, and you can draw on this knowledge to bring order to your workflow management project.

In this chapter, we'll review some techniques you can use to participate on or lead a workflow management project team, and we will outline the following steps of a workflow management project of larger scope.

- Understanding project management, including identifying team members and approaching information systems development methodologies.
- Evaluating workflow management software.
- Defining a pilot project.
- Planning for system security.
- Developing a training program.

Understanding Project Management

Any professional who has completed a task requiring more than a couple of hours has probably done some form of project planning. First you think about the steps required to complete the task. Then you decide which step you should do first, second, and so on. If it's a busy day, you think about how long the entire task will take, and whether or not you will do all the steps today, or spread them out over a couple of days.

Workflow management system projects, like any information systems projects, require the same sort of planning on a much larger scale. In fact, there is an entire field devoted to project planning, and professional specialists who focus on project management. In most companies, however, large information systems projects are led by the managers who will be responsible for the final system. These managers bring groups of colleagues together in project teams, and as a group they establish the steps necessary to build a workflow management system and monitor its day-to-day operation. If you find yourself responsible for leading a workflow management system project team in a large organization, you should familiarize yourself with project management techniques and use them to structure your team's activities.

One source of project management information is the Project Management Institute (PMI), a professional organization that supports project management education and knowledge dissemination.

At their very informative Web site (**http://www.pmi.org**), PMI publishes a document entitled the *A Guide to the Project Management Body of Knowledge*, or *PMBOK Guide*. This book-

length project management manual is divided into the following chapters, the titles of which indicate the breadth of information covered in the book:

- Chapter 1: The Project Management Framework.
- Chapter 2: The Project Management Context.
- Chapter 3: Project Management Processes.
- Chapter 4: Project Integration Management.
- Chapter 5: Project Scope Management.
- Chapter 6: Project Time Management.
- Chapter 7: Project Cost Management.
- Chapter 8: Project Quality Management.
- Chapter 9: Project Human Resource Management.
- Chapter 10: Project Communications Management.
- Chapter 11: Project Risk Management.
- Chapter 12: Project Procurement Management.

Like many large online documents, this file is stored at the Web site in an archived file which, when unzipped, is in Adobe *Acrobat* (PDF) format.

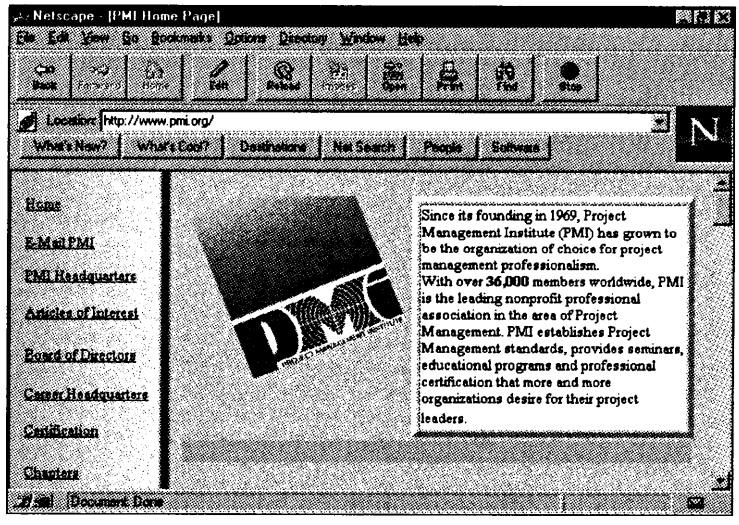


Figure 7.1 *Web site of the Project Management Institute, publisher of A Guide to the Project Management Body of Knowledge.*

However you choose to learn about project management, through a training course, book, or online information, there are several concepts that will be very important to your workflow management project. First you will need to define the life cycle of your project, which is the total duration of the project from start to finish. The project life cycle will include all the preliminary research and planning activities that take place before purchasing and installing workflow management software, and it will also incorporate the training and documentation tasks that take place after the software is up and running.

Once you define the start and end-points of the project life cycle, you will need to divide the life cycle into phases. In information systems projects, each phase of the project generally can be associated with a deliverable, which is a concrete work product such as a document or computer program. Each phase of the project will include various processes, such as evaluating software, installing the LAN, or writing the user manual. And finally, the entire project will take place within a closely defined scope. The scope of a project determines exactly what is to be done–for instance, a workflow management system might have the very limited scope of automating the purchase order process or the much broader scope of supporting the entire research and development effort.

Identifying Workflow Management Team Members

In a larger organization, a workflow system can impact a wide range of personnel and departments. Your challenge as a project leader will be to identify every possible area that will be affected by the system and to make sure that each of those areas is represented on your workflow management team. The persons or departments that have a vested interest in the system, or that will be affected by the system, are called stakeholders. The persons who will actually use the workflow management software are

called users. Thus, not all stakeholders will be users of the system, but all users will almost certainly be stakeholders. Almost every information systems project has stakeholders in the following categories:

- Project Manager—The person who manages the project team and is responsible for the planning and implementation of the project.
- Sponsor—The department or office that funds the project.
- Customer—The person(s) or department(s) that will use the final project product, which in this case is the workflow management system itself.
- Performer or Performing Organization—The staff or organization area that does the work of the project. In the case of a workflow management system in a larger organization, most of the performers will probably be information systems personnel.

Of course, not each and every stakeholder can be a part of your workflow management team. In most cases, a manager or supervisor from each area can be chosen to represent the interests of the group as a whole. However, if you want to make sure that a wide range of perspectives is represented, include at least one actual user of the system and at least one customer of your company in some of the planning and testing activities.

Information Systems Development Methodologies

In information systems projects, the general concepts of project management are applied in specific, structured ways. Computer professionals develop application systems through software engineering and systems development processes called methodologies. If you are leading a workflow management team that includes information systems personnel, it is likely that those professionals will want to use some sort of structured

methodology to accomplish some or all of the technical aspects of the work. While you might not need to manage the methodology yourself, it will be important for you to understand at least the general concepts involved in this type of planning system. Most information systems methodologies share some version of the following phases or components.

- Analysis—Activities centered on assessing user needs.
- Planning—Evaluating potential technical solutions and deciding between purchasing software or creating custom applications.
- Development—Constructing the software or purchasing and customizing the software.
- Testing—Using structured scenarios to assess the quality of the system.
- Implementation—Launching the system on the target hardware and beginning user activities.
- Modification—Making requested changes, improvements, and updates to the system.

It will be important for you to coordinate the phases of the system development methodology used with the overall project planning process you choose to follow in managing the workflow project. Fortunately, information systems methodologies are based on project management techniques, and thus the two types of planning techniques share many common characteristics.

Evaluating Workflow Management Software

Software evaluation is the process through which you will define which characteristics of workflow management software are important to you, such as cost or hardware requirements, and compare that list of characteristics to the features of various software packages. Some of the characteristics you might wish to consider have been covered in previous chapters–for instance, we grouped workflow software into three general categories in Chapter Six and also looked at various types of local area networks. In this section, we'll identify the modules that most integrated, or collaborative, workflow software includes. You will learn the categories into which you can group the features of collaborative workflow software so you can compare packages. In addition, we provide a planning worksheet for software evaluation that you can use to consider together the many software-related issues raised in this book.

As discussed in Chapter One, there is a move afoot to standardize many aspects of workflow management software so that organizations can mix-and-match workflow applications from various vendors and still benefit from very closely integrated systems. Toward this goal, the Workflow Management Coalition has created a document called the *Workflow Reference Model* that proposes a set of common terminology and definitions of the components of workflow software. The Coalition provides the following general diagram of workflow systems and their various components.

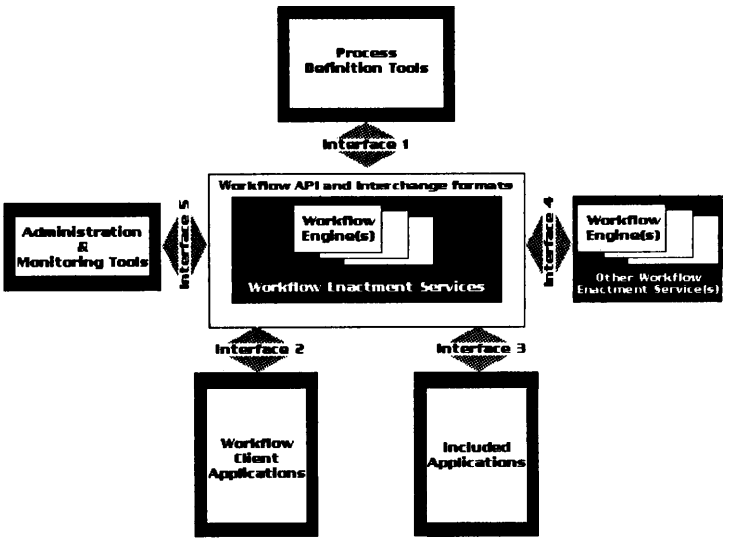


Figure 7.2 *Graphic representation of the Workflow Reference Model proposed by the Workflow Management Coalition.*

In this section, we will follow the Coalition's lead and divide workflow software functions into the three categories discussed below. We have provided a copy of the entire *Workflow Reference Model* document as Appendix A of this text. However, because this document is updated from time to time, you might wish to refer to the online version. To access the online *Workflow Reference Model*, download it from the Workflow Management Coalition's Web site at **http://www.wfmc.org**. The document is available in the following formats: HTML, Microsoft *Word*, RTF, PDF, and plain text.

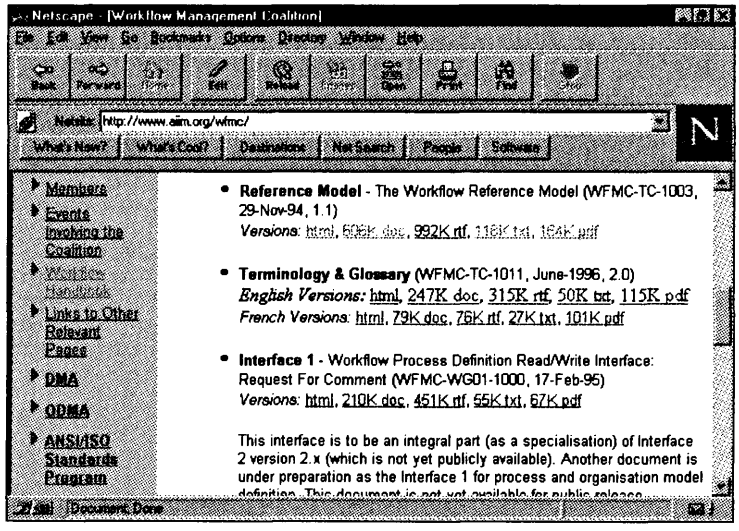


Figure 7.3 *Accessing the Workflow Reference Model document.*

Build-Time Functions

The first category of workflow software features, called build-time functions, is concerned with the analysis and modeling of business processes. The *ActionWorkflow Process Builder* tool profiled in Chapter Six is an example of this category; you may recall that this tool is used to create graphical maps of flows of work and to define the phases and participants in various workflows.

Not surprisingly, workflow software vendors consider the build-time functions of their software to be unique, competitive advantages. Thus, you will encounter lots of information about the particular features of build-time functions when dealing with software representatives and reading marketing materials. In many ways, this emphasis is beneficial for organizations implementing workflow management systems, because the analysis and definition of workflow is the base upon which the whole system will rest. If you design efficient and effective business processes, and define them correctly with build-time

functions, you are much more likely to create a system that will reduce costs and increase quality.

However, the build-time functions of workflow software have not come under the same standardization pressure as other workflow components. In fact, the Workflow Management Coalition has explicitly stated that they do not consider the analysis of business processes and the creation of process definitions to be beneficial areas to standardize. This means that companies will probably continue to develop and market analysis and modeling tools that will use proprietary methods and terminology. As you select workflow management software, you should be aware that you will be "stuck" with the methods and terminology used by your software vendor. The build-time functions should be easy to learn, easy to use, and based on your intuitive understanding of the nature of flows of work (or the intuitive understanding of the person who will be responsible for this phase of the project). The build-time functions also should be closely integrated with the workflow applications themselves–the most advanced of such tools actually create the application directly from the processes defined in the analysis stage.

Run-Time Process Control Functions

When you see software vendors refer to the "engine" or "workflow engine" of a particular software package, they are speaking of the run-time process control functions. This component of workflow management systems is the link between the processes as they have been defined in the build-time functions and the workflow application itself that is used by organization personnel each day. The workflow engine is the part of the software that handles tasks such as initiating or ending processes, scheduling activities within workflows, and allowing for process definitions to be modified.

The standardization of workflow software interfaces is focusing on this area. In environments where multiple workflow management software packages are being used, it will be important for the workflow engine to accommodate activities and tasks that originate in document image processing, electronic data interchange, groupware, and transaction modules. The *Workflow Reference Model* document identifies the potential interfaces between these disparate types of products and shows how the interfaces could be developed to allow integration between various types of workflow software. If you anticipate that your organization might need, now or in the future, to create one interoperable system from packages purchased through several vendors, it will be very important to determine how committed potential vendors are to the evolving standards and what their future plans are for creating standardized interfaces.

Run-Time Activity Interactions

This category of workflow management software functions comprises the interface that system users will see. If a user is required to fill out a form to initiate a purchase order, that form is part of the run-time activity interactions. Other run-time activity interactions are: reports, exception notices, authorizations, and messages. Basically, anything a user sees on the screen in the day-to-day use of the workflow management system is a run-time activity interaction.

When evaluating workflow management software, you will, of course, want the screens and graphics that your system users see every day to be clear, easy-to-read, and consistent. You should discuss the features of the user interface in detail with both the vendor and with the user representatives on your workflow management team. In particular, you will want to know how the screens have been designed and how this design impacts user efficiency. Your vendor should be able to provide you with a

rationale for the arrangement of icons and menus on the screens and to explain how this arrangement facilitates user training and productivity.

Vertical Industry Applications

Some of the leading workflow software vendors have pre-configured versions of their packages to address the specialized needs of particular industries. In fact, PeopleSoft has even organized units of its company around specific industry areas–each unit customizes software along with focusing installation and training activities in a particular business sector. Use the descriptions below as an example of industry-specific workflow software, and, when researching workflow software for your organization, be sure to see if such packages are available.

> *PeopleSoft Financial Services is dedicated to serving the needs of the banking, insurance and securities industries. The unit is staffed with individuals who understand the specific needs of different sectors of the financial services industry and are skilled at providing customized PeopleSoft solutions to help streamline operations, reengineer for more efficient operations, and improve decision-making. As mergers, acquisitions, new competitive threats, and electronic delivery channels transform the financial industry, PeopleSoft can provide the supporting technology required to enable financial services organizations to thrive.*

> *PeopleSoft Manufacturing delivers a scaleable, comprehensive enterprise resource planning manufacturing support package. PeopleSoft's approach has a unique focus on supply chain optimization, enabling adaptable, intelligent process management that is customer driven. Demand Planning, a new module, is designed to improve the accuracy of the forecasting process, integrate it tightly with supply planning, and enable efficient collaboration across departments as well as throughout the supply chain.*

PeopleSoft Healthcare focuses on providing complete business support for the healthcare industry, enabling healthcare enterprises to focus on their primary mission of serving the needs of their patients. Financials, materials management, and HRMS provide a complete enterprise business solution for integrated delivery systems, managed care organizations, hospitals, university medical centers, long-term care facilities, and other health-service businesses.

PeopleSoft Higher Education is strongly differentiated by having the only complete Student Administration application suite on the market. Together with other application modules, PeopleSoft can deliver a comprehensive package that creates a competitive edge for academic institutions seeking to attract top students, research and project funding, and alumni financial support. Everything from tracking student course registration and degree progress to systems to manage compensation for professionals in instruction, research, and administration is supported by PeopleSoft application modules.

PeopleSoft Public Sector provides applications to meet the needs of non-profit institutions, including provincial, state, and local governments. The goal of the business unit is to help customers reduce costs while increasing responsiveness to their constituencies. Human resources, financial transactions, budgetary management, as well as project and grant tracking are examples of the functions that are automated and streamlined by PeopleSoft application modules.

PeopleSoft Retail offers a complete solution for the retail industry, including merchandising and decision support applications from an alliance with Intrepid Systems and the acquisition of Red Pepper for supply chain management. The combination of technologies enables businesses to manage all of the requirements for success in today's highly competitive retail environment, including transactional

systems, supply chain coordination, decision support with online analytical processing tools and data warehousing, human resources, and accounting.

PeopleSoft Federal Government is tightly focused on the requirements of US federal government agencies. The integrated suite of human resource, payroll, benefits administration, and time and labor applications has been specifically designed to support the Request for Personnel Action (SF-52) and SF-113 processes, as well as benefits programs like the Thrift Savings Plan, Federal Employee Group Life Insurance, and Federal Employee Health Benefits.

PeopleSoft Service Industries solutions address the unique needs of people oriented, project driven service industries. Service industries represent one of the largest and fastest growing segments of the economy, and PeopleSoft provides an integrated suite of products to support all aspects of managing a service business. PeopleSoft's applications are customized to meet the needs of specific organizations in market segments that include temporary staffing services, entertainment, advertising, accounting, consulting, media, publishing, hospitality, construction, and engineering.

PeopleSoft Infrastructure (Communications, Transportation and Utilities) brings specialized software applications support to market for key infrastructure industries. PeopleSoft for Communications focuses on the needs of telecommunications firms as they deal with the challenges of technological convergence, the transformation of carriers due to deregulation, and entry into new businesses such as Internet service. PeopleSoft for Transportation addresses the needs of airlines, express transportation services, transit services, trucking, a variety of different shipping companies, railroads, and other transportation businesses. PeopleSoft for Utilities adds industry-specific functionality to PeopleSoft's applications to provide added value for the utilities industry, including solutions for shared services,

performance management, activity-based costing, profitability analysis, work management, and customer systems. (Product descriptions and further information available at the PeopleSoft Web site, ***http://www.peoplesoft.com****.)*

Defining a Pilot Project

There are many reasons for confining your organization's initial workflow effort to a pilot project, even if there are clear-cut plans for a much larger implementation. Through a pilot project, you can begin to quantify the potential cost savings of workflow management software and use that data to create momentum for larger-scale workflow projects. For instance, Staffware reports the following results for insurance companies that have implemented its software.

> *Efficiency gains which range from 30% to eight fold often cost-justify a workflow system on their own. One health insurer reported an 80% increase in throughput over a population of 2000 users. The "minimum" one can expect—where efficiency is one of the goals—is around 30%; in practice more than 50% is common. A question often asked is what benefit is due to workflow and what benefit is due to the business process re-engineering (BPR) that often accompanies a workflow project.*
>
> *One life and pensions company sought to pin down this issue in a pilot project. They measured the situation before any changes were made; the process had around 24 steps. They then re-engineered the process without using workflow and reduced the process to 12 steps. It was then automated using Staffware, and provided an efficiency gain of 65% between the re-engineered process and the automated process.*

As this anecdote illustrates, one approach to a pilot project is first to manually redesign the business process using only paper. This can be accomplished using a specific BPR technique such as IDEF, or even using a common-sense approach to efficiency by examining the steps of the process and eliminating redundancies and outdated requirements.

Logistically, it is easier to accomplish a paper redesign of this type using a business process that is standard (that is, does not have many exceptions) and occurs in relatively high volume involving relatively few people. Some examples are: internal supply orders, printing requests, travel reimbursements. Each of these potential pilot projects involves a service or product being ordered from one department or area only–the storeroom, the print shop, the travel coordinator. To further simplify the pilot project business process, you can narrow the list of possible requesting areas. For example, you could conduct a pilot project that automates travel reimbursements for one region's sales representatives, all of which funnel through that region's sales manager for approval.

Planning for System Security

Network security is an enormous, rapidly-changing, highly technical field. Since your large organization will be implementing workflow management software on a local area network or other type of network, it is very important that your network administrator, or another qualified information systems professional, take responsibility for developing and implementing a comprehensive information security plan for your organization. Discussing the components of an organization-wide information security plan is beyond the scope of this text; however, effective

plans typically address the issues listed below. You may wish to provide this list to your network administrator and discuss with the members of your workflow management team how each of these issues will be addressed.

- Risk analysis (cite assets and identification of threats).
- Physical security (securing and protecting hardware, software, and data).
- Viruses.
- Encryption.
- Network firewalls.

In addition to network security requirements such as those listed above, workflow management software highlights some issues related to individual users of the software. Two individual computer use issues that are brought to the forefront when organizations implement workflow systems are information access rights and passwords.

Information Access Rights

When thinking about internal information access rights, you can use the simple analogy of a filing cabinet to consider the threats to your organization's confidential information and alternatives for protection. For instance, if you are the payroll manager of a large corporation, it is likely that you keep your hard-copy payroll files under lock and key all day long. Probably only one or two other persons have access to these files–maybe your secretary and perhaps your boss, the vice president of administration. If a manager of a particular department comes to you for payroll information on her department's employees, you will release to her the files relevant to her own employees, not the files for her peer managers or the employees of another department. It would be understood that this manager would not release the payroll information for one employee to another, and that she would not

publish her department's payroll information company-wide or world-wide.

Now, for comparison, let's suppose that you have a payroll system that has been automated through workflow management software that runs from the server of your local area network. Perhaps that system has built-in password authorization levels in place for managers to access and modify information in their employees' payroll records. These are useful security measures, and you should use them as appropriate for your organization, but their efficacy depends on each authorized person using the information only as intended. As an example: what good would the multi-level password system be if the manager accessed the confidential information in an authorized manner, but then printed it on her laser printer, photocopied it, and gave a copy to each company employee?

What you need in this instance is a clear definition of the information access rights of each level of employee in your organization. Even if these "rights" are defined by parameters in your workflow software, you should document why they are in place and how employees should handle data after they have retrieved it. This is especially important in workflow projects that, for the sake of efficiency and increased effectiveness, make more information available to employees than was previously available. While your new workflow management system might be especially helpful toward the goal of making information widely available to those who need it, the change in culture can lead to some disastrous consequences in terms of confidentiality and the appropriate use of information.

When deciding about information access rights, use a rule of thumb common to the medical and legal professions, called the "need to know" rule. According to this rule, only employees who

need to know information to perform their jobs should have it. For instance, a manager who evaluates employees' performance and grants merit raises obviously needs to know her employees' salaries, but very few other people do. Everyone in the company probably needs to know the contents of the company's strategic plan, but very few people need to know the competitor analysis on which certain aspects of the plan were based.

Your workflow management team should work together through the levels of information that particular classes of employees "need to know." This activity can be part of the planning for workflow system security, because all workflow management software packages include some sort of authorization scheme and user verification. Many organizations keep track of information access rights through use of a table which documents job titles or levels and the types of information available to people in those roles.

Passwords

Your workflow software vendor will make you aware of the particular requirements for user passwords on the system. Obviously, it is crucial that the users of a workflow system enter and exit the software securely and that only authorized users be allowed to complete workflow tasks such as initiating processes and authorize events such as issuing checks and placing orders. And, if your network is effectively secured, it is unlikely that an external person will be able to enter your organization's network environment and attempt to access the workflow system. However, it is easy to construct very secure passwords and follow some simple procedures for using and protecting them.

Use the following list to help employees choose passwords that are safe and appropriate. You might wish to include this checklist as part of the documentation for your workflow management

system, and you will want to discuss it with the members of the workflow management team and compare it to any specific technical password specifications provided by your workflow software vendor.

Password Security Checklist

	yes/no
1. Is your password shorter than eight characters? Increasing the length of your password from six to eight characters forces a cracker to check many more possibilities.	_____
2. Is your password "letmein," "password," "hello," or some other clever response to the password prompt? These are commonly known and are the first checked by cracker programs.	_____
3. Is your password your log-in name in any form? Is it your license plate number, telephone number, street name, or the make of car you drive? Information like this is easy to discover, and so it makes an insecure password.	_____
4. Is your password all digits (like "12345678"), or a repeated character (like "aaaaaaaa")? Is it a repeated sequence of digits, or a keyboard pattern (like "12341234" or "asdfasdf")? Passwords like these significantly decrease the length of time needed to crack a password.	_____
5. Is your password in <u>any</u> dictionary? Crackers first check words in online dictionaries, both in English and some other languages.	_____
6. Is your password a word in a dictionary modified by prepending or appending a digit? Passwords like "house1" are not secure; cracker programs check appended and prepended digits as a matter of course.	_____
7. Is your password a word constructed by rotating or reversing one of the above classes? For example, Frank may think that "knarf" (his name spelled backwards) or "rankf" (his name with the first character moved to the end) is more secure than his name, but this is not true.	_____
8. Is your password an example taken from a printed source?	_____

If you answered "no" to all of the questions above, your password is probably secure. If it is not, consider the following suggestions:

1. If the system distinguishes between upper and lower case letters in a password, mix the case of letters in your password. "TomCaT" is more secure than "tomcat" or "TOMCAT."
2. Use non-alphabetic characters inside the password. "Tom3CaT" is more secure than "TomCaT" or "TomCaT3."
3. Choose a line or two from a favorite song or poem and use the first letters of each word. For example, "To be or not to be, that is the question" becomes "2Bon2btitq?."
4. Choose two short words and concatenate them together with a punctuation character between them. For example: "dog+rain," "book!mug," "kid?goat."
5. Choose an adjective, a noun, a verb, and an adverb. This will make a (possibly nonsense) sentence that you can remember. Now use the first two letters of each word for your password. For example: "Orange Cars Fly Silently" becomes "OrCaFlSi."

Developing a Training Program

For some workflow management project leaders, training will begin the moment the project begins. You may choose to attend an executive or management session intended specifically for project leaders. Several of the leading workflow management software vendors offer such sessions, and these can be useful activities if you already have decided to purchase a particular vendor's product. If you wish to obtain a more objective viewpoint, you can take advantage of some of the educational opportunities offered by the Workflow and Reengineering International Association (**http://www.waria.com**).

When it comes to educating the users of the workflow system, the success of the effort will depend heavily on the quality of system training provided by your vendor. Look for the following qualities in vendor training programs:

- Clearly defined objectives for all sessions.
- A wide range of levels of training: analysts, developers, managers, and users.
- Well-written training documentation.
- A period of training support immediately after the session.
- The ability to customize training programs to meet special organizational needs.
- Hands-on sessions, with a computer for every student.

For instance, the quote below describes InConcert's introductory training session. Notice that the skill prerequisites and appropriate audience are clearly defined, and that the learning objectives are described in some detail.

InConcert Introductory Concepts (IC100)

InConcert is workflow management software which models and manages activities involving people, procedures, business applications and electronic information. It is capable of handling both structured and ad hoc business processes. Using its object-oriented design, InConcert provides flexibility, scalability and modularity. InConcert is ideally suited for distributed and collaborative computing environments.

Course Goal/Audience:
The goal of this course is to educate the workflow designer, analyst, programmer or user in the techniques needed to effectively design, manage, and use InConcert-enabled applications. This course uses the InConcert graphical user interface and does not require a programming background.

Objectives:
At the conclusion of the course the student will be able to:

Create and modify an InConcert Process Definition
Create or modify a custom Task User Interface
Start and manage an active Process Instance
Manage documents and folders
Work on and manage tasks
Use subtasks and conditionals to automate workflow functions
Create and run ad hoc processes
Use triggers to automate workflow functions
Control access and privileges

Prerequisites:
Experience using MSWindows is required, preferably Windows95.
Background in application analysis and/or design is helpful.

Students must bring a description of a business application with which they are familiar. The final lab requires each

student implement his/her business application using InConcert.

Delivery Method:
This course is instructor-led and consists of lecture, labs and demonstrations.

Duration: Two days

Cost: $1195.00

In addition to vendor-defined training parameters, your workflow management team can enhance training efforts by observing a few guidelines of effective employee education and development. The most important of these guidelines is to schedule training so that employees can use their newly gained skills immediately after the session. Thus, it makes sense to schedule user training in parallel with system implementation, so a department's employees can be trained just before their department's workflow system is launched.

You will also want to be aware of the fact that system users will take longer to complete routine tasks when the system is launched. The workflow management team might wish to create work schedules that allow for a short period of lower production and schedule additional employees or back-up help to keep various departments running smoothly. Along the same lines, as soon as employees are facile with the new system, your organization will begin to experience the productivity benefits of the workflow environment. Your team should be ready to assist managers in identifying how and where the workflow system has affected personnel needs. The more quickly and positively you can re-assign personnel, the less fear will be created among people wondering how the workflow system will affect their jobs.

Training professionals are in agreement that employee training and development is always more effective if it is connected to performance appraisal and merit rewards. To take advantage of this linkage, you should ensure that your workflow management team identifies how the job descriptions of system users might have changed and how these changes might affect employee performance toward stated goals or objectives. As soon as possible, supervisors and managers should begin to create new performance standards based on the new working environment. If employees are rewarded promptly and fairly for taking on the challenges of a changing work routine, the system will run much more smoothly and quality gains will be optimized.

Executive Summary

As a leader or participant on a workflow management team, you will need to draw on project management techniques to identify potential team members and create an effective group. You will draw on the group of stakeholders and users to create a workflow management team. If information systems professionals are involved, it is likely that they will suggest using an established information systems development methodology, which you should be prepared to coordinate with your project management scheme.

When evaluating workflow management software, it is useful to adopt the Workflow Management Coalition's categories of software characteristics: build-time functions, run-time process control functions, and run-time activity interactions. In addition, you will want to investigate whether or not there is a vertical industry workflow application already customized for your organization's business activities.

The security of the information and processes automated in your workflow system will depend in large part on the network security measures put in place by the network administrator. If your organization does not already have an information security plan in place, you should discuss the development of such a document with your network administrator. In addition, there are security practices that can be addressed at the user level, including defining information access rights and ensuring secure passwords. These and other topics can be addressed through an integrated, well-planned training program that includes both vendor-defined parameters and the tenets of effective employee education and development.

Planning Worksheet #4:
Evaluating Workflow Management Software

Task	Action Steps Required
Determine if your organization requires integrated workflow software, as opposed to message-based or process-based workflow software (if not, review Planning Worksheet: #3 in Chapter Six).	
Establish a list of selection criteria for build-time functions (for example, BPR methodology used and ease-of-use).	
Establish a list of selection criteria for run-time process control functions (for example, compliance with standards or inclusion of special functions such as EDI or document image processing).	
Establish a list of selection criteria for run-time activity interactions (for example, consistency of screens and clarity of menus).	
Establish a list of selection criteria for vendor training (for example, needed levels of training, quality of documentation, and on-site customized training).	
Determine if any vendors provide a vertical industry application for your organization's line of business.	

Planning Worksheet #4: (Continued)

Task	Action Steps Required
Rank items on above lists in order of importance, making sure to clearly mark any crucial or mandatory items.	
Use vendor information in Appendix B and Chapter Eight to begin a list of potential vendors, expanding research to other sources of vendor information.	
Evaluate identified vendors against selection criteria lists, determining the top three software candidates.	
Obtain the final cost estimate for entire workflow management project implementation from top three vendors (including consulting, training, and modifications).	
Create recommendation from workflow management team for software/vendor selection.	

Planning Worksheet #5:
Participating on a Large Workflow Management Project

Task	Action Steps Required
Familiarize yourself with the terminology and concepts of integrated workflow software, using information sources such as the *Workflow Reference Model.*	
Familiarize yourself with project managment techniques, using information sources such as the *PMBOK Guide.*	
Identify the stakeholders and users of the workflow management system, and select members of the workflow management team from among them.	
Determine if an information systems development methodology will be used; if so, familiarize yourself with it.	
Identify a suitable pilot project.	
Assess, with your network administrator, your organization's readiness to address system security issues such as information access rights and passwords.	

Chapter Eight Internet Resources for Workflow Management and BPR

The Internet has changed the ways that savvy financial professionals gather information about how technological advances can benefit them. In short, spending some time visiting Internet sites devoted to recent advances in business process redesign in general and workflow management in particular can help you assess the current needs of your organization, as well as plan future growth. In this chapter, we will describe some strategies for searching for useful resources on the Internet. Topics covered include the following:

- Using search engines.
- Tips for successful searching.
- Relevant resources.

Using Search Engines

In the world of information science, running searches for online information is both an exact science and a creative art. Library professionals spend years in training to use specific search-and-retrieval schemes, as well as specialized research tools, and go on to make careers locating and obtaining information for the rest

of us, as any visit to a corporate information center will demonstrate. But now that the technology of the Internet has delivered access to millions of files and databases to each of our desktops, the rest of us need to learn to survive in the world of targeted searches.

When we begin to research a topic in a library, generally, we start with an index. Research on the Internet is no different. The most important tools you will use when researching topics online are Internet indexes, known as search engines. Simply put, a search engine is an Internet site running special software that catalogs other Internet sites and allows users to search through the catalog using keywords to find matches. There are a number of search engines currently available with varying sizes of catalogs and various methods for running broad and specific searches. Despite their many small differences, most search engines operate in the same manner. Just follow these simple steps:

- ⇒ Access the search engine by typing the site's address in your Web browser.
- ⇒ Once at the site, look for a query box, which allows you to enter your keyword(s).
- ⇒ Type in the keywords that relate to your topic.
- ⇒ Press the **<ENTER>** key or click the **Search** button.
- ⇒ Wait for the results to be displayed on your screen.

Let's take a look at a sample search engine, AltaVista, available at **http://www.altavista.digital.com**. The opening screen of the AltaVista search engine is fairly intuitive to use. First, select from various settings that control the general scope of the search and the language(s) in which documents may appear; then enter your keyword(s). In general, in AltaVista and in other search engines, multi-word search strings result in more focused matches, so enter two or three words related to your topic.

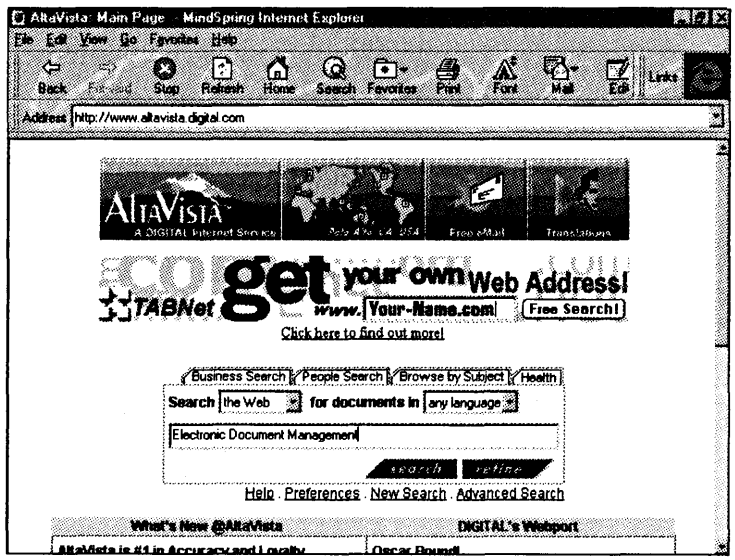


Figure 8.1
Entering keywords in the AltaVista search engine.

When the **search** button is clicked, the program compares the keywords you entered to the items in its database and displays a listing of items that appear to be matches.

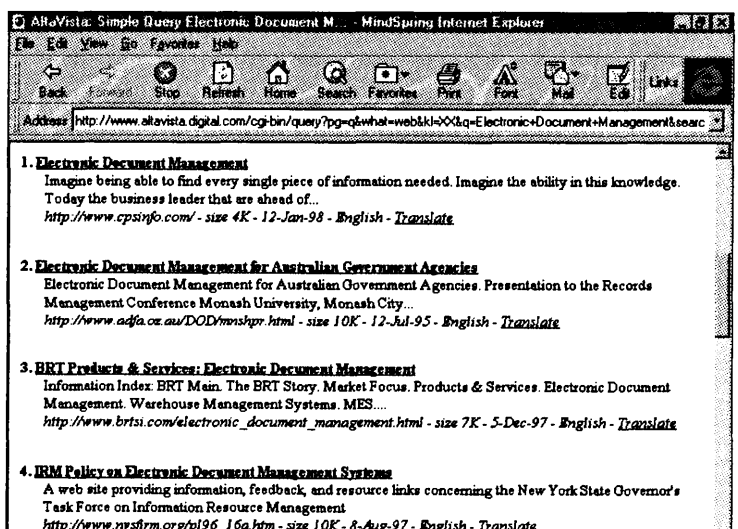


Figure 8.2
An AltaVista "hits" listing.

Each of the listings includes a link to the listed item, so when you find an item that interests you, click the link to access the site. When you are done with the resource, click the **Back** button on your Web browser to return to the listing of hits and select a new lead to follow. It's that simple!

The best way to learn about WWW search engines is to use them. Soon, you will begin to build an experiential sense of what works and what doesn't work. Other sites with WWW search engines and directories that you may want to try are listed below:

ALIWEB	**http://web.nexor.co.uk/public/aliweb/search/doc/form.html**
CUSI	**http://web.nexor.co.uk/susi/cusi.html**
Einet Galaxy	**http://www.einet.net/**
Infoseek	**http://www.infoseek.com**
Metacrawler	**http://www.metacrawler.com**
Lycos	**http://www.lycos.com**
Open Text	**http://www.opentext.com**
WebCrawler	**http://webcrawler.com**
Yahoo	**http://www.yahoo.com**

Refining Your Results

Although you will probably never say, "There is nothing on the Internet about my topic," you may often say, "There are so many Internet resources on my topic, I don't know where to begin!" The simplest way to restrict or expand the number of items you retrieve in a search is to use any of the operators or symbols recognized by a particular search engine. Although the specific symbols, words, and characters recognized by various search engines may differ, the most common, Boolean operators, are recognized by most. The most often used Boolean operators and the effects they can have on your search results are described below:

OR

The OR operator is useful for the first phases of a search, when you are not sure what information is available on your topic or what words are used to categorize it. When used between two words, the OR operator instructs the search tool to retrieve any record containing either of the words. For instance, the search query

business OR process

would retrieve items containing either the word "business" or the term "process," as illustrated below:

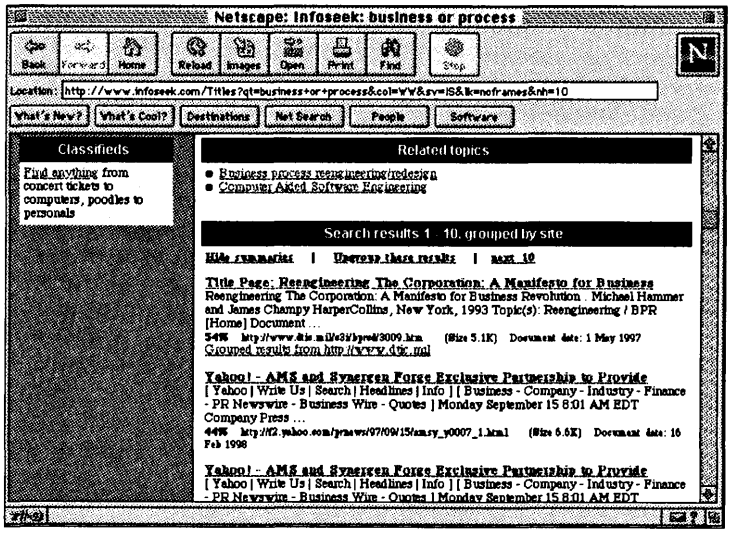


Figure 8.3 *An Infoseek listing of more than 27 million "hits" for the search string "business or process."*

Once you view the types of items containing either word, you might want to narrow your search by dropping one term and confining your search to the other. For instance, you might find that the records indexed under the term "process" are more relevant to your research question than those indexed under "business." Or, as in the example below, you might find that the items related to the specific subject of "business process" must

contain both words, not simply either one. Because OR is the Boolean operator that returns the most "hits" (items meeting the search criteria), search queries containing OR are very broad and sometimes return items that are not relevant.

AND

If you need to pose a more specific query, use the Boolean operator AND, which limits results to those items that contain both (or all) of the search terms in your query. Again using the two words from the example above, the search query

business AND process

would retrieve only those items containing both words in the same item, as illustrated below:

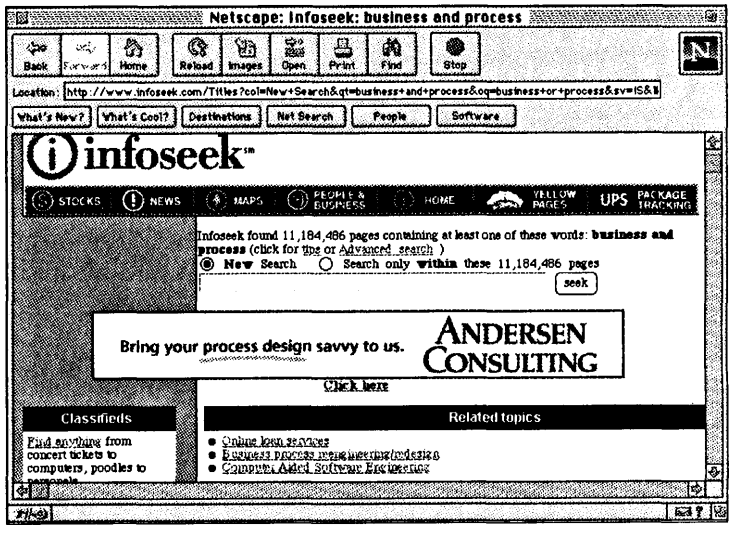


Figure 8.4 *The search engine Infoseek returned only 11 million documents using the search string "business and process."*

This search query would return a much smaller set of hits, and the items would be more applicable to the topic of business processes.

NOT

The last of the three most common Boolean operators is the word NOT. The NOT operator is used to eliminate records containing a particular word or combination of words from your search results. For instance, if you are performing a general search on data image processing vendors, you might wish to exclude items dealing with the very specific software vendor, FileNET. To make this exclusion, you could construct your search query as:

DIP NOT FileNET

This search would return all items containing the term "DIP" except for those that also contain the word "FileNET."

When you visit a search site, always read the instructions or help file before beginning your search. Each search engine has different parameters for using upper- and lower-case letters and combining Boolean operators, and some offer special methods of refining queries. Another good method for refining your search is to run a few searches experimentally to see what results are returned. By browsing through your results list, you can determine whether or not your strategy is returning relevant items. Then, you can construct a search strategy using the Boolean operators OR, AND, and NOT to improve your results. Most search engines assume a predetermined Boolean operator for multi-word search strings. Be sure to consult the search engine's documentation to determine what default Boolean operator is at work.

Other Tools for Restricting a Search

In addition to Boolean operators, there are various other characters and symbols that can be used to refine searches by defining the relationships between words in your search strings. For example, both Infoseek and AltaVista recognize a minus sign

(-) rather than the Boolean operator NOT. Many search engines recognize that words placed within quotation marks should be treated as a phrase; in other words, in order for an item to qualify as a hit, the words in the search string must appear together. For example, the keyword string "scanners and software" will retrieve any items that contain the word "scanners" and the word "software." But the search string "scanner software" will retrieve only items in which the words "scanner" and "software" appear together. As you can imagine, the results of these searches will be quite different.

The best way to determine what symbols and characters are recognized by a search engine is to access the engine's Help or Advanced Searching documents. For example, in the AltaVista WWW search engine that we demonstrated earlier, clicking on the **Help** option opens the document shown below.

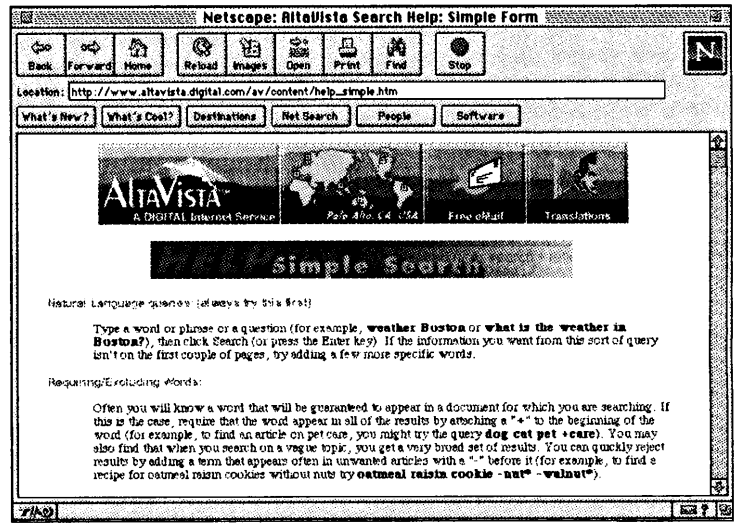


Figure 8.5 *AltaVista's Help document helps you restrict your search.*

Among other things, from this document we learn that AltaVista can support natural language queries (queries that use language that imitates a natural speech pattern rather than specific search

terms and characters) and exact phrases. This document also reveals that AltaVista can find pages that include specific graphic files, sort results listings into various topic categories, and much more!

Workflow Management Resources

Although using search engines will empower you to find myriad useful resources on the Internet, the listing below provides some sites that may be helpful to you as you research possibilities for your workflow management project. Review the items listed here and visit any sites that interest you. Please note that although we try to provide readers with current material, resources on the Internet change far too rapidly for any print publication to keep up with. In the event that you cannot access a site listed here, use a search engine to locate the site's new location or to access a site with similar content. To further assist you in your research, remember that many, if not most, sites that offer products and services related to hardware also provide information and links to software as well, and vice versa.

Background Research on Workflow Management and BPR

BPR Online Learning Center

Sponsored by ProSci, this site is one of the most comprehensive BPR resources on the Internet. Features include an index of BPR articles from around the world, an online tutorial series, benchmarking studies, Yellow Pages for BPR resources, and information on toolkits and document templates for project teams.

http://www.prosci.com

@Brint (The Ultimate Business, Management, and Technology Resource)

Calling itself "Your One Stop Resource for Business, Management and Technology Research," this site is an excellent place to begin researching BPR and workflow management. This site maintains a huge database of articles on all aspects of BPR, workflow, document management, and benchmarking.

http://www.brint.com/

Business Process Management Journal

This journal explores the practical relevance of leading-edge theoretical advances in BPR by presenting and discussing actual case studies.

http://www.mcb.co.uk/cgi-bin/journal1/bprmj

Business Process Reengineering Advisory Group

Hosted by the Enterprise Integration Laboratory of the Department of Industrial Engineering, University of Toronto, this site features an extensive list of BPR tools.

http://www.ie.utoronto.ca/EIL/tool/BPR.html

Business Processes Resource Centre

This Warwick University group provides access to BPR research, document managing, innovative manufacturing initiative materials, and documentation of industry practice. The BPRC supports self-sustaining networks of researchers and practitioners in business process analysis and management.

http://bprc.warwick.ac.uk/

Datamation

The online journal presents current feature articles about data warehousing, data managing, and small networks, as well as an archive of white papers.

http://www.datamation.com

"Eastman Kodak Company Digital Archive: A Strategic Positioning"

This paper, while a promotional document, does provide an excellent overview of digital storage issues and solutions.

http://www.kodak.com/about/Kodak/bu/bis/dmc/whitePapers.shtml

Electronic College of Process Innovation

The US Department of Defense hosts this knowledge center of documents, tools, and guidebooks available on the topic of business process change.

http://www.dtic.mil/c3i/bprcd/mhome.htm

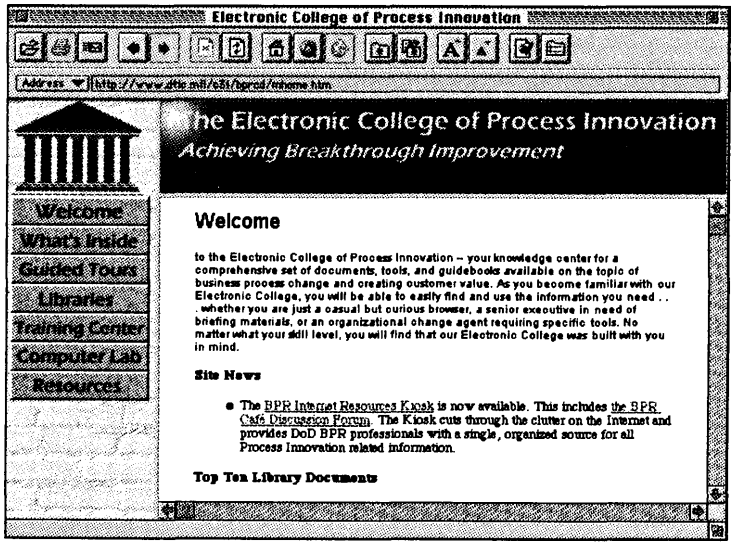


Figure 8.6 *DoD's Electronic College of Process Innovation.*

Exotica Project at the IBM Almaden Research Center

The Exotica project, which ended in 1997, focused on workflow systems and advanced transaction management. From this site, you can access papers describing the project's methods, findings, and general applications to the field of workflow management.

http://www.almaden.ibm.com/cs/exotica/

Inform Online Magazine

The magazine of the AIIM (Association for Information and Image Management International), Inform Online focuses on the document management industry, presenting real-world applications, product reviews, and insights on markets, trends and technologies.

http://www.aiim.org/inform

Knowledge and Process Management (formerly Business Change and Reengineering)

This John Wiley (UK) journal is the official publication of the Institute of Business Process Reengineering.

http://www.mgmt.utoronto.ca/~wensle/kpm.htm

The Process Handbook Project

The project, sponsored by Massachusetts Institute of Technology, focuses on collecting examples of how different organizations perform similar processes, and representing these examples in an online "process handbook" which will include the relative advantages of various alternatives. The handbook is intended to help redesign existing organizational processes and invent new processes that take advantage of information technology.

http://ccs.mit.edu/pbookintro.html

Product Data Management Information Center

This site seeks to be a central information resource for data management. Features include information on the benefits of PDM technology, recent products, technologies, and trends, and case studies of companies' PDM experiences.

http://www.pdmic.com

Reengineering Resource Center
Formerly the online version of the now-defunct Enterprise Reengineering publication, this site archives old journal articles. Hosted by Coe-Truman Technologies, Inc. (CTT), a computer consultant and custom software developer, the site features a marketplace of software solutions and has plans to add discussion forums, job/resume postings, and a calendar of events for BPR.
http://www.reengineering.com

Document Image Processing Resources

Carere
Carere is a leader in the imaging software industry. This site provides information on current industry trends, as well as information on all Carere products and services, such as OCR and image editing software.
http://www.carere.com

Expert Graphics
The North American distributor of Rasterex products, Expert Graphics' Web site offers contact information, product overviews, free downloadable demos, and product specifications to name a few.
http://www.expertg.com

Filemark Corporation
This site allows you to explore the company's products and services, and provides easy access to information on archival and retrieval software. Additionally, Filemark's site offers case studies, customer success stories, and distribution solutions.
http://www.filemark.com

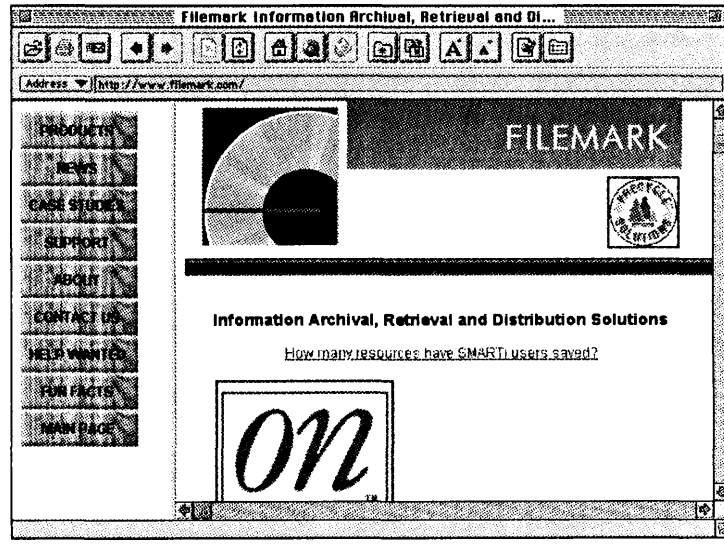


Figure 8.7
The home page of Filemark Corporation.

IMAGE-L

This mailing list is devoted to announcements and discussions related to image processing.

Subscribe through e-mail to listserv@vm3090.ege.edu.tr with the message "subscribe IMAGE-L" in the body of the message.

I.R.I.S. (Image Recognition Integrated Systems)

An international organization, I.R.I.S. manufactures and distributes a family of hardware and software imaging products in both PC and Macintosh platforms. This site provides numerous relevant links, as well as online technical support.

http://www.irisusa.com

Millenial Vision, Inc.

This is a most informative site, particularly for the novice in imaging systems. This site provides a wide range of products and services, as well as information on tutorials and a useful list of definitions.

http://www.mvimvi.com

Newsgroups

comp.doc.management

"Reading Between the Lines"

This informative article describes OCR and reviews various OCR products.

http://www.zdnet.com/cshopper/contents/9611/cshp0035.html

ScanSoft Inc.

A Xerox company, ScanSoft's site provides a wealth of information that can be especially helpful as you begin your research. Some of the areas the site offers include links to technical bulletins, product registration, a problem report form, and a tip of the week.

http://www.scansoftinc.com

Evaluation and Implementation Resources

Carras Group

This consulting firms helps companies with Business Process Management, reengineering training and team-building, workflow automation choice, and implementation. Past clients include Tandy, Estee Lauder, and Coca Cola.

http://www.carras.com/index.html

Delphi Group

The Delphi Group is a leading provider of advisory services, consulting, market research, education, seminars, and conferences in the areas of knowledge management, document management, workflow, and BPR. The firm has designed a "Workflow Factory," a product-independent methodology for workflow, reengineering, and BPR.

http://www.delphigroup.com/bprtools/bprtools.htm

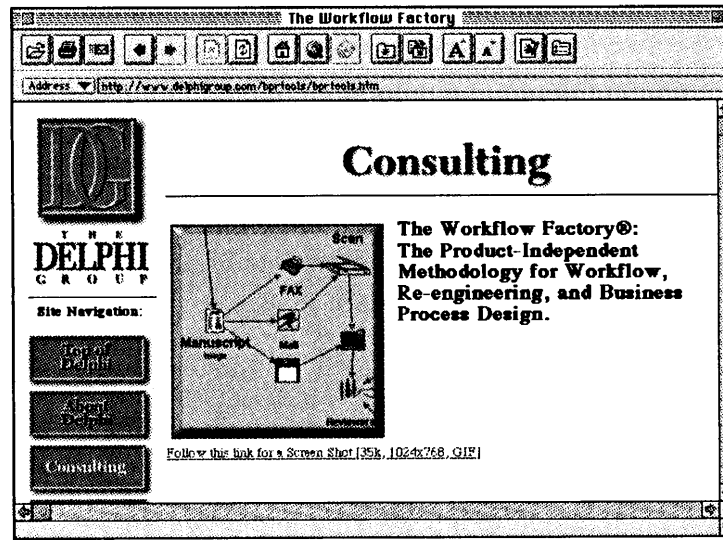


Figure 8.8 *The Delphi Group is one of many successful consulting firms specializing in BPR.*

Document Management Solutions, Inc.

This consulting team of professional technical experts and experienced users provides workflow analysis and integration services for electronic publishing and document management systems.

http://www.dmsi-world.com

E.W.S. & Co.
Provides engineered solutions for industry. For 35 years, E.W.S. has been a leader in automotive assembly processing and tool design, but recent diversification allows the company to provide solutions for any type of processing, logistical, or facilities management problem.

http://www.ewsco.com

Intellecte
This consulting firm helps clients analyze their business processes and implement image processing, document management, and automated workflow solutions.

http://www.intellecte.com/

John Costanza Institute of Technology
JCIT provides evaluation and implementation services, as well as software products, for workflow and BPR. At the Web site, you can find a current schedule of workshops conducted in the US and in Europe.

http://www.jcit.com

Professional Organizations and Associations

AICPA (American Institute of Certified Public Accountants)
http://www.aicpa.org

AIIM (Association for Information and Image Management International)
http://www/aiim.org

Aslib (Association for Information Management)
http://aslib.co.uk/index.htm

Business Process Management Group
http://www.bprsg.org.uk/

CPA Tech Online
http://cpatech.hbpp.com

DMA (Document Management Alliance)
http://www.aiim.org/dma/

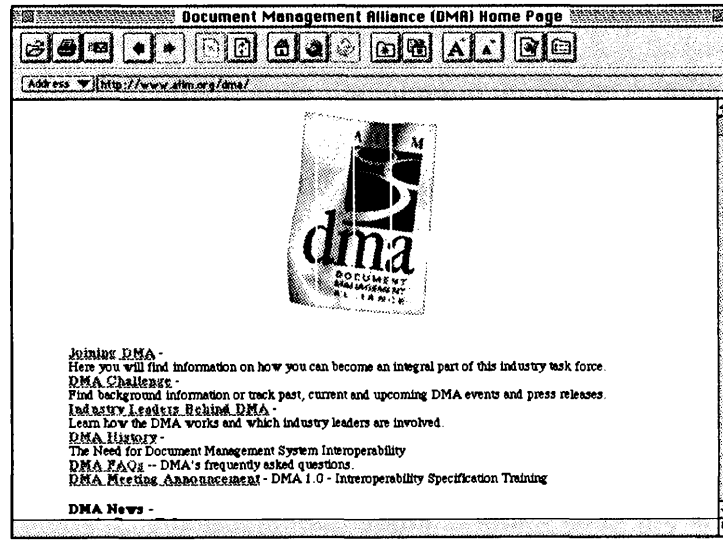


Figure 8.9
The DMA Web site.

IHRIM (International Association for Human Resources Information Management)
http://www.ihrim.org

IMC (International Information Management Congress)
http://www.iimc.org

TAWPI (The Association for Work Process Improvement)
http://www.tawpi.org/

Workflow and Reengineering International Association
http://www.waria.com

Workflow Management Coalition
http://www.wfmc.org/

Xplor (Electronic Document Systems Association)
http://www.xplor.org/index.html

SODAN

SODAN is an independent consultancy and publisher specializing in workflow management and associated technologies, including document management, business process modeling, and Web enabled workflow.

http://www.sodan.co.uk/

Workflow and Document Management Vendors

Action Technologies

From the home page, you can click to information, articles, and press releases on Action Technologies' workflow, enterprise workflow, and document management products.

http://www.actiontech.com/

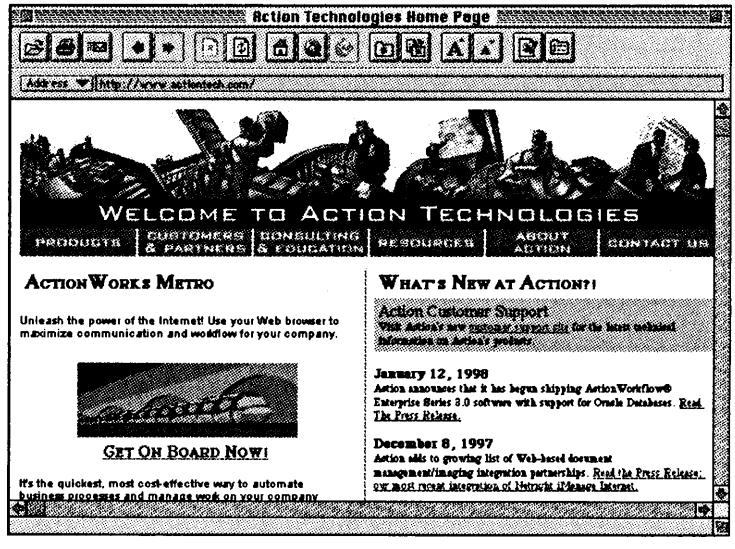


Figure 8.10 *Action Technologies' home page.*

Blue Ice

This company is a business systems development, marketing, and consulting group specializing in automated tools for the implementation of enterprise reengineering, business process management, and enabling technologies. The site organizes information on ice tools, a collection of Business Process Reengineering templates for Microsoft *Office* and Microsoft *Project.*

http://www.blueice.com/icetools.htm

Blue Ridge Technologies

Blue Ridge workflow software is optimized for Windows, Macintosh, and the Internet. Features include workflow, document imaging, text retrieval, and document management.

http://www.blueridge.com

CabinetNG

Cabinet Next Generation is a software system designed to integrate people, technology, and paper files together in one document management system for personal computers. The site provides information on CabinetNG workflow features.

http://www.cabinetng.com/index.html

Cambros

Cambros provides products and services for workflow and BPR, as well as a full range of business concerns, including Internet/intranet development, Java applications, networks, and data warehousing.

http://www.cambros.com

CD Dimensions

This company offers a wide array of products and services in document management. From scanners to storage systems, this site provides information on all aspects of imaging in a networked environment.

http://www.cddimensions.com

FileNET, Inc.

Providing information on all their integrated software suites, FileNET's site offers help in assessing imaging and workflow needs. In addition to a wealth of information on products and services, this site offers a free Cost/Benefit Analysis Tool download.

http://www.filenet.com

IBM Corporation

This industry giant maintains a Web site that is an excellent source for all the products and services that IBM provides. From the home page, you can access information on business solutions, case studies, and sales of specific products.

http://www.ibm.com

InConcert

A Xerox company, InConcert provides workflow solutions to automate and manage complex business processes. The site indexes information, articles about products, and software demos.

http://www.inconcertsw.com/prodinfo/welcome.htm

ISYS

Developers of a wide assortment of document management, imaging, and search products. The ISYS Web site offers product information, case studies, and free downloadable product demos.

http://www.isysdev.com

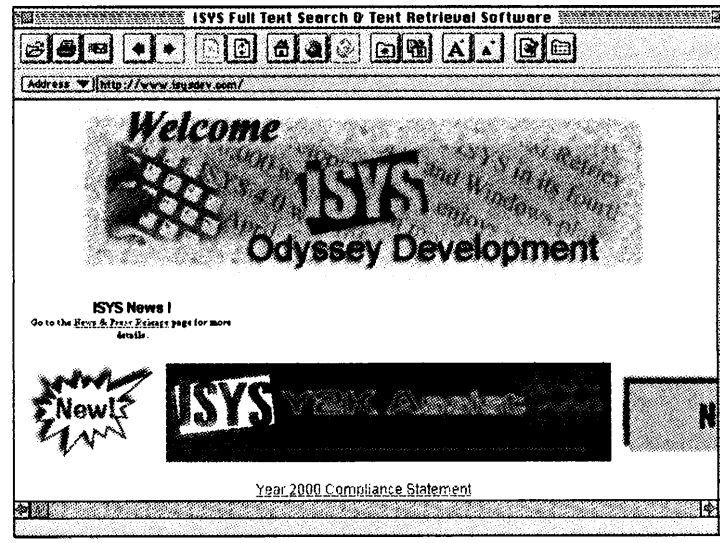


Figure 8.11
ISYS develops many products in the fields of document management and document image processing.

Knowledge Based Systems, Inc.
This company provides consulting, training, and products in the areas of Business Process Analysis (BPA), project and cost management, activity based costing, process modeling, data modeling, and functional analysis.

http://www.kbsi.com/

Logic Works
Logic Works provides modeling and design solutions covering client/server database design, data warehouse, and BPR. The tools are adaptable to a variety of leading technologies.

http://www.logicworks.com

Logical Software Solutions
LSS is a software development/business solutions firm providing enterprise engineering, software technology, and business process improvement tools.

http://www.lssc.com

Meta Software
This company offers a complete suite of BPR solutions, including workflow automation software and BPR modeling. The site also provides consulting services and training.

http://www.metasoftware.com

Mobius
This site provides a wealth of information on electronic document management products, services, and solutions; the links to other relevant sites are extensive.

http://www.mobius-inc.com

PC DOCS
At this site, PC DOCS hails its flagship product, DOCS Open, as well as its long list of document management systems and add-on products. This site offers customer success stories, system analysis information, and numerous relevant links.

http://www.pcdocs.com

PeopleSoft
This maker of workflow software groups information into industry categories, including Federal, financial services, healthcare, higher education, and private sector.

http://workflow.peoplesoft.com/index.htm

Scan Optics High Speed Document Management Page
This site provides reams of information on products and solutions, as well as links to distributors and resellers.

http://www.scanoptics.com

StaffWare

This comprehensive Web site gives detailed information about Staffware workflow solutions and maintains an archive of white papers describing how the products integrate with other software, such as Lotus *Notes* and Microsoft *BackOffice,* as well as with intranets. The "About Workflow" section provides a quick rundown on the basics of workflow systems.

http://www.staffware.com

TAC Systems Incorporated

The TAC Systems Networked Storage Products page provides information on all aspects of optical storage, as well as links to VAR resellers and an extensive online technical support system. Additionally, this site boasts updated downloads for product manuals and a useful FAQ page.

http://www.tacsys.com

Ultimus

Ultimus designs solutions for the automation of common administrative workflow processes using intranets and the Internet. Examples of administrative workflow include purchase requisitions, order processing, budgets, forecasts, surveys, expense reports, time sheets, change orders, and performance reviews. From the home page, you can download an interactive demo of the Ultimus *Workflow Suite.*

http://www.ultimus1.com

UMAX Technologies, Inc.

This company is a leader in scanning products and services for any sized business. Like many companies involved in imaging and workflow technology, Umax has created a Web site that allows the user to gather relevant information about the company and access myriad relevant links.

http:www.umax.com

Westbrook Technologies

This company is a leader in integrated document management software systems. At the Web site, you can access information on products like *FileMagic*, *FileMagic Plus*, and *CDExpress*, to name a few. Additionally, the site provides links to relevant sites and information.

http://www.filemagic.com

Workflow Systems, Inc.

This company provides advanced technologies for document management and workflow automation. WSI offers workflow analysis and design, integration of new software with existing systems, and custom-built applications.

http://www.workflowsystems.com/news.shtml

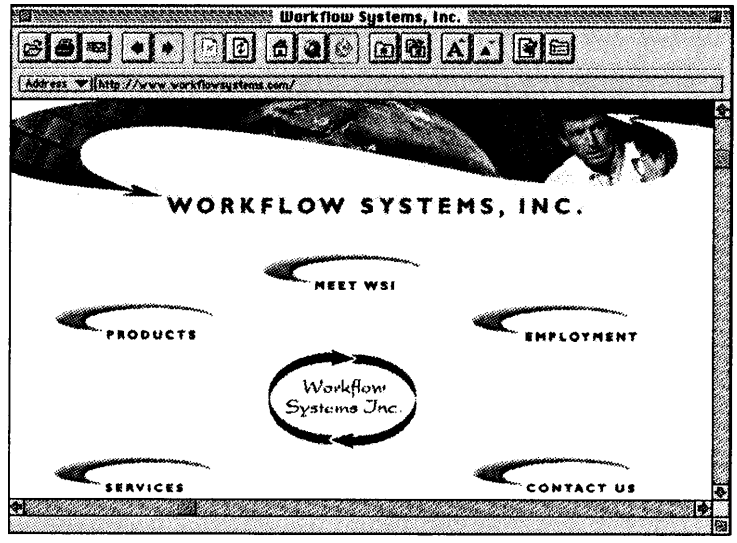


Figure 8.12
The home page of Workflow Systems, Inc.

Networks (General)

3Com

This leading manufacturer of Network Interface Cards provides technology news, product information, and customer support.

http://www.3com.com/

ARDIS

Claiming to be the largest provider of wireless networking in the US, this company offers information about its products and remote networking capabilities.

http://www.ardis.com

Arthur Andersen's Computer Risk Management

Consulting services for information systems auditing and security.

http://www.arthurandersen.com/bus_info/services/crm/index.htm

Artisoft

This site provides information on products, support and training, and upgrades from the makers of *LANtastic*.

http://www.artisoft.com/

Bay Networks

This company offers products and services for networks of all sizes, from desktop connectivity to service provider backbones. Specializes in "adaptive networking" for enterprise intranets. The site is searchable by key word and maintains a database about network products, services, technical innovations, and industry trends.

http://www.baynetworks.com

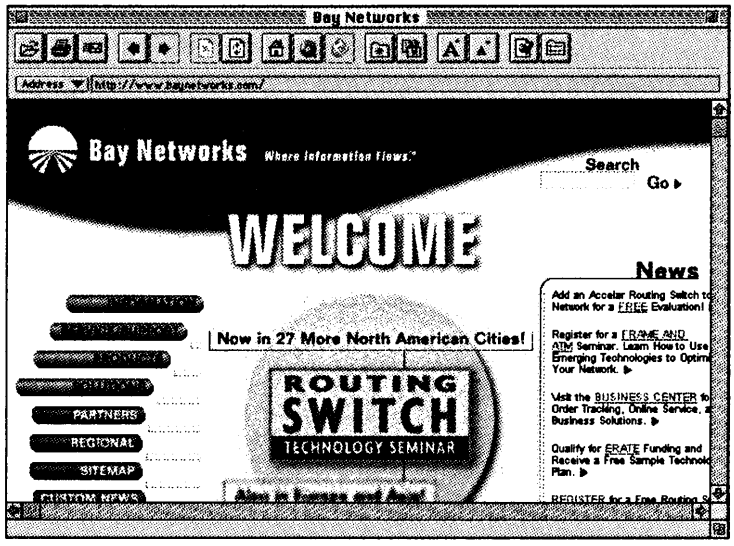


Figure 8.13
Bay Networks' home page.

Cabling FAQs

The Massachusetts Institute of Technology hosts this extensive list of Frequently Asked Questions about network cables.

ftp://rtfm/mit.edu/pub/usenet/news.answers/LANs/cabling-faq

Charles Spurgeon's Ethernet Page

This page discusses Ethernet LAN Technology, including the original 10 Mbps system, the 100 Mbps system, and Gigabit Ethernet.

http://wwwhost.ots.utexas.edu/ethernet/ethernet-home.html

Coffeehouse on the Internet

This is a question/answer and comment forum for persons interested in client/server computing. Randy Langel of IBM Southern California Consulting and Services answers daily questions and posts topics that discuss how organizations can implement client/server systems.

http://www.onr.com/oz/house.html

Compatible Systems, Inc.
Provider of Internet solutions for businesses.
http://www.compatible.com/

Data Communications on the Web
This free electronic magazine is designed for managers of corporate networks. The site includes a "Products and Services Buying Guide" that gives results of comparative lab tests of network products.
http://www.data.com/

Digital Equipment Corporation Network Products Page
This section of the company's site includes a product list, announcements of technology seminars, information on training and events, and "customer application stories," which detail real-world solutions. Company stories are indexed by company, industry, and product family.
http://www.networks.digital.com

Dobe Microsystems Online
This firm, located in Eden Prairie, Minnesota, specializes in standard and customized designs for small networks and workgroups. Maintains a *Technology and Trends* magazine and provides lists of readings, a technology news page, and product and consulting information.
http://www.dobemicro.com/

Glossary of Networking Terms
This helpful reference is maintained by Interforce Information, Inc.
http://www.interforce.com/i3spinff/technof/glossary.html

IBM Networking

This page provides links to network hardware products and software solutions developed by IBM. It also features news stories about networking technology, software support information, and numerous links to other networking resources.

http://www.networking.ibm.com

Inside NetWare

This electronic magazine offers tips for users and administrators of Novell *NetWare*. The publisher, Cobb Group, provides a free sample issue online.

http://www.cobb.com/inw/

InternetWeek

Billing itself as "The Home Page for the Networked Generation," this electronic magazine features a news department with audio updates; information about products and services for small networks and the Internet; and NetCentral, a list of online resources about the Internet, intranets, and Local Area Networks.

http://techweb.cmp.com/cw/cwi

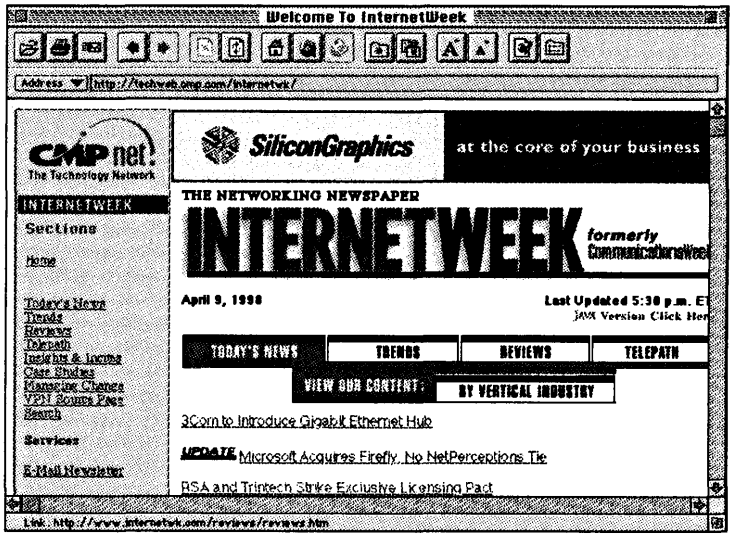


Figure 8.14
The InternetWeek networking newspaper.

Intranet Design Magazine
An online magazine devoted to intranet issues and edited by Gordon Benett, author of Introducing Intranets.
http://www.innergy.com

Intranet Resources
One of the oldest, most comprehensive online resources about intranets. Features include FAQs, a Discussion Board, Internet and intranet news, articles and white papers, and an "Introduction to Intranets" tutorial for beginners.
http://www.intrack.com/intranet/

Invisible Software
Contains a *Windows 95* troubleshooting guide for installation and implementation of advanced features, such as peer-to-peer networking.
http://www.invisiblesoft.com/

KMJ Communications
Maintains a database of Network Interface Cards organized by type and vendor.
http://www.kmj.com/nic.html

LAN Times Online
This electronic magazine offers news about networking products, feature articles on management and installation issues, analysis of industry trends, and a Testing Center that reviews products. The index is searchable by subject.
http://www.wcmh.com/lantimes

NetWare Connection Online
Aimed toward users of Novell *NetWare*, this site features articles, archives of past issues, and an online bookstore. A hard copy subscription is also available.

http://www.novell.com/nwc/

NetWare Users International
An independent, non-profit group of *NetWare* professionals maintains this site to support *NetWare* group users worldwide. Members receive product demonstrations, conference information, and a monthly newsletter.

http://www.novell.com/nui/

Network Computing Online
This electronic magazine explores all aspects of networking, from hardware and software to management issues. Includes news, features, and "how-to" articles about product implementation. The subscription is free.

http://techweb.cmp.com/nc/docs/

Network General
A provider of network fault and performance management solutions.

http://www.ngc.com

Network Interface Card Buyer's Directory
LANTimes Online hosts this directory of NICs, which includes a product index and direct links to vendors.

http://www.lantimes.com/lantimes/buyers/index/s111.html

Network Management Basics
This document, maintained by Cisco Systems, covers the background and evolution of networking and network management, including issues such as security and network auditing.

http://cio.cisco.com/univercd/data/doc/cintrnet/ito/55018.htm

Network World Fusion
A free electronic magazine about enterprise computing. Maintains a large list of other online resources.

http://www.nwfusion.com/

Networking: A Primer
This white paper at the Bay Networks site describes the evolution of Local Area Networks and explains basic terminology and operations, including how to connect a LAN to the Internet.

http://www.baynetworks.com/Products/Papers/wp-primer.html

Newsgroups

bit.listserv.novell
comp.dcom.lans.novell
comp.os.netware.announce
comp.os.netware.connectivity
comp.os.netware.misc
comp.os.netware.security
comp.dcom.lans.ethernet
comp.dcom.lans.misc
comp.dcom.lans.token-ring
comp.dcom.net-management
comp.protocols.tcp-ip

Novell
The company maintains a large database about its products and services. The home page links to separate departments, including *Intranetware, GroupWise, ManageWise, Beta Programs,* and *Novell/NT* integration.

http://www.novell.com/

Novell NetWare Self-Teaching Tutorials
A list of video tutorials that help users master new and advanced features of Novell *NetWare.* The tutorials are priced at $59.95 each.

http://www.candico.com/training/windows/n/netwarecne4.html

Novell Software Utilities
Maintained by Softseek.com, this site lists utilities and tools for Novell *NetWare,* including auditing, e-mail, and security helper applications. Click on the product name to read a review.

http://www.softseek.com/Utilities/Networking/Novell/index.htm

Small Business Networking Solutions
Sponsored by Joseph Williams and Associates, an independent consulting firm, this site offers overviews of *Windows 95* peer-to-peer networking and Novell systems.

http://jwa.perdido-key.com/network.htm

Virtual Motion
This company develops and markets software products for LAN-to-Internet access, network security, remote networking, and network management.

http://www.virtualmotion.com/

Windows 95.com
A service of Jenesys, LLC, this site maintains a database about *Windows 95,* covering user tips, 32-bit shareware and driver updates, and bugs and fixes. The Networking department features advice on installation and troubleshooting, and an Internet glossary.

http://www.windows95.com/

Security

Building and Auditing a Trusted Network Environment with Netware 4
Novell has included a great deal of general information about auditing networks at this site. They also market their own network software and auditing software.

http://occam.sjf.novell.com/nw410.english/trustenu/1.toc

CERT
Computer Emergency Response Team's server with articles about security concerns, tools for evaluating security, and an archive of alerts about break-in attempts.

ftp://cert.sei.smu.edu/pub

CERT Security Advisories
Indexed list of Computer Emergency Response Team's warnings issued to mailing lists.

WAIS cert-advisories.src

Check Point Software Technologies
Producer of network security solutions, including firewalls.

http://www.checkpoint.com/

CMS Technologies

A provider of physical security products for networks and stand-alone PCs.

http://www.cmstech.com/

The Computer Security Institute

This site provides links and information about computer and network security, including a series of electronic manuals for managers.

http://www.gocsi.com

Computer Security Resource Clearinghouse

Maintains security awareness and training information, publications, conferences, software tools, as well as security alerts and prevention measures.

ftp://csrc.ncsl.nist.gov

gopher://csrc.ncsl.nist.gov

http://csrc.ncsl.nist.gov/

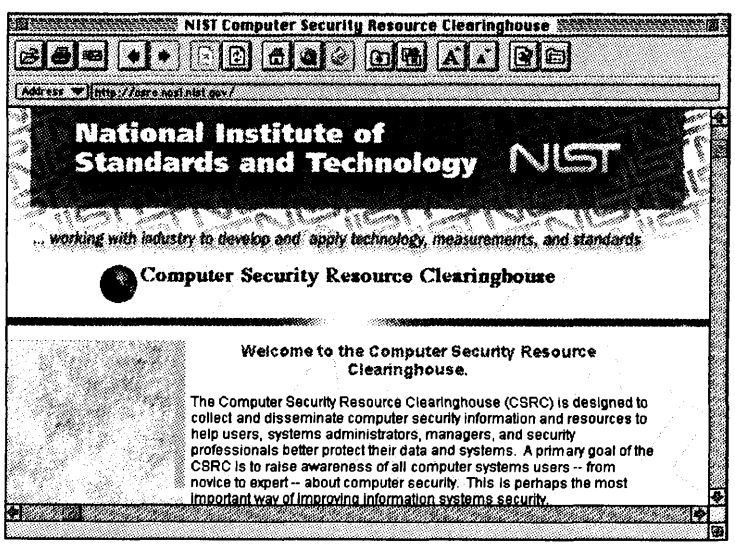


Figure 8.15 *Computer Security Resource Clearinghouse home page.*

Computers and Information Resources (CIRT) Home Page
This site provides links to resources about ethics and security. The site was established by Dr. David Grisham, Security Administrator for the University of New Mexico.

http://www.unm.edu/cirt/irc/svcs/secpage.html
ftp://ftp.unm.edu

Cylink Corporation
Specializes in encryption and network security solutions.

http://www.cylink.com/

Data Fellows Virus News Updates
At this site, you can access a database of information about computer viruses either alphabetically or through a keyword search.

http://www.datafellows.fi/news/vir-news/

Dr. Solomon's Online
An information center for users of Dr. Solomon's anti-virus software, this site also provides a "Virus Encyclopedia" and articles on viruses and hoaxes.

http://www.drsolomon.com

Dynasoft
This company's products include computer security solutions for client/server environments, including UNIX, and a smartcard-based PC security system.

http://www.dynas.se/

Firewalls mailing list
An e-mail discussion group focused on the subject of firewalls and Internet security.

Subscribe through e-mail to majordomo@greatcircle.com
with message: subscribe firewalls-digest

GreatCircle Associates
A firm that specializes in training about and consulting on Internet security firewall systems.

http://www.greatcircle.com/

A Guide to Understanding Audit in Trusted Systems
This useful resource for auditors is presented by the National Computer Security Center and offers guidelines for Internet and intranet security audits.

http://bilbo.isu.edu/security/isl/audit.html

IBM Anti-Virus Online
An electronic magazine that disseminates information about computer viruses through articles, virus and hoax alerts, and technical support from IBM labs.

http://www.av.ibm.com/

Information Security Discussion List
A non-moderated Internet discussion list for information security and auditing professionals in government, industry, and academic institutions.

Subscribe through e-mail to listserv@etsuadmn.etsu.edu with message: SUB INFSEC-S yourname

International Computer Security Association
Formerly the National Computer Security Association, this independent organization acts as a clearinghouse on security issues affecting networks and stand-alone PCs. The site offers information on cryptography, firewalls, and anti-virus products, and hosts a message board for the discussion of security topics.

http://www.ncsa.com

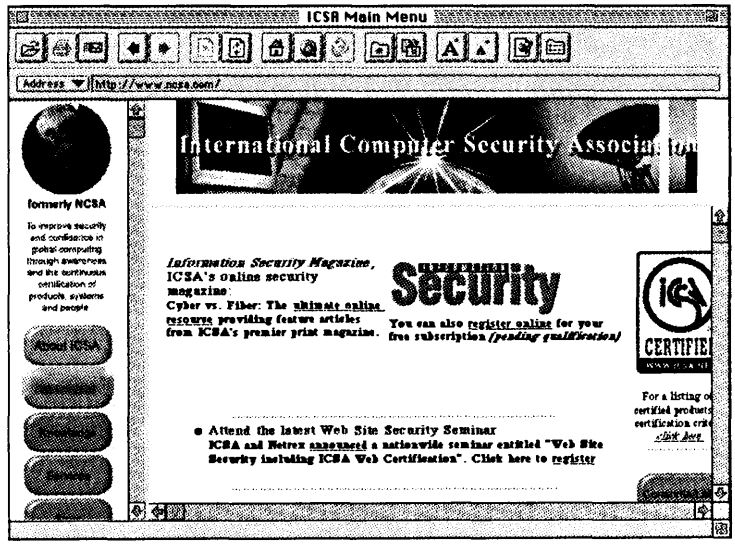


Figure 8.16 *International Computer Security Association home page.*

InterNIC Site Security Handbook

Currently under revision, this document is a popular reference guide for Internet security issues.

http://internic.net/nic-support/fyi/rfc2196.html

McAfee Software

Maker of the anti-virus software, *VirusScan.*

http://www.mcafee.com

Memco Software

Provides enterprise security solutions, including UNIX, single sign-on, and distributed security administration. The site also offers security news and resources.

http://www.memco.com/

Netscape Data Security
Netscape Communications devotes a section of its site to discussing Internet security concerns and how its SSL protocol works.

http://home.mcom.com/newsref/ref/netscape-security.html

RSA Data Security, Inc.
This network and computer security software vendor publishes white papers as well as a FAQ on cryptography export laws, which can be downloaded and read in *Adobe Acrobat* PDF format.

http://www.rsa.com

Security Dynamics
Provides network security hardware and software products. Holds a patent on the SecurID Card, a personal identification token supported by various host, server, and network systems.

http://www.securid.com

Security First Technologies
Develops system security for UNIX, networks, and Internet communication authentication products.

http://www.sware.com/

Snake Oil FAQ
This document by Matt Curtin, chief scientist with Megasoft, Inc., explains how encryption systems work and offers tips on how to choose encryption software.

ftp://rtfm.mit.edu/pub/usenet/news.answers/
cryptography-faq/snake-oil

Symantec Antivirus Research Center
Symantec, maker of anti-virus software, maintains a research library about computer viruses and Symantec products, and gives special coverage of Macintosh viruses.

http://www.symantec.com/avcenter.index.html

Technologic
An Atlanta-based corporation that specializes in network security and firewalls.

http://www.tlogic.com/

Trusted Information Systems, Inc.
Provides security analysis and risk assessments, firewalls, mail encryption, and other tools for network and computer systems security.

http://www.tis.com

The World Wide Web Security FAQ
A frequently-browsed FAQ providing an overview of security concerns and solutions. Topics include: threats to security; how to run a secure server; how to protect confidential documents; CGI scripts; client-side security; and information on Windows, UNIX, and Macintosh servers.

http://www.genome.wi.mit.edu/WWW/faqs/
www-security-faq.html

Appendix A
The Workflow Reference Model

Workflow Management Coalition
The Workflow Reference Model

Document Number TC00-1003

Document Status - Issue 1.1

29-Nov-94

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Editor's Note: The numbering system in this document is that of the Workflow Management Coalition.

Table of Contents

1. Introduction

1.1. Background

Work Flow Management is a fast evolving technology which is increasingly being exploited by businesses in a variety of industries. Its primary characteristic is the automation of processes involving combinations of human and machine-based activities, particularly those involving interaction with IT applications and tools. Although its most prevalent use is within the office environment in staff intensive operations such as insurance, banking, legal and general administration, etc, it is also applicable to some classes of industrial and manufacturing applications.

Many software vendors have WFM 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, as yet, no standards defined to enable different WFM products to work together, which is resulting in incompatible "islands" of process automation.

The WFM Coalition is a grouping of companies who have joined together to address the above situation. It has been recognised that all work flow management products have some common characteristics, enabling them potentially to achieve a level of interoperability through the use of common standards for various functions. The WFM Coalition has been established to identify these functional areas and develop appropriate specifications for implementation in workflow products. 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.

1.2. Purpose

The purpose of this document is to provide a framework to support the development of the various specifications described above. It provides a common "Reference Model" for workflow management systems identifying their characteristics, terminology and components, enabling the individual specifications to be developed within the context of an overall model for workflow systems. The detailed specifications will be developed as separate documents.

1.3. Scope

This document covers the concepts, terminology, general structure of a workflow management system, its major functional components and the interfaces and information interchange flows between them. It identifies the areas appropriate for standardisation and illustrates the potential interoperability scenarios which may be supported through the use of common standards. It also discusses, where appropriate, the applicability of existing standards to workflow management systems and their integration with other standard IT services. It does not cover wider aspects of business process engineering which lie outside the use of information technology to support the business process.

1.4. Audience

The intended audience of this document is the work flow coalition membership as well as others that are interested in the efforts of the coalition and wish to understand the top level technical architecture which underpins the work of the Coalition. The document is intended for a moderately technical audience but extensive prior knowledge of workflow systems is not assumed.

1.5. How to read this document

Chapter 2 provides a general introduction to the concepts of workflow systems technology, its evolution, the business context and background on the types of systems which may incorporate this type of technology. If you are unfamiliar with workflow technology you should start here; if you are already familiar with workflow management systems, consider starting at Chapter 3.

Chapter 3 discuses the internal structure of workflow systems, the major functional components and the nature of their interactions. It introduces the top level architecture and identifies the various interfaces which may be used to support interoperability between different system components and integration with other major IT infrastructure components.

Chapter 4 provides a general overview of the workflow application programme interface (WAPI), comments on the necessary protocol support for open interworking and discusses the principles of conformance to the specifications. It identifies those aspects of the specifications which are required to support various classes of interoperability. The detailed WAPI specifications are published as separate specification documents (see cross references below).

1.6. Cross References

WFMC SC00 - 1002	WFM Coalition Proposal Information
WFMC SC00 - 1006	WFM Coalition Technical Committee Operations
WFMC TC00 - 1008	Interoperability White Paper
WFMC TC00 - 1009	Client application API descriptions
WFMC TC00 - 1010	Workflow Definition Read/Write Descriptions
WFMC TC00 - 1011	Terminology and Glossary
WFMC TC00 - 1013	Workflow APIs - Naming Conventions

1.7. Revision History

This issue (1.1) is the second major version, incorporating the following changes from the previous version (0.6):

- Incorporation of updated terminology and glossary
- Incorporation of monitoring and metrics interface within the reference model
- Updated material on workflow interoperability (derived from the Coalition work on the Workflow Interoperability White Paper) and its associated interface operations, clarifying the various interoperability scenarios and proposed areas for open interoperability
- Incorporation of comments on the (optional) use of organisational roles within the basic model
- Incorporation of comments clarifying the use of workflow relevant data within the basic model
- Incorporation of minor changes to align with the output of other Coalition Working Groups, particularly the initial API specifications
- Improvements in clarification and consistency in various areas throughout the text, including amended document structure

Version 1.1 incorporates minor editorial changes as a result of the TC meeting in Vienna (10th Nov 94), plus revisions to improve consistency with other Coalition documentation.

2. Workflow Systems Overview

2.1. What is Workflow?

Workflow is concerned with the automation of procedures where documents, information or tasks are passed 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 and it is to this area that the work of the Coalition is directed.

Workflow
The computerised facilitation or automation of a business process, in whole or part.

Workflow is often associated with Business Process Re-engineering, which is concerned with the assessment, analysis, modelling, definition and subsequent operational implementation of the core business processes of an organisation (or other business entity). Although not all BPR activities result in workflow implementations, 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, for example implementations to automate an existing business procedure.

A Workflow Management System is one which 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.

Workflow Management System
A system that completely defines, manages and executes "workflows" through the execution of software whose order of execution is driven by a computer representation of the workflow logic.

An individual business process may have a life cycle ranging from minutes to days (or even months), depending upon its complexity and the duration of the various constituent activities. Such systems may be implemented in a variety of ways, use a wide variety of IT and communications infrastructure and operate in an environment ranging from small local workgroup to inter-enterprise. The WFMC Reference Model thus takes a broad view of workflow management, which is intended to accommodate the variety of implementation techniques and operational environments which characterise this technology.

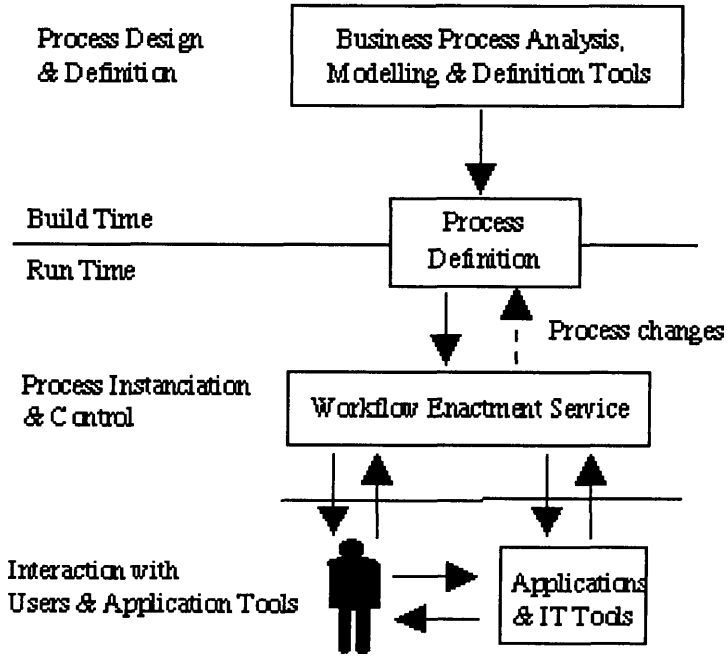
Despite this variety, all WFM systems exhibit certain common characteristics, which provide a basis for developing integration and interoperability capability between different products. The Reference Model describes a common model for the construction of workflow systems and identifies how it may be related to various alternative implementation approaches.

At the highest level, all WFM systems may be characterised as providing support in three functional areas:

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

Figure 1 illustrates the basic characteristics of WFM systems and the relationships between these main functions.

Figure 1
Workflow System Characteristics



2.1.1. Build-time Functions

The Build-time functions are those which result in a computerised definition of a business process. During this phase, a business

process is translated from the real world into a formal, computer processable definition by the use of one or more analysis, modelling and system definition techniques. The resulting definition is sometimes called a process model, a process template, process metadata, or a process definition. For purposes of this document, the term 'process definition' will be used.

Process Definition
The computerised representation of a process that includes the manual definition and workflow definition.

A process definition normally 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. The process definition may be expressed in textual or graphical form or in a formal language notation. Some workflow systems may allow dynamic alterations to process definitions from the run-time operational environment, as indicated by the feed-back arrow in the above diagram.

Coalition members do not consider the initial creation of process definitions to be an area of standardisation. Rather, this is considered to be a major distinguishing area between products in the marketplace. However, the result of the Build-time operation, the process definition, is identified as one of the potential areas of standardisation to enable the interchange of process definition data between different build-time tools and run-time products.

2.1.2. 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 and invoking the appropriate human and IT application resources, etc. These run-time process control

functions act as the linkage between the process as modelled within the process definition and the process as it is seen in the real world, reflected in the runtime interactions of users and IT application tools. The core component is the basic workflow management control software (or "engine"), responsible for process creation & deletion, control of the activity scheduling within an operational process and interaction with application tools or human resources. This software is often distributed across a number of computer platforms to cope with processes which operate over a wide geographic basis.

2.1.3. Run-time Activity Interactions

Individual activities within a workflow process are typically concerned with human operations, often realised in conjunction with the use of a particular IT tool (for example, form filling), or with information processing operations requiring a particular application program to operate on some defined information (for example, updating an orders database with a new record). Interaction with the process control software is necessary to transfer control between activities, to ascertain the operational status of processes, to invoke application tools and pass the appropriate data, etc. There are several benefits in having a standardised framework for supporting this type of interaction, including the use of a consistent interface to multiple workflow systems and the ability to develop common application tools to work with different workflow products.

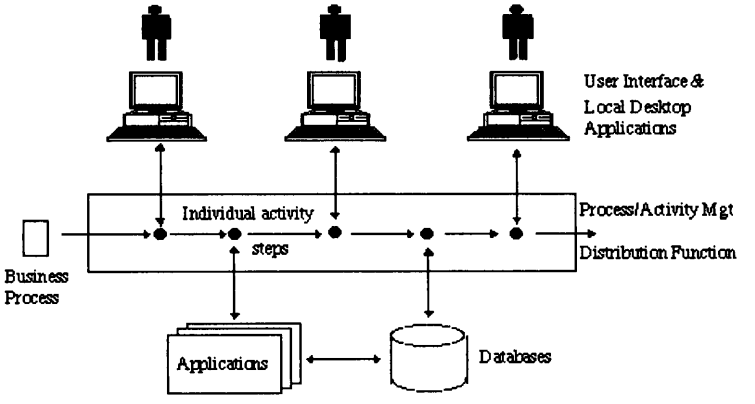
2.1.4. Distribution & System Interfaces

The ability to distribute tasks and information between participants is a major distinguishing feature of workflow runtime infrastructure. The distribution function may operate at a variety of levels (workgroup to inter-organisation) depending upon the scope of the workflows; it may use a variety of underlying communications mechanisms (electronic mail, messaging

passing, distributed object technology, etc). An alternative top-level view of workflow architecture which emphasises this distribution aspect is shown in figure 2 on the following page.

The workflow enactment service is shown as the core infrastructure function with interfaces to users and applications distributed across the workflow domain. Each of these interfaces is a potential point of integration between the workflow enactment service and other infrastructure or application components.

Figure 2 *Distribution within the workflow enactment service*



The flow of work may involve the transfer of tasks between different vendors workflow products to enable different parts of the business process to be enacted on different platforms or sub-networks using particular products suited to that stage of the process. In this scenario the flow within the central box passes between two or more workflow products - for example activities 1, 2 and 5 may be executed by one workflow system and activities 3 and 4 by a different system, with control passed between them at appropriate points within the overall workflow. Standards to support this transfer of workflow control enable the development of composite workflow applications using several

different workflow products operating together as a single logical entity.

The full range of interfaces being defined by the WFM Coalition therefore covers:

- specifications for process definition data and its interchange
- interfaces to support interoperability between different workflow systems
- 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

These are further developed in Section 3.

2.2. 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 recognised in its own right. The evolution of workflow as a technology has thus encompassed a number of different product areas.

2.2.1 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.

2.2.2 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 organisation 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.

2.2.3 Electronic Mail & Directories

Electronic mail provides powerful facilities for distributing information between individuals within an organisation or between organisations; 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 organisation 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.

2.2.4 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 focussed 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.

2.2.5 Transaction-based Applications

For many years applications to support certain classes of business procedures ("transactions") have been developed using transaction management facilities within TP monitors and/or Database Management software. From the initial centralised 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. Over time, this is leading to a requirement to consolidate workflow capabilities to control the business procedures with the ability to invoke traditional transaction application programs for appropriate parts of the business process, as well as other types of application (document or office based, etc..) for other parts of the business process.

2.2 5 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 generalised to support a wider, business-oriented view of process and a wider range of application tools - offering a more general workflow capability.

2.2.6 BPR and Structured System Design Tools

Business Process Re-engineering tools have provided IT based support for the activities of analysing, modelling and (re-)defining the core business processes of an organisation and the potential effects of change in such processes or organisational 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 organisational 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.

2.2.7 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 focussed 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 recognised 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.

2.3. Product Implementation Model

Overview

Despite the variety in workflow products in the market, it has proved feasible to construct a general implementation model of a workflow system which can be matched to most products in the marketplace thereby providing a common basis for developing interoperability scenarios.

This approach identifies the main functional components within a workflow system and the interfaces between them as an abstract model. It is recognised that many different concrete implementation variants of this abstract model will exist and therefore the interfaces specified may be realised across a number of different platform and underlying distribution technologies. Furthermore not all vendors may choose to expose every interface between the functional components within the model; this will be dealt with by the specification of a variety of conformance levels which will identify the particular interworking functions where open interfaces are supported for multivendor integration.

The main functional components of a generic workflow system are illustrated in figure 3.

The generic model has three types of component:

- software components which provide support for various functions within the workflow system (shown in dark fill)
- various types of system definition and control data (shown unfilled) which are used by one or more software components
- applications and application databases (shown in light fill) which are not part of the workflow product, but which may be invoked by it as part of the total workflow system

The roles of the major functional components within this system are described below.

Process Definition Tool

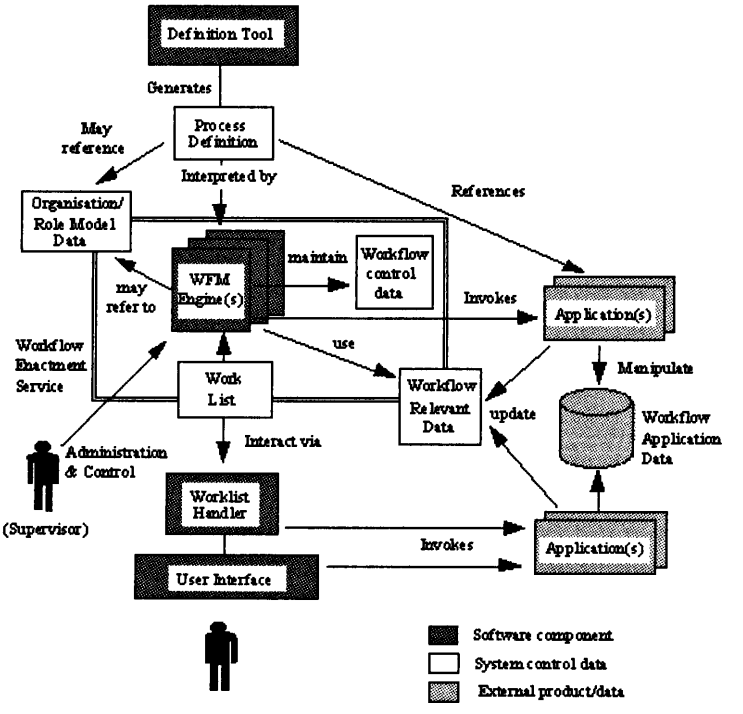
The process definition tool is used to create the process description in a computer processable form. This may be based on a formal process definition language, an object relationship model, or in simpler systems, a script or a set of routing commands to transfer information between participating users. The definition tool may be supplied as part of a specific workflow product or may be part of a business process analysis product, which has other components to handle analysis or modelling of business operations. In this latter case there must be a compatible interchange format to transfer the process definitions to/from the run-time workflow software.

Process Definition

The process definition contains all necessary information about the process to enable it to be executed by the workflow

enactment software. This includes information about its starting and completion conditions, constituent activities and rules for navigating between them, user tasks to be undertaken, references to applications which may to be invoked, definition of any workflow relevant data which may need to be referenced, etc.

Figure 3
Generic Workflow Product Structure



The process definition may refer to an Organisation / Role model which contains information concerning organisational structure and roles within the organisation (eg an organisational directory). This enables 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. The workflow enactment service then has the responsibility of linking organisational entities or roles with the specific participants within the workflow runtime environment.

Workflow Enactment Service

The workflow enactment software 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. This is done through one or more co-operating workflow management engines, which manage(s) the execution of individual instances of the various processes. The workflow enactment service maintains internal control data either centralised or distributed across a set of workflow engines; this workflow control data includes the internal state information associated with the various process and activity instances under execution and may also include checkpointing and recovery/restart information used by the workflow engines to co-ordinate and recover from failure conditions.

The process definition, in conjunction with any (run-time) workflow relevant data is used to control the navigation through the various activity steps within the process, providing information about the entry and exit criteria for individual activity steps, parallel or sequential execution options for different activities, user tasks or IT applications associated with each activity, etc. This may require access to organisation / role model data, if the process definition includes constructs relating to these entity types.

The workflow engines also include some form of application tool invocation capability to activate applications necessary to execute particular activities. The generality of such mechanisms may vary greatly, with some simple systems only offering support of a single fixed tool such as a form or document editor, whereas others may provide methods for the invocation of a wider range of tools, both local and remote to the Workflow engine.

Workflow Relevant Data and Application Data

Where process navigation decisions, or other control operations within the workflow engine, are based on data generated or updated by workflow application programs, such data is accessible to the workflow engine and termed workflow relevant data (also known as "case data"); this is the only type of application data accessible to the workflow engine. Workflow application data is manipulated directly (and only) by the invoked applications, although the workflow engines may be responsible for transferring such data between applications (if necessary), as different applications are invoked at different activity points within the workflow process.

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. This process may be invisible to the workflow participants with the worklist maintained within the workflow software and the user being presented sequentially with the next task to be performed. On other systems 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.

Worklist Handler & User Interface

The worklist handler is a software component which manages the interaction between workflow participants and the workflow enactment service. It is responsible for progressing work requiring user attention and interacts with the workflow enactment software via the worklist. In some systems, this may be little more than a desktop application providing a simple in-tray of work items awaiting user attention. In other systems this may be far

more sophisticated, controlling the allocation of work amongst a set of users to provide facilities such as load balancing and work reassignment. In addition to these worklist handling functions, workflow engines typically support a wider range of interactions with client applications, including sign-on and -off of workflow participants, requesting the commencement of an instance of particular process types, requesting workitems queued for particular participants, etc. Within the reference model the term *workflow client application* is used in preference to "worklist handler" to reflect this wider range of potential usage, which includes process control functions as well as worklist manipulation.

In the diagram the User Interface is shown as a separate software component, responsible for the look and feel of the user dialogue and control of the local interface with the user. In certain systems this may be combined with the Worklist Handler into a single functional entity. It also expected that some client applications will interact with several different workflow services, enabling workitems from such services to be consolidated into a unified task list for presentation to participants via a common user interface.

Invocation of local applications may be necessary to support the user in the particular tasks to be undertaken. This may be done by the Worklist Handler, for example at the time of presenting workitems to the user, or may be the responsibility of the user, using general facilities available at the User Interface software to load appropriate supporting applications. There is a distinction between application invocation at the Worklist Handler/User Interface (which is not directly controlled from the workflow engine and may not be visible to it) and direct application invocation by the workflow enactment software.

Supervisory Operations

Within a workflow system there are a number of supervisory functions which are normally provided; these are typically supported on the basis of supervisory privilege to a particular workstation or user(s). These functions may enable supervisors 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, etc. Where distributed workflow engines are used there may need to be specific commands to transfer such control operations or (partial) responses between different workflow engines to provide a single administrative interface.

Exposed and Embedded Interfaces

Whilst the majority of workflow products can be related to the above structure, not all products offer exposed interfaces between the various individual system functional components; some products may implement several functional components together as a single logical entity with the interfaces embedded within the software component and not available for third party product use. The WFM specifications will identify, for each interface, the role of that interface in achieving interoperability, so that individual products can identify conformance against particular interoperability criteria. (For example, a particular product might offer an exposed interface for worklist manipulation but not for process definition interchange.)

2.4 Alternative Implementation Scenarios

The structural model of a generic workflow product identifies a series of software components and interfaces. In a concrete product implementation this structure may be realised in a variety of different ways; this is an important area of product differentiation. Major distinguishing factors between products

include choice of platform and network infrastructure, as well as the inherent functionality of the workflow software itself. This section illustrates how the generic model copes with this variety of implementation approach, whilst retaining visible interfaces to facilitate multi-vendor product interworking.

A full discussion of all potential implementation design issues lies outside the scope of this document. Amongst the main alternatives considered are:

- centralised or distributed workflow enactment service
- worklist handler location(s) and distribution mechanism

Workflow Enactment Software - Alternative Approaches

The workflow enactment software consists of one or more workflow engines, which are responsible for managing all, or part, of the execution of individual process instances. This may be set up as a centralised system with a single workflow engine responsible for managing all process execution or as a distributed system in which several engines cooperate, each managing part of the overall execution.

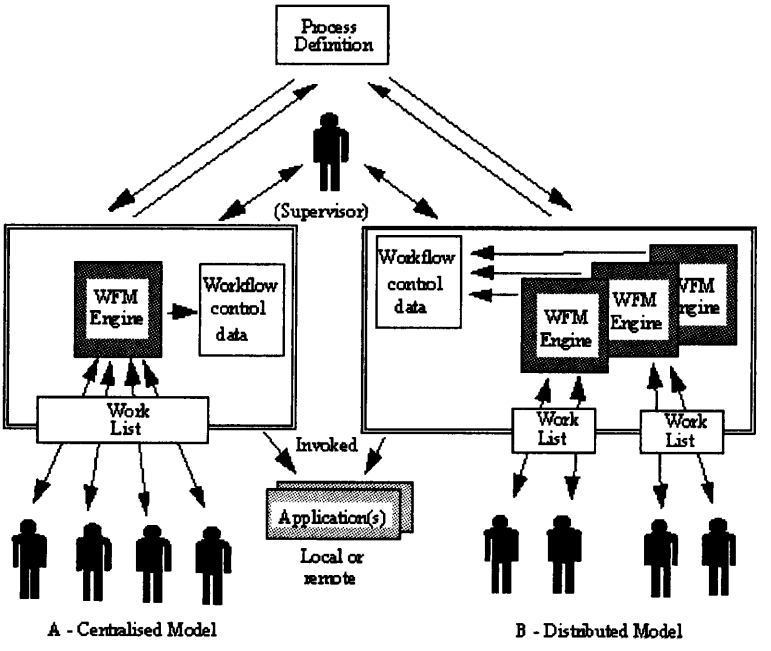


Figure 4
Standard workflow enactment service boundary

In the above scenario the two workflow services exhibit common properties at the boundary but follow different internal implementation architectures, whose characteristics may be product dependent.

Where several workflow engines cooperate in the execution of a process instance, the control data associated with the process instance must be accessible to the different engines. This workflow control data may be distributed across the engines, located at a master engine or held as a shared filestore resource, or some combination of these. The particular implementation approaches by which this data is made available to the engines is considered to be outside the current scope for standardisation. Similarly, the process definition data may be distributed across all engines or parts transferred to individual engines from some master source during process execution. Interfaces to handle supervisory operations or application invocation may be

supported as distributed features or localised to particular engines. The implementation approaches to manage distribution of workflow across multiple engines are thus complex and numerous.

The approach taken by the Coalition is to define a boundary around the workflow enactment service, which exhibits various standard functional attributes accessible via a set of common APIs. The internal mechanisms by which the enactment service delivers this capability are not defined and may include one or more homogenous workflow engines, communicating in a variety of ways.

To support interworking between different products, interfaces are defined for specific co-operative functions between different enactment services so that a composite multi-vendor workflow application may execute parts of a particular process on different enactment services (each comprising one or more specific vendors workflow engines). This is considered a more realistic approach (except perhaps in the long term) than attempting to standardise the internal interfaces and state data of a distributed workflow service.

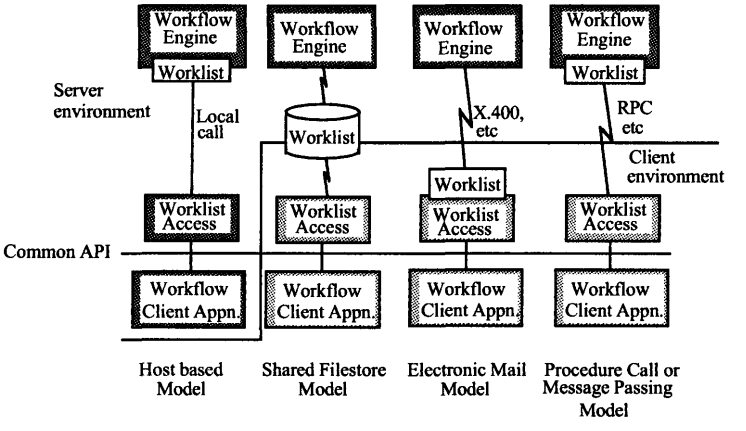
Workflow Client Applications - Alternative Approaches

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

There are various possible product implementations of this worklist interaction model depending upon the nature of the product implementation and, in particular, on the type of infrastructure used to support the distribution of worklist handling.

Four possible approaches are illustrated in the following diagram, one supporting centralised worklist handling and three using a distributed worklist handler function.

Figure 5
Alternative client worklist handler implementations



The four example scenarios are as follows:

- Host based Model - the client worklist handler application is host based and communications with the worklist via a local interface at the workflow engine. In this case the user interface function may be driven via a terminal or a remote workstation MMI.
- Shared filestore model - the worklist handler application is implemented as a client function and communication is via a shared filestore, which lies on the boundary between host and client platform environments and is accessible to both.

- Electronic mail model - communication is via electronic mail, which supports the distribution of work items to individual participants for local processing. In this scenario the worklist would normally lie at the client.
- Procedure Call or Message Passing model - communication is via procedure call, or other message passing mechanism. In this scenario the worklist may be physically located on the workflow engine or at the worklist handler according to the particular implementation characteristics.

In each case it is feasible to construct a common API, which supports worklist handler access to the worklist and workflow engine functions, but which is located behind a specific worklist access function appropriate to the product implementation style.

2.5. The Need for Standardisation

The basic rationale to achieve standardisation of important workflow functional interfaces is driven by two major considerations:

- Ongoing support for business re-engineering & operational flexibility
- Integration requirements resulting from product specialisation and market variety

Business re-engineering & operational flexibility

The strategic importance of business process re-engineering and associated workflow implementations will lead to the requirement for sufficient flexibility of product to cope with ongoing business change, indeed this is one of the key motivations behind the use of the technology. This will include cases where several separate business processes have been implemented using different workflow products, and require to be

re-engineered into a single composite process involving interaction between existing workflows. These requirements may arise due to reorganisation, legislative changes, changing business objectives, etc. As the use of electronic data interchange develops, these workflows are likely to embrace inter-organisation communications as well as those internal to a single organisation.

In these situations it is extremely likely that different products will be in use within different organisations or departments and the inability of such products to interoperate will cause a significant potential problem in coping with business change. The market projections for the penetration of workflow technology suggest very widespread adoption during the next 5-10 years, leading to the potential incompatibility problems seen in previous generations of information technology unless appropriate interworking standards are developed.

The early availability of such standards with subsequent product implementations will provide a degree of confidence to the market critical to the effective take up of workflow technology.

Specialisation and market variety

There are currently estimated to be in excess of a hundred different workflow (and related) products in the market, focussed on different aspects of functionality and data/application integration. The development of interworking standards will allow application choice of "best of breed" products for individual aspects of a workflow implementation. This may embrace process analysis and definition products from one vendor, coupled with workflow engine software from a different vendor, integrated with a client worklist handling application from a third.

An individual workflow may conveniently be broken down into several sub-processes each enacted on a specialist product suited to the specific data type, platform or network environment related to that particular sub-process. The availability of interworking standards will provide the opportunity to implement composite solutions to business process requirements, linking several such specialist products to meet the precise needs of the process.

Furthermore, many workflow applications require to integrate with other, existing or emerging applications, ranging from desktop office functions to corporate transaction processing / database. The provision of a standard interface to support this will reduce product complexity and the amount of specialist integration skills necessary during implementation.

Members of the Coalition, both vendors and users, recognise the potential importance of standards in all these areas and are co-operating in their definition.

3. Workflow Reference Model

3.1. Overview

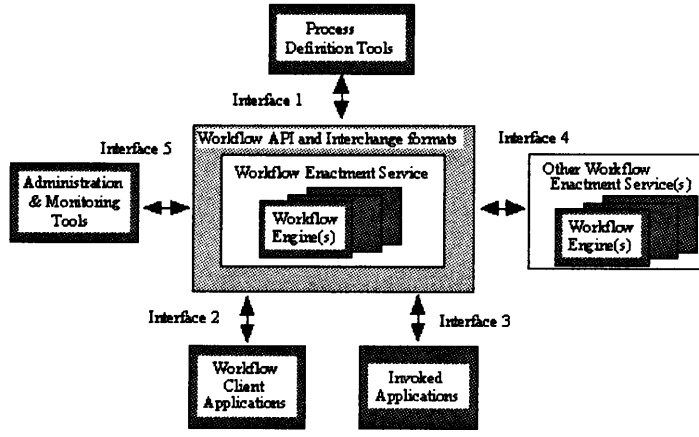
The Workflow Reference model has been developed from the generic workflow application structure by identifying the interfaces within this structure which enable products to interoperate at a variety of levels. All workflow systems contain a number of generic components which interact in a defined set of ways; different products will typically exhibit different levels of capability within each of these generic components. To achieve interoperability between workflow products a standardised 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.

3.2. The Workflow Model

Figure 6 illustrates the major components and interfaces within the workflow architecture.

Figure 6
Workflow Reference Model - Components & Interfaces



The architecture identifies the major components and interfaces. These are considered in turn in the following sections. As far as possible, the detail of the individual interfaces (APIs and interchange formats) will be developed as a common core set using additional parameters as necessary to cope with individual requirements of particular 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. Many of the functions within the 5

interface areas are common to two or more interface services hence it is more appropriate to consider WAPI as a unified service interface which is used to support workflow management functions across the 5 functional areas, rather than 5 individual interfaces.

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, utilising 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.

> **Workflow Enactment Service**
> *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 the model adopted, there is a logical separation between this process and activity control logic, which constitutes the workflow enactment service, and the application tools and end user tasks which constitute the processing associated with each activity. This separation provides the opportunity for a wide range of industry standard or user specific application tools to be integrated within a particular workflow application.

Interaction with external resources accessible to the particular enactment service occurs via one of two interfaces:

- The client application interface, through which a workflow engine interacts with a worklist handler, responsible for organising work on behalf of a user resource. It is the responsibility of the worklist handler to select and progress individual work items from the work list. Activation of application tools may be under the control of the worklist handler or the end-user.
- The invoked application interface, which enables the workflow engine to directly activate a specific tool to undertake a particular activity. This would 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. By using a standard interface for tool invocation, future application tools may be workflow enabled in a standardised manner.

These interfaces are described in sections 3.5 and 3.6 respectively.

Within this section, the workflow enactment service has been discussed as a single logical entity, although physically it may be either centralised or functionally distributed.

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 synchronise

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.

Where heterogeneous products are involved, a standardised interchange is necessary between workflow engines. Using interface 4, the enactment service may transfer activities or sub-processes to another (heterogeneous) enactment service for execution. Within the Workflow Reference Model this is termed Workflow Engine Interchange and is considered under section 3.7.

Common administration and monitoring functions may also be required in such a heterogeneous environment; these are considered in section 3.8.

3.3.2. The Workflow Engine

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

Workflow Engine
A software service or "engine" that provides the run time execution environment for a workflow instance.

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 workitems 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

An 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. The mechanisms by which process execution is organised across the various workflow engines and protocols and interchange formats used to support this are product specific and not standardised.

A heterogeneous workflow enactment service comprises two or more homogeneous services, which follow common standards for interoperability at a defined conformance level. 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

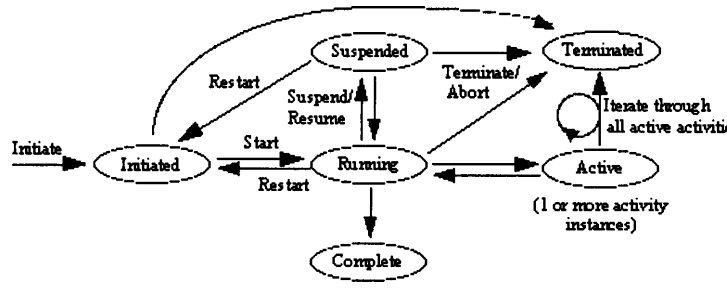
Support for common workflow control data and its interchange (eg shared process and activity state data) would be necessary to support totally open interworking between heterogeneous products; whilst an interesting standardisation challenge it is considered unattainable in the foreseeable future, hence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

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 (eg completion of an activity) or to specific control decisions taken by a workflow engine (eg navigation to the next activity step within a process).

An illustrative basic state transition scheme for process instances is shown below.

Figure 7
Example state transitions for a process instances



Within the above diagram, transition between states (represented by the arrows) take place in response to the particular WAPI commands identified; transition between certain states will also take place as a result of transition conditions within the process definition being met (eg as the result of an external event, or time or data dependent condition, etc). The basic states are:

initiated - a process instance has been created, including any associated process state date 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 (ie a workitem has been created and assigned to an appropriate activity instance)

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; any internal post-completion operations such as

logging audit data or statistics will be performed and the process instance destroyed
terminated - execution of the process instance has been stopped before its normal completion; any internal operations such as error logging or logging recovery data may be performed and the process instance destroyed

Activities may be non-interruptable; ie 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. The potential treatment of interruptable activities and atomic activity units with restart capability will require further consideration and is beyond the initial work of the Coalition.

Ignoring these additional complexities, a simple illustration of the basic states and transitions for an activity instance is thus:

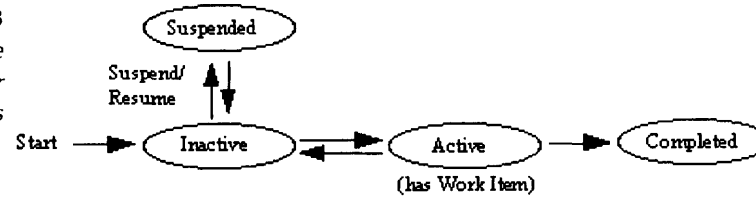


Figure 8
Example state transitions for activity instances

The basic states of an activity instance are:

inactive - the activity within the process instance has been created but has not yet been activated (eg because activity entry conditions have not been met) and has no workitem for processing
active - a workitem has been created and assigned to the activity instance for processing
suspended - the activity instance is quiescent (eg as a result of a change_state_of_activity_instance command) and will not be allocated a workitem until returned to the running (inactive) state
completed - execution of the activity instance has completed (and any post-activity transition conditions will be evaluated)

A particular product implementation may, of course, support additional state types or use a different representation of the basic states and transitions shown above. The reference model does not attempt to prescribe standardised internal behaviour of workflow systems but the state transitions illustrate the basic underlying concepts which are necessary to scope the effects of the API command set which the Coalition is developing.

3.3.4. Workflow Application Programming Interface & Interchange

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.

The majority of WAPI functions comprises of APIs calls with defined parameter sets / results codes. Where appropriate it also defines interchange data formats, for example for the exchange of process definitions. The use of WAPI within each of the five functional areas is described within the following sections (3.4 - 3.8).

3.3.5. Workflow Control, Workflow Relevant and Workflow Applications Data

The workflow enactment service maintains internal control data to identify the state of individual process or activity instances and may support other internal status information. This data is not accessible or interchangeable, as such, via the WAPI commands, but some of the information content may be provided in response to specific commands (eg query process status, give performance metrics, etc). Homogeneous workflow enactment services may exchange such information between workflow engines by specific private dialogue.

Workflow Control Data
Internal data that is managed by the workflow management system and/or workflow engine.

Workflow Relevant Data is used by a workflow management system to determine particular transition conditions and may affect the choice of the next activity to be executed. Such data is potentially accessible to workflow applications for operations on the data and thus may need to be transferred between activities by the workflow enactment software. When operating in a heterogeneous environment, such data may need to be transferred between workflow engines, where the process

execution sequence spans two or more workflow engines; this process may (potentially) require name mapping or data conversion.

Workflow Relevant Data
Data that is used by a workflow management system to determine the state transition of a workflow process instance.

Manipulation of application data may be required within each activity of a process definition, for example by a particular tool or application, either under the direct control of the application or in conjunction with some form of user interaction. The workflow model must, therefore, cope with any necessary interchange of case data between the various activities. In some circumstances this may also require some form of case data transformation between different tool data formats, for example conversion of a document or spreadsheet from one application format to another. (In some systems this may be a function of the workflow enactment service, in others data conversion may be defined as an activity in its own right within the process definition.)

Workflow Application Data
Data that is application specific and not accessible by the workflow management system.

Workflow application data is not used by the workflow enactment software and is relevant only to the applications or user tasks executed during the workflow. As with workflow relevant data, it may need to be transferred (and/or transformed) between workflow engines in a heterogeneous enactment service, so as to be made available to the appropriate activities executed on the individual engines.

The relationship between an application and any workflow relevant or application data it needs to manipulate will normally be defined within the process definition. In some cases this may be an implicit relationship (for example in those systems where case data is physically transferred to the next activity as part of the activity navigation within the process), whereas in others (for example access to a shared object store) it may be an explicit relationship defining a specific object name and application access path. Within the reference model the former scenario will be called direct data interchange and the latter indirect data interchange.

3.3.6. Data Interchange

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

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

This section covers the general principles of data interchange; this area will require further specification work. 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.

The direct interchange of application data is typified by email driven workflow systems in which the data is physically transferred between activities, either application or user-driven. In this situation there is no need to define an explicit relationship between activities and application data; the data is transferred as part of the standard workflow activity navigation and locally

linked to the application on invocation. Where there is a requirement to provide data format conversion between activities, the model recognises that a particular application may define, as an attribute, the data type (or types) with which it is associated (this attribute information may be held local to a particular software environment or global to the entire workflow service - for example in a directory). This enables systems which are constructed to use heterogeneous workflow applications to provide data conversion (where necessary) on the basis of attribute types defined for the respective applications. Conventions will need to be adopted (or developed) for transferring and retaining the data type information, for example by the use of X.400 body part object identifiers or the Internet mail MIME mechanism (RFC-1341).

Some types of workflow system (for example, those implemented via a shared document store) do not physically transfer application data between activities. In these systems, data is accessed in situ by the application using an appropriate access path (which may be networked). In this case, the access path naming scheme must be global to all applications which may be invoked within the workflow service and appropriate access permissions must be available and controlled for each active process instance. Data format conversion in this scenario, if necessary, may be modelled as an activity in its own right, using an appropriate application tool (for example a document converter).

Homogenous systems may use private conventions for object names and access permissions, but heterogeneous systems require a common scheme. In this case, either the (common) process definition must include access path references to the application data object storage, or the navigation between activities must include transfer of the necessary access path

references for any data objects to be transferred between activities.

Where interworking between heterogeneous workflow products is planned they must either follow the same approach to application data interchange or interwork through a gateway mechanism (section 3.7), which can map between the two approaches and/or handle any differences in object naming and data type conventions by appropriate conversion. Further work is required on the detail in this area, but it is possible that alternative interchange conformance criteria could be identified to cover the two cases.

The way in which application or workflow relevant data interchange is to be handled across the 3 interfaces is for more detailed study; the following notes identify some initial options.

Client applications - workflow relevant data may be embedded in the workitem and extracted from the worklist for presentation to the user or for linkage to a particular application tool (for example by the worklist handler locating it in a particular local directory). Alternatively, the data may be indirectly passed to a specific application via some form of shared object store (for example by the use of a common file for data in transit between applications, or by passing a specific file reference embedded as part of the workitem.)

Invoked applications - the data interchange will depend upon the nature of the application invocation interface (section 3.6) and may require the invocation service to embed the data within a specific application protocol. APIs for reading /writing workflow relevant data are feasible for specific workflow-enabled applications or to construct generalised application agents.

Workflow engine interoperability - considerations are similar to the Client Application interface, although 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.

3.4. Process Definition

3.4.1. Process Definition Tools

A variety of different tools may be used to analyse, model, describe and document a business process; such tools may vary from the informal ("pencil and paper") to sophisticated and highly formalised. The workflow model is not concerned with the particular nature of such tools nor how they interact during the build-time process. As noted earlier, such tools may be supplied as part of a workflow product or as a separate, for example, BPR 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 modelling 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 specialised 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, modelling and definition tools may include the ability to model processes in the context of an organisation structure (although this is not a mandatory aspect of the workflow reference model). Where an organisation model is incorporated into such tools the process definition will include organisation related objects such as roles. These are related (typically) to system control data such as role: actor relationships (eg within an organisational directory) which may be referenced during process execution.

3.4.2. Workflow Definition Interchange (Interface 1)

The interface between the modelling and definition tools and the runtime workflow management software is termed the process definition import/export interface. The nature of the interface is an interchange format and API calls, which can support the exchange of process definition information over a variety of physical or electronic interchange media. The interface 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.

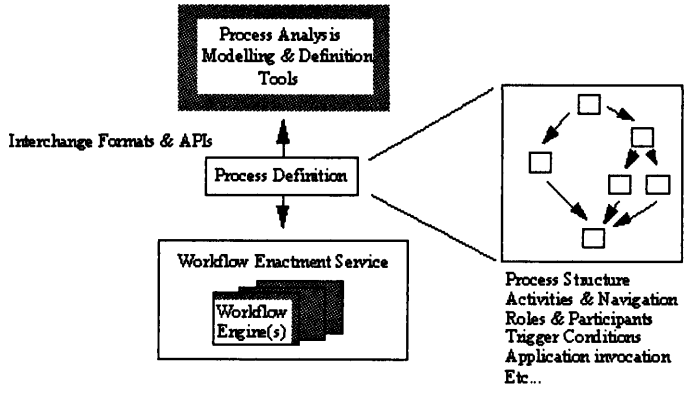


Figure 9
Process Definition Interchange

There are clear benefits in using a standardised 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 modelling tool to be used as input to a number of different workflow runtime products. This enables user choice of modelling 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. (The ability to exchange process definition data is only one aspect of such a distributed service; there are other requirements in terms of runtime interactions between WFM-Engine, which are considered in section 3.8.)

There are two aspects to the Coalition's work in this area:

1. 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
2. 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 (for example defined in a product type register).

A Basic Meta-Model

The 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.

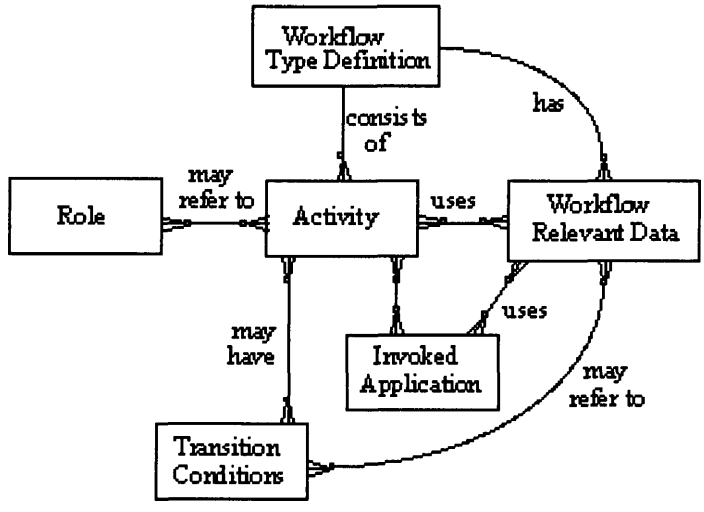


Figure 10
Basic Process Definition Meta-model

It is envisaged that particular attributes of the following types will be defined:

Workflow Type Definition

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

Activity

- Activity name
- Activity type (subflow, 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 organisational entity

Invoked Application

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

In the case of distributed services, an allocation of activities to individual Workflow engines may also need to be made within the process definition, as an additional activity attribute. Process definition aspects affecting security and administration, for example controls over privileged or supervisory activities within the process, also require consideration in the longer term.

In defining interchange formats, it is assumed that a symbolic naming scheme would be supported which could be unambiguously mapped to real names and addresses in the runtime enactment service. This may be handled by dynamic address resolution mechanisms (for example by the use of a directory service) or by other mechanism external to the process definition. There are other industry groups working in related areas such as process modelling and CASE interchange tools; the proposed WFM Coalition approach in this area is to work with other groups to advance the definition of suitable interchange formats.

APIs to access Process Definitions

A set of API commands within WAPI is under development to support access to process definition data. It is expected that such

specifications will cover a number of functions of the following general types. Commands are expected to be provided which operate on a list, or on individual objects or attributes.

Session Establishment

- connection / disconnection of sessions between participating systems

Workflow Definition Operations

- retrieval of lists of workflow process definition names from a repository or other source list.
- selection / de-selection of a workflow process definition to provide a session handle for further object level operations
- read/write top level workflow process definition object

Workflow Definition Object Operations

- creation, retrieval & deletion of objects within a workflow definition
- retrieval, setting and deletion of object attributes

3.5. Workflow Client Functions

3.5.1. Workflow Client Applications

The worklist handler is the software entity which interacts with the end-user in those activities which require involve human resources. The worklist 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 utilising 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.

In the workflow model interaction occurs between the client application and the workflow engine through a well defined interface embracing the concept of a worklist - 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 worklist is accessible to the workflow engine for the purposes of assigning work items and to the worklist handler for the purpose of retrieving work items for presentation to the user for processing. There are various possible product implementations of this worklist interaction (see section 2.4).

Activation of individual work items from the worklist (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 worklist, completed activities to be removed from the worklist, activities to be temporarily suspended, etc. These are described in section 3.5.2.

Application invocation may also be handled from the worklist handler, either directly or under the control of the end-user. In general it is expected that the range of applications invoked from the worklist 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 worklist is the necessary information to enable the worklist handler to invoke

the appropriate applications(s). Where the application data is strongly typed, an association may be stored at the worklist handler and used for this purpose. In other cases an interchange of the full application name and address information may be necessary between the worklist handler and Workflow engine, in which case the workflow Client Application may also implements some functions from the invoked application interface (i/f 3) to obtain the necessary information.

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

3.5.2. Workflow Client Application Interface (Interface 2)

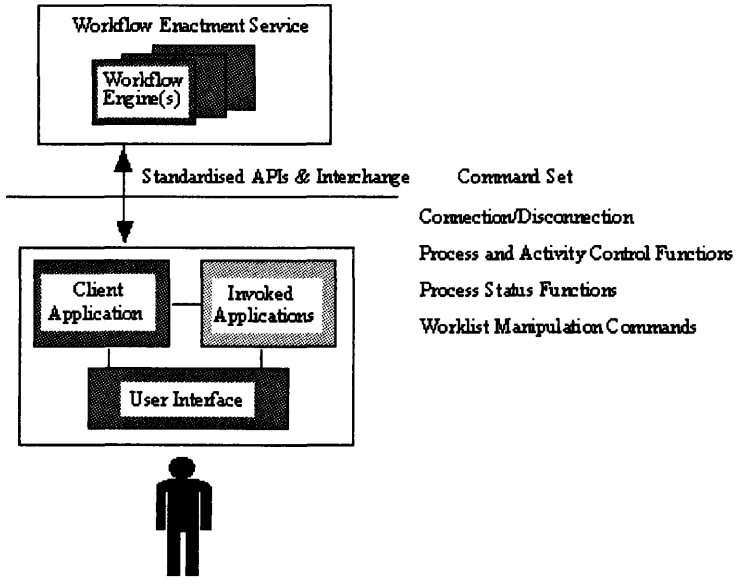
The approach to meet the above requirement is to contain the variety behind a standard set of APIs (the WAPI), which may be used in a consistent manner for access from a workflow

application to the Workflow engine and worklist, 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 worklist 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 worklist handler application will take responsibility for filtering any non-workflow email items and handling them in an appropriate manner. Similarly commands or responses directed at the Workflow engine by the workflow application may be submitted directly to an outgoing mailbox handler. In this scenario a simple level of interoperability is achieved through the use of standardised mail interchange formats, rather than the full WAPI.)

The overall approach to the client application API is shown in figure 11, following.

Figure 11
Client Application Interface



The API specifications are published in a separate Coalition document; the following provides an overview of the intended APIs for client application use, grouped into various functional areas. Commands are provided for operations on individual or collective process or activity instances as well as worklist manipulation.

Session Establishment

- connection / disconnection of sessions between participating systems

Workflow Definition Operations

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

Process Control Functions

- 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 (eg priority) of a process or activity instance

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

Worklist/Workitem Handling Functions

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

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

Data Handling Functions

- retrieval / return of workflow relevant or application data

Administration Functions

Support for additional administration functions across the WAPI may be appropriate for certain client applications. A subset of the operations discussed in 3.8.2 may be included in a future conformance level.

Application Invocation

The functions outlined above provide a base level of functionality to support application invocation by the worklist handler function (eg by providing access to process/activity/workitem attributes and workflow relevant data). Some of the proposed commands for the application invocation function (section 3.6.2) may also be relevant to the client application environment.

It is possible that some product implementations may wish to support a subset of the full WAPI; further consideration will be given to identifying conformance levels to cater for the different interoperability requirements arising from the range of workflow products available in the market.

3.6. Invoked Application Functions

3.6.1. Invoked Applications

It may be assumed that any particular WFM implementation will not have sufficient logic to understand how to invoke all potential applications which might exist in an heterogeneous product environment. This would require the logic to cope with invocation across (potentially) all platform and network environments, together with a means of transferring application or workflow relevant data in a common format and encoding (or transforming it to the individual application environments).

However there are many workflow systems which deal with a more restrictive range of applications, particularly those where the data is strongly typed and may be directly associated (for example via a directory) with a particular application tool such as a word processor or spreadsheet. In other cases invocation of an operation by a particular application may be accomplished through a standard interchange mechanism such as the OSI TP protocol or X.400. Some implementations use the concept of a "Application Agent" to contain this variety of method invocation behind a standard interface into the workflow enactment service. There is also the possibility of developing "workflow enabled" application tools which use a standard set of APIs to communicate with the workflow enactment service - to accept application data, signal and respond to activity events, etc. Such APIs may be used directly by an application tool or by a application agent process acting as a front end for interaction with heritage or other applications written without a specific knowledge of workflow.

Some of the possible types of interface for application invocation are identified in the following table.

Table 1 *Application Invocation Interfaces*

Interface Type	Workflow Relevant Data Access	Standardisation Candidate
Local Process Call	Local File	No
Shell Script	Local File	POSIX environments?
ORB Call (eg object linking and launch service)	Via reference (call parameters)	Yes
Remote Execution Call	Via reference (call parameters)	Yes
Message Passing (eg X.400)	Embedded or via reference	Yes
Transaction (eg OSI-TP)	Embedded or via reference	Yes

Further discussion will be required on the full range of possible options for application invocation. The initial work of the Coalition is likely to focus on developing a catalogue of interface types, together with a set of APIs for use in future workflow specific applications.

3.6.2. Invoked Applications Interface (Interface 3)

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" (ie to interact directly with a workflow engine).

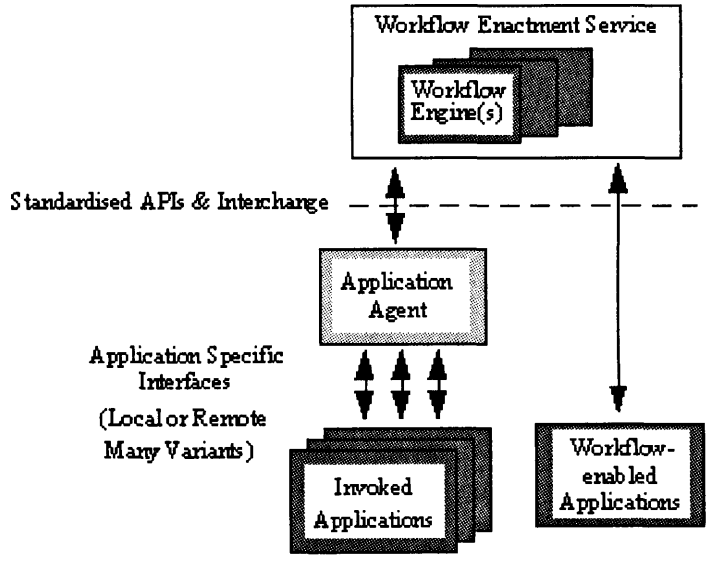


Figure 12
Invoked Application Interface

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.

The detailed semantics and syntax of an API set for application invocation are for further study and will be documented as part of the Coalition specification set. Operation is envisaged over a variety of underlying interfaces, including a selection from the above table, some of which may operate synchronously and others asynchronously. The operation of the API is assumed at

this stage to be potentially either single- or multi-threaded (in the latter case using an activity id handle for thread discrimination). The following provides an outline of a possible command set applicable to application invocation functions.

Session Establishment

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

Activity Management Functions
(workflow engine to application)

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

(application to workflow engine)

- Activity complete notification
- Signal event (eg synchronisation)
- Query activity attributes

Data Handling Functions

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

More complex scenarios, involving interworking between heterogeneous Workflow engines, may require application invocation information to be transferred between Workflow engines, either as part of the run-time interchange or by importing (parts) of the process definition after the process development phase. This is considered under section 3.7 (workflow interoperability).

3.7. Workflow Interoperability

3.7.1. Heterogeneous Workflow Enactmnent Services

A key objective of the coalition is to define standards that will allow workflow systems produced by different vendors to pass work items seamlessly between one another.

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. In its drive for interoperability standards the Coalition is determined not to force workflow product vendors to choose between providing a strong product focused on the needs of its customers and giving up those strengths just to provide interoperability.

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. In this area it is expected that relatively simple interoperability scenarios will be supported initially, with the more complex situations requiring further work on interoperability definitions.

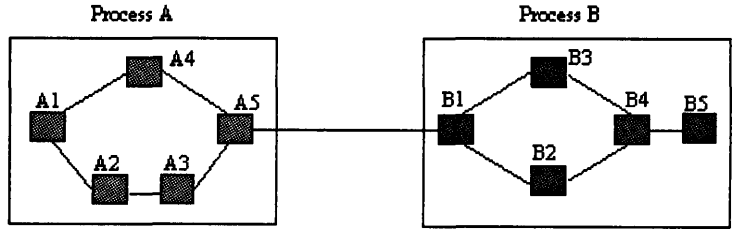
Although it is possible to consider the development of very complex interoperability scenarios in which a number of different vendor engines cooperate to deliver a single enactment service, this scenario is unlikely to be realised in the near future as it requires that all engines can interpret a common process definition and share a common set of workflow control data, in effect maintaining a shared view of process states across the heterogeneous workflow control engines. A more realistic target in the near term is the ability to transfer parts of a process for runtime support on a different enactment service.

Four possible interoperability models has been identified, covering various (increasing) levels of capability. The following sections describes these potential interoperability models; the illustrations use squares to indicate tasks or activities, with different shading to denote tasks co-ordinated by individual workflow enactment services.

3.7.2 Scenario 1 - Connected Discrete (Chained)

This model allows a connection point within process A to connect to another point within process B. Although the illustration shows these connection points at the terminus and starting points of the processes, this is done for illustration purposes only. It is presumed that the connection points can be anywhere within the processes that makes sense for the meat-process created by the connection of the two.

Figure 13
Chained Services Model

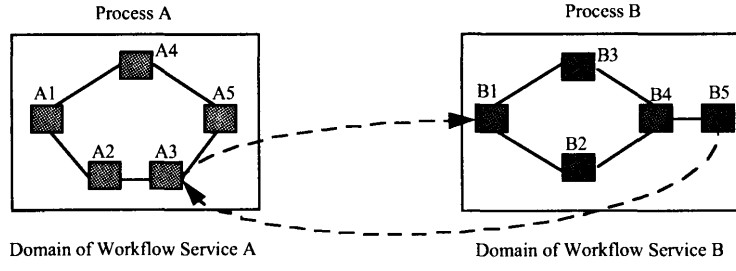


This model supports the transfer of a single item of work (a process instance or activity) between the two workflow environments, which then operates independently in the second environment with no further synchronisation. In implementation terms it may be realised via a gateway application function, handling data format conversion, process and activity name mapping, etc, or may be subsumed into one of the workflow services, for example when a standard API call is used between the two services.

3.7.3 Scenario 2 - Hierarchical (Nested Subprocesses)

This allows a process executed in a particular workflow domain to be completely encapsulated as a single task within a (superior) process executed in a different workflow domain. A hierarchic relationship exists between the superior process and the encapsulated process, which in effect forms a sub-process of the superior. The hierarchic relationship may be continued across several levels, forming a set of nested sub-processes. Recursion within this scenario may, or may not, be permitted by individual product implementations.

Figure 14 *Nested Subprocesses Model*



In the diagram, Workflow Service A has an activity defined (A3) which is enacted as a complete process (B) on Workflow Service B with control returned to Service A on completion. As in scenario 1 earlier, transfer of activity control may be via an applications gateway function or by direct API calls between the two workflow services. The diagram illustrates the simple case with a single entry and exit point in Process B, although activity navigation rules within B may permit other activity flow scenarios, for example process completion conditions enabling the process to be completed prior to activity B5 and control returned to workflow domain A.

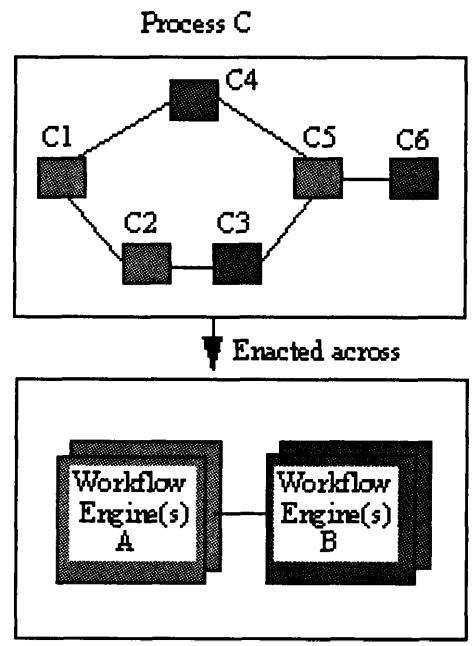
3.7.4 Scenario 3 - Connected Indiscrete (Peer-to-Peer)

This model allows a fully mixed environment; the diagram indicates a composite process C, which includes activities which

may be executed across multiple workflow services, forming a shared domain. Activities C1, C2 and C5 could be co-ordinated by server A (or even several homogenous servers within a common domain) and activities C3, C4 and C6 co-ordinated by server B.

In this scenario, the process would progress transparently from task to task, without any specific actions by users or administrators, with interactions between the individual workflow engines taking place as necessary.

Figure 15
Peer-Peer Model



This scenario requires that both workflow services support common API sets for communication and that both can interpret a common process definition, either imported to both environments from a common build process or exported between

services during the runtime phase. Workflow relevant and application data may also need to be passed between the various heterogeneous engines.

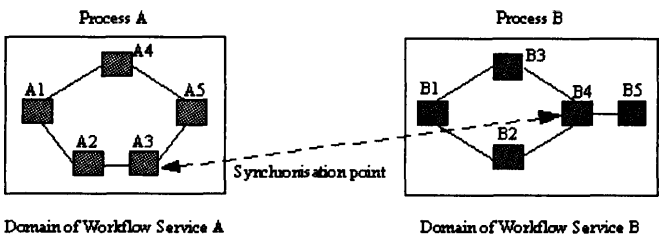
Whilst simply illustrated as an interworking scenario, there are various complexities within the peer-peer model which will require further study. As shown each particular activity is associated with a specific workflow domain, for example predefined within the process definition. Further complexities arise where a specific activity may be executed on either of two independent workflow services or where a particular process instance can be created or terminated independently by either service. Systems administration, security and recovery across co-operating workflow services will also need to be addressed. In the extreme, the two different workflow enactment services may require to share much of the process state data normally maintained internally to each, in effect forming a single heterogeneous service. The Coalition intends to define a number of conformance levels, allowing earlier specifications to cope with simpler scenarios and additional functions to cope with more complex scenarios to be added in the future.

3.7.5 Scenario 4 - Parallel Synchronised

This model allows two processes to operate essentially independently, possibly across separate enactment services, but requires that synchronisation points exist between the two processes. Synchronisation requires that once the processes each reach a predefined point within their respective execution sequences, a common event is generated. This type of mechanism may be used to facilitate functions such as process scheduling across parallel execution threads, checkpointing of recovery data or the transfer of workflow relevant data between different process instances.

In the diagram following synchronisation is shown between activity A3 within process A and activity B4 within process B.

Figure 16 *Parallel Synchronised Model*

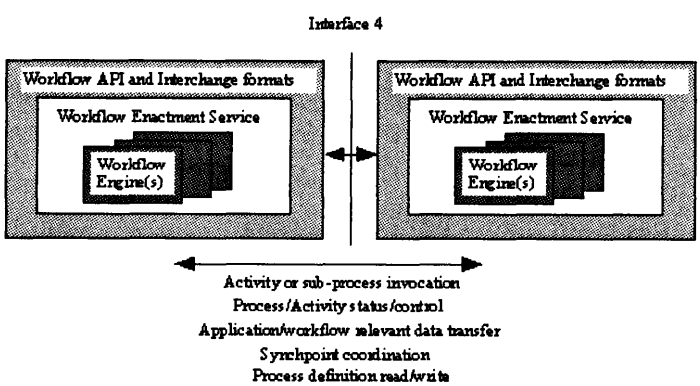


Matching pairs of work can thus be synchronised at specific points in each process. This requires an event co-ordination and tracking mechanism, in addition to both services being able to recognise tasks from the two process definitions. It is included for completeness but is recognised as lying beyond the scope of the Coalition's current specification activity.

3.7.6 WAPI Interoperability Functions (Interface 4)

The general nature of the information and control flows between heterogeneous workflow systems is shown in diagram 17.

Figure 17 *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

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, organisation 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.

Where this shared view of a process definition is not feasible, the alternative approach of "exporting" details of a process definition subset as part of the runtime interchange may be possible. The process definition interchange APIs provide a means of requesting object and attribute data from a particular workflow service, thus enabling a workflow engine to obtain process definition data relevant to the execution of an individual activity or sub-process assigned to it in a co-operative enactment environment.

Where process definition interchange by either of the above approaches is infeasible, interoperability is constrained to a

gateway approach, in which (typically a subset of) object names and attributes are mapped between the two environments via an application interworking gateway. In this simplest case, the two separate enactment services use their own process definition formats with any mapping between the two handled within the gateway. This approach effectively constrains interworking to the simpler scenarios 1 and 2 or relatively trivial examples of scenario 4.

RunTime Control Interactions

At runtime, the WAPI calls are used to transfer control between workflow services to enact subprocesses 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.

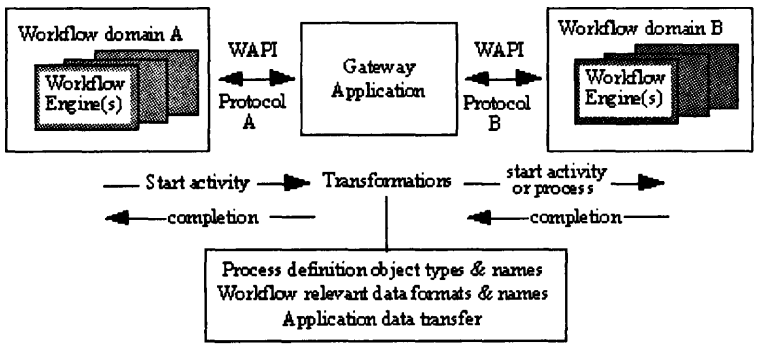


Figure 18 *Gateway operation using WAPI*

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 / subprocess 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 discussed earlier (sections 3.4.2, 3.5.2 & 3.6.2) are also potentially applicable in workflow interoperability interactions:

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

A degree of common administration between multiple workflow domains will also be necessary using functions developed for interface 5 (section 3.8.2).

Once activities are being enacted on a separate (subordinate) service, interactions from workflow client applications with the original service (for example query status of activity/process instance, or suspend/resume/terminate process instance) may need "referral" to the subordinate service. Some operations may thus need to be chained across several workflow engines (for example, where different activities within an active process instance are distributed across several machines). Some form of event notification service is also likely to be required to inform the initiating service of activity status changes and completion of activities and/or subprocesses. It is envisaged that a number of additional WAPI operations will be developed, over time, to support these and other functions arising from more complex interworking scenarios.

The range of possible interactions is relatively extensive and complex in terms of state transitions (including, for example aspects such as failure containment and recovery); further study will be required to develop the necessary conformance levels which could form a practical basis for interoperability between different products.

3.8. Systems Administration

3.8.1. Administration & Monitoring Tools

The final area of proposed specification is a common interface standard for administration and monitoring functions which will allow one vendor's management application to work with another's engine(s). This will provide a common interface which enables several workflow services to share a range of common administration and system monitoring functions.

Although process status commands are defined within the interfaces already described, there is a recognised requirement in some industries for a function to apply overall status monitoring

and extract metrics information. The proposed interface is intended to allow a complete view of the status of work flowing through the organisation, regardless of which system it is in; it is also intended to present a comprehensive function set for administration purposes, including specific considerations of security, control and authorisation.

The interface will include specific commands within the WAPI set to manipulate designated administration and monitoring functions. In addition, further review is intended to ascertain to what extent this interface can exploit existing protocol mechanisms such as CMIP and SNMP to set and retrieve management status and statistical information defined in an open MIB (Management Information Base).

3.8.2. Administration & monitoring Interface (Interface 5)

The interface as illustrated shows an independent management application interacting with different workflow domains, although alternative implementation scenarios are also feasible; for example the management application may be an integral part of one enactment service, although capable of managing various functions across additional (heterogeneous) workflow domains.

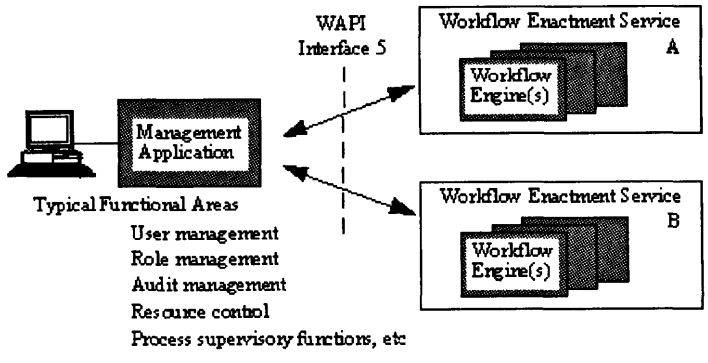


Figure 19
Systems Administration & Monitoring Interface

It is also feasible for the management application to take on other management functions, beyond those shown. For example, it may also manage workflow process definitions, acting as a repository and distributing process definitions to the various workflow domains via operations within interface 1.
The detail of this interface is for further study, but it is envisaged to include the following types of operation (some of which are common to other interface areas):

User Management operations

- establishment / deletion / suspension / amendment of privileges of users or workgroups

Role Management operations

- define / delete / amend role:participant relationships
- set or unset role attributes

Audit Management operations

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

Resource Control operations

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

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

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

4. WAPI Structure, Protocols and Conformance

4.1 WAPI - Functional Overview of APIs

The WAPI is envisaged as a common set of API calls and related interchange formats which may be grouped together as required to support each of the five functional interface areas. Operations already identified across these 5 interface areas (and discussed in section 3) include those in the following groups:

API Calls

- Session establishment
- Operations on workflow definitions and their objects
- Process control functions
- Process control supervisory functions
- Process status functions
- Activity management functions
- Data handling operations
- Worklist/Workitem Handling Functions
- User Management operations
- Role Management operations

- Audit Management operations
- Resource Control operations

Data Interchange Functions
Interchange formats are expected to be defined to cover:

- Process definition transfer
- Workflow relevant data transfer

API Call Structure and Naming
API calls will be defined initially in terms of their logical operations, the datatypes on which they may operate (ie as call parameters) and the supporting data structures referenced from such parameters. Language bindings are expected to be developed, initially for the C language and subsequently for other important development environments (both C++ and IDL are candidates for further study). Naming conventions are being specified for the call functions themselves, plus the supporting datatype definitions, parameter types and data structures (see document reference WFMC_TC00-1013 for API naming convention information).

4.2 WAPI Protocol Support

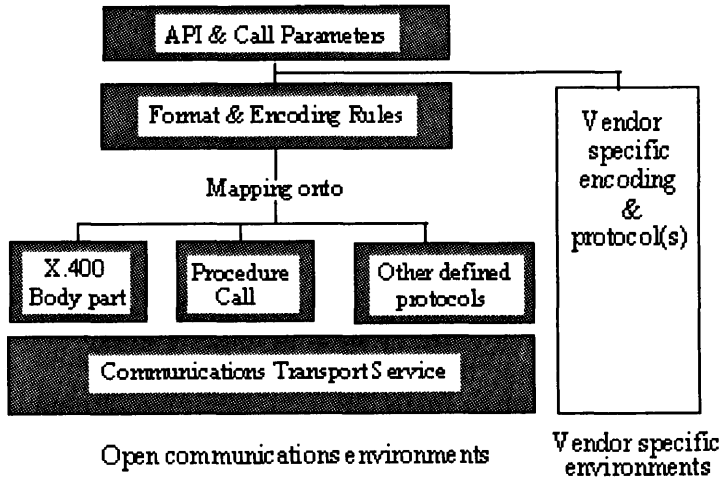
The WAPI calls will be able to function in two types of interconnection scenario:

1. Where an exposed WAPI interface is provided as a boundary function to a workflow enactment service (eg as vendor stub routines embedded in a client application or application agent), vendor specific mappings may be used to encode the call and associated parameters to the particular vendor protocol environment used to communicate with the workflow engines.

2. Where direct interworking between different products is provided (eg interoperability between different workflow engines), open (common) protocol support will be necessary. This will require a standardised mapping from WAPI calls onto one or, more likely, several interworking protocols.

The expected areas of standardisation relating to these two scenarios are as illustrated in the following diagram.

Figure 20
WAPI protocol support



The details of protocol usage within WAPI are for further study, but it is expected that WAPI mappings will be developed onto important communications environments, ie those widely used by workflow products available in the market. Initial support for client application integration and workflow interoperability via an application gateway can be achieved using approach 1 (with vendor specific protocols); however, this approach has some inherent limitations and the development of appropriate protocol usage specifications is a clear requirement in the medium term.

Implementations would be expected to identify the particular communications environment(s) which are supported, along with the specific API command set options being implemented for the particular interchange function. This subject will be further considered as conformance rules are developed (see following section).

4.3. Conformance Principles

4.3.1. What does conformance mean?

Conformance will be defined against each particular functional area corresponding to one of the 5 interfaces, so that product vendors can offer an exposed interface for conformant interworking in one or more areas but do not have to implement all 5 functions to achieve interoperability.

For each interface it is expected that conformance will be classified at several levels, providing a minimum level of interoperability at level 1, with the option for more complex products to achieve conformance against a higher level of functionality for richer interworking, where appropriate. In the case of interface 4 functions, this will be particularly essential due to the potential complexities of workflow service interoperability. Products which achieve conformance at a particular level are expected to interwork with products at any conformance level below or equal to their own.

Conformance will need to be separately considered in terms of API support and protocol usage. It is likely that some form of matrix will need to be constructed indicating the particular API functions supported at a specific level and the protocol environments supported for interworking with other products.

It is possible that some form of interoperability testing or certification may be feasible, but this is an area requiring further investigation by the Coalition.

4.4. Interoperability Classifications & Conformance Levels

Conformance levels will be developed to assist in the classification of interoperable products.

The potential scope of workflow interoperability and application integration is very wide and to develop a full range of APIs and interchange formats to cater for all potential interoperability scenarios is a major task. For these reasons it is considered essential that a set of interoperability scenarios is developed, ranging from the simple to the complex, so that interfaces for the simpler scenarios can be developed earlier. This will enable some of the benefits of interoperable systems to be realised in the nearer term, whilst further development work is done to develop the more complex interfaces. Various conformance levels can be defined to group the particular APIs, interchange formats and protocol support necessary to meet specific interoperability scenarios. The remainder of this section documents a simple classification as a basis for further discussion in this area.

4.4.1. Definition Tool - Workflow Enactment Software

Purpose - to allow separate choice of products for development tools (modelling, definition, etc) and runtime workflow service delivery or to enable storage and retrieval of process definitions from a repository.

Interoperability - based on support for the Process Definition Import/Export Interface. The process definition is exported by the definition tool and imported by the workflow enactment software.

Conformance levels - based on a basic (minimum) set of process definition objects with optional extensions to cater for more sophisticated process definitions. File interchange formats and API call details to be discussed.

4.4.2. Client Application interoperating with Workflow Enactment Service(s)

Purpose - (1) to allow for the construction of a common worklist handler to provide worklist management for one or more workflow systems, for example to provide a common house style for task management dialogue with the user, independently of the workflow management software in use. This enables the delivery of several different workflow services to be combined at the desktop, giving the appearance to the end user of a single service.

- (2) to support simple interaction between the two workflow services controlled from the desktop environment (for example, workflow relevant data interchange between two process instantiated on different workflow services or an activity within one process enactment causing the start of a new process on the second service - the activity gateway approach)

Interoperability - based on support for the WAPI calls and interchange formats from interface 2.

Conformance levels - to support varying degrees of sophistication at the client application; details to be discussed. Protocol usage options - to be specified.

4.4.3. Application & Tool Integration

Purpose - (1) to allow applications or tools to be workflow-enabled in a standardised manner (for example, to interact with a workflow engine via activity control functions or to accept/return case data, etc)

- (2) to allow the development of standardised application agents to interface non workflow-enabled applications in a similar manner

Interoperability - based on support for the subset of WAPI calls to handle application invocation and access to workflow relevant data.

Conformance levels - to be discussed, possibly classified by application type.

4.4.4. Workflow Service Interoperability

Purpose - (1) to support the development of process automation applications utilising different workflow enactment software products.

- (2) to enable existing (heterogeneous) workflow applications to exchange application or workflow relevant data, which is common to both processes, at an appropriate point within the processes.

Interoperability - based on support for the WAPI calls and interchange formats using either the activity gateway or direct interfaces. The gateway model is of more immediate applicability; direct interoperability requires agreement on common process definition interchange and compatible protocol support.

Conformance levels and protocol support - to be discussed, reflecting the various interoperability scenarios described in section 3.7.

4.4.5. Common Workflow Administration & Mgt

Purpose - to support common management, administration and audit function across several workflow management products

Interoperability - based on support for WAPI calls from interface 5 to enable administration and monitoring functions to be supported by a common management application.

Conformance levels and protocol usage - to be defined

Appendix - Glossary of Terms and Abbreviations

(Please refer to the WfMC Glossary Document for full terminology usage, including synonyms.)

Process Activity
A logical step or description of a piece of work that contributes toward the achievement of a process. A process activity may include a manual activity and/or an automated workflow activity.

Workflow Activity
The computer automation of a logical step that contributes toward the completion of a workflow .

Manual Activity
The manual steps that contributes toward the completion of a process.

Process Activity Instance
An instance of a Process Activity that is defined as part of a process instance. Such an instance may include a manual activity instance and/or a workflow activity instance

Workflow Activity Instance
An instance of a workflow activity that is defined as part of a workflow instance.

AND-Join
When two or more parallel executing activities converge into a single common thread of control.

AND-Split
When a single thread of control splits into two or more parallel activities.

Workflow Application
A software program(s) that will either completely or partially support the processing of a work item in order to accomplish the objective of a workflow activity instance.

Application Data
Data that is application specific and not accessible by the workflow management system.

Audit Trail
A historical record of the state transitions of a workflow instance from start to completion or termination

Business Process
A kind of process in the domain of business organisational structure and policy for the purpose of achieving business objectives.

BPR - Business Process Re-engineering
The process of (re-)assessment, analysis, modelling, definition and subsequent operational implementation of the core business processes of an organisation, or other business entity.

Case Data
See Workflow Relevant Data

CMIP
Common Management Information Protocol - an ISO standard (9596) for transferring mangement information across a network.

Iteration
A workflow activity cycle involving the repetitive execution of workflow activity(s) until a condition is met.

OR-Join
When two or more activity(s) workflow branches re-converge into a single thread of control without any synchronisation.

OR-Split
When a single thread of control makes a decision upon which branch to take when encountered with multiple workflow branches

Parallel Routing
A segment of a workflow instance where workflow activity instances are executing in parallel and there are multiple threads of control.

Process
A co-ordinated (parallel and/or serial) set of process activity(s) that are connected in order to achieve a common goal. Such activities may consist of manual activity(s) and/or workflow activity(s).

Process Definition
The computerised representation of a process that includes the manual definition and workflow definition.

Workflow Definition
That part of the process definition that includes the automated aspects only versus the manual.

Manual Definition
That part of the process definition that includes the manual aspects only versus the automated (workflow).

Process Instance
Represents an instance of a process definition which includes the manual and the automated (workflow) aspects.

Workflow Instance
Represents an instance of a workflow definition which includes the automated aspects of a process instance only.

Manual Instance
Represents an instance of a Manual definition which includes all manual aspects of a process instance.

Process Definition Mode
The time period when manual and/or automated (workflow) descriptions of a process are defined and/or modified electronically.

Process Execution
The duration in time when manual and workflow execution takes place in support of a process.

Manual Execution
The duration in time when a human participant executes the manual definition of a process definition.

Workflow Execution
The duration in time when a workflow instance is created and managed by a Workflow Management System based on a workflow definition.

Workflow Relevant Data
Data that is used by a Workflow Management System to determine the state transition of a workflow instance. It may be typed (Engine may understand) or untyped (Engine will not understand).

Organisational Role
A collection of participants based on a set of attributes, qualifications and/or skills.

Process Role
A mechanism that associates participants to a collection of workflow activity(s)

Sequential Routing
A segment of a process instance where activity's are executed in sequence.

SNMP
Systems Network Management Protocol - an Internet standard for network management

Sub Process Definition
A process that is enacted or called from another process or sub process that includes the manual and automated (workflow) parts of the process

Tool
A tool is a workflow application that is invoked by the workflow management system.

Transition Condition
Criteria for moving, or state transitioning, from the current activity to the next activity(s) in a process instance be it manual or automated (workflow).

WAPI
The application programming interface for workflow applications and tools in order to be able to interface to the Workflow Enactment System. WAPI is an acronym for **W**orkflow **A**pplication **P**rogramming **I**nterface.

WFM -Workflow Management
see Workflow Management System

Workflow
The computerised facilitation or automation of a process, in whole or part.

Workflow Monitoring
The ability to track workflow events during workflow execution.

Workflow Engine
A software service or "engine" that provides the run time execution environment for a workflow instance (individually, or in conjunction with other workflow engines).

Workflow Interoperability
The ability for two or more Workflow Engines to communicate and work together to co-ordinate work.

Workflow Participant
A resource which performs partially, or in full, the work represented by a workflow activity instance.

Workflow Management System
A system that completely defines, manages and executes workflows through the execution of software whose order of execution is driven by a computer representation of the workflow logic. Such a system maps to the Workflow Coalition's reference model.

Workflow Enactment Service
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).

Workflow Control Data
Data that is managed by the Workflow Management System and/or a Workflow Engine.

Work Item
Representation of work to be processed in the context of an activity in a workflow instance.

Work Item Pool
Represents all work items

Worklist
A list of work items.

Worklist Handler
Software component that manages and formulates a request to the workflow enactment service in order to obtain a list of work items.

Appendix B
Leading Vendor Information

In order to help you get started in researching workflow management vendors and software for your organization, this appendix provides you with corporate background and product descriptions of software offerings from six of the leading makers of workflow software. The information has been gleaned from vendor materials, so the positioning and marketing aspect of the informaton will be apparent. Even so, software vendor Web sites are rich sources of information on workflow management and related technologies, so be sure to conduct at least part of your research online to take advantage of the wealth of materials provided.

Staffware plc

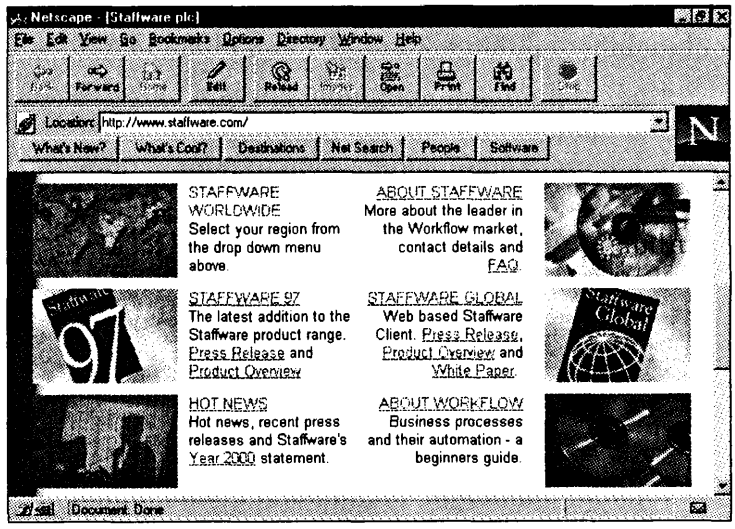


Figure B.1 *Home page of Staffware, located at http://www.staffware.com.*

Product Overview

Staffware 97 is a major enhancement to the Staffware Workflow system. By working closely with partners and users, Staffware has developed a product that will bring benefits in terms of scalability, usability and integration. *Staffware 97* also provides the underlying architecture for a new Java-based Web client.

Staffware

Volatile and increasingly competitive markets confront companies and organizations as they strive to adapt to changing conditions. The drive to provide ever better customer service, while constantly improving levels of efficiency, are forcing organizations to reassess their businesses at every level. The key to survival will be the ability to capture, route and track information. The need to manage and improve the very Business Processes of an organization will give it the competitive edge.

Putting You in Control of Your Business Processes

Staffware plc has developed a leading workflow system which enables organizations to map, control and improve their business processes. Staffware workflow has been a key tool for enterprises striving to improve customer service, organizational productivity and competitive advantage since it was launched in 1987. Today over 250,000 users world-wide use Staffware products. *Staffware 97* builds on that success, providing the robust architecture required for the future, including Web based access. *Staffware 97* is fully upgradable from previous versions and is marketed and supported in over 40 countries worldwide and 20 language variants.

Process Automation Made Simpler

Business process rules are defined by drawing the process as a flowchart using Staffware's *Graphical Workflow Definer.* In many circumstances this can be achieved by non-technical staff or business analysts. Once a process and its participants have been defined the Staffware server can then run that particular process, passing work items to the users involved.

Staffware provides an array of easy to use integration facilities as most processes are integrated with additional systems such as line of business applications, call centre systems, document imaging systems and legacy systems. Staffware also provides a full audit trail and an Executive Information Service (EIS) enabling supervisors and managers to track work and gain a graphical overview of the business process itself.

Staffware reports these benefits experienced by its customers:

- Improved levels of customer service.
- Greater efficiency levels.

- Reductions in time to market.
- Improved management control.
- Greater return on IT investment.
- End user empowerment.

High Performance Mission Critical Workflow

Many Staffware customers run their applications 18 hours a day, processing millions of dollars of business a week, involving thousands of users, connected to hundreds of Staffware servers across a wide area.

Some are implementing Staffware processes which start on one continent and are passed to offices on another continent for further processing. Top class functionality is no longer sufficient: *Staffware 97* is designed to provide not only the performance, but the robustness and reliability demanded by world class organizations today.

Intranet Workflow Across and Beyond the Enterprise

Staffware 97 includes a number of architectural changes that provide a platform for a completely new client version. This client, written in Java, enables Staffware processes to be run from Web browsers as well as conventional clients such as *Windows, NT,* or *OS/2.*

Usability

Procedure Development

By developing the business process rules directly through the server, the process can be run there and then. The *Graphical Workflow Definer* can also draw up the process remotely via a stand-alone PC or notebook. Staffware's *Graphical Workflow Definer* also includes a module to create the forms that the end user will see when the process is run.

Work Queue Manager

The Staffware *Work Queue Manager* provides both users and managers with quick on-screen access to outstanding work. The system enables the control and balancing of workloads, enabling the re-allocation of work items in the absence of participants or an unexpected overload of work. As well as having work queues for individuals, Staffware also enables group or 'Team' work queues, allowing easy distribution of work throughout a group.

Security

Staffware has an advanced level of security, which will match security of the server operating system as set up by the System Administrator. Specific features include encryption, forced password change as well as password sign off for documents.

Scalability

Staffware 97 is fully scalable, enabling organizations of all sizes to benefit from the technology. For small implementations companies can use Staffware in a single node environment, whereby the only requirements are a server and client. For larger organizations wishing to create a workflow architecture that both maps the physical business processes and makes efficient use of computing resources, then the multi-node Staffware option is available, linking a number of servers together.

Work Queue Server

In order to reduce network traffic and maximize the use of existing multiprocessor hardware configurations, Staffware has a separate server, which manages and processes all work queue facilities, including full filtering and sorting capabilities.

Universal Clients

Staffware 97 can be used throughout an organization, irrespective of the operating and database environment, utilizing thin client technology and an independent database layer.

Personal Workflow

Personal Workflow is a stand alone implementation to workflow which has been developed for the *NT* and *OS/2* platforms. Users can use the full product, client and server, on a single *NT* platform. Given its ability to operate in a multi-node environment, *Personal Workflow* can be used as an integral part of an enterprise-wide workflow environment. The procedure will deliver work items to the *Personal Workflow* node, and the recipient can operate attached to the network or unplug it and operate in a self contained way. Work items once processed in stand-alone mode can then be transferred back to the master node when the user reconnects.

Personal Workflow is an essential component for Staffware installations with members of staff such as sales personnel or field engineers who spend time away from the office without the need to be connected to a network. *Personal Workflow* enables them to fully participate in working procedures while carrying our their normal duties.

Integration

Lotus Notes Integration

The Lotus *Notes* integration makes full use of the *Notes* User interface and uses *Notes* Views for the Work Queues and *Notes* Forms for Data Entry and Display. The process can be implemented in a mixed environment of Staffware and *Notes*, catering for ad-hoc as well as production Workflows.

Exchange Integration

The integration of Staffware with Microsoft *Exchange* makes use of all appropriate *Exchange* facilities such as use of the *Exchange* User Interface, *Exchange* Folders for Work Items, Searching, Sorting and Filtering. A case may be started in Staffware, passed to *Exchange* utilizing *Exchange* Forms and then returned. According to Microsoft, Staffware is the first production workflow product to integrate with MS *Exchange*, and it has been developed with input from Microsoft development in Redmond.

Open Client Steps

This is a Staffware innovation which makes integration with desk top applications even easier. Using the *Graphical Workflow Definer*, the user simply selects the Open Client Step object and identifies the application to be invoked.

Workflow Management Coalition

As a founder member of the international standards body for workflow, Staffware is committed to supporting the technical standards as they are ratified. *Staffware 97* includes support for the current standards.

PeopleSoft

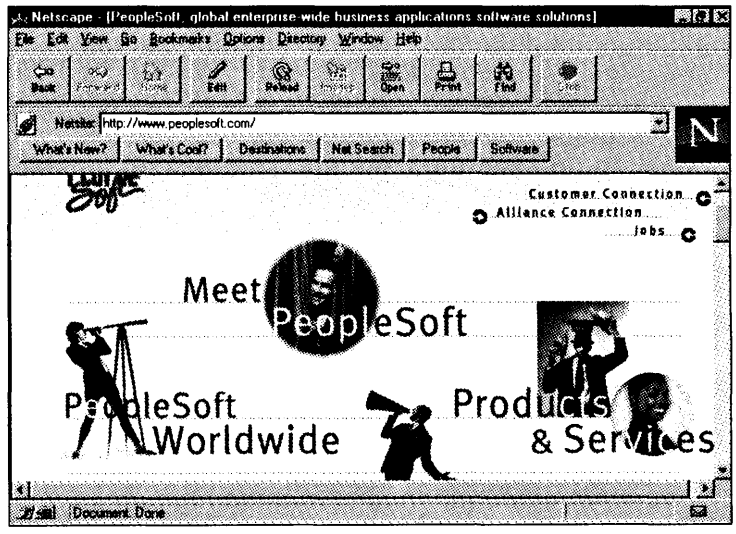


Figure B.2 *Home page of PeopleSoft, located at http://www.peoplesoft.com.*

Mission and Business

PeopleSoft's mission is to provide innovative software solutions that meet the changing business demands of organizations worldwide. Founded in 1987, PeopleSoft is a market leading provider of business application software for Fortune 1000-class corporations.

From an early focus on the core enterprise applications of human resources and finance, PeopleSoft has since expanded its tools and application portfolio to support such other core business processes as materials management, project performance analysis, supply chain planning, and manufacturing operations. The company has also developed industry-specific applications and supporting business units dedicated to providing competitive advantage to organizations in the fields of manufacturing, retail, financial services, federal government, public sector, healthcare,

services, higher education, communications, transportation, and utilities.

PeopleSoft has been a resounding business success, with revenues roughly doubling in each of the past seven years to reach $815 million in 1997. PeopleSoft currently has approximately 4,500 employees, with 47% of personnel dedicated to customer service. The company operates in over 25 markets around the world to support more than 2,200 customer organizations. In a survey of 502 customers completed in 1997, PeopleSoft found that over 99% of the respondents would choose the company again.

Philosophy

The core principle underlying PeopleSoft's approach to software development is that all organizations and individuals are unique. PeopleSoft's philosophy is to create products that enable people and organizations to leverage their particular strengths rather than imposing conformity to rigidly defined, externally contrived business processes. In the era of knowledge workers functioning in self-directed teams, PeopleSoft believes that the best way to add value to an organization is to optimize the ability of the individual to contribute.

Modular Approach

PeopleSoft's applications are all modular in design and can readily be customized using the *PeopleTools* software development environment, including building completely new modules for applications. PeopleSoft's product portfolio was created to enable solutions to be constructed that support each customer's specific organization and market segment. The ability to build with interoperable, flexible modules allows a customer to

differentiate and gain competitive advantage through business processes that the customer chooses to implement.

Rapid, Phased Implementations

In addition to enabling customers to improve the effectiveness and efficiency of their organizations in unique ways, PeopleSoft's product philosophy also carries other benefits. The use of software modules that are based on a common architecture yet that can be used separately or as components of a larger, tightly integrated system makes phased implementation approaches with PeopleSoft easy.

A customer organization can start with one module, quickly begin to realize the associated benefits, and then continue to refine and improve the implementation as the PeopleSoft deployment advances. Because all PeopleSoft products are based on a common architecture and use the same *PeopleTools* software toolset, integrated enterprise-wide systems can readily be built one department at a time without sacrificing any functional capabilities.

PeopleSoft's uniquely flexible approach also provides the customer with the means to evolve an application as business conditions change. PeopleSoft designs its products with the goal of giving customers the ability to anticipate, adapt to, and manage the rapid rate of change typical of today's business environments.

International versions of PeopleSoft applications share a common code base with basic multi-lingual, multi-currency capabilities that can be adapted by market. Since different national versions of PeopleSoft software have the same capabilities and are not on separate development tracks, phased global application implementations are greatly facilitated.

DirectPath Implementation Acceleration

PeopleSoft has initiated the DirectPath program to assist customers with rapid enterprise-class implementations and upgrades of PeopleSoft's suite of applications. DirectPath consists of a set of methods, models and tools providing a focused approach to achieving rapid project completion. DirectPath is designed to provide a guide to optimizing the effectiveness of PeopleSoft implementations and upgrades while also automating large parts of the process.

Three-Tier Client/Server Architecture

PeopleSoft was the first vendor to develop and deliver a client/server human resource management system (HRMS) in 1989. Since then, the company has broadened its application portfolio while simultaneously incorporating new technology into the underlying architecture. With the introduction of *PeopleSoft 7*, customers could choose whether to implement a traditional two-tier or three-tier client/server environment.

Three-tier environments incorporate local application servers that offload much of the burden of processing transactions from clients while simultaneously reducing traffic on wide area networks. Three-tier client/server implementations also provide a means to increase scalability to accommodate high volumes of concurrent users while maintaining consistent, reliable performance levels.

Web-Based Clients, Universal Applications

PeopleSoft recently introduced a Java-based Web Client that runs on industry-standard browsers to provide Internet or intranet-based access to PeopleSoft's core applications. The PeopleSoft Web Client can be used to provide fully encrypted application

access for occasional users both inside and outside of a customer's organization.

PeopleSoft's Web Client also works with the company's set of Universal Applications, designed for users who only need limited access to specific PeopleSoft applications. Universal Applications are linked to PeopleSoft's core human resources, procurement, and supply chain product applications, and provide an organization's customers, suppliers, and employees with the ability to perform self-service administrative tasks relevant to their roles. For example, employees could use the Web Client to look up available training courses and register online, or a supplier could review their company's invoice status.

Third-Party Support

All PeopleSoft products are designed to be interoperable with other applications in the portfolio as well as standards-based third party tools and databases. Customers can select hardware platforms, database engines, tools, and specialized consulting services from over 150 members of the PeopleSoft Global Alliance Program. Leading participating systems vendors include Compaq, Data General, Digital Equipment Corporation, Hewlett-Packard, IBM, Pyramid Technology, Sequent Computer Systems, Silicon Graphics, and Unisys. Database vendors include IBM, Informix, Microsoft, Oracle and Sybase. Operating environment support includes all major versions of UNIX, *Windows NT, OS/2* LAN servers, and OpenVMS.

OLAP Integration

PeopleSoft's *Cube Manager* is designed to work with popular Online Analytical Processing (OLAP) tools from third parties and allows the construction of multidimensional data cubes with information extracted from PeopleSoft applications and third

party databases. Data can then be viewed from different angles to provide decision support by testing alternative scenarios and strategies. With analyses presented in quick-read formats, managers can make better decisions, react faster to competitive threats, and identify inefficiencies more effectively.

Customer Support and Training

All customers licensing a PeopleSoft application are assigned an account manager who acts as the customer's advocate. Customers also receive a complete first-year support package consisting of implementation services, 24x7 hotline support, credits for training classes, and any new releases of the application purchased that may be issued. PeopleSoft has established 45 customer centers across the United States, Canada and Europe to provide support and training cost-effectively.

PeopleSoft also maintains *Customer Connection*, a Web-based communication resource for customers and business partners. The system uses Lotus' *Domino Web Server* to provide secure access to a continuously updated site featuring product support, documentation, registration for training courses, PeopleSoft news and information, and discussion groups.

PeopleSoft also sponsors dedicated customer events such as Product Planning Forums, Regional User Group meetings, and an annual Users Conference. In 1997, the PeopleSoft Users' Conference had over 11,000 attendees.

InConcert, Inc.

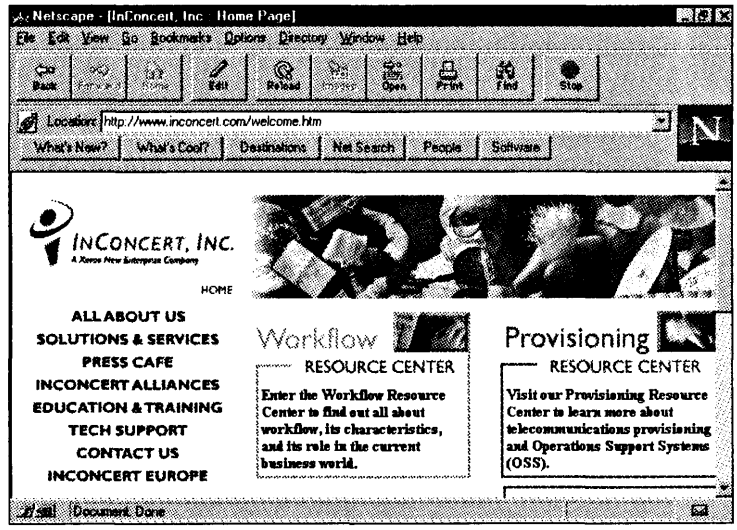


Figure B.3 *Home page of InConcert, located at http://www.InConcert.com.*

Since its inception, InConcert, Inc., a Xerox New Enterprise Company, has provided Fortune 500 companies with the high-end software solutions needed to successfully meet their complex, business objectives. Today, these companies are feeling the effects of competitive markets, whether driven by industry deregulation or increased customer service demands, and must reevaluate how they conduct their business–focusing on the bottom line, worker productivity, product quality and customer satisfaction. InConcert, Inc. is providing the tools and solutions needed to meet these needs by streamlining business processes, reducing costs and meeting the demands of competitive markets with two product lines: *InConcert Version 3.6*™, the company's core workflow toolkit; and *Teoss*™, InConcert's first vertically focused solution built specifically for companies that provision telecommunication services.

Becoming A Multiple Product Line Company

With its powerful and highly customizable workflow engine, the company manages complex business problems in many industries. Specifically, *InConcert* lends itself to industries with complicated or intricate business processes where the ability to manage change is critical.

A new management team installed in early 1997 recognized that the company's product focus needed to reflect dynamic market conditions. In particular, they recognized that *InConcert* was ideally suited to intensely competitive and rapidly-changing vertical industries such as telecommunications and manufacturing. While continuing to pursue sales of the company's core product, InConcert, Inc. developed and executed on a vertical market product strategy by introducing their first industry-specific software application, *Teoss*, using their core workflow technology as the foundation.

A Complete Process-Centric Workflow Solution

InConcert Version 3.6 enables organizations to model, execute, monitor and control complex, business processes that involve multiple participants and multiple software systems. By providing the right information to the right users at the right time, *InConcert* increases worker productivity, product quality and customer service. *InConcert* is unique in that, it not only enables an organization to perform its current operations more efficiently and effectively, but it also provides the flexibility to support process change and improvement over time in response to dynamic business conditions. Additionally, *InConcert* incorporates a powerful method of business process design, Process Design By Discovery™, which allows users to deploy their workflow-based solutions without a protracted process design phase, uncovering

the details of their business processes by simply conducting their business.

Because *InConcert* can be customized to meet every customer's specific needs, it is utilized in a wide range of industries including government, manufacturing, aerospace and defense, engineering and telecommunications. Its open architecture provides the scalability and robustness required to support mission-critical applications throughout the enterprise, via the Internet or a company's intranet, LAN, or WAN. Rather than adding another layer to the corporate infrastructure, *InConcert* unites diverse databases, applications, and legacy systems into a meaningful, productive whole through the use of the product's open development environment and robust set of application programming interfaces (APIs).

Giving Management the Tools to Analyze and Facilitate Change

One of the most critical capabilities lacking in many businesses today is the ability to assess the efficiency and effectiveness of business processes. *InConcert* provides these management reporting tools while also empowering workers to map the way their work should be performed.

With *InConcert*, managers can view work in progress and stay on top of issues. Entire processes are tracked, creating a built-in audit trail and an objective record of employee performance. Managers have the ability to utilize existing reports or customize them to meet their information needs, delivering a wealth of information to help identify bottlenecks and areas of concern. With these tools, managers can monitor and analyze the flow of work, efficiently allocate resources, continuously modify and improve business processes, and companies can utilize "best practices" across the organization.

JetForm Corporation

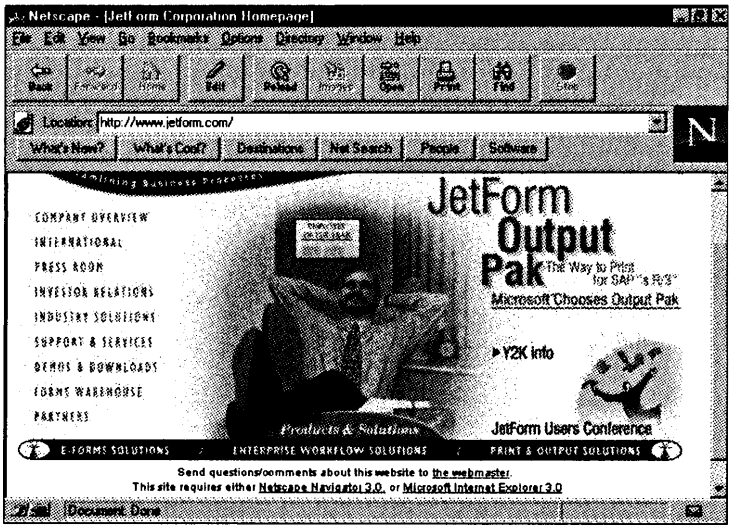


Figure B.4
Home page of JetForm, located at http://www.jetform.com.

JetForm Corporation headquartered in Ottawa, Canada is the global leader in enterprise workflow and electronic forms that streamline business processes. JetForm offers products for designing, completing, routing, printing, and managing forms and the underlying business process they represent, helping organizations reduce costs and increase productivity.

The $120 Billion Challenge

Even today, after decades of computerized automation of specialized processes such as finance, accounting, manufacturing, and more, paperwork still constricts the flow of information and work in most companies today. Some analysts estimate that more than 80 percent of company documents remain paper-based forms.

These forms typically initiate some type of workflow, a formalized task or action that must be processed by one or more people,

such as approving a loan application. While the GartnerGroup estimates the annual worldwide cost of printing and storing printed forms is as much as $6 billion, the real expense, up to $120 billion, lies in the underlying workflow processing of these forms, such as filling, routing, approving, and faxing.

Productivity and Cost Savings

Paper forms are static, inefficient, error-prone, and expensive to use as the front-end to an enterprise workflow process. Errors are common in paper forms and can often be difficult to identify. Printing, storage, and shipping of pre-printed paper forms drive up costs substantially.

By contrast, electronic forms are ideal for enterprise workflow because they eliminate these obstacles by exploiting intelligent, dynamic, context-sensitive forms on screen to capture structured information. That e-form can act as the window into a complete enterprise workflow system that lets users route information quickly and economically to all stakeholders, partners, approvers, and other participants. The intrinsic benefits of e-forms are numerous:

- Accessible online—There's no preprinting and storage of multi-page, multi-part blank forms that tie up warehouse space and administrative budgets. Remote offices don't run out of critical forms when they're e-forms. And companies needn't worry about obsolete forms. When a change is needed, the new form is instantly available to all.

- Intelligent, fast, and easy to fill—Automatic data validation ensures forms data is accurate and complete. Dynamic forms are context-sensitive; fields intelligently appear when necessary and there's always enough space.

- Easy to route and track—You can send and manage e-forms according to built-in business rules. There are no lost forms, and there's no need to store multiple copies for each participant processing the form.

Enterprise Strategies for Output Management

Many JetForm customers initially deploy JetForm solutions to gain control of their output: hardcopy printouts, faxes, e-mails, and more. JetForm provides substantial advantages in "back-office" applications for production-level output. Leveraging existing computing systems and architectures, JetForm products can create a comprehensive solution for output management.

Leadership in the Booming Enterprise Workflow Market

According to market research firm International Data Corporation, the market for enterprise workflow was $336 million in 1996 and will grow at a compounded annual growth rate of 50 percent over the next five years to $1.5 billion in 2000. Already, through earlier enterprise workflow software tools licensed by JetForm, the company enjoys a 10 percent share of the enterprise workflow market, the largest share of any vendor, according to IDC.

Enterprise workflow addresses the underlying business processes initiated by forms that affect virtually all companies, such as purchase orders, expense reports, vacation requests, research requests, time sheets and payroll processing, claims reports, invoice and order processing, capital requisitions, or other similar functions. Enterprise workflow dramatically reduces the time and expense associated with these processes by automating the flow of information to appropriate stakeholders in the processes–requesters, approvers, and fulfillers.

JetForm's enterprise workflow solutions are flexible enough to support different participants and different structured, unstructured, or ad hoc processes. Users can easily track the status of any information, automate certain steps, handle exceptions, and administer the rules and roles to tailor each flow to individual needs.

Unlike production workflow systems that are more expensive and are deployed only in certain departments, enterprise workflow is a lower cost, higher ROI proposition that brings benefits to any user of forms, virtually the entire company. What's more, these users can also integrate as needed with the production workflow system, approving exceptions from the production system, for example. JetForm has partnerships with several leading production workflow vendors such as Staffware and FileNet.

Enterprise workflow can become even more valuable when it extends beyond local groups of users to encompass not only remote offices, but users, partners, and customers as well through Web connections.

Technical Principles

JetForm pursues its product vision from a foundation of:

- Superior Scalability—JetForm solutions are renowned for their ability to scale easily throughout the enterprise. By exploiting the organization's existing e-mail and Web/intranet infrastructures, JetForm offers the ultimate in scalability, growing with the organization at a very low cost.

- Client Independence—JetForm solutions can support thin-client architectures such as Java-based Web browsers and network computers. That reduces expenses

associated with dedicated client software and desktop administration costs. However, the company also provides thick-client solutions, including JetForm's own *JetForm Filler*, HTML, *Lotus Forms*, *Acrobat*, and other formats. Companies can deploy solutions irrespective of their choices and investments in client platforms.

Worldwide Leadership

JetForm's acclaimed family of electronic forms, print and output solutions, and enterprise workflow solutions have made it the worldwide leader with nearly 80 percent of the market and hundreds of corporate customers across the globe. JetForm has offices in 15 locations throughout North America, Europe and the Pacific Rim. In addition, the company has a worldwide network of distributors to provide multinational enterprises with the local support and global strength they demand. Technology development labs assure a steady stream of innovation and support for contemporary architectures and standards. Local language versions of JetForm products are available in several languages, including Asian character sets.

Action Technologies, Inc.

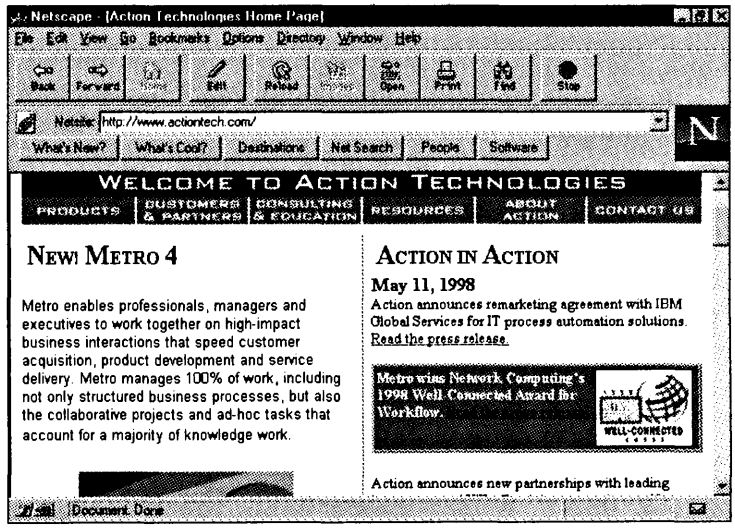


Figure B.5 *Home page of Action Technologies, located at http://www.actiontech.com.*

Action Technologies is at the forefront of providing solutions for an issue of looming importance as we move into the new millenium–leveraging the skills and energies of knowledge workers. With business demands rising unceasingly and cycle times shrinking to fractions of previous norms, companies are increasingly focusing on empowering that part of their workforce most responsible for core competencies, revenue-producing business processes, and organizational agility.

Action is the leading provider of Web-based workflow and work management software for knowledge workers. The company offers open, scalable, extensible products for managing business processes that encompass a wide variety of planned and impromptu work styles and for dealing effectively with the change and uncertainty that are inherent in today's fast-paced, volatile business world.

ActionWorks software comprises ready-to-run applications for work management as well as tools to develop workflow applications. The patented *ActionWorks* work management engine provides unique capabilities for managing both planned work processes and unforeseen problems, demands, and opportunities that force midstream changes. It also provides users with tools for managing ad-hoc collaborations and tasks–all within a single environment.

Customers can build a complete work management environment for Web or client/server deployment across and between networked enterprises. *ActionWorks* products combine Internet technologies, including rich Web-based forms and electronic messaging, with industrial-strength SQL transactional technologies and built-in safeguards to ensure business process integrity for even the most complex, widely dispersed, and change-prone workflows. Support for multi-server distributed architectures and the full range of industry standards (e.g., LDAP, ODBC, Java, ActiveX, CORBA, SMTP, MIME, etc.) provides customers with scalability, flexibility, and investment protection.

Action Technologies is privately held with venture funding provided by Volpe, Welty, and Co., Olivetti, Inc. and others. The company is based in Alameda, California. Action markets and sells its products through its direct sales force as well as through partnerships with OEMs, ISVs, systems integrators, VARs, and distributors worldwide. Action's European Support Center, Work Management Europe, provides dedicated support for Action's products in Europe.

The Action Solution

Action Technologies' suite of workflow and work management software is the first to bring the ad-hoc and unpredictable into the sphere of manageable work. Our unique Internet-enabled work

management engine handles 100% of knowledge worker business processes, including planned work sequences as well as unexpected process variances and midstream changes in work scope and deliverables. Action products provide ways for users to efficiently handle fluidity in team makeup, roles, and work assignments and to respond to situations that call for impromptu collaboration, troubleshooting, and creative problem solving.

Action's products provide this unprecedented combination of agility and accountability because they are based on a unique, patented work management engine. This engine captures the essence of knowledge work, which is a series of commitments. A commitment is an agreement with someone to do something in the future–and it is the basic unit of economic activity in today's modern, competitive businesses.

As a result, in an Action solution, users are no longer passive recipients of work. They are managers of their own work and fully aware of the larger business processes in which they make their contributions. Action users have many options when they receive a work message. They can ask for more information, negotiate a different due date, convene a group collaboration and offer work to other individuals.

Action products are able to allow this extraordinary degree of flexibility because they also incorporate robust underlying controls to enforce business rules. Our products combine messaging with central transaction control and have built-in safeguards to ensure the integrity of business processes. These industrial-strength features include process rollback and locking, exception condition and latency management, consistency check reinforcement, and checkpoint controls. No matter how many participants are involved in simultaneous negotiations and commitments, no matter how many servers the work is

distributed across, and no matter how much unexpected change occurs, Action's work management engine ensures that every aspect of the process is documented, tracked, and accounted for. It also performs constant status tracking and data collection against user-defined metrics, enabling organizations to baseline their processes and measure improvements.

The work management infrastructure is transparent to users. While processes, access profiles, and roles can be distributed across any number of physical or logical servers, users still log on only once and can manage all their work–enterprise processes, team-based projects, individual tasks–from a single WorkBox. Action also provides solutions for linking internal organizational workflows with customers, suppliers and business partners via extranets.

The ActionWorks Product Line

ActionWorks™ is the brand name for a suite of powerful workflow and work management software products for knowledge workers. The suite offers a flexible work environment that integrates the Web, messaging, line-of-business and production applications into one collaborative work process. The result is dramatic time savings, substantial cost reductions, increased teamwork, new levels of corporate productivity and ultimately, increased customer satisfaction.

ActionWorks solutions manage the mission-critical efforts of skilled professionals, working together, to deliver custom products and services to demanding clients.

ActionWorks Metro

ActionWorks Metro is the most widely used software for building Web-based work management applications for knowledge workers. *Metro* manages 100% of work, including not only

structured business processes, but also the collaborative projects and ad-hoc tasks that account for a majority of knowledge worker activity. *Metro* enables professionals, managers and executives to work together on high-impact business interactions that speed customer acquisition, product development and service delivery. *Metro* provides users with a WorkBox, the one place to manage enterprise, team, and personal work, and one-click navigation between work-related email messages and rich Web-based work management forms. The suite includes:

- A set of extensible work management applications.
- *ActionWorks Process Builder,* a graphical process modeling and application development tool.
- *ActionWorks Process Manager,* a robust, time-tested work management engine that features a complete, extensive open API.

Metro is scalable, enabling work processes to be geographically and logicially distributed over multiple servers while providing users with a single place to manage work.

ActionWorks Metro is available in configurations for:

- Microsoft® BackOffice® (*Windows NT Server, SQL Server, Internet Information Server, Exchange Server*).
- Open Software (Netscape *Suitespot,* SMTP/POP3, LDAP, Java).

Standards

Action products support both open and defacto industry standards thus enabling future scalability and "plug and play" with a host of complementary platforms and products.

Action customers can:

- Create agent performers that automate tasks by communicating with any DLL, ODBC database, or OLE automation server.
- Build applications in their choice of development environment: Java, Visual Basic, C, C++, etc.
- Use their choice of protocols: HTTP, C-language, LDAP, ActiveX, CORBA, SMTP, MIME, etc.

Action is a co-founder of the Workflow Management Coalition, a non-profit, international organization of workflow vendors, users and consultants. The Coalition's mission is to promote the use of workflow through the establishment of standards for software terminology, interoperability and connectivity between workflow products.

FileNET Corp.

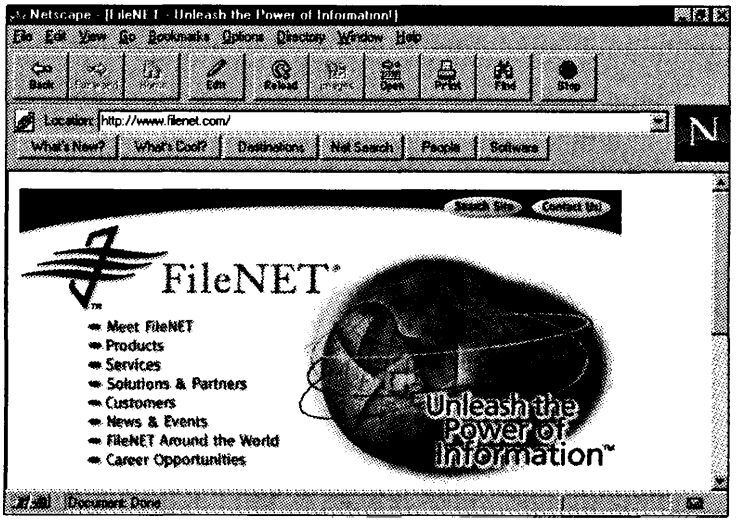


Figure B.6 *Home page of FileNET, located at http://www.filenet.com.*

FileNET Corp. is a proven leader in delivering integrated document management (IDM) software to unleash the power of information for corporate and government organizations. FileNET's Internet and client/server solutions provide standards-based workflow, document imaging, electronic document management and report management (COLD) software for managing information and enhancing productivity. Costa Mesa, Calif.-based FileNET markets its innovative products in more than 60 countries through a global FileNET sales, services and support organization, including its ValueNET® partner program of resellers, system integrators and application developers.

FileNET's *Panagon Visual Workflo* suite is anchored by a flexible architecture that makes it easy to build and modify workflow applications to address dynamic business processes. Benefits of this design include the ability to quickly scale the application to handle a rapid influx of transactions, a situation that can occur when workflow applications are deployed over a corporate extranet. Additionally, the software gives workflow authors and business managers the tools to track, monitor and measure process productivity and effectiveness.

With its open architecture, *Panagon Visual Workflo* supports major industry standards, including Workflow Management Coalition (WfMC) specifications that allow applications from multiple vendors to be integrated seamlessly to handle tasks for business processes that span multiple departments or organizations. In addition, *Visual WorkFlo* has been re-architected to take advantage of the transaction processing power of Microsoft *SQL Server*, and upcoming versions of the software will support *SQL Server 7.0*.

The new software builds on FileNET's status as the recognized leader in workflow software. The Delphi Group, a prominent

Boston-based industry market research firm, recently named FileNET the market share leader for process workflow software products. Additionally, Delphi reported last month that FileNET maintained its spot as the leader in their mindshare poll for workflow software, an accomplishment the company has achieved for seven consecutive years.

Software Components

The *Panagon Visual Workflo* family includes client, server and toolkit components. The software allows technology managers to quickly and easily create solutions that reflect the way work should be performed and enable line-of-business managers to control and modify business processes to meet the needs of a changing business environment. The components, which run on popular software platforms including Microsoft *Windows*, are:

- *Visual WorkFlo Desktop*—This software features an intuitive user interface that can be configured to meet specific business process needs and can accommodate a number of business process models. In keeping with the Panagon product family's focus on "dual deployment," a Web version of this client/server software will be available shortly and will offer the same level of functionality for users operating in an Internet environment.

- *Visual WorkFlo Services*—This high-performance server software manages work queues and repositories, and centralizes workflow tasks to minimize network transfers and maximize fault tolerance. The software can be configured to accommodate specific departmental needs or enterprise solutions with thousands of users. In conjunction with the Web version of the desktop

software, a Web version of the *Services* software will also be offered as part of the *Visual WorkFlo* product suite.

- *Visual WorkFlo Toolkit*—This authoring tool allows managers to quickly create workflow process maps and enables developers to tailor applications that mirror their customers' business processes. The software features a flexible framework for rapid application development that uses RAD (Rapid Application Development) controls based on Microsoft ActiveX™ technology to quickly create custom process automation. The versatility of the *Visual WorkFlo Toolkit* has made it possible for FileNET business partners such as Commerce One, ALLTEL and Lawson Software to easily embed this technology into their industry-specific product offerings.

Development Capabilities Benefits

FileNET *Panagon Visual Workflo* is the only product in its class to extend the benefits of object-oriented technology to workflow application development, promoting a high percentage of "reuse" of software components in application building. These "building blocks" allow workflow authors to refine business processes using the Visual WorkFlo Toolkit without having to undertake new development activities. This reusability of components also makes the software attractive to FileNET's ValueNET business partners, who are developing a wide variety of industry-specific solutions that deliver "out-of-the-box" functionality.

One FileNET partner that has recently announced the integration of *Visual WorkFlo* into its product offering is Commerce One, Inc., a leading provider of real-time, business-to-business electronic commerce solutions. By embedding *Panagon Visual Workflo* in its *C1 BuySite* Electronic Procurement Application, Commerce One's customers can now further streamline and

automate the procurement process across the enterprise, while supporting the enforcement of unlimited business rules and cross-functional business processes. Both Commerce One's Web-based e-commerce solutions and FileNET's *Visual WorkFlo* today support server-centric architecture and browser-enabled applications. Commerce One and FileNET's commitment to this server-centric architecture, open APIs and industry standards ensures that customers will benefit from rapid product development and support, easy integration and interoperability, and the ability to leverage previous technology investments.

Additionally, the software has built-in integration with leading business process reengineering (BPR) products, including Meta Software, IDS Prof. Scheer and Holosofx. Using *Panagon Visual Workflo*'s short- and long-term statistical gathering capabilities in conjunction with business modeling software, managers can document, simulate, and optimize business processes and then import the resulting model into *Panagon Visual Workflo*. This integration assures a rapid and automated transition from the business model to implementation.

Appendix C
Small Networks

Network Adapter Card

As children, many of us played "telephone" with friends by attaching two soup cans with string and walking away from each other while talking through our primitive communications module. The same principle that allows a child to hear–or almost hear–a pal through a soup can applies to networking: in order for your computers to communicate, they must be linked together.

A network adapter, or network interface card (NIC), is an extremely sophisticated soup can; in other words, when used with cabling, it is the device that enables computers on a network to "hear" and "talk" to each other. The network adapter is a circuit board or card that is inserted into a slot inside the computer's central processing unit (CPU); simply open the computer's main console and slide the card directly into one of the computer's expansion slots. When installed, this card provides a communication gateway between the network and the computer. On the backplate of the card is a receptacle for the communication cable plug–from the back of the computer the NIC looks something like an internal modem card. The NIC uses a specialized processor and routines stored in memory to move data to and from the computer's memory and to transmit and receive data on the network cable.

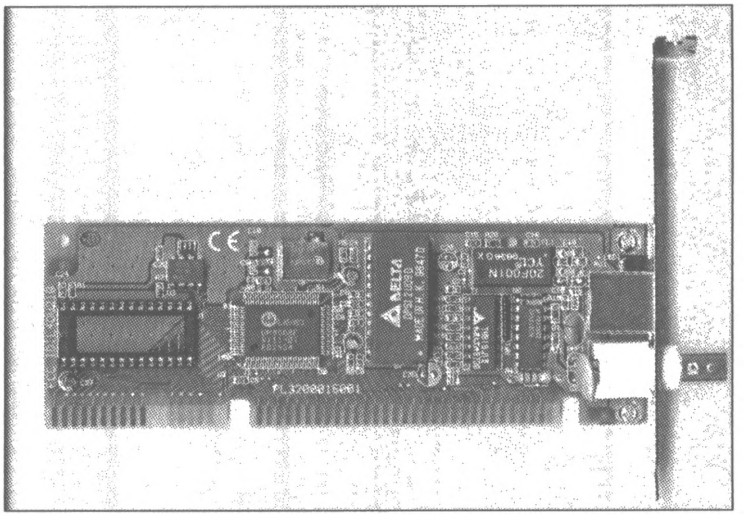


Figure C.1
Network adapter card.

Like most computer hardware components, there are different types of adapter cards. The three most popular categories are described below:

Ethernet

Ethernet cards are the most popular types of network interface cards. They provide a 10 Mbps (megabits per second) throughput (transmission speed) on the network. This card can determine when a transmission is occurring on the network, and it waits for a break in the transmission before it transmits data. If a data collision occurs, all cards on the network stop sending data until the collision is resolved.

Token Ring

Token Ring cards provide up to 16 Mbps throughput. This type of device uses a special message, known as a "token," that is passed throughout the system. When a computer initiates a transmission with this type of card, it attaches the data to be transmitted to the traveling token. The data is delivered, and the token travels

through the system waiting to pick up another transmission to deliver. With this system, other computers must wait until the token is free to perform their transmissions, creating some time lags. However, data collisions are totally avoided.

ARCnet

ARCnet also uses the token-passing method, transmitting data at up to 2.5 Mbps, but it delivers data by numerical network addresses.

In computers that lack expansion slots, such as portable PCs, special network adapters can be used. For example, a PCMCIA network adapter can be used to connect PCs with PCMCIA expansion slots, while pocket adapters can connect a PC to a network through a printer port.

Hub

The hub is one of the most important elements of a network. (Note: Some network configurations do not require hubs.) It acts as a central connection point where all stations on the network are linked to each other.

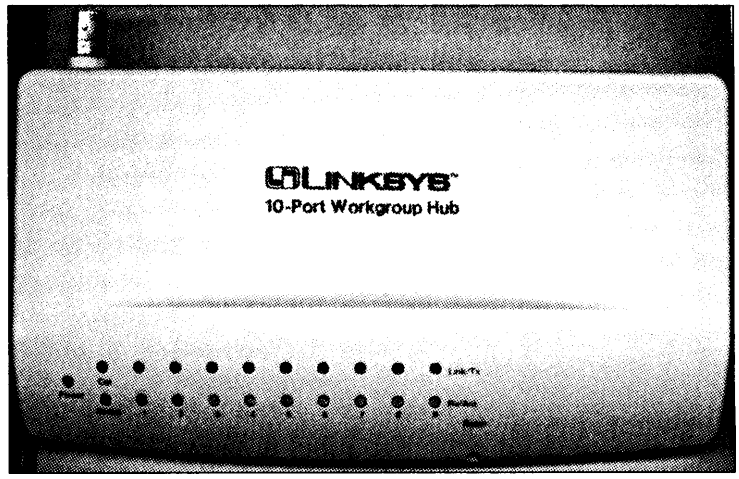


Figure C.2
LinkSys 10-port workgroup hub.

A typical hub includes many ports to which computers and peripheral devices are attached using special network cabling. Depending on the type of design, a network might use one or many hubs in various arrangements. Typically, today's hubs are "manageable" or "intelligent." Each port on a manageable hub can be configured, monitored, and enabled from a hub management console. Manageable hubs can also supply network administrators with valuable information about network transmissions, such as the number of packets that pass through a certain port.

Hubs may also be classified as active or passive. Active hubs regenerate and retransmit network signals, reducing message degradation on a network. On the other hand, passive hubs merely act as connection points through which network signals pass.

As you might imagine, there are several types of hubs available to fit the diverse requirements of various networks and network administrators, including the three types of hubs listed below:

1. Standalone hubs.
2. Stackable hubs.
3. Modular hubs.

Standalone Hubs

Standalone hubs are single box units with a number of ports to which various network nodes are connected. Typically, standalone hubs can be linked to other standalone hubs, but they do not usually provide any method for central management of the ports. As you might guess, these "no frills" hubs are usually the least expensive type of network hub. They are most practical for small, independent workgroups, departments, or offices with fewer than 12 persons on the network.

Modular Hubs

Modular hubs are popular in networks because they are easy to expand and always include management tools. A modular hub begins with a frame, or "card cage," with multiple expansion slots that can accommodate communication cards or modules. Each module that is added functions like a standalone hub. When the modules are placed in the modular hub, they are linked so that a port on one module can easily communicate with a port on another module.

Stackable Hubs

Stackable hubs look and perform like standalone hubs, except that several of them can be stacked, or connected together with short lengths of cabling. When they are linked together, they function like a modular hub; that is, they can be managed as a single unit. These hubs are good choices for organizations that need to start with minimum financial investments in hardware, but anticipate that their networks will grow.

Communications Cabling

In addition to the network adapter cards that enable communication between computers and a network, and the hub that acts as a central connecting point on a network, a network system requires some type of cable or communication channel to physically connect the networked computers. The two most popular types of communication cabling that can be used in networks are twisted-pair cabling (or 10BaseT) and thin coax cabling (or 10Base2). More expensive and very fast options selected by some organizations are shielded twisted pair wire (used only in Token-Ring networks) and fiber optic cable.

Twisted-Pair Cabling

Twisted-pair cabling (sometimes referred to as RJ-45 cabling) is the type of cable used to connect computers to a hub. Because the cable from all the nodes converge at a central point, the configuration of networks that use this type of cable is frequently referred to as "star." Twisted-pair cabling resembles telephone wire in that it has RJ-45 clips at both ends of the wire (that are slightly larger than the RJ-11 clips used in telephone lines). The "twisted pair" designation means that the paired wires within the cable are twisted around each other. By producing cable in this manner, line static and noise is greatly reduced. This cabling is ideal for small networks, where the physical distance between the computers and the server is relatively small and there are fewer than 10 computers on the network. It is flexible and inexpensive.

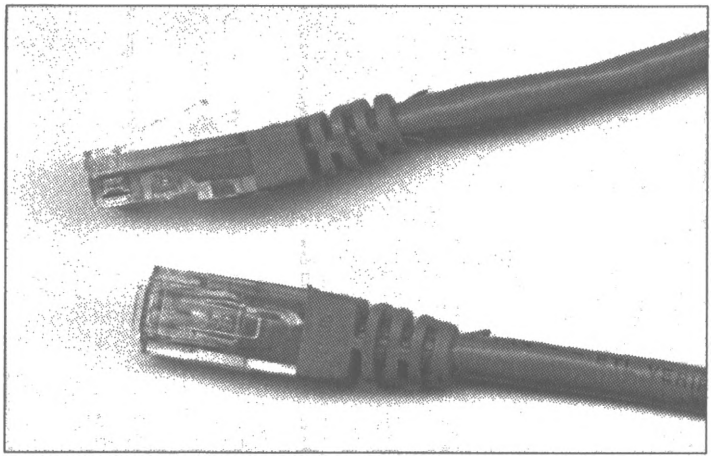


Figure C.3
Twisted-pair (10BaseT) cabling.

Thin Coax Cabling

Thin coax cable resembles the coax cable used to connect cable TV or a VCR to a television set. This cabling is ideal for longer distance connections between computers and a server, for larger networks with 10 or more computers, and for networks without hubs. It includes heavy shielding around the wire components, which makes it ideal for situations where electromagnetic interference might be a problem.

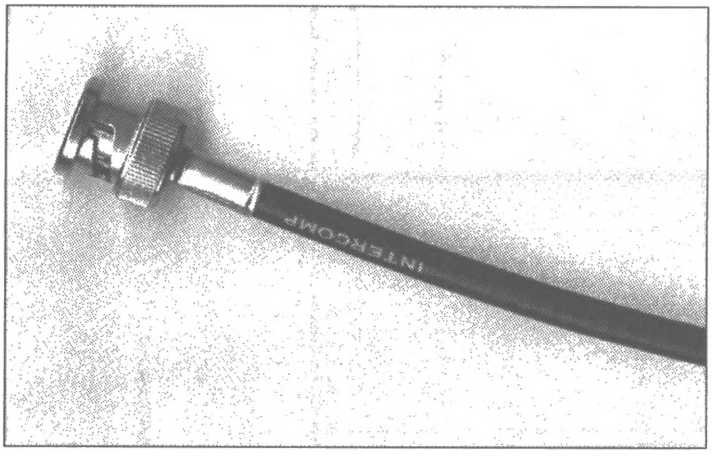


Figure C.4
Thin coax (10Base2) cabling.

The configurations of networks in which thin coax cabling is used are referred to as "linear" or "backbone." This is because the nodes are not connected to a central point or hub. Instead, the thin coax is arranged in a straight line of PCs or other devices that are terminated at both ends of the cable. Instead of inserting the cable directly into the hardware device, a component called a T-connector is used, which divides the network adapter card's input into two separate ports. One port receives an incoming network cable and the other receives an outgoing network cable.

You might use a combination of twisted-pair and thin coax cabling within a network. In fact, larger networks often do. Thin coax can be used as a backbone cable with small groups of twisted-pair cabling branching off at regular intervals. Network cabling can be run under floors, around office dividers, or over dropped ceilings. When planning your wiring layout, try to keep cables away from power outlets, florescent lighting fixtures, uninterruptable power supplies, and other sources of strong electromagnetic interference.

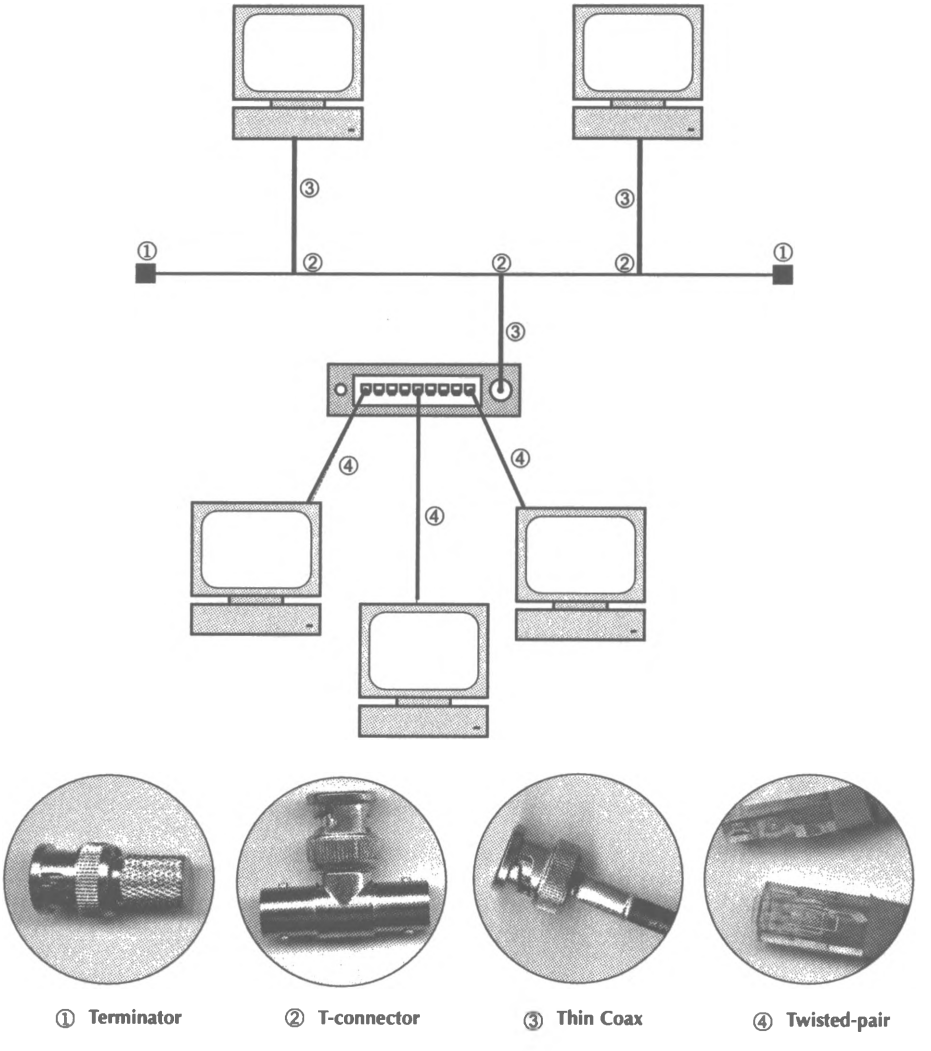


Figure C.5
Combinations of cables are often used in small network configurations.

Networked Peripherals

Another hardware category to consider when planning your network is networked peripherals; this category includes hardware components, such as printers and modems, which have their own network connections. These peripherals use specialized internal processors and networking software that allow various computers to use the peripherals as if they are locally attached.

Network Topologies

Frequently, networks are classified by their topologies. The topology can be compared to a map–a structure that shows where each element of the network is and how all elements are connected together physically via cables.

There are three types of topology commonly used for small networks: (1) star, (2) bus, and (3) ring. Each configuration is described and illustrated below.

Star Topology

This layout requires that all computers be connected to a hub with twisted-pair cabling. This simple configuration allows the hub to pass signals that allow each computer to gain access to the other computers on the network. You can think of star topology as a wagon wheel: the hub is the wheel hub, the spokes are the twisted-pair cabling from each computer. The hub device determines on which spoke a particular transmission should be routed.

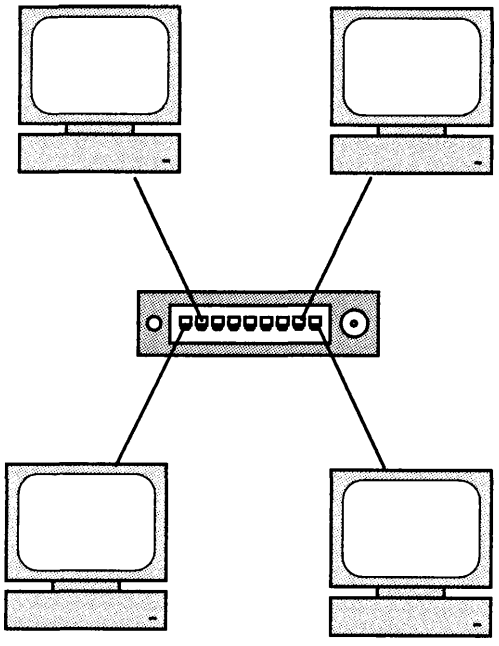


Figure C.6
A star topology network.

This is the most common topology for peer-to-peer networks. All computers are plugged into the hub, and all are treated equally by the system. This topology is advantageous in the same way that parallel electrical wiring is. If one computer crashes, it does not take the other computers on the network system down with it. It simply removes itself from the network system, and thus is not accessible from the network hub.

In many newly built office buildings, twisted-pair cabling is installed within the walls with network jacks installed at both a central location (usually an equipment room) and at each computer location within the office. Cabling is plugged into the wall jack at the computer's location. In the equipment room, additional cables are connected from each computer wall jack into the hub, completing the network circuitry.

Bus Topology

Bus topology can be thought of as a line of computers on a single route that runs through the office. Like star topology, computers are plugged into the cable at their office location in this topology. Line boosters are sometimes needed to boost the communication signals where the bus line is long. Unlike star topology, if one computer goes out on a bus network, they all go out.

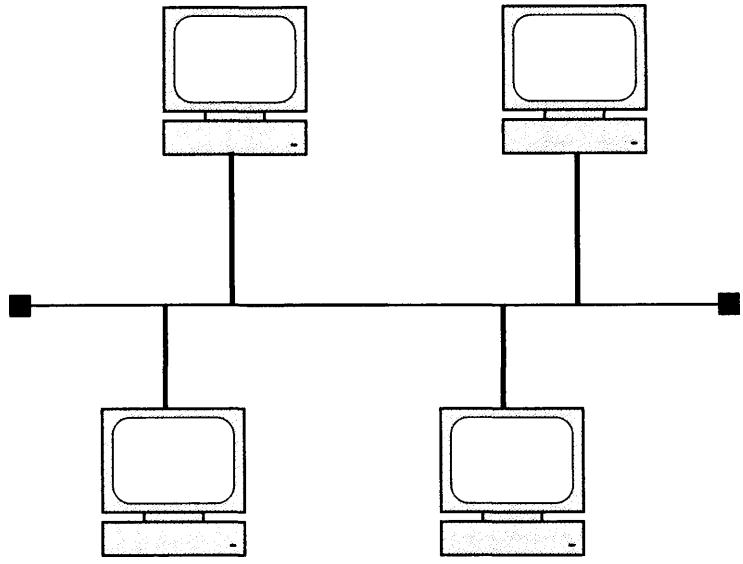


Figure C.7
A bus topology network.

Ring Topology

The ring topology uses a multistation access unit to pass packets of information along the network. It is used with Token Ring and ARCnet networks, because the communication structure of networks that use these types of cards is built on a token that travels through the network, delivering data.

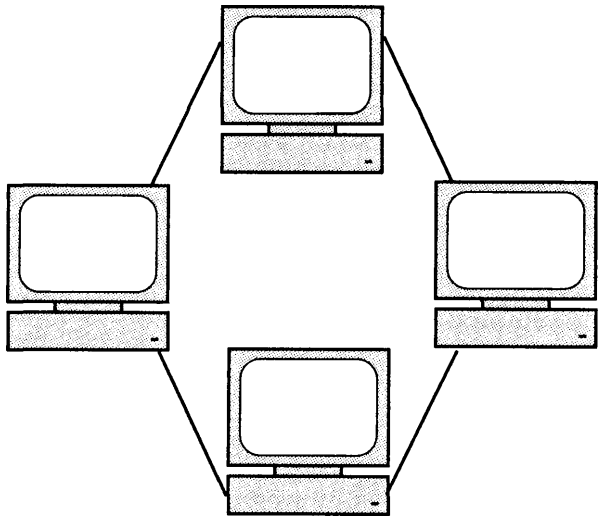


Figure C.8
A ring topology network.

Network Operating Systems

The first program loaded when a computer is started is called the operating system. The operating system interprets instructions sent to the computer by the hardware and software. Among other things, operating systems allocate memory for workspace, and load configuration settings and device drivers. In short, the operating system creates and controls the computing environment. A Network Operating System (or NOS) handles all of these functions and also bundles the various network protocols that are necessary to control other aspects of network communication.

As with other types of software, there are various types of operating systems from which you may choose when building a network. For example, *Windows NT* is Microsoft's flagship 32-bit network operating system. *NT 4.0* has the *Windows 95* graphical

interface, which runs on Intel, Digital Alpha, IBM PowerPC, and RISC platforms. An *NT* network will seamlessly support clients running *Windows 3.1, Windows 95, Windows NT Workstation,* and other operating systems, which makes it especially useful for organizations with many types of *Windows* machines. *NT* has also incorporated *Netware* interoperability functions to work with existing Novell networks. (For more information about *Windows NT,* visit the Microsoft Web site at **http://www.microsoft.com**.)

Network Protocols

Network protocols are developed according to a communications model known as the OSI Reference Model (Open Systems Interconnect). This model, developed by the International Standards Organization, defines all the services provided by a LAN and, by extension, all the protocols that are necessary to control those services. The model includes seven layers, each of which identifies a subset of all LAN services. These layers are listed and described below:

1. Physical Layer—Defines how electronic signals are passed over the network.
2. Data Link Layer—Controls the ways that the machines handle the physical sending and receiving of signals.
3. Network Layer—Controls how packets are routed on the network.
4. Transport Layer—Controls the methods that assure that a message has been received correctly.
5. Session Layer—Controls how machines identify each other and how users sign on and identify themselves.
6. Presentation Layer—Controls what information looks like when received on the user's machine.

7. Application Layer—Controls how information fits into the system of software that will be used to process it.

The advantages of layering communication protocols in this way are that (1) new versions and updates can be added without changing the layers above and below, and (2) computers on the network need only use the layer appropriate to the particular task they are completing, saving computer resources. Obviously, many different types of protocols could be developed to control these layers in various ways. However, in order for computers to communicate on a network, they must follow a common set of protocols.

Three common protocol suites are listed and described below:

1. IPX/SPX (Internet Packet eXchange/Sequenced Packet eXchange), which is generally used for Novell client/server networks.
2. NetBEUI (NetBIOS Extended User Interface), which can access *Windows for Workgroups* or *Windows NT* machines, and works well with peer-to-peer networks.
3. TCP/IP (Transmission Control Protocol/Internet Protocol), which is the protocol used for the Internet. It also works with *Unix* and *Windows NT* systems.

Client/Server Networks

As we discussed above, the majority of workflow management software must be run on a client/server network. A client/server system has at least two physical components: a server computer (usually a "file server" in small networks), and client computers, also known as workstations. The server is a dedicated computer

that supplies services, such as data files, program files, and access to printers, to the client computers that are connected to the system. This can be a highly efficient arrangement for tightly integrated workgroups, for instance, when large databases of customer information must be accessed and updated by several staff members on a continual basis. The database file can be located on the server, making it accessible to all parties at any time. Another common use of client/server systems is application sharing. Instead of installing the same program on every computer in the office, special network versions can be installed on the server and shared by all client computers on the system, thus saving disk space on the individual desktop computers and, perhaps, also saving licensing costs for the software. Most workflow software is of this type.

You may have heard about the newly developed "network computers," also called NCs or "thin clients," that several computer manufacturers are now marketing. These stripped-down client computers are intended specifically for client/server network environments, where the bulk of the processing and storage tasks are allocated to the server computers. In these environments, individual workstations can consist of only a small processing unit, a monitor, and a floppy diskette drive. The application software, and perhaps even the operating system software, are stored on server computers and supplied to workstations as needed. These thin-client computers are being touted as the beginning of the real network computing revolution, because, with their use, organizations can avoid placing costly personal computers on each employee's desk. *NC World* magazine is one of the most recently launched periodicals to cover this evolving market; visit their Web site at **http://www.ncworldmag.com** to learn more about this new technology.

In order for the server to actually serve the clients on the network, a special network operating system (NOS) must be installed on the server computer. The NOS allows the dedicated server computer to share many programs as well as resources (such as printers and modems) with all computers attached to it.

The client computers are the computers that are attached to the server. The client computers are able to process and update the information requested from the server. Just as the server requires special software, client computers require "client" software. Client software communicates between the client computer and the server by requesting necessary program files, data files, and resources it needs from the server to complete a task.

Peer-to-Peer Networks

Unlike a client/server system, a peer-to-peer network does not have a dedicated server or designated client computers. All computers on a peer-to-peer network function as both a server and a client. This means that designated resources, such as folders, disk drives, and CD-ROMs, on one computer can be readily shared with another network computer. This also applies to the local resources attached to a networked computer in a peer-to-peer environment, such as a printer. For small offices with 10 or fewer computers, where accessing printers and sharing files are the only required network tasks, a peer-to-peer network can be the answer. Only the simplest workflow management applications can be run on this type of network.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ISBN 1-892855-03-8

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