

Technologies for the Virtual Enterprise

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The development of the Internet, coupled with the development of technologies for Knowledge Management and Work Management, will have deep influence on the way economic actors play their role in the worldwide market place. This will lead to the development of a new form of economic undertaking, the "Virtual Enterprises" where sets of economic actors are associating their strengths to provide a specific service traditionally provided by a single enterprise. Such a possibility will have, in the long term, deep influence on the economy and enterprise development strategies. The purpose of this chapter is to show how this can modify the way work can be organized and conducted, to demonstrate how those effects enable competition between virtual enterprises and traditional ones, and finally to give an overview of the conditions to make it happen.

FOREWORD

The development of Internet, coupled with the development of technologies for Knowledge Management on one side, and Work Management on the other side, will have deep influence on the way economic actors play their role in the worldwide market place. This will lead to the development of a new form of economic undertaking where sets of economic actors are associating their strengths to provide a specific service traditionally provided by a single enterprise. Such a possibility will have, in the long term, deep influence on the economy and enterprises development strategies:

1. Launching a new product or service on the market will become accessible to much smaller organizations with a portion of the capital required in a traditional way. This will intensify competition on traditional organizations.
2. Localization of partners of the virtual enterprise will become irrelevant; this will accelerate the international co-operation and intensify work mobility between countries and areas.
3. Overall, this will accelerate product and services diversification and innovation, a condition for further economic development.
4. Traditional organizations will have to face emerging competition from non-traditional competitors, and will probably have to invent new ways to organize their production.

The purpose of this article is:

- To describe how new technologies can affect working conditions
- To show how this can modify the way work can be organized and conducted
- To demonstrate how those effects make possible competition between virtual enterprises and traditional ones
- To outline the possible scenario for the creation of a virtual enterprise
- And finally to give an overview of the conditions to make it happen.

We will first present an overview of Knowledge Management and Work Management technologies and how the Internet will favor their development. Then we will further elaborate on Workflow, the most important technology in our opinion.

We will show how traditional enterprise can take benefits of those evolutions. And then how those tools can promote the development of virtual enterprises.

Finally, we will give guidelines on how information systems can be modelled to take maximum benefits of those new possibilities.

NEW TECHNOLOGIES

We can classify major technologies into three main areas of applications:

Knowledge Management (KM) technologies that provide the way to share and organize strategies, research and development, market research, and so on.

Enterprise Resource Planning (ERP); represented by application from vendors like SAP, People Soft, and Baan. They are used for traditional “accounting like” activities: accounting, inventory management, sales statistics, etc.

Work Management (WM) technologies provide assistance to groups work, and enhance productivity and quality of work. They are used to assist day-to-day production work.

KNOWLEDGE MANAGEMENT

Knowledge Management (KM) technologies are a collection of tools designed to store and retrieve knowledge. They include such tools as:

- Document Management to store and retrieve documents.
- Data Ware Houses and Data Mining tools to store and analyze data coming from accounting based applications.
- Full text indexing and search agents, basis of search engines as known today on the Internet, to search documents based upon their content.

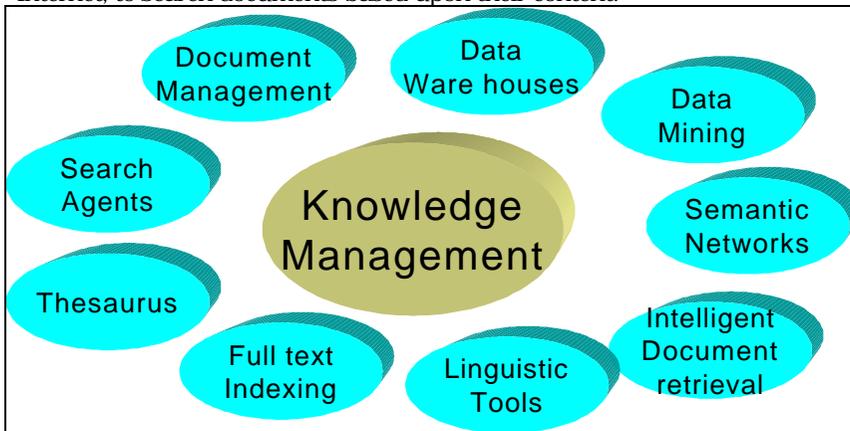


Figure 1 Knowledge Management technologies

- Thesaurus to enable intelligent search on full text indexes by storing terms hierarchies, relationships and similarities.
- Linguistic tools to support natural language queries.
- Semantic networks to store meaning of documents as a network of actions on objects and enable powerful searches on a document based on network patterns matching (e.g. all documents speaking about transforming materials under high temperature conditions).
- Intelligent document retrieval tools with “learning capabilities” of both the user interest, and the target systems delivering capabilities.

As said before, these tools are used for understanding the market place, and the possibilities that are offered in various areas, in order to take better decisions, orient product definition, organize production, enhance sales activities efficiency, and so on.

WORK MANAGEMENT

Work Management technologies are a collection of tools designed to assist production work. They include such tools as:

- E-mail, which accelerates communication between people, and can monitor basic question and answer cycles.
- Meeting scheduling, which assists a group in organizing and planning collective activities, as well as sharing common resources.
- Forum, which provides a shared space to a group for structured discussions and document base.

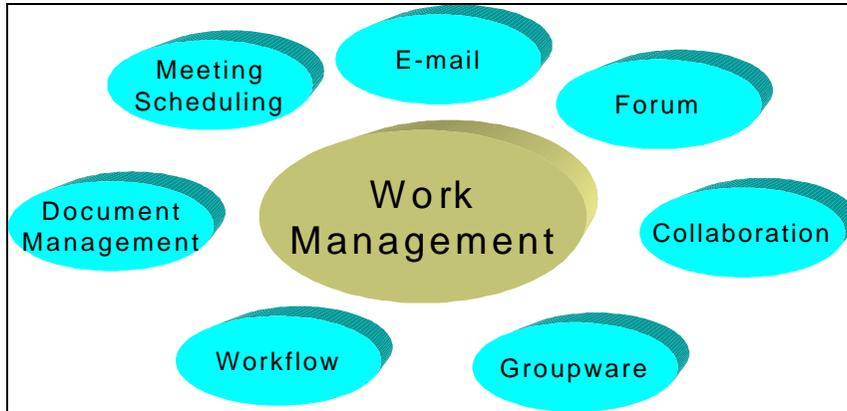


Figure 2 Work Management Technologies

- Collaboration tools, which provide a group the means to edit collectively in real time documents of many different forms (specifications, contracts, planning, budgets, proposals, etc.)
- Groupware, which combines above tools in a uniform environment, ready to use by groups.
- Document Management, which stores large quantities of documents in an organized way, and maintain versions, renditions, indexes and so on.
- Workflow, that supports business processes for their whole lifetime.

Those tools are used to assist the work done for producing products and services. In contrast with KM tools that are used to decide what to produce and how to produce it.

INTERNET

Internet provides essentially two features:

- HTML, a multimedia presentation protocol, enabling the definition of pages containing multimedia elements as well as forms fields. HTML is very simple and enables presentation tools (web browsers) and edition tools (HTML editors) at reasonable cost.
- URL, a universal service identification, able to locate anywhere in the network an HTML page, or a program invocation (CGI call).

Thanks to these features, Internet provides a very easy to use interface, and a set of tools to support it at low cost. More important, any page or application created and stored using Internet standards can be seen or activated from any workstation connected to Internet, anywhere in the world.

Today, everyone is likely to agree on the fact that Internet is a major technological revolution that every company needs to consider. However, even three years ago it was not like that. Internet deployment around the world—both at public and professional levels—is the fastest technological evolution of this century. The Internet will connect 200 million users in the year 2000, and perhaps one billion in 2010. Within the past two or three years, the whole computer and telecommunication industries have redeployed their development and marketing forces to provide tools and services on the Internet, to enhance its infrastructure and standards and provide supporting products. The level of investment is unprecedented and has now gone far beyond the point of no return.

Massive Deployment

Internet technology will for these reasons enable massive deployment of Knowledge Management and Work Management applications.

KM and WM were previously deployed in the client/server mode, inside carefully selected teams restricted to enterprise employees. The cost to install and maintain client applications in each workstation, and the proprietary protocols used by those applications are the main reasons for those restrictions.

Today, thanks to billions of US dollar investments by the software industry on Internet technologies, most KM and WM tools are using Internet architecture, and can be used with just a web browser installed on the workstation.

Once installed on a server, an Internet-enabled application becomes potentially accessible from any workstation. This opens use of intelligence tools (KM) and production tools (WM) to almost every employee inside an enterprise, at marginal cost.

And the same application becomes also accessible from any workstation connected to the Internet. This is critical for electronic commerce applications. This is essential to open applications to enterprise partners. This is vital for enabling the creation of virtual enterprises.

SOME EXAMPLES

We believe that any activity has three dimensions:

- Intelligence,
- Accounting, and
- Production.

As a first example, in any sales activity:

- **Production** part, relates to actual sales activities, like meeting with potential customers, writing proposals, negotiating sales conditions, actually ordering products and services, delivering them, handling customer claims, providing support services and so on.
- **Accounting** part includes inventory management, invoicing systems, e-commerce system, e-payment systems, and sales statistics.
- **Intelligence** part involves activities like market segmentation, competitive positioning, pricing strategy, service quality benchmarking, sales productivity benchmarking, identifying potential customers, enhancing supporting tools, searching for new sales tools.

As a second example in a production activity, like for example, the work done to handle a health insurance contract,

- **Intelligence** part would consist in looking for the best possible organization at any time, searching for best people to do the job, looking for most economic places and building to host them, selecting the best support technologies, subcontracting part of the job when required.
- **Production** is essentially handling each insurance claims. It heavily involves Work Management tools, with strong imaging based document management systems, and process management support through Workflow.
- **Accounting** involves Insurance oriented ERP for contract identification, customer database management, yearly subscription and payment, statistics and accounting. It is based upon traditional applications built upon transaction processing monitors.

Any activity has those three dimensions, and can be assisted in each one. The main difference between activities classes relies on the percentage of time to be spent on each one. Intelligence part of production work is very low (less than 10 percent of the time spent), it is the essential part of the work of the staff of a large enterprise.

PRODUCTION AND WORKFLOW

Among the tools provided by KM and WM technologies, Workflow plays a specific role, because it is essential in production activities, and production activities cover more than 70 percent of average enterprise costs.

We will present shortly:

- What workflow tools can provide in supporting business processes execution,
- How workflow tools can take into account enterprise organization to automatically dispatch work items to participants, and
- How workflow tools can contribute to integrate disparate existing applications in a consistent whole organized around business processes.

IMPORTANCE OF PRODUCTION

As we have seen previously, any activity can be categorized into three activity classes: intelligence, accounting, and production.

- At the enterprise level, **production** activities represent at least 70 percent of the costs. In some sectors, like retail, 85 percent or more.

- **Accounting** activities represent some 10 percent of the total costs, and cover traditional accounting inventory management, and so on.
- **Intelligence** activities represent less than 20 percent of the total costs.

Traditionally management information systems are concentrating on accounting activity automation, a strategic goal because it enables the management level to take decisions based upon a really measured and controlled situation. However, the scope of these tools is some 10 percent of the company costs.

Intelligence activities have twice the importance in terms of costs of accounting activities.

Production activities account for more than 70 percent of the costs, seven times the ones related to accounting. In terms of opportunities, it is a really massive target for automation. And we believe that this will be a major target in the next 20 years.

In production activities, Knowledge Management tools usage remains marginal.

For very flexible and difficult to predict production activities; for instance very personalized financial services, groupware tools offer the flexibility to support group work in a versatile way. But for the bulk of the production activities, Workflow and Document Management, by taking into account business processes, are offering major opportunities to change radically productivity as well as quality.

What is Workflow?

Workflow's primary mission is to handle business processes that span several areas in the company to support external demand. The following are the definitions given in the Workflow Management Coalition (WfMC) Glossary:

- **Business Process**—A set of one or more linked procedures or activities that collectively realize a business objective or policy goal, normally within the context of an organizational structure defining functional roles and relationships
- **Workflow**—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
- **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 appropriate IT tools and applications.

Role and Information

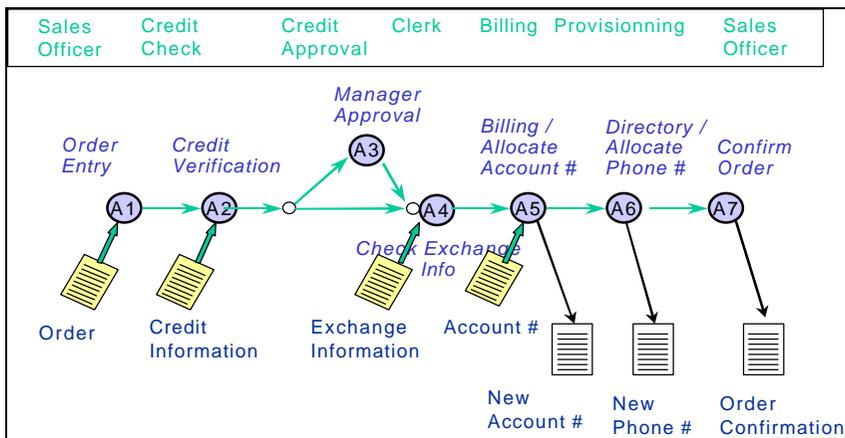


Figure 3 Roles and Information

A workflow tool is also able to represent two major elements of a business process:

- The roles of the participants involved in the process, and
- Information handled by the process.

Roles

Roles are abstractions of an organization model, which enable the representation of the procedure independently of the actual organization (how people are assigned to roles, how roles

are grouped into organizational units). Using roles, and a database representing the organization of the enterprise, a workflow tool is able to assign automatically each activity (or work item) to the adequate employee inside the company.

Information

The set of documents used by the process, and produced by the process, as well as the set of fields used to identify each process instance (customer number, contract number, state of the process) constitutes the context of the process. This context is stored and maintained by the workflow tool in its database. It is used to determine through business rules which path in the procedure definition should be selected for each process instance.

Application Integration

Activities to be executed are usually interactive activities, operated by human beings on a workstation.

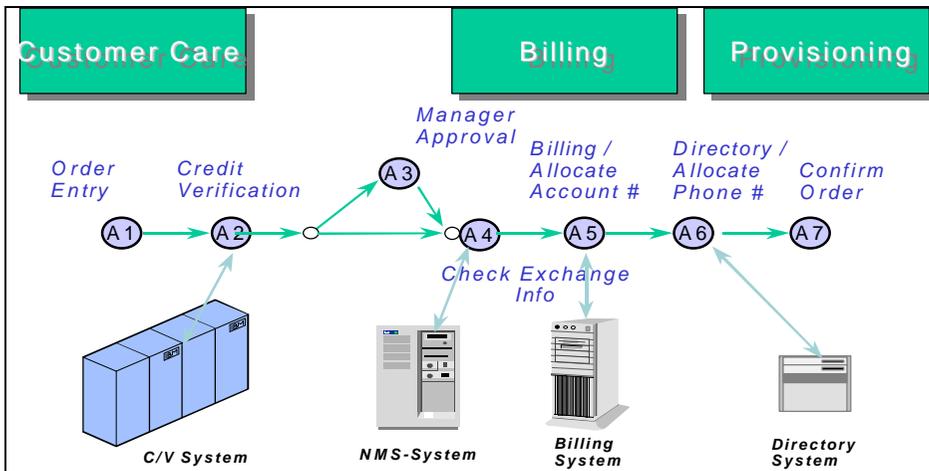


Figure 4 Application Integration is an Essential Component of Workflow Solutions

But some of those activities can be completely automated, and executed on the server, because they are already supported by application programs. As examples:

- When receiving a phone call in a call center, a customer care application can provide from the CTI provided phone number the customer identification automatically to the workflow tool.
- An automatic activity in the flow can create an account in the billing system, and initiate billing activities; and
- Another automatic activity can trigger provisioning activities to get a phone number allocated to a customer.

Integrating People and Applications

By supporting integration of existing applications, in the form of activities automatically invoking transactions on hosts or servers on the network, workflow ensures global integration of people and programs in the framework of a business process. The benefits of workflow can be seen at all levels:

Company Benefits: Workflow increases control over the productivity of information-related tasks. While reinforcing confidentiality and access-control measures, Workflow brings factory methods for managing and controlling processes.

Client Benefits: from improved service quality, better response time, clear information about the status of their request and more accessible company agents.

Company Agent Benefits: each agent sees a list of activities they have to carry out and can organize their own work accordingly. The context of each activity can be presented. For agents, Workflow means flexibility in their work, speed of execution and a high comfort level.

Manager Benefits: Workflow present managers with decisions to be made at the appropriate time and with enough information to enable them to intervene effectively. They can act sooner,

more rapidly and with greater fairness. Workflow gives constant access to the status of each case, and a monitoring system allows managers to keep processes under control. Workflow can revolutionise the supervisory function, bringing it much closer to its industrial counterpart.

Organization Analyst Benefits: With Workflow-assisted procedures, organization analysts have every kind of statistic necessary to analyze workloads, costs, peak periods and many other aspects of the company's operations. They can use simulation tools to model procedural refinements, at an unprecedented level of detail and accuracy and the logged data is available at marginal cost.

ENTERPRISE EVOLUTION

From the perspective of workflow potentialities, we will present a typical evolution of a traditional enterprise toward business process approach and support through workflow tools.

We will highlight:

- The strengths provided by traditional enterprises,
- The weaknesses that traditional organizations have to face,
- The growing importance of customer contact activities,
- How the quality approach attempts to solve some of the problems of traditional enterprises,
- How workflow tools can efficiently assist the process approach implied by quality management, and
- How end-to-end process is the ultimate solution to better serve customers.

TRADITIONAL ENTERPRISES

Traditional enterprises (by contrast to virtual enterprises) integrate under one single umbrella all the functions needed to provide products or services they were created for.

The main benefits of such a structure are that all the resources required are under a single control point. As such, it is possible to adapt each function to the precise requirements of the customers, and to precisely and rapidly evolve them as product and services evolve to meet demand.

Furthermore such an organization should be easy to optimize, moving employees from one activity to the other, changing location for logistic optimization, enhancing the supply chain, precisely targeting investments on critical aspects, are many examples of changes that should be easier to handle under a single control point.

In addition, and this is probably the strongest argument, precise and real time control of all activities can be accurately exercised through powerful and centralised accounting applications, and the aggregated results can provide the means to monitor activities in an integrated way, and to take proper management decisions to ensure satisfaction of short terms and long terms goals.

Such an approach requires huge investments and capital. Which can be considered as an advantage since it keeps the activity in the hands of few economic actors, and prevents new comers to enter and compete.

TRADITIONAL ORGANIZATIONS

All these arguments in favor of traditional enterprises are somehow severely challenged when you consider their actual organization.

In most large enterprises, and in all developed economies (Europe, USA, and Asia), the traditional organization is mostly vertical: sales, factory, accounting, or marketing departments. Each department has developed its own internal organization, own information system, own management principles around what they consider as their specific mission.

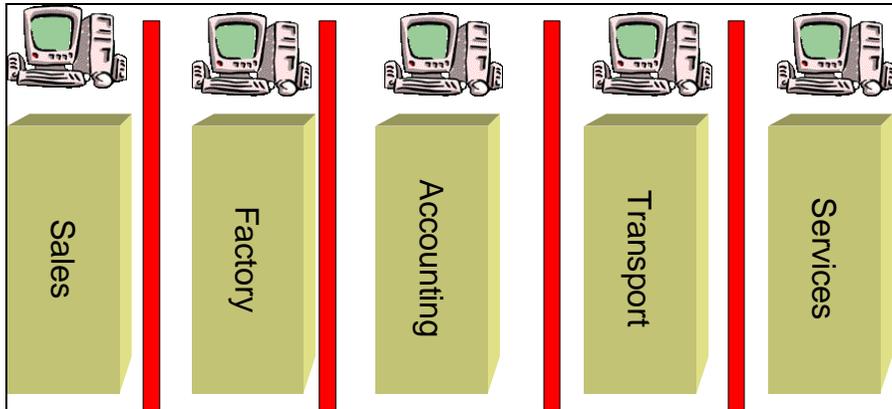


Figure 5 The Creation of Internal “Walls” Creates Inefficiencies

This often results in islands of culture, tools, and methods where the specialised mission (accounting, for example) has taken more importance than the enterprise mission (provide products and services to the market place).

Sometimes this leads to the creation of strong internal “walls” between departments, together with a complex system mixing technical and political arguments to “protect” those walls from potential threats from other departments.

In such a context, transformations required to support products and services adaptations to market demand can become very difficult to manage, and in some instances just impossible.

After a while, the integrated organization might very well have moved to a point where each of its components is independently optimized, but the service provided to the market is not at the required quality level (and might be no longer adapted to market demand). This results in below-average customer satisfaction, higher costs of sales and higher costs of servicing customers.

CUSTOMER CONTACT

A classic attempt to correct the situation is to work on the customer side by enhancing customer relationships. Several technologies can be used to support enhancing the data entry process and moving to electronic document management to accelerate the processing of received postal mails.

- Creating call centres to process customer claims in real time, and in some case to take orders on the phone.
- E-commerce to accelerate and optimize customer access to product and services.

Though usage of such technologies, the sales department will strongly enhance customer relationships, and will be able to measure much more precisely quality of service finally provided to customers. This will NOT break the wall that separates sales from other departments, however, and will NOT fundamentally change the quality of products and services provided.

Nevertheless, the precise facts and figures will be available, and can be used as a basis to undertake necessary changes.

QUALITY

Another attempt to cope with the problem of better customer service and overcome vertical specialisation is the quality approach.

The major goal of a quality approach is to define for each basic function a specification defining precisely:

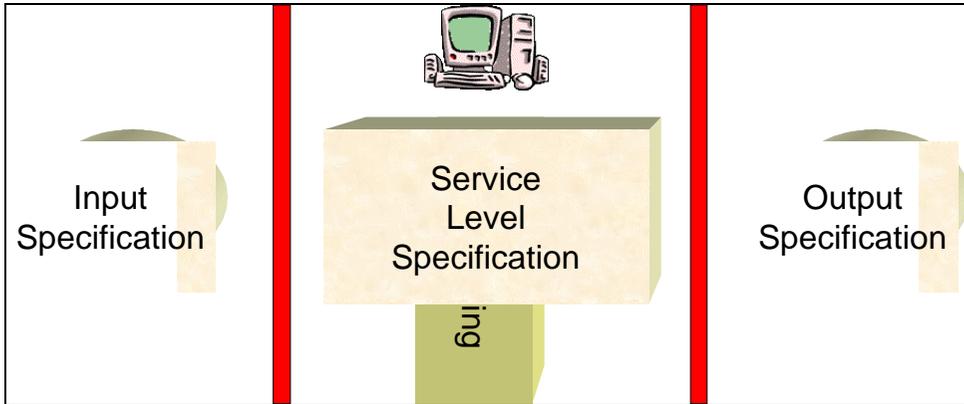


Figure 6 The Quality Approach is a Step to the Solution

- **Input specification** defining precisely what should be provided to request the service;
- **Service level specification** describing how the service should be delivered like maximum delay, error rate, and exceptions;
- **Output specification** describing precisely the service provided when successful.

Such an approach can be used to better master problems highlighted by customer services, like over-long delivery delays, improper goods delivery, or errors in invoicing. The source of the problem can be precisely identified, and service specification negotiated and adjusted to better answer to customer needs.

However, a quality approach generates a lot of additional work to ensure traceability, control of service level, proper measurement and statistics and enforcement of standard operation procedures.

WORKFLOW ENABLED

Workflow tools provide a direct answer to those additional constraints by:

- Describing precisely the procedure the must follow the process required to support the service;
- Ensuring automatic validation of input required according to their specification;
- Applying automatically the procedure definition to each instance of the process with automatic creation of each activity that must be executed according to business rules applied to the context of each process instance;
- Dispatching activities to the adequate participant by interpreting a description of the organization in place;
- Following automatically deadlines and overdue situations, and alerting on those events participants able to react;
- Producing output that conform to intended specifications, and handle exceptions otherwise;
- Gathering detailed statistics on time and costs related to each process category; and
- Maintaining automatically detailed logs ensure full trace-ability of the processes.

This is provided together with improvements in productivity that can go up to 30 percent in intensive production applications like insurance claims processing.

END-TO-END WORKFLOW

As quality approach progressively propagates to all the departments, a customer service can be presented as a succession of services that are chained to support it.

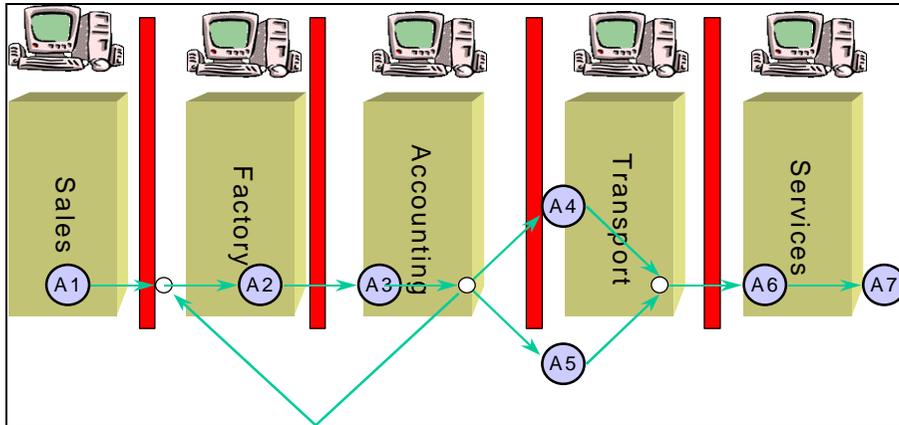


Figure 7 A Quality Chain is in Fact an End-to-End Process

Such a description becomes then an end-to-end process description, and can be analyzed as a whole to check that it fulfils customer service requirements.

In the same way, workflow tools can ensure automation and support of the full process, by assembling and controlling all the process parts previously defined. Then a workflow tool can assist the whole process regardless of the number of departments that contributes to it. It will then be able to:

- Automatically generates alerts when the process is slowed down, and precisely pinpoint the place where it is blocked or slowed down;
- Provide a precise status of the process, enabling call centre to give precise indication to customers on the state of the process servicing them;
- Provide statistics not only for each function contributing to the process, but for aggregated results representing the customers view of the enterprise performance;
- Provide costs analysis per process type, and precisely contribute to continuous process improvements.

CUSTOMER ORIENTED

From that point, enterprises can deploy a comprehensive customer-oriented approach of its internal activities entirely based upon a process-based point of view.

Process analysis tools, and Process Reengineering tools can be used to handle the analysis part of that work, to streamline processes, to simulate several alternatives and evaluate efficiency and cost of each solution.

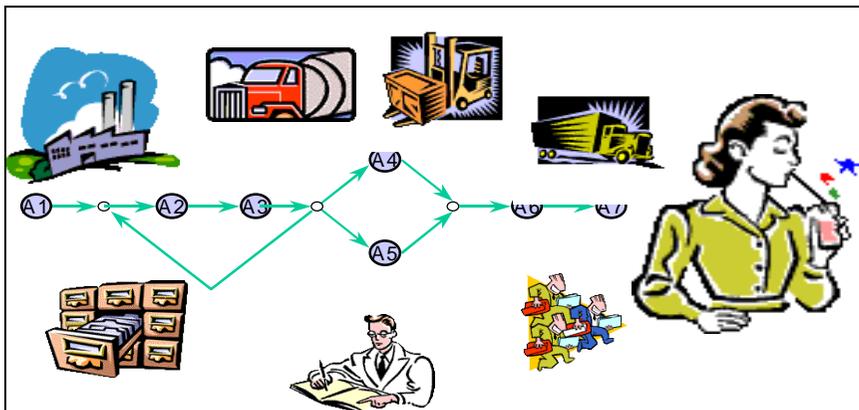


Figure 8 The most Essential Processes Serve Customers

Workflow tools will enable enterprises to directly translate that process view into a process automation, assistance and monitoring application crossing completely units' boundaries.

At that stage of the evolution, the vertical organization of specialised departments should not interfere with the customer service process view, which is the real goal of the enterprise. All statistics, analysis, and decisions should become based upon that process view, including the definition of new products and service that should include a complete analysis of the new processes to support them, of their cost, and of their feasibility.

THE VIRTUAL ENTERPRISE

If a process view becomes centric to any economic activity, then the structure of the resources required to support it, including by which they are owned, and where they are located becomes just an optimization decision on the proper means to support a process. Here comes the concept of a virtual enterprise.

We will first present the ultimate definition of a virtual enterprise. Then we will propose our view of the succession of steps such an enterprise creation imply including:

- How to design processes;
- How to map processes on resources required to support them;
- How to contract resources from other companies when appropriate;
- How to operate the virtual organization; and finally
- How to keep control on such complex organizations.

THE ULTIMATE GOAL

The Internet offers any individual the ability to exchange information with anyone in the world as if they were in the same village—the “global village.” This makes it possible to create communities of people with a common interest where distance is irrelevant. Electronic commerce is part of the scenario because any electronic shop is potentially part of the village. Similarly, Workflow can spread across company boundaries and anywhere in the world on the Internet. This opens up a new way of doing business through homework, mobile work and virtual enterprises. It is possible to realise cooperation between economic actors for common undertakings and allow dynamic reconfiguration as the need arises. In the long term this will bring a major breakthrough in productivity, organization, international exchanges and economic growth through:

- Innovative products and services combining communication, electronic commerce and business process automation to provide effective and low cost customer service world-wide
- Innovative processes where the client is a direct participant in the process and Workflow-enabled processes track transactions across unit, company and enterprise boundaries
- Innovative organizations relying on Workflow-based end-to-end business processes to provide the best possible service, in spite of the internal structure being adapted to match market needs
- Dynamic win-win cooperation between enterprises and individuals. Better service for the market will be based upon optimum performance of each of the assembled partners being enabled through Workflow-controlled business processes.

DESIGN THE PROCESSES

Assuming that the mission of the virtual enterprise has been already defined, and that the services it plans to provide has been evaluated as potentially economically sound, the first step to proceed is to define all the processes required to support the proposed services.

This can be done with a new family of business process reengineering (BPR) tools designed initially to support reengineering of existing processes, and used in that case just to engineer them. With such tools it is relatively easy to define graphically, up to the smallest detail, every activity in a process, and every document and field to be used as input and output.

Then simulation tools can determine resources required to support the processes, compute total time to complete processes, and even compute costs of the processes. BPR tools can also represent many variations of the same process definition, and evaluate and compare their global efficiency.

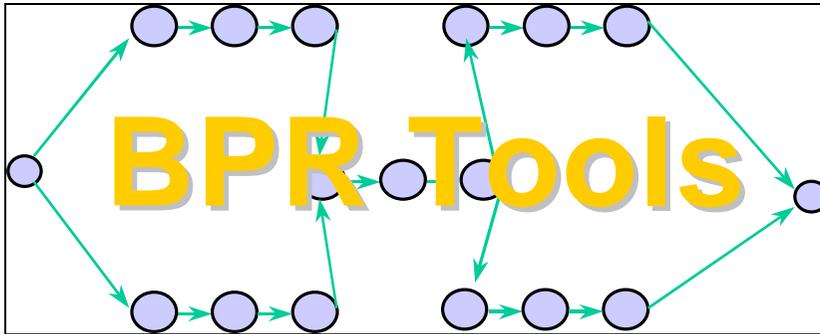


Figure 9 BPR Tools to Design and Streamline Processes

When all the supporting processes are fully defined and evaluated, the feasibility of the planned enterprise is much more seriously established, and the team gets a comprehensive specification on how functionally it should operate.

If the project is still considered serious, then the enterprise can enter in the next step.

MAP ON RESOURCES

Once the set of supporting processes are completely designed, each activity in each process must be mapped on a resource to take it under control.

For instance, some activities required by the supply chain might be assigned to a warehouse. At that level, it is not yet the problem to decide which warehouse and where it is located. Determining that a warehouse is required, and selecting the activities that should be executed are the only goals of that step.

At the completion of that step, the enterprise has available a list of required resources, and for each resource, a list of activities that will have to be accomplished by that resource with input definition, output definition and service quality specifications.

Methodologies to support that work are well known and are all organization methodologies that assist the organization specialist in assigning and grouping task together in the most efficient possible way.

CONTRACT RESOURCES

With the precise definition of required resources, and the precise specifications of activities they should accomplish, the next step in the process is to select and assign resources to the various processes.

At that stage, in the perspective of a virtual enterprise, the principle is to find resources that are external to the enterprise structure. This includes hiring warehousing services, call centre services, manufacturing services, assembling services, accounting services, e-commerce hosting, and so on.

The idea here is to select the best provider for each required resource, based upon benchmarking their results or financial commitments using the activities' specifications previously defined.

Only critical resources must be mastered in a very specific way, which itself forms a distinctive part of the service offered that the organization's own resources will be established inside the enterprise.

One of the essential benefits of such an organization is to drastically reduce the capital required to start the business, because most of the resources required would be provided on a contractual basis, and paid as services are provided. The enterprise launching the new services is relying upon investments, people, tools and methodologies already in place. This can go toward reducing capital by a factor of three compared to more traditional structures.

The second advantage the reduction of the time needed to set up operation of the service, considerably lower than traditional ways of doing it.

OPERATE THE SERVICE

Once all the resources are in place, the really essential issue is the capability of the management of the enterprise to operate a complex assembly of resources under control of many different and independent organizations. This is where workflow tools on Internet plays a major role.

- Workflow tools, because they can support cross organization processes, can automatically transfer each activity to the adequate resource for execution, as soon as the activity has been scheduled according to the process definition and the business rules, with the adequate input information.

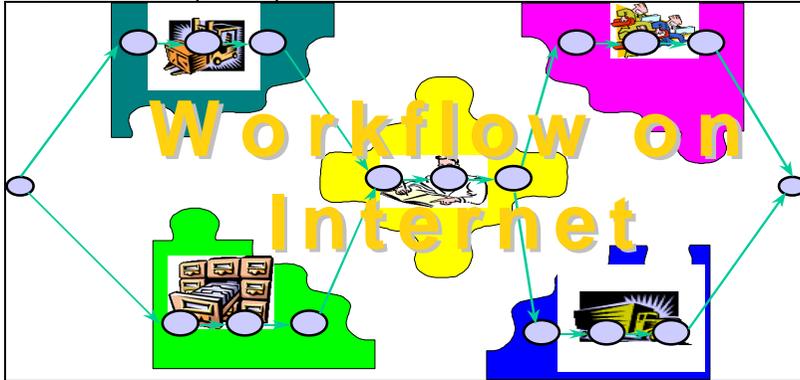


Figure 10. Workflow on Internet to Operate the Service

- The Internet, because it provides a universal communication and presentation medium that enables applications deployment anywhere, efficiently, and at low cost, thanks to relatively well-recognised and supported standards.

Without workflow, the cost of operating such a complex assembly would certainly offset the expected benefits. However, as we have seen before, the same tools must be used and will be used to overcome the deficiencies of traditional enterprises. It is where workflow and the Internet will really open new perspectives, by enabling different organizations with different economic actors' structures.

MONITOR PROCESSES

The critical part of monitoring such an assembly of economic actors, its to control that each actor fulfils its service contract.

Here again, workflow tools provide the solution through their logging mechanisms that log any single event with date, time and participant involved. From that comprehensive log, complete traceability can be achieved and serve as the basis for monitoring and controlling the service quality level of each actor in the chain.

This capability is offered as a sub-product of workflow-enabling all business processes, at no additional cost. This is probably the strongest argument for workflow technology as a virtual enterprise enabler.

IN A CONTROLLED WAY

Finally, inside a virtual enterprise, there is one entity that organizes and controls the others. This entity is the one that designed, implemented, operate, market and owns the service.

Such an enterprise necessarily relies on an individual or a small group of visionaries that initially designed the service, and decided to launch it. It must gather a team of highly efficient specialists for:

- Designing all the processes required to support the service;
- Forecasting market opportunities to size the required resources and constantly adjust them;



Figure 11. Knowledge Management to Control the Virtual Company

- Marketing the planned services aggressively, and protecting them through all possible legal means;
- Contracting required resources;
- Auditing the provided services in terms of quality;
- Constantly benchmarking contracted resources and renegotiating, where appropriate, alternate resources.

All those activities are more or less “intelligence” activities, and can be efficiently supported by Knowledge Management technologies.

BE PREPARED

If you are at this point convinced that such an evolution has real likelihood of happening, then it is of interest to understand under what conditions.

We will first advocate for preparing yourself to use KM and WM technologies, and insist more specifically on Work Management. To use KM and WM efficiently requires a limited set of prerequisites but they are essential ones.

We will then present what are the main enabling technologies for virtual enterprise deployment, and insist on the selection of open infrastructures.

Then we will come back on workflow to present the most essential standards, and show an example of workflow tools used as integration between versions applications.

PERSPECTIVES

Document Management and Workflow applications can support production tasks to bring superior productivity, quality and customer services. Production tasks represent some 70 to 90 percent of any company workload. This is a massive opportunity that no company can afford to miss to radically change production modes.

Knowledge Management and Groupware applications can assist corporate groups efficiently in their attempt to conduct always more precise market analysis, develop sharper strategies, with goals to enhance focus of the activity on its market place. This involves 10 to 30 percent of enterprise resources.

These technologies have a far larger scope than traditional “accounting” applications that still form 90 percent of the Electronic Data Processing (EDP) expenses of traditional companies.

It is thus essential to learn how to work with KM and WM technologies, and more specifically with Document Management and Workflow that might have the most important quantitative impact.

PREREQUISITES

Some important conditions must be met in order to take full benefits of KM and WM technologies:

- The EDP system must be based upon an open infrastructure, including local and wide are network, server and workstations.

- KM and WM tools cover a wide range or different requirements and needs; it is essential to have a good understanding of the requirements of the enterprise for a reasonably long period (five years) before selecting specific tools.
- The learning processes to not only operate those technologies, but more importantly to master their usage, which can take from one to three years. This must be planned and seriously monitored.

The only way to learn rapidly is to start with well-identified projects, with short-term goals. It is better to run several short-term projects than a large long-term one, at least in the beginning.

WM and KM projects are complex projects because they involve many different aspects: organizational, technical, change management, different methodologies, inter-departmental cooperation, etc. The first projects can be difficult because they include a strong learning phase for all the participants. The willingness to make them successful is of prime importance, and failure on one or two projects is not sufficient reason to give up on a third one.

ENABLING TECHNOLOGIES

KM and WM technologies require a strong EDP infrastructure in place to support efficiently the high demand in terms of processing power at server levels, and network bandwidth at the communication level.

Workflow, Document Management and Groupware applications require an efficient operation team, able to maintain high up-time of deployed services in any conditions. Tools are available to achieve such results, but the quality of the team using those tools is critical.

More specifically, when Workflow and Document Management applications are deployed, they become the main working tools, and service levels must be at the same quality standard as the one requested for host-based transaction processing applications.

OPEN INFRASTRUCTURE

This list of standards on which it is reasonable to rely, covers the main tools to be used for KM and WM applications. Working outside those standards may prevent universal deployment of applications inside the enterprise and certainly outside it.

TCP/IP is certainly the most universally supported communication protocol both over local and wide area networks. HTTP, HTML, XML, MIME, LDAP, and SMTP are Internet standards and they must be used to ensure large deployment over the Intranet, Extranet, and Internet. This applies even if Netscape and Microsoft are "inventing" non-standard extensions inside their software offering as a "fix" for their customers.

Electronic Data Interchange standards (EDI) are moving towards XML and will, through that, join the Internet as the main vehicle for data interchange.

DMA and ODAM are the document management standards enabling universal access to documents; an essential feature for Knowledge Management and Work Management applications. Web-DAV is an Internet standard to access via a browser; documents stored in a simple document management standard, and will play a very essential role in the future.

WfMC Workflow Standards are moving fast on top of Internet technology, with MIME being used for inter operation in Interface 4. This last key point relates to ERP products that should be selected for their capabilities to support open standards for interconnection with other tools.

WORKFLOW STANDARDS

The Workflow Management Coalition (<http://www.wfmc.org>) has defined standards for workflow products. Two of them are essential for virtual enterprises operations.

Interface 1: Process Definition Interchange interface deals with process analysis, modeling and procedure definition tools. It proposes a Meta Data Model which represents those objects in a process definition, which are necessary for interchange, it defines a standard interface between process definition tool(s) and the workflow engine, and it produces a process definition 'format' which various products can understand and are able to convert for their own use.

By using that standard procedure definition format, Business Process Reengineering tools can load the results of a complete BPR cycle directly into the workflow engine, accelerating live implementation of the reengineered business processes and lowering the development costs.

For example, a BPR service in Los Angeles could be used for analysis of the business process. The resulting process description could be sent to a Paris-based Process Definition tool where a detailed procedure description would be produced. The resulting procedure definition could then be loaded into workflow engines in Tokyo and Sydney.

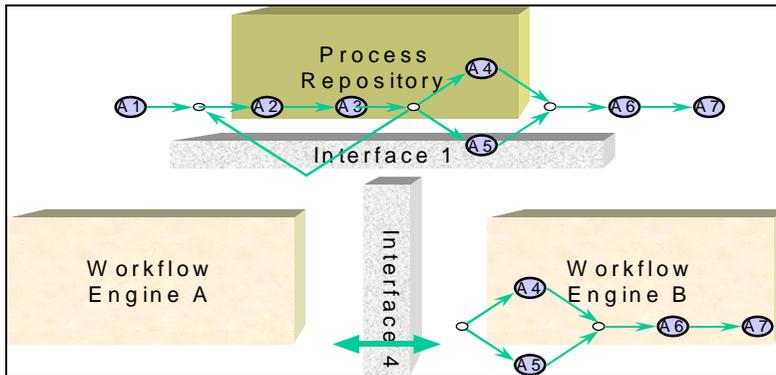


Figure 12 The Most Important WfMC Specifications

Interface 4: Workflow Inter Operability Interface defines information and control flows between heterogeneous workflow systems. This covers the extent to which common interpretation of the process definition (or a subset) is necessary and can be achieved, as well as runtime support for the interchange of control information and to transfer data between the different enactment services.

By exchanging electronic information and commands through networks, workflow interoperability goes far beyond traditional EDI applications by supporting processes that cross enterprise boundaries. One procedure can span several workflow engines; enterprise wide workflows can be built using several different workflow engines. Workflow engines can cooperate without human intervention across the Internet. This is the basis for virtual enterprise application deployment.

WORKFLOW AS AN INTEGRATION TOOL

Thanks to WfMC standards, workflow products can cooperate across Internet infrastructures. This is the basis of virtual enterprises support, as well as building infrastructures in large corporations organized internally as a virtual enterprise. Through workflow applications, processes can spread over all the units involved and run on several different workflow products thanks to inter-operation over Internet.

Workflow applications act as the integration point for various applications like document management, customer care, e-commerce, and ERP. The distributed workflow applications handle the processes states, and keep their context up to date. They transfer part of the context required to activate connected applications when required. They monitor the whole behaviour of each process and alert responsible actors of any problem that requires attention.

Using the appropriate standards is the only practical way to deploy such architectures at reasonable costs. And the stability and quality of those standards will become vital as this sort of architecture becomes used intensively.

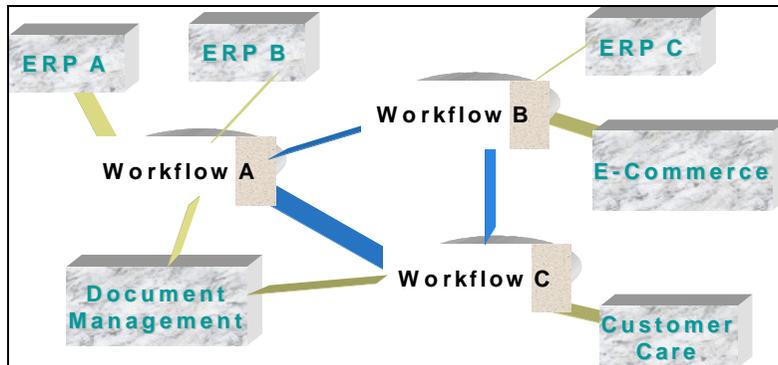


Figure 13. Workflow as an Integration Tool

It is in the interest of users to participate in standardisation efforts, mainly to promote the creation of certification authorities to check that product implementations adheres to standards, and to restrict themselves to the use of certified products.

VIRTUAL ENTERPRISES

The Internet (Intranet and Extranet) together with Workflow Knowledge Management and Work Management are powerful enablers of virtual enterprises activities.

These virtual enterprises constitute groups of people that work together on a common undertaking, regardless of their physical location, across enterprises and countries, in real time (synchronously) or deferred time (asynchronously). They are able to react to changes rapidly, and at low cost.

These virtual undertakings will constantly reconfigure themselves to maintain excellence in front of a much more dynamic marketplace. Their existence will challenge large traditional corporations by being able to set-up and operate more innovative and precisely targeted services with less capital in a shorter time, and with considerably less financial risk.

This will translate into a more dynamic global market with larger diversity of products and services, evolving more rapidly. This should in turn boost the economic development in developed countries.

This will also have consequences on stability of economic actors, with frequent adjustments imposing a system enabling quick creation and destruction of enterprises, with people moving rapidly from one to the other. The only basis for security will be the capability to provide efficiently specialised services for enterprises and people, and to constantly enhance and market those capabilities.

CONCLUSIONS

The evolution towards the true virtual enterprise will likely be a very long process because it requires many changes in current practices in many areas:

- It will have legal implications.
- It will imply new methods of evaluating enterprises assets, not only based upon their physical properties, number of employees, but essentially on their capability to attract a large customer base, to operate their business with impeccable quality, and to deliver real value-added products and services.
- It will change relationships between unions and enterprises.
- It will create many movements of activities between countries, and between major economic areas, inducing new regulation mechanisms for international work distribution.
- It will change the nature of competition between enterprises, breaking in some instances, the current entry barrier to jumping into an existing business, by bringing new distribution and production modes.

This will probably take some 20 years to generate its full effect, and even then, large traditional enterprises will remain strong by fronting several different forms of more or less virtual enterprises.

Some fast-moving companies serving traditional enterprises are already virtual organizations, thus calling for their customers to evolve their own operations. Provided they fulfil their service contracts, this new direction will appear very similar to the virtual enterprise, but with departments having greater autonomy.