Workflow: An Introduction

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INTRODUCTION

Workflow is important. It's a valuable technology. It is also a discipline, practice, and concept. Like knowledge management, all types of vendors claim that their product or service is "workflow" because it's so important. It has taken the Workflow Management Coalition (W*f*MC) some five years of constant collaboration and education to achieve a common appreciation of what workflow really is, and what it is not. In those five years, the technology and deployment practice have developed and matured substantially, such that we may have difficulty in recognizing five-year-old workflow products!

It is very important that workflow is correctly implemented, because the technology has a significant impact on the operations of an organization. For example, the 1998 Viewstar installation in the Revenue & Benefits Department of Lewisham (London, England) Borough Council impacted their operations in the *first full year* in the following ways:[i]

- £5 million additional revenues
- Fraud Investigations save an additional £1.7 million through speedier processes and cross checking capability
- £0.5 million savings on operational costs

This chapter describes the current understanding of "workflow" with the assumption that the reader has no prior knowledge of the topic. It is designed as a basic primer that will help with the appreciation of the more advanced topics described in later articles.

WHAT IS WORKFLOW?

In 1996, the Workflow Management Coalition published a glossary of all useful terms related to workflow. The latest version is published in Section Two. It defines workflow as:

The automation of a business process, in whole or part, during which documents, information or tasks are passed from one participant to another for action, according to a set of procedural rules.

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

Now workflow technology has matured; it is the process itself that is automated. A work item or data set is created, and is processed and

changed in stages at a number of processing points to meet business goals. Most workflow engines can now handle very complex series of processes. Any condition that can be expressed mathematically can be managed by a workflow system. There is a new branch of Calculus being created to assist the workflow industry to manage this increase in complexity.

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

WHAT IS A WORKFLOW MANAGEMENT SYSTEM?

A system that defines, creates and manages the execution of workflows through the use of software, running on one or more workflow engines, which is able to interpret the process definition, interact with workflow participants and, where required, invoke the use of IT tools and applications.

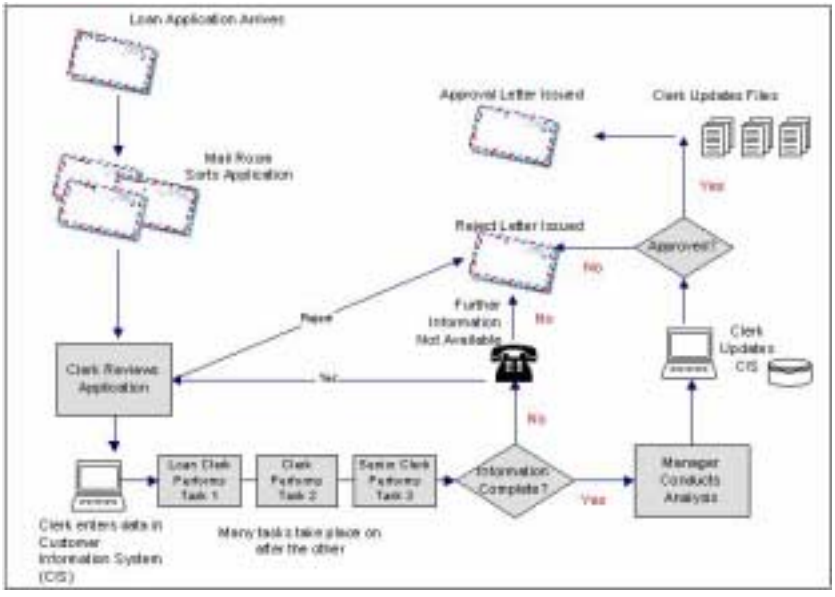
It might seem an over simplification to say that a workflow management system manages workflow. However, the categorization of a WMS is that it can interpret a workflow definition, commonly, but not always, produced separately, manage triggers, alarms, and interoperate with external systems. It is important to note that whilst this definition covers the spectrum of workflow systems; it excludes simple relational database systems and e-mail systems with programmable delivery mechanisms.

WORKFLOW DEPLOYMENT

Workflow has a practical effect on business operations. Let's look at a before-and-after scenario in a business department that receives applications for loans, sorts and reviews them and then decides whether to grant the loan. The processes have been simplified to help show the impact that workflow has.

The Manual Process—Before Workflow

An application form arrives in the post. It is sorted by the mailroom and distributed to one (of many clerks), who checks it for completeness. The form might be returned to the customer for more information at this point, or rejected out-of-hand, or the clerk will enter details of the application into the Company's Customer Information System, and then pass it to the next clerk. The process of granting a loan can include up to eight sub-processes. In some organizations, there is a clerk or team of clerks for each sub-process; in others, one clerk manages all the tasks for an individual application.



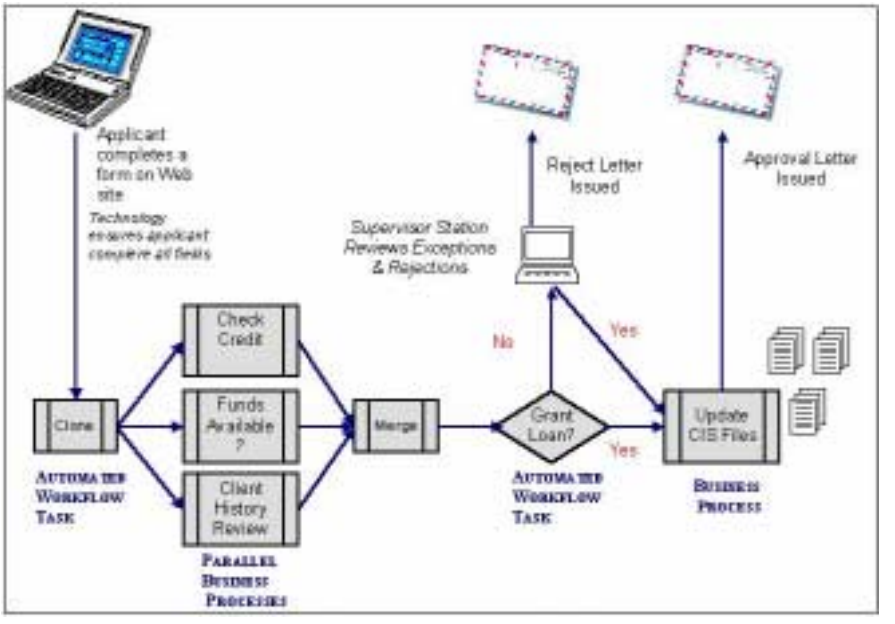
It can become difficult to try to find out what the status of any application is. (Handling an increased workload has a direct relationship with the number of staff; the more work, the more staff a company needs.) The application can be referred to a supervisor at any of the process points. Normally, a supervisor also reviews the application form and all associated internal documentation before the loan is finally granted.

The Automated Process

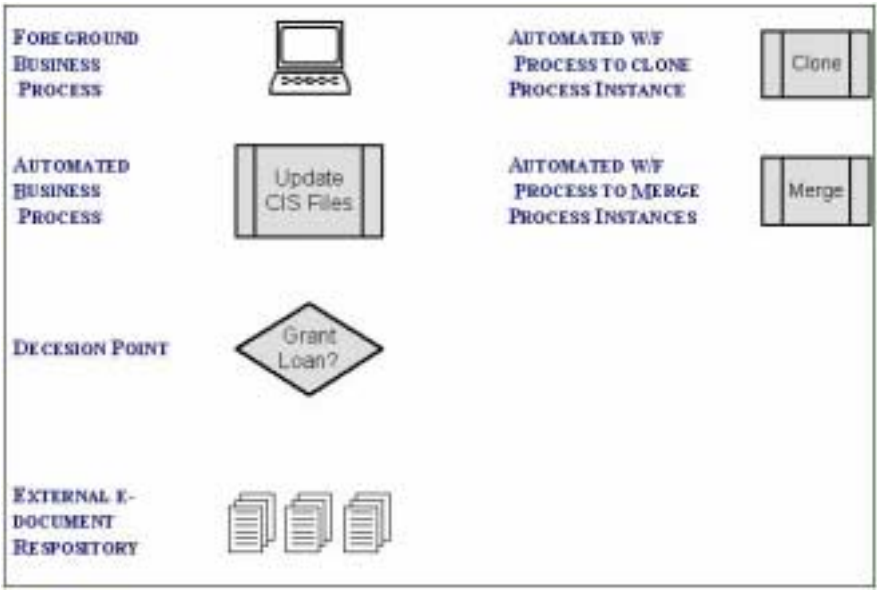
The applicants visit the loan company web site. They are provided with all the information necessary to decide whether to proceed, and then completes an application form. The technology ensures that all mandatory fields are completed. The company then receives an application as a data set completed by the customer. The first workflow activity is to validate the form, and send e-mail to the applicant, thanking him for his application and providing an application reference number.

Next, the application is cloned so that the workflow management system can execute the many activities in parallel—reducing the time taken to handle each application and improving customer service. The effects are dramatic. Workflow implementations are reducing work times substantially; a decade ago it was reasonable for a loan application to take a week or so to process, now the applicant expects an almost instantaneous answer. The time has dropped from weeks, not to days, but to hours!

With workflow handling the routine work, the supervisor is only required to handle exceptions. The logic in workflow engines is quite capable of deciding whether a loan should be granted or not.



With workflow, the basis of the decision can now be determined automatically, 24 hours a day. This is becoming a requirement of participating in web-based e-commerce. Customers expect to be able to contact you and do business at any time of day. E-commerce also means that for many businesses, sales opportunities can arrive from any time zone on the planet.



The WMS will also update the other systems automatically. Providing the system is well tested, human error is eliminated. The WMS can drive applications to create the rejection or acceptance letters and loan contracts; they supervise the approval process, and drive other applications to dispatch the documents electronically by fax or by e-mail.

Key to Illustrations

Workflow is making important contributions to many types of business. Different types of workflow are described in this primer, and each user organization will deploy the software in different ways. So for each, the value of the software will be measured in a slightly different way. Nevertheless, the returns are considerable. Look at what the Accounts Payable Group of Kraft Foods achieved in their San Antonio Center:[ii]

After a number of mergers, Kraft Foods decided to consolidate all accounts payable and customer services activities. This meant that a single unit would handle 2,500,000 invoices per year for 60 operating plants. The company installed a document management system and a FileNET workflow system.

The new technology has achieved a 37 percent reduction in transaction costs. The project has shown an internal rate of return of 46 percent, and the cost per transaction is around 54 percent of the cost prior to the project. Also the workflow system regulates Kraft's operations policies, providing productivity for the audit work. This really is a significant achievement when you are issuing 2,500,000 invoices per year together with associated documentation such as credit notes and amendments.

Improvement Summary

- Reduced headcount by 31 percent.
- Saved over $300,000 annually in tax penalties and interest.
- Reduced the time to generate and track correspondence by 80 percent.
- Reduced the time to complete a customer service inquiry by 18 percent Reduced document retrieval time by 99 percent.

Tangible Benefit Summary

- **Reduced Operating Costs**—All organizations using workflow are reporting that their unit costs to execute a transaction are reduced. One bank commenced using workflow in five years ago, and staff members were pleased when they achieved a 33 percent improvement in productivity, as measured by the cost to handle each case. Now the manager will not even authorize a workflow project unless the team can show a saving of over 67 percent. He believes that now they are experienced in process automation and unless they can achieve this rate, they have not properly thought through the business process.
- **Improved Productivity**. Routine and repetitive tasks can be automated, reducing cycle time by significant factors. Work can be processed 24 hours a day—a vital factor for large organizations with global operations and for all organizations involved in web-based commercial activities.
- **Faster Processing Times**. As well as executing processes automatically in a computer, which tends to be faster than

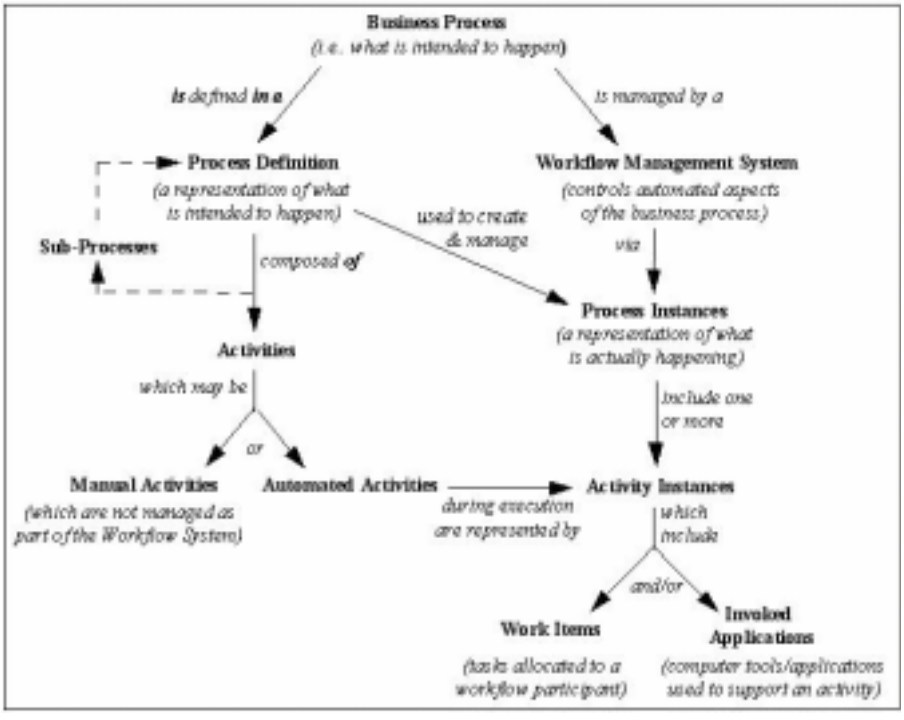
manual processing, workflow supports parallel processing. This means that if a task involves eight activities, maybe four of them can be executed at the same time, reducing the actual lapsed time considerably.

Intangible Benefit Summary

- **Improved Services,** Managers claim that they are able to give better service to customers. The time to do the work is reduced, fewer mistakes are made, and information about the work in progress is readily available.
- **Improved Conditions for Employees,** Few people enjoy dull repetitive work. This type of work is the best candidate for automation, in most cases liberating staff to contribute at a much higher level to the success of the organization.
- **Improved Change Management.** Organizations can define, automate and continuously redefine its business processes
- **Quality**. Fewer mistakes from automation means a huge increase in quality of service for customers.
- **Improved Communication**. With information about the business tasks readily available, communications are improved between people and across enterprises.
- **Decision Support**. It is easier to make well-informed and effective decisions.
- **Improved Planning Capability**. With information available about how the organization does its business, and about work-in-progress it is easier to make effective plans.
- **Improved Deployment Capability**. Users report that they are able to effect rapid changes in organization structure, and respond faster to market changes and new opportunities.
- **Inter-Organization Communications**. Workflow supports activities that stretch across many organizations. For example, it supports shared processes within supply chain extending between many organizations.

TERMINOLOGY

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



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

Business Processes are normally discussed at length within the operations group. IT professionals generally participate in the review, as do the legal and accounting teams. This process of discussing the process has value in its own right. Having attained consensus on the process definition (however long this takes—it is essential), it is uploaded into a WMS. When the process definition has been tested and put into production, instances of that process flow through the system.

The process definition describes how a loan is granted by the company; the instance is actually granting a loan to a client. The instance of a process comprises of activity instances that will include work items that are passed to an individual (or workflow participant, or user) for action, or to another process for action. So, a user might receive all documents relating to a loan, and he may be asked to approve the loan. Alternatively, the activity instance might invoke a query on a public credit checking system, and then take the result, measure it against pre-determined criteria, and pass to the next activity a binary result (APPROVED! *or* DECLINED!)

TYPES OF WORKFLOW

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

PRODUCTION

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

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

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

Autonomous Workflow Engines

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

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

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

Embedded Workflow

An embedded workflow management system is only functional if it is employed with the surrounding (embedding) system; for instance, an

Enterprise Resource Planning (ERP) system. The workflow functionality of embedded workflow management systems is exhibited by the surrounding software system. Common examples include ERP systems, payment and settlement systems. The workflow components are used to control the sequence of the application's functions, to manage queues and to assist with exception processing.

It is valuable for users to be able to differentiate between rules based sectors of an application that are normally activated by database triggers, and workflow engine-based components, that usually allow for a more complex specification of processes. The former is normally written by the application authors and only operates within their application and only supports relevant functions. The latter is normally an interchangeable component, that is, the same engine will work in many applications. Normally, these engines provide more functional interfaces which are standards based.

ADMINISTRATIVE

The most important feature of an administrative workflow system is the ease to define the process. Typically, there are many definitions running concurrently and they tend to involve a large number of employees. Process Definitions are usually created using forms—and if the definition is too complex for the form then you just have to use another product. Flexibility is more important than productivity, and these systems handle one or two orders of magnitude lower numbers of instances per hour than Production Workflow Systems.

COLLABORATIVE

Collaborative workflow focuses on teams working together towards common goals. Groups can vary from small, project-oriented teams, to widely dispersed people with interests in common. Effective use of collaborative workflow to support team working is now considered a vital element in the success of enterprises of all kinds. The use of Internet and the World Wide Web to support team communications across enterprises is also a critical success factor to most organizations.

Throughput is not an important consideration, and Process Definitions are not rigid and can be amended frequently. Collaborative Workflow is sometimes called Groupware. On the other hand, there are certain types of groupware that are NOT workflow; for example, bulletin boards or videoconferencing.

AD-HOC

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

Ad-Hoc Workflow maximizes flexibility in areas where throughput and security are not major concerns. Whereas in Production Work-

flow, clearly the organization owns the process, Ad-Hoc Workflow users own their own processes.

Conclusion

As with most classifications, there are exceptions, and gray areas. For example, some production systems are now supporting some dynamic change in an individual process instance by specifying dynamic "–abilities" associated with an activity which can be varied during enactment—skip-ability, delegate-ability, etc, providing a sort of half-way house between production and ad-hoc workflow.

WORKFLOW COMPONENTS

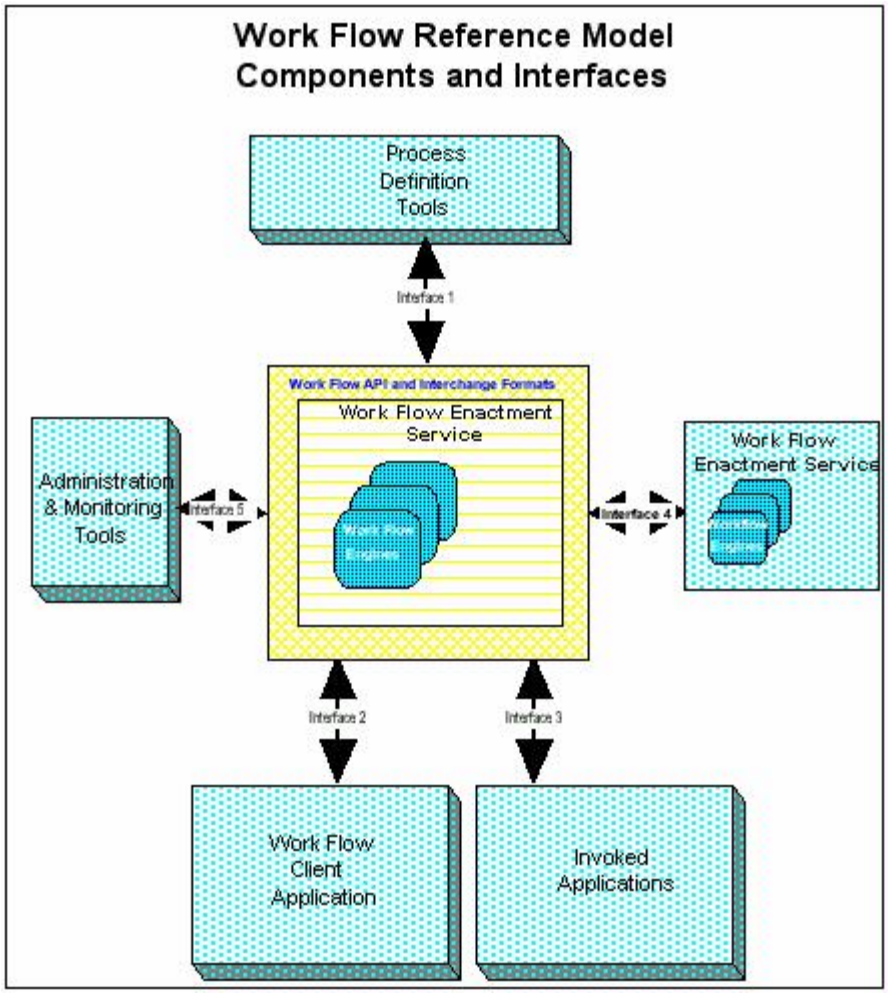
Workflow engines rarely, if ever, work alone. When the Workflow Management Coalition began its work to define standards for the workflow industry sector in 1994, achieving workflow interoperability was seen as a key objective.

Early work focused on 'C' program calls, and using MIME based messages for workflow interoperability. Then some members began work on an object-oriented version of the interfaces. It soon became clear that the Coalition should specify the workflow enactment system as a large component as this would conceal the complexity of the technology within, and allow for individual vendor innovation within their products.

There was a joint project with the OMG[iv] to define the Interfaces to the workflow component. The result is a description of the workflow component as a CORBA object. Some members have released products that comply with this description. Others have released ActiveX DCOM products. Both enable users to use workflow as part of an overall architecture.

Workflow Engine Inter-operability

In 1996, the U.S. Department of Defense sponsored an initial study to kick-start the W*f*MC work in this area. The most visible result of this work was the Workflow Reference Model that describes FIVE Interfaces. With this established, the Coalition set up teams to write the Interface definitions.



Process Definitions (Interface 1)

Interface 1 Definition deals with passing Process Definitions from external tools to the workflow engine where there are enacted. In fact, this proved to be a very difficult task and it was almost five years before a viable specification was published. The coalition published a new language—the Process Definition Language as a precursor to the Interface definition.

Process Definition Language

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

The new wave of interest in using the intelligent messaging language, XML, has swept through all areas of IT—including workflow. Interface 1 has recently been rewritten to use Wf-XML. The goal of Interface 1

is to enable users to employ many different process visualization tools with each workflow engine deployed.

For example: a simple drawing package might be suitable to draw a straightforward workflow process, such as managing the approval and payment of salesmen's commission payments. However, if you wish to automate trade operations for an Equity Derivatives Trading Desk, you would wish for a visualization tool that can manage high levels of complexity and run simulations so that you can make sure your processes work fully and are efficient, before enacting it!

Not all workflow products will support external process visualization tools. Some have embedded visualization facilities. Some enable users to create workflow definitions through forms. There is a good deal of variety in the area of process definition methods and this makes the exchange between these tools and workflow engines complicated.

As described later, when workflow engines are set up to work together, for example, in supply chains, then the choice of process definition tool is crucial.

Workflow APIs (Interface 2 & 3)

These interfaces have been combined and cover the WAPIs (Workflow API's). The support of these interfaces in workflow management products allows the implementation of front-end applications that need to access workflow management engine functions (workflow services). Such implementations might be written by workflow management exploiters or workflow systems integrators (W*f*SI). Integration between workflow and other desktop tasks (calendar, mail, reminders, etc) is often a common target and the workflow APIs allow workflow task integration into a common desktop.

These API calls allow a W*f*SI to have a single end-user interface and functions set, regardless of the number of workflow management products existing in an installation. WAPI calls may be implemented in a number of languages. Version 1 definitions were written for the 'C' language. More recent versions are in Java. The API operates as a call function. No assumption is made regarding the underlying implementation of the calls in a particular workflow management product implementation.

Inter-Engine Workflow (Interface 4)

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

workflow engines, there is a requirement for audit data to be produced.

The W*f*MC's Interoperability White Paper[v] identified eight levels of interoperability. The levels are distinguished by the architectural and consequent operational characteristics of implementations of workflow engines.

Level 1—No interoperability

This level is characterised by products that have no way of communicating with each other and hence no potential for interoperability.

Level 2—Coexistence

There is no standard approach to the interoperability of workflow products at this level. Rather there is exploitation of industry, national and international standards by vendors of workflow products to improve the availability of their products on multiple platforms. Thus, this level is characterized by workflow products sharing the same run-time environment (hardware, operating system, network). This level does not imply any direct interaction between different workflow products, but does enable organizations to implement different parts of a "whole process" using different workflow products as appropriate to their needs and the availability of suitable products.

Gateways

A gateway is a mechanism that allows specific workflow products to move work between each other. Where more than two workflow instances are involved, the gateway will also have to perform routing operations. The Interoperability White Paper defines two levels of gateway.

Level 3—Unique Gateways

This level is characterised by workflow products working together using some bridging mechanism that performs:

- routing of operations between workflow engines and instances
- translation and delivery of workflow relevant data
- translation and delivery of workflow application data

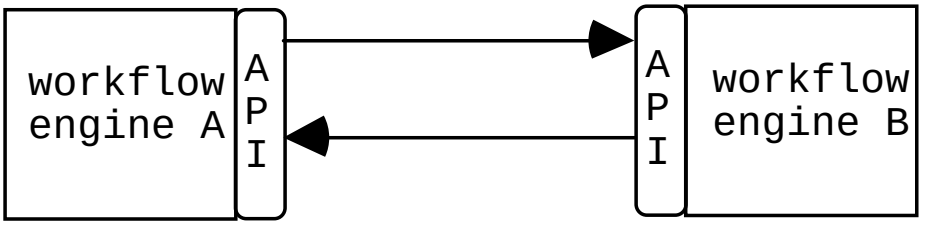
Level 3a—Common Gateway API

This level is characterised by workflow products working together using gateways that share a common (standard) API. This level carries the implication that the operations supported by different gateway mechanisms have been normalised to produce a common subset that can be supported by a standard, but does not exclude the possibility of supersets.

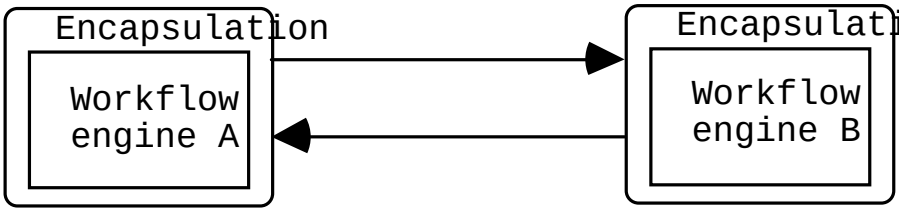
Level 4—Limited Common API Subset

This level is characterised by workflow products that share a common (standard) API that allows them to interact (interoperate) with each other directly in order to move and manage work between them.

To implement this level of interoperability requires that a core set of API function calls are defined in a published standard and that most/all workflow engines can implement that API. The implementation models for this level are actually quite simple and are based on the use of APIs or encapsulations, i.e.



Workflow Engines Interoperating via API Calls



Encapsulated Interoperating Workflow Engines

Level 5—Complete workflow API

This level is characterised by all workflow products sharing a single standard API that gives access to the full range of possible operations by any workflow management system. This does exclude any domain specific functionality that might be offered by workflow products developed to address the needs of particular market segments.

Level 6—Shared Definition Formats

This level is characterised by different workflow products having a shared format for process definitions that covers routing decisions, user access rights and the maintenance of workflow system resources. The consequence of this is that an organization can produce a single definition for each process that is to be supported on a workflow system, and can guarantee the behavior of the process whatever the workflow engine used to enact it. Constraints on this approach will naturally arise from the different forms and characteristics of present and future workflow products.

Level 7—Protocol Compatibility

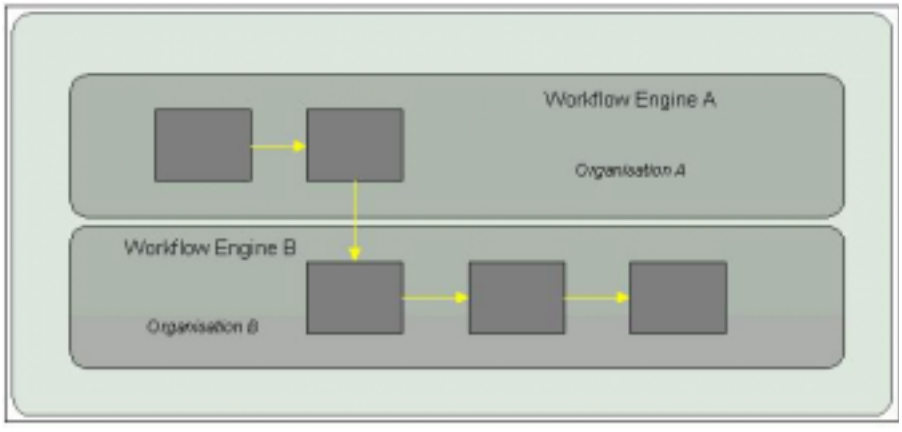
This level assumes that all API client/server communication including the transmission of definitions, workflow transactions and recovery is standardized. To achieve this level of interoperability, vendors may be required to support a number of different mechanisms through which such interoperation can be effected.

Level 8—Common Look and Feel Utilities

This level assumes that in addition to the preceding levels, all workflow products present the user with the same standard user interface or at least "look and feel." For commercial and practical reasons, this level may never actually be attained.

Illustrations

The tests completed by the workflow vendors during 1999 demonstrated the practical deployment of the Chained sub-Process and the Nested sub-Process.

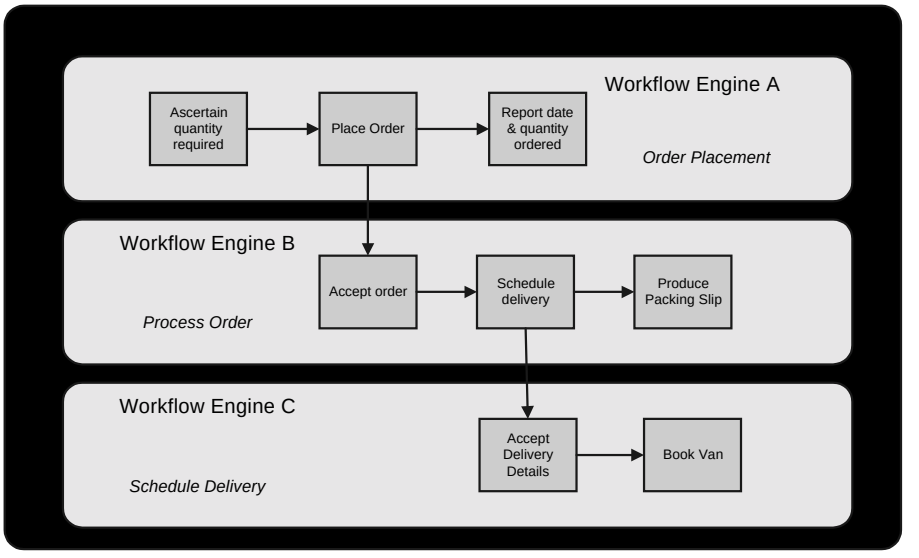


Chained sub-Process

The illustration above represents the Chained sub-Process. An instance of workflow is commenced in workflow engine A. When is has completed the first two 'roles' then the instance passes to the second engine where, after three more 'roles' have been performed, the definition has been completed.

A commercial example of this can be provided by the common occurrence of one company placing an order on another that then picks the stock and schedules the delivery.

For example, Company A (a retailer) determines that they require 10 beds. This event commences the workflow instance. Workflow Engine A then sends a message that places an order on Workflow Engine B, which resides at the supplier—Company B (A bed manufacturer). Workflow Engine A records that the order has been placed. The arrival of the purchase instruction from Company A commences the instance in Workflow Engine B. This schedules the delivery, sends a message to Workflow Engine C, and produces a packing slip.



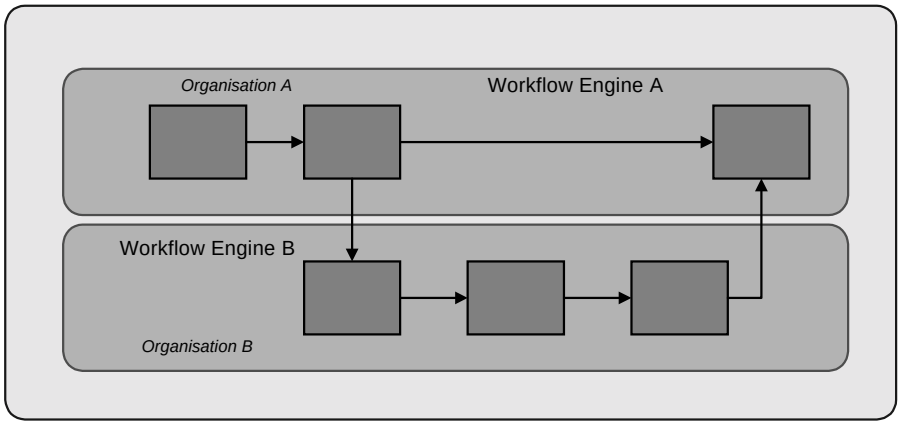
The arrival of the delivery instruction for Workflow Engine B commences the instance in Workflow Engine C.

In practice, this method of simply chaining commands will not be extensively used between organizations. Anyone who has placed an order with another company will know that just because the order has been sent does not guarantee that the order has been received or that it will be handled satisfactorily. The buyer needs to be sure that his instructions are being carried out. In other words, there has to be a checking process down the chain from A to B to C.

However, the chained sub-process will be immensely beneficial to organizations that have deployed separate departmental systems. Engine A in the human resources group will be able to update the company register when a new employee commences work. In addition, it will be able to advise new employee details to Engines B, C, and D, so that the individual can participate in all appropriate activities.

Nested Sub-Process

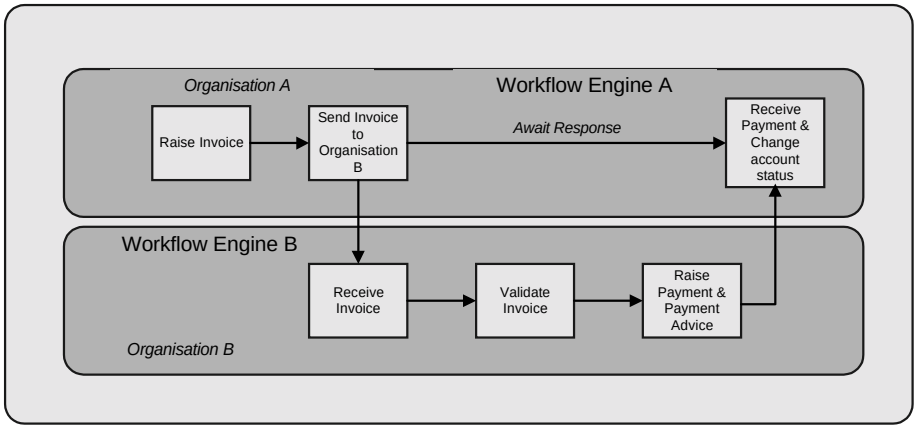
In this example of workflow engine interoperability, data is passed from Engine A to Engine B and a process is enacted based upon the values of that data. Meanwhile Engine A awaits input from Engine B that is, in effect, the result of the work in the sub-process.



There are huge implications for this type of process. Organization A sends an instructions to Organization B, awaits the response and then continues when it is received. Many normal commercial transactions are of this form. For example, Organization A has delivered widgets to Organization B and now would like payment. Organization A produces a document called an invoice and passes it to Organization B. The letter investigates the document and checks that the details are correct.

- Did we order these goods from Organization A?
- Did we receive them in good condition?
- Is the price correct?
- When is the correct time to make the payment?

Upon complete validation, which might involve further sub-processes, payment is authorized, and then payment is made, probably via a secure Internet payment method. A payment advice is sent to Organization A. Upon notification, Organization A reconciles the account and the process definition is complete. This is illustrated below.



Once set up, the cost of running these automated processes will be very low. Because the workflow engines can report the status of each instance, it will be possible for the manager to know clearly what is

occurring in his business. Moreover, automating order placing, invoice delivery and payments will help organizations participating in E-Commerce. The effect will be that E-Commerce activity will grow rapidly.

Audit and Monitoring (Interface 5)

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

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

When it is necessary to know what the current status is of a given process instance, an inquiry can be made using the process instance ID. The current state (e.g. open-running) is returned. To understand where the process really is, the audit information measured against the process definition can provide an indication of the true state. The interoperability specifications include the root process id as part of the control data so that all audit data across a distributed environment may be related back to the common initiating process.

RESOURCE MANAGEMENT ISSUES

In the early days of workflow the number of the users were fairly low, and the automated processes were fairly easy to comprehend. Currently, the levels of complexity are increasing rapidly such that workflow systems with more than a million users are being contemplated. In addition, process automation stretching across many organizations to support Supply Chain Management is being deployed.

It is becoming more important to manage the resources that participate in workflow carefully. For example, managers have to assign access to the workflow system to people that are qualified for the work. If there is a population of over 1,000 employees, it becomes quite a challenge to ensure that this deployment is done accurately and securely.

An individual is a likely to be a part of a department or team, and there will be the some of form of supervision. The individual will have a role, or more typically, a number of roles for which he or she is adequately qualified. In that individual's absence, an alternative individual should be able to fulfill the role. Roles might be exclusive or shared within a group. It's easy to see how complex it can become to

ensure that the right person is actually doing the right work, and to match the number of people to the volumes of work.

Resource management is also a major issue for fully automated processes. A process might need to obtain a variable from another system. For this to happen, that other system must be available. Many complex processes in fact require substantial computing resources and if these are not available then the whole process becomes very slow.

At the time of writing, there is an open RFP from the OMG for Resource Management. For example: in a manufacturing or machining environment, resources can include staff, machines and consumables. The W*f*MC Resource Model identifies various options for defining resource and associating it with a task.

Careful resource planning early in the workflow project will assist the appropriate design of the workflow application. Currently, designing a workflow system that will scale adequately requires experience of the workflow product. All relevant workflow vendors offer professional services to assist their clients in this area, and their help should be sought.

WORKFLOW PROJECTS

There is nothing mystical about a workflow project. It is very similar to other information technology projects. You must decide at the beginning of the project what its scope is. You must then plan the implementation carefully, develop the technology, implement the technology and finally test rigorously before putting it into production.

There are three main steps:

Project scope

It is vital to clearly identify the boundaries of the project. As the project progresses, changes to the scope must be controlled carefully. Large organizations that are familiar with deploying workflow technology are now implementing global complex projects, but even they would recommend that the first workflow projects in each organization be done in a non-mission critical department.

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

Implementation Planning

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

It is not unusual to get different pictures from different participants and it is important to gain consensus of the current process. Having achieved this, then process improvements can be studied, particularly reviewing the productivity improvements which workflow technology can bring. After this work has been completed there will be two process models; the 'NOW' Model and the 'TO BE' model.

Application Development

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

Testing

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

Pre-implementation

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

Post-Implementation

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

Automation creates efficiencies, but process automation alone does not provide the maximum pay-off. Together, process redesign, leveraging the technology to optimise the way you work, combined with automation fundamentally change the way work gets done.

IN CONCLUSION: A SUCCESS STORY[vi]

The Tennessee Valley Authority (TVA) is the largest power producer in the USA. It generates more than 123 billion kilowatt-hours of electricity a year and serves over 8 million customers. The TVA operates and maintains 29 hydroelectric dams as well as 11 coal-fired and three nuclear powered plants. The utility also maintains more than 15,000 miles of transmission lines and manages more than 650 miles of the Tennessee River.

All organizations working on the authority's nuclear power plants rely heavily on its Procedures Control Process for the performance and maintenance and operation of its nuclear plants. Inherently paper-intensive, this process used to cost more than $4.8 million a year, so the Authority embarked on a major business process redesign in order to increase efficiency and operational performance and to reduce costs.

The Authority had a good understanding of their processes prior to the workflow implementation, and was able to compare these costs with post project costs. They achieved a 42 percent cost reduction and a 53 percent time-saving for operations, and 33 percent cost reduction and a 41 percent time-saving in the initiation, planning, scheduling, and performance of maintenance. The total savings from implementation of the redesigned processes is a reduction of approximately 52,693 man-hours and $2.2 million a year. These are significant achievements.

PROJECT DESCRIPTION

The Authority created redesign teams from various parts of the organization. These teams were trained to use a redesign process that the TVA had developed. The teams were empowered to take a "clean sheet of paper" approach to design new, radically improved business processes. As part of these redesigns, the teams:

- Rigorously analyzed existing processes.
- Conducted extensive and detailed interviews with operations teams.
- Interviewed people from other utilities and other commercial companies that might have had useful information.
- Investigated available information system technology.
- Developed new processes using process visualization techniques.
- Tested the new processes carefully, consulting with the users and modifying the processes as required.
- Performed a phased implementation, breaking the activity into manageable segments, focussing on the areas where the most benefits could be achieved early in the project.

The teams conducted painstaking research and reviews:

Identifying reason for improvement

One of the major paper-based processes at a nuclear plant is the revision, routing, approval, and performance of maintenance or operation of equipment with hard copy plant procedures. During their research, the team discovered 235,000 men-hours per year spent in this process.

Analyzing

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

Discovering and researching new ideas

The team determined two main deliverables for the project:

- To confer all hard copy procedures to electronic media;
- To provide the ability to electronically revise, approve, and automatically route procedures to multiple users at any given time.

The team visited other utilities and commercial companies to learn about their maintenance and procedures management processes. The team also investigated available information system technologies, specifically, maintenance work management and procedures management software tools. They established that an integrated maintenance management, procedures management, and workflow system did not exist at any of the external utility and commercial companies interviewed. They decided that such a system could significantly improve maintenance and procedure management processes for the TVA.

Redesign in the process

The new processes were designed using workflow process modeling. During this step, the team examined the intricate details of the processes and allowed for investigation of every possible opportunity for improvement. They involved all the people they had previously interviewed, and ensured that they achieved an organization-wide prospective of the new processes. All the participants were encouraged to contribute new ideas, and the review process were kept as flexible as possible.

Piloting the redesigned process

The team established a test laboratory to verify software functionality and compatibility with all of the necessary systems and databases. This way, innumerable problems were identified and resolved before implementation.

Implementing the redesigned process

The implementation of the procedure control process redesign was completed in phases for approximately 5,000 site procedures. Each phase was chosen to ensure maximum benefits were realised in a timely manner. The team developed detailed implementation plans, including hardware installation, document conversion, data migration, user training, and procedure revisions.

Benefits: Cost savings

- Proven savings of $2.2 million with a promise of considerably more in the future.
- 42 percent cost savings on operations.
- 33 percent cost reduction on document revision work.

Benefits: Work improvements

- Integrated scheduling improved adherence to the work schedule by 33 percent.
- Lost work documents reduced to zero.
- Instantaneous routings.
- Parallel routing of procedures reduces the time it takes to achieve any particular task.
- No manual tracking of documents required.
- Filing and distributing 40,000 procedures performed automatically.
- Duplicate work order preparation eliminated.
- The number of stand-alone databases was significantly reduced.
- Support work hours reduced via improved job co-ordination.
- Supervisory reviews consolidated.
- Manual ordering of materials replaced by automated processes.
- No need for manual revision verification.
- Duplicate work order preparation eliminated by automated check for duplicates.
- Duplicate word processing eliminated.
- Work scheduling and job co-ordination automated.
- Automated documentation of consumables inventory.
- Supported work hours reduced via improved job communication.

- Work orders and procedures no longer have to be reprinted when a change is made because documents are not printed until just before they are used.

This successful project at the TVA clearly shows the various phases of a well-managed workflow project. The benefits summary clearly demonstrates why it is worth doing: Workflow is important.

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[i] Fischer, Layna, *Excellence in Practice Volume III,* Future Strategies Inc., Lighthouse Point. 1999

[ii] Fischer, Layna, *Excellence in Practice Volume III,* Future Strategies Inc., Lighthouse Point. 1999

[iii] *Embedded & Autonomous Workflow*: A WfMC White Paper, available at www.wfmc.org

[iv] More details at www.omg.org

[v] More details at www.wfmc.org

[vi] Fischer, Layna, *Excellence in Practice Volume II,* Future Strategies Inc., Lighthouse Point. 1998