Technical Report

Automation, Integration and ERP

By

International Technology Services Ltd. (ITS)

Automation, Integration and ERP.

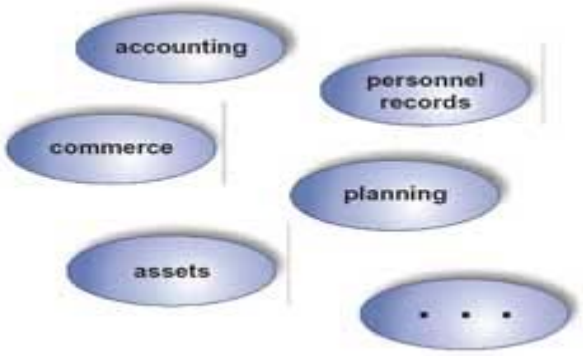
Overview

The business environment has changed more in the last five years than it did over the previous five decades. The pace of change continues to accelerate and corporations around the world seek to revitalize, reinvent and resize in an effort to position themselves for success in the 21st century. The ability to respond to new customer needs and seize market opportunities as they arise is crucial. Successful companies today recognize that a high level of interaction and coordination along the supply chain will be a key ingredient of their continued success. Enterprises are continuously striving to improve themselves in the areas of quality, time to market, customer satisfaction, performance and profitability. Tomorrow's winners will be those businesses that can most effectively gather, and quickly act upon crucial information. Making informed business decisions in this manner would enable organizations to accomplish their business growth and at the same time enable them to utilize the information to competitive advantage.

To make it possible for the companies to execute this vision, there is a need for an infrastructure that will provide information across all functions and locations within the organization. The Enterprise Resource Planning (ERP) software fulfils this need.

The integrated information system is one complete computerized business management system, covering all business functions in every part of the Enterprise.

Traditionally, companies were developing separate software applications to meet different needs of a particular organizational part of the enterprise such as accounting, sales, human resources, inventory, planning...



Such development in a form of informatics isles, as inconsistent as its is, became unsuitable due to the impossibility to assemble all information in one unique information pool.

The integrated information system unites the business processes of different organization parts according to the business functions of the company.

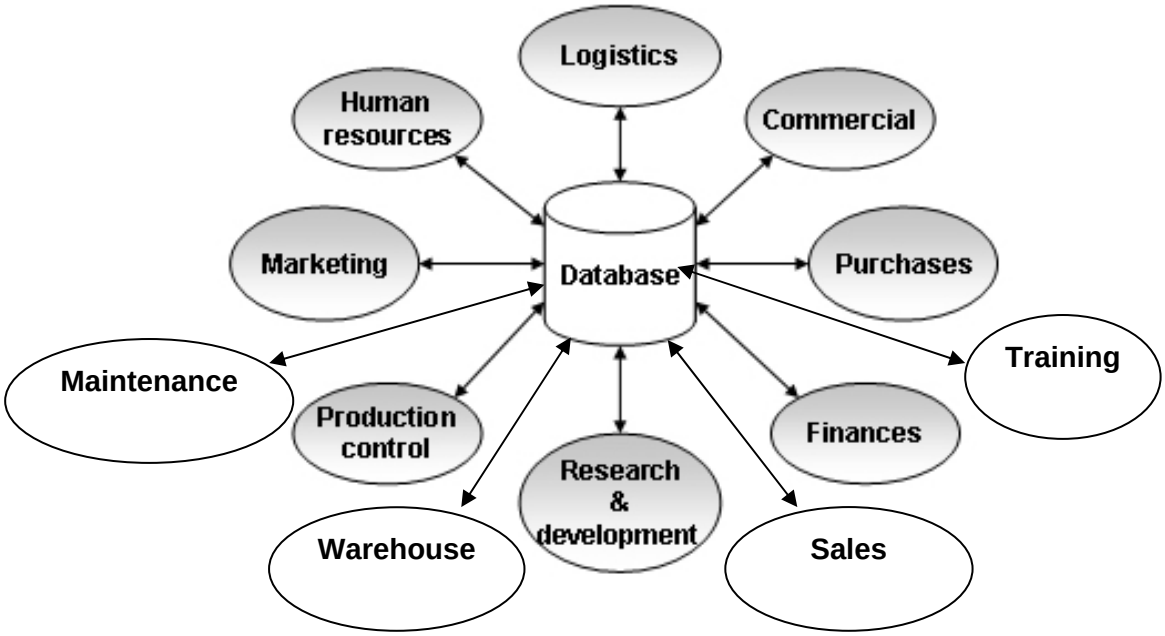
The integrated information system allows to the top-management immediate access to information needed for decision-making process and is compulsory for good control over the whole business. This integration process is formally called ERP.

ERP is a set of integrated applications that automate finance and human resources departments and help manufacturers handle jobs such as order processing and production scheduling. In more detail, an ERP system manages functions and activities as different as the bills of materials, order entry, purchasing, accounts payable, human resources, and inventory control, finance ... etc. As needed, ERP is also able to share the data from these processes with other corporate software systems.

ERP solutions are effective at streamlining business processes that cut across the functional areas of your business. ERP brings together fragmented operations, often replacing a multiplicity of legacy systems. By sharing common information across an integrated set of application modules, ERP can speed up transactions that cross your business. For instance, ERP can consolidate financial records, providing you the ability to close the books faster and more accurately.

Enterprise resource planning software, or ERP, doesn't live up to its acronym. Forget about planning—it doesn't do much of that—and forget about resource, a throwaway term. But remember the enterprise part. This is ERP's true ambition. ERP integrates all departments and functions across a company into a single software system that can serve all those different departments' particular needs.

That is a tall order, building a single software program that serves the needs of people in finance as well as it does the people in human resources and in the warehouse. Each of those departments typically has its own computer system optimized for the particular ways that the department does its work. But ERP combines them all together into a single, integrated software program that runs off a single database (as illustrated by the following figure) so that the various departments can more easily share information and communicate with each other. That integrated approach can have a tremendous payback if companies install the ERP software correctly.



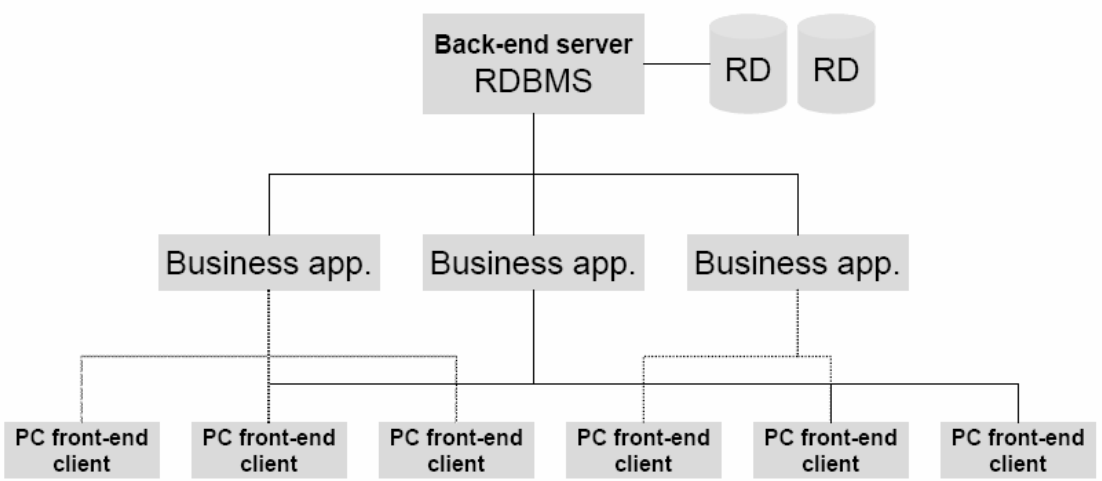
Take a customer order, for example. Typically, when a customer places an order, that order begins a mostly paper-based journey from in-basket to in-basket around the company, often being keyed and re-keyed into different departments' computer systems along

the way. All that lounging around in in-baskets causes delays and lost orders, and all the keying into different computer systems invites errors. Meanwhile, no one in the company truly knows what the status of the order is at any given point because there is no way for the finance department, for example, to get into the warehouse's computer system to see whether the item has been shipped. "You'll have to call the warehouse" is the familiar refrain heard by frustrated customers.

ERP vanquishes the old standalone computer systems in finance, HR, manufacturing and the warehouse, and replaces them with a single unified software program divided into software modules that roughly approximate the old standalone systems. Finance and materials, accounting, manufacturing, purchases, personnel, tender committee, organizing affairs and the warehouse ...etc all still get their own task specific software modules, except now the software is linked together so that someone in finance and materials can look into the warehouse software to see if an order has been shipped.

People in different departments of the company all see the same information and can update it given that they have the appropriate privileges. When one department finishes with the order it is automatically routed via the ERP system to the next department. To find out where the order is at any point, you need only log in to the ERP system and track it down. The order process moves instantaneously through the organization, and the orders are guaranteed to be processed faster and with much fewer errors than before. ERP can apply that same magic to the other major business

processes, such as employee benefits or financial reporting. The architecture used by ERP is illustrated by the following picture.



One benefit of ERP is that it integrates financial information. In legacy un-integrated systems environment, as the CEO tries to understand the company's overall performance, he may find many different versions of the truth. Finance has its own set of revenue numbers, Sales has another version, and the different business units may each have their own version of how much they contributed to revenues. ERP creates a single version of the truth that cannot be questioned because everyone is using the same system.

Another benefit is that ERP standardizes and speeds up manufacturing processes. Manufacturing companies often find that multiple business units across the company make the same product using different methods and computer systems. ERP systems come with standard methods for automating some of the steps of a manufacturing process. Standardizing those processes and using a single, integrated computer system can save time, increase

productivity, reduce head count and most importantly eliminates data mismatch and entry errors.

ITS' ERP software solution is flexible enough that you can install some modules before the others in the package. For example, we can just install an ERP finance or warehousing module and leave the rest of the functions for a later time. This way, we guarantee the avoidance of problems stemming from random, ad hoc, unplanned integration.

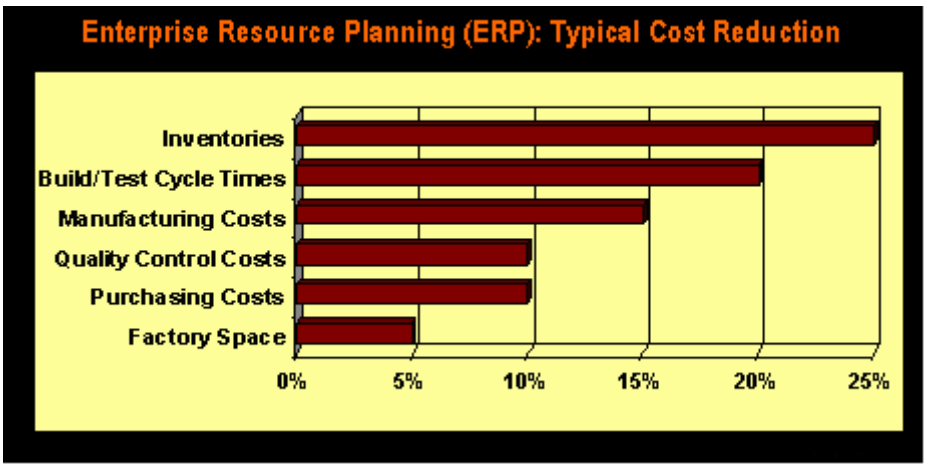
More Advantages of ERP

As defined previously, ERP applications help streamline business processes within an organization to enhance the competitive edge. Other advantages of ERP applications are:

- Modular and Open. ERP systems are designed with open system architecture. This means that a module can be interfaced or detached as needed without affecting the other module's performance. ERP systems may support multiple hardware platforms for those organizations with a heterogeneous collection of systems.
- Standardized Business Processes. ERP applications are generally designed to offer the best business processes applicable worldwide. When focusing on a particular process to be streamlined by ERP, the organization is forced to assess their current processes and standardize as needed for all those points of business implementing ERP. Re-engineering of processes may be a result of the need to standardize. Standardization as a result of packaged applications offers the

advantage that as the state of the art moves, you move with it.

- Cost Advantage. One of the many reasons organizations implement ERP applications is to achieve cost savings. Most savings are achieved by overall efficiencies that are put in place, reduction in inventory levels, better management of resources, and by strategic alignment achieved by the inherent nature of the ERP system. Some of these savings are intangible and hard to measure, but can play a key role in gaining competitive edge.



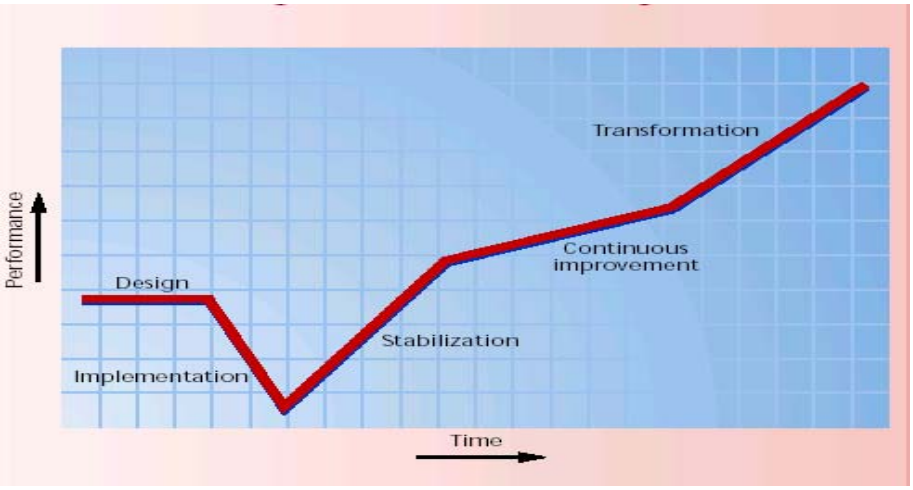
- Empowers Users. ERP provides accountability and responsibility to users in ways not available before. With the integration and flow of data, more information is available to users. User screens may provide data which allows users the ability to make informed decisions, whereas before they were just a conduit for keystrokes. For example, when placing an order for a maintenance part, a service representative may not have had access to inventory stock. Therefore they would just take the order, and if not in stock, the client would find

out at a later date. With integrated systems, the service rep is able to tell that the item is out of stock and when it is expected. The information can be relayed to the requestor, whereby they can make a decision to purchase the item. This information empowers the service rep.

- Real time financial data. ERP applications facilitate the real-time movement of financial data throughout the company. General ledger interfaces between processes such as accounts payable, payroll and purchases allow for ease in recording and monitoring these transactions. Additionally, the interfaces allow for consistency of reporting when tracking back GL source data.
- Internal Management. ERP can improve analytical and planning capabilities for management by storing data in a common, consistent format that can be accessed quickly. As a result of the implementation process, many business processes and data requirements were standardized. This standardization allows for the ability to extract, manipulate, and analyze information at a more comprehensive level. Management is provided valuable information from which to make decisions. One aside on this subject, it is important to remember that data integrity, one aspect of the value of information, can be at risk if users are not properly trained or process requirements not fully explored in the course of the ERP implementation.
- Strategic placement. Most organizations are moving toward Internet, intranet and extranets in their business. ERP lays the back end groundwork to support business on the "net".

This is most evident with the material/inventory processes. Many companies are online with suppliers where the tracking of materials becomes a crucial process as items are often in "virtual warehouses". ERP provides the flow of information between the sales department, inventory, purchasing, on to outside suppliers who need to know when to ship materials. ERP also supports globalization and helps transcend across geographic or language barriers.

- lower inventory carrying costs
- lower production costs
- lower accounting and record keeping costs
- lower investment in equipment
- lower investment in plant
- reduced assembly-line down-times
- more flexible production processes
- reduced errors due to poor co-ordination
- the cost and efficiency improvements (mentioned above) could increase profitability or increase market share (at a lower price)
- reduced number of stock-outs
- reduced fulfillment times
- Growth in performance within very less time (3 to 5 months)



All the previous offer reasons why Today's Enterprise should choose to move from traditional, segmented business functions to ERP's integrated systems.

The ERP Benefits for Management

ERP is every business managers and executives dream. Just think if you were a manager and all the information you ever needed to do your job and help others do theirs, was right at your finger-tips and was available at every second you needed. ERP allows for this to happen.

ERP is this fantasy for everyone in a business. From executives being able to access critical financial information on the spot and it being to the second accurate. People who work on the manufacturing side love the ERP fantasy because they know exact inventory levels at any given point in time and the system helps automate their job by ordering more materials when they are needed. It allows for every piece of a company to integrate together and every function to share information allowing for executives,

managers, production workers and customers/clients to execute and perform their job to the best of their ability.

There are many other key aspects that ERP will help improve a business. ERP allows for financial information and figures to be accurate and available at any given point in time. This is important because this allows for the executives to be able to evaluate the businesses worth, cash flows and other financial information.

The reduction in inventory can increase a company's financial situation. ERP allows for companies to keep less inventory in stock and adopt a "Just In Time" inventory practice. Reducing inventory allows a company to be able to get ride of the buildings and space that the inventory used to occupy. In this process reducing cost of storage and the taxes on inventory that companies have to pay.

Integrated Management Information

Today's managers require flexible reporting tools to extract the information as and when they need it without depending on an information systems department to produce the report. And they also need electronic data interchange (EDI) to electronically accept information such as purchase orders, schedule amendments or cash and electronically send data such as order acknowledgment and invoices.

Integration of information systems can be further enhanced through imaging. Imaging provides the ability to display drawings or specifications. In addition, it provides the ability to store original sales orders, purchase orders, quotations, contracts, etc. Closely

aligned to this is the electronic approval process. To reduce paperwork, e-mail should be tied to the electronic approval process for purchase orders and engineering change orders. All this adds up to effective workflow automation.

Costs of ERP

- Implementation

- Training. Inadequate training is probably one of the largest problems facing ERP implementations. Companies often mistakenly regard ERP implementation as purely technical issues. In fact, at least half of the issues in ERP disasters are not technical but people and culture related. Successful ERPs require users to be properly trained not only on how to do their job, but the why as well. If a user doesn't understand the ERP process or degree of integration, there is every likelihood that they won't understand the importance of data integrity. Since the whole concept of ERP is that data and information are transient, mistakes by users can quickly become exponential as their data input is integrated with other information and processes. Therefore, much emphasis should be placed on proper training.
- Integration and testing. Testing the links between ERP packages and other corporate software links that have to be built on a case-by-case basis is another often-underestimated cost. For example, scanning modules, barcode reader modules all require integration links to ERP.

- Data conversion. Most data in legacy systems is of little use in a new modern ERP system. Companies often deny their data is dirty until they actually have to move it to the new client/server setups that popular ERP packages require. But it is important to move corporate information, such as customer and supplier records, product design data and the like, from old systems to new ERP homes.

- Data analysis. Often, the data from the ERP system must be combined with data from external systems for analysis purposes. Users with heavy analysis needs should include the cost of a data warehouse in the ERP budget—and they should expect to do quite a bit of work to make it run smoothly. Users are in a predicament here: Refreshing all the ERP data every day in a big corporate data warehouse is difficult, and ERP systems do a poor job of indicating which information has changed from day to day, making selective warehouse updates difficult. One expensive solution is custom programming. The result is that the wise will check all their data analysis needs before signing off on the budget.

- Implementation team's work doesn't stop with the completion of the ERP implementation. Most companies intend to treat their ERP implementation as they would any other software project. Once the software is installed, they figure the team will be scuttled and everyone will go back to his regular duties. But after ERP, you can't go home again. The implementers are too valuable. Because they have worked intimately with ERP, they know more about the purchasing

process than the purchases people and more about the manufacturing process than the manufacturing people. Companies can't afford to send their project people back into the business because there's so much to do after the ERP software is installed. Just writing reports to pull information out of the new ERP system will keep the project team busy for a year at least. And it is in analysis—and, one hopes, insight—that companies make their money back on an ERP implementation. Unfortunately, few IT departments plan for the frenzy of post-ERP installation activity, and fewer still build it into their budgets when they start their ERP projects. Many are forced to beg for more money and staff immediately after the go-live date, long before the ERP project has demonstrated any benefit.

- Waiting for ROI. One of the most misleading legacies of traditional software project management is that the company expects to gain value from the application as soon as it is installed. Most of the systems don't reveal their value until after companies have had them running for some time and can concentrate on making improvements in the business processes that are affected by the system.

Installation Methods

The Big bang Approach

The big bang method is the more ambitious and risky of the two. Organizations taking this approach attempt to switch operations from their old legacy systems to the new system in a single event that implements the ERP across the entire company. While this method has certain advantages, it has been associated with numerous system failures. Since the new ERP system means new ways of conducting business, getting the entire organization onboard and in sync can be a daunting task. On day one of the implementation no one within the organization will have had any experience with the new system. In a sense, everyone in the company is a trainee learning a new job. The new ERP will initially meet with opposition because using it involves compromise. The legacy systems with which everyone in the organization was familiar with and had been honed over the years to meet exact needs. In most cases, ERP systems don't have the familiarity of the legacy systems that they replace. Also, because a single system is now serving the entire organization, individuals at data input points often find themselves entering considerably more data than they did previously with the more narrowly focused legacy system. As a result, the speed of the new system often suffers, causing disruptions to daily operations. Theses problems are typically experienced whenever any new system is implemented. The magnitude of the problem is the issue under the big bang approach where everyone in the company is affected. Once the initial adjustment period has passed and the new culture emerges,

however, the ERP becomes an effective operational and strategic tool that provides competitive advantage to the firm.

The Phased-In Approach

Because of the disruptions associated with the big bang approach, the phased-in approach has emerged as a popular alternative. It is particularly suited to diversified organizations whose units don't share common processes and data. In these types of companies, independent ERP systems can be installed in each business unit over time to accommodate the adjustment periods needed for assimilation. Common processes and data can be integrated across the organization without disrupting operations throughout the company.

Organizations that are not diversified can also employ the phased-in approach. The implementation usually begins with one or more key processes, such as general ledger. The goal is to get ERP up and running concurrently with legacy systems. As more of the organization's functions are converted to ERP, legacy systems are systematically retired. In the interim the ERP is interfaced to legacy systems. During this period, the objectives of system integration and process reengineering, which are fundamental to the ERP model, are not achieved. Otherwise, the organization will have simply replaced its old legacy system with a very expensive new one.

ERP Applications Types

ERP functionality falls into two general groups of applications: core applications and business analysis applications. Core applications are those applications that operationally support the day-to-day activities of the company. If these applications fail so does the company. Typical core applications would include but are not limited to sales and distributions, business planning, production planning, shop floor control, and logistics.

Sales and distribution functions handle order entry and delivery scheduling. This includes checking on product availability to insure timely delivery and verifying customer credit limits. Unlike the previous example, customer orders are entered into the ERP only once. Since all users enter a common database, the status of an order can be determined at any point. In fact the customer may be able to dial in over the internet and check the status of an order directly. Such integration reduces manual activities, saves time, and decreases human error.

Business planning consists of forecasting demand, planning product production, and the detailed routing information that describes the sequence and the stages of the actual production process. Capacity planning and production planning can be very complex; therefore some ERPs provide simulation tools to help managers decide how to avoid shortages in materials, labor, or plant facilities. Once the master production schedule is complete, the data enter the MRP (Materials Requirement Planning) module, which provides three key pieces of information: an exception report, a materials requirements

listing, and inventory requisitions. The exception report identifies potential situations such as late delivery of materials that will result in rescheduling production. The materials requirements listing shows the details of vendor shipments and expected receipts of products and components needed for the order. Inventory requisitions are used to trigger material purchase orders to vendors for items not in stock.

Shop floor control involves the detailed production scheduling, dispatching and job costing activities associated with the actual production process. Finally, the logistics application is responsible for assuring timely delivery to the customer. This consists of inventory and warehouse management, and shipping. Most ERPs also include their procurement activities within the logistic function.

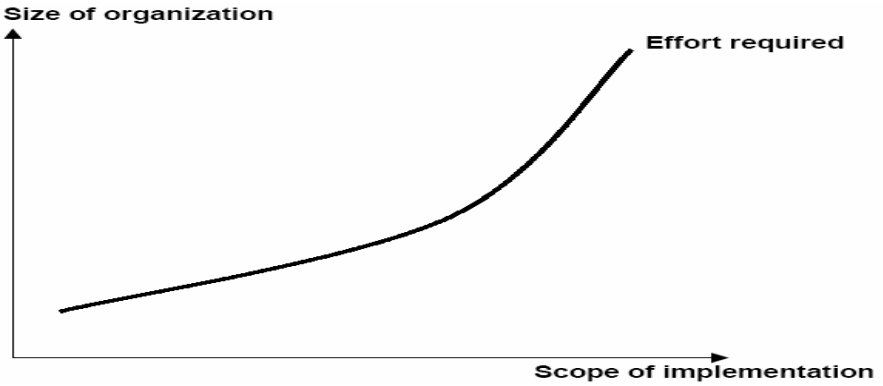
An ERP is more than simply an elaborate transaction processing system. It is a decision support tool that supplies management with real-time information and permits timely decisions that are needed to improve performance and achieve competitive advantage. On-line Analytic processing (OLAP) includes decision support, modeling, information retrieval, ad-hoc reporting/analysis, and what-if analysis. Some ERPs support these functions with their own industry-specific modules that can be added to the cord system. Other ERP vendors have designed their systems to accept and communicate with specialized packages that are produced by third party vendors.

However, a data warehouse is a requirement for the successful implementation of business analysis applications. A data warehouse is a database constructed for quick searching, retrieval, ad hoc

queries, and ease of use. The data is normally extracted periodically from operational database or from a public information service. An ERP system could exist without having a data warehouse; similarly, organizations that have not implemented an ERP may deploy data warehouses. The trend, however, is that organizations that are serious about competitive advantage deploy both. The recommended data architecture for an ERP implementation includes separate operational and data warehouse databases.

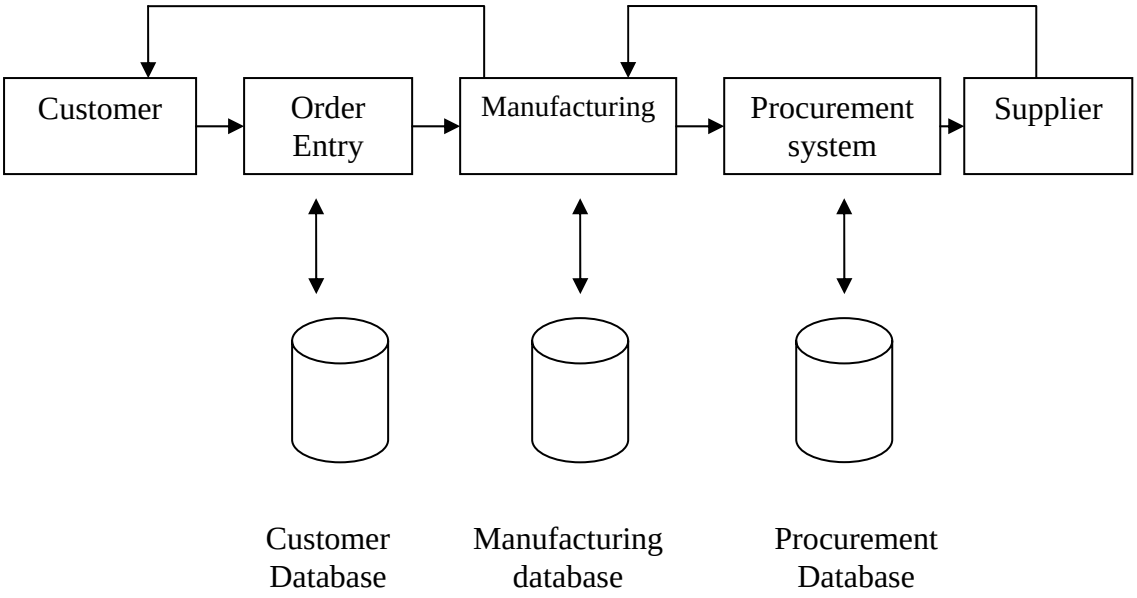
How long will an ERP project take?

Companies that install ERP do not have an easy time of it. One should not be impressed nor should believe it when ERP vendors tell him that ERP installation should only take about a three or six-month average implementation time. Those short implementations are grossly misleading and all have a catch of one kind or another: The company was small, or the implementation was limited to a small area of the company, or the company used only the financial pieces of the ERP system (in which case the ERP system is nothing more than a very expensive accounting system). To implement ERP properly, the way people do their jobs will need to change. And that kind of change doesn't come without pain. Real transformational ERP efforts usually run between one and three years, on average.



Accounting Systems vs. ERP

Traditional AIS process economic events that affect the assets and equities of the organization, is reflected in its accounts, and is measured in monetary terms. It also process non-financial transactions that directly affect the processing of financial transactions. ERP is more than simply an elaborate transaction processing system. Beside its support of the functions above, it is a decision support tool that supplies management with real-time information and permits timely decisions that are needed to improve performance and achieve competitive advantage. The objective of ERP is to integrate key processes of the organization such as order entry, manufacturing, procurement and accounts payable, payroll and human resources. By so doing a single computer system can serve the unique needs of each functional area. Under traditional model each functional area or department has it's own computer system optimized to the way that it does its daily business. ERP combines all of these into a single database to facilitate the sharing of information and to improve communications across the organization.



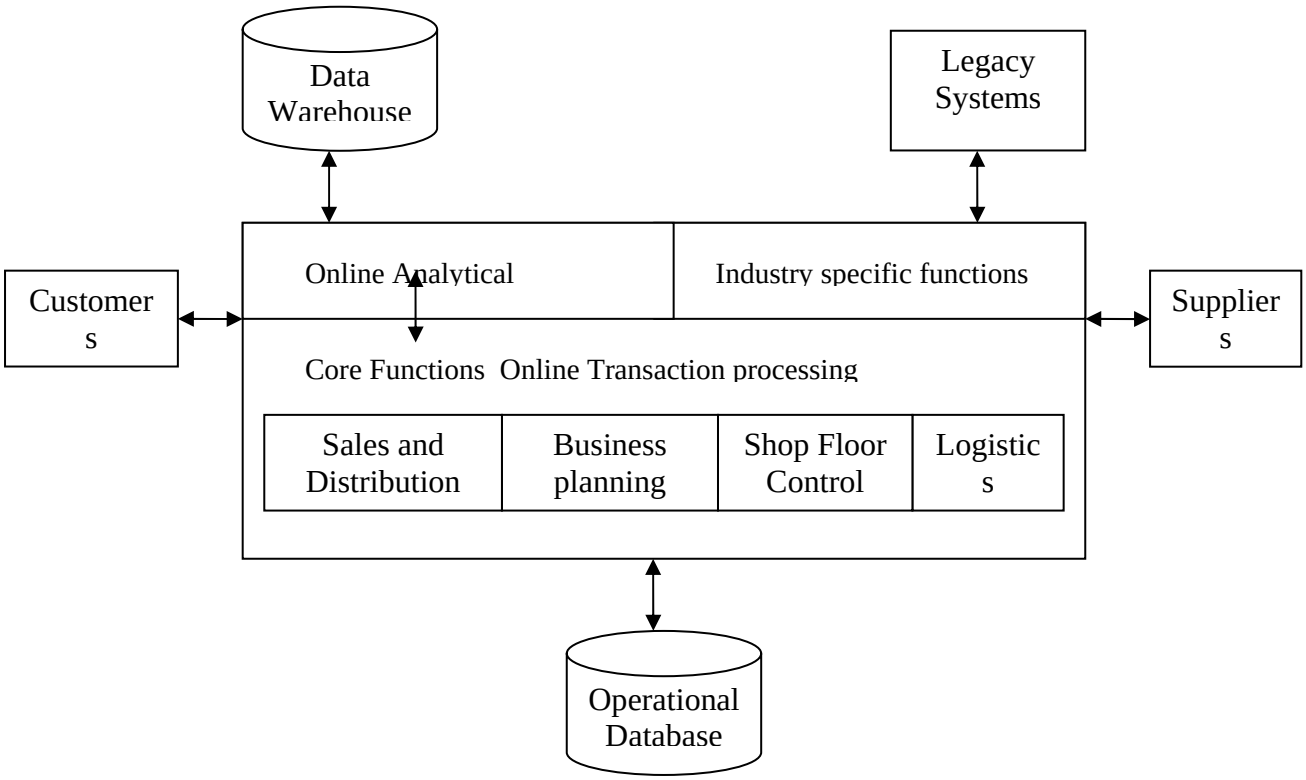
Traditional AIS System Architecture

Traditional AIS employs a closed database architecture, which is similar in concept to the basic flat file model. Under this approach, a database management system is used to provide minimal technological advantage over flat file systems. The DBMS is little more than a private but powerful file system. As with the flat file approach, the data remains the property of the application. Thus distinct, separate, and independent database exists. As is true with the flat file architecture, there is a high degree of data redundancy in a closed database environment. When an order is placed, it begins a paper-based journey around the company where it is keyed and retyped into the systems of several different departments these redundant tasks cause delays, lost orders, and promote data entry errors. During transit through the various systems, the status of the order may be unknown in any point in

time. For example, responding to a department director query, the purchases department may be unable to look into the warehousing database to determine whether a purchase order has been fulfilled. Instead, the frustrated manager is told: ”You will need to call warehousing department.” This results in delays.

The lack of effective communication between systems in the traditional model is often the consequence of a fragmented systems design process. Each system tends to be designed as a solution to a specific operational problem rather than as part of an overall strategy. Furthermore, since systems designed in-house emerge independently and over time, they are often constructed on different and incompatible technology platforms. Thus special procedures or programs need to be created so that older mainframe systems using flat files can communicate with newer distributed systems that use relational databases. While communications between such systems is possible, it is highly fragmented and not conductive to efficient operations.

ERP systems support a smooth and seamless flow of information across the organization by providing a standardized environment for a firm’s business processes and a common operational database that supports communications. Data in the operational database are modeled, structured, and stored in accordance with the internal attributes of the data. They remain independent of any specific application. Extensive data sharing among users occurs through application-sensitive views that present the data in a way that meet all user needs. The figure below reflects that.



ERP Architecture

Networking for ERP

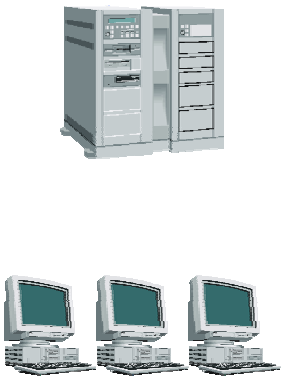
ERP applications are most commonly deployed in a distributed and often widely dispersed manner. While the servers may be centralized, the clients are usually spread to multiple locations throughout the enterprise.

Generally speaking, there are three functional areas of responsibility that is distributed among the servers and the clients. First, there is the database component – the central repository for all of the data that are transferred to and from the clients. Then, of course, the clients – here raw data gets inputted, queries for information are submitted, and the data satisfying these requests is presented. The application component acts as the intermediary between the client and the database.

Where these components physically reside and how the processes get distributed will vary somewhat from one implementation to the next. The two most commonly implemented architectures are outlined next.

Two-tier Implementations

In a typical two-tier architecture, the server handles both application and database duties. The clients are responsible for presenting the data and passing user input back to the server. While there may be multiple servers and the clients may be distributed across several types of local and wide area links, this distribution of processing responsibilities remains the same. Figure below provides a simple illustration of a two-tier implementation.



Three-tier Client/Server Implementations

In three-tier architectures, the database and application functions are separated. This is very typical of large production ERP deployments. In this scenario, satisfying client requests requires two or more network connections. Initially, the client establishes communications with the application server. The application server then creates a second connection to the database server. Figure below illustrates this type of implementation.

Transaction Flows and Volumes

So far, this all looks pretty unremarkable. We have clients talking to servers, servers talking to other servers. After all, in the vast majority of cases, there are several other applications already in place that are doing similar things in terms of transactions flows

long before the ERP application enters the picture. There are PC, Mac, or UNIX clients talking to web servers, sending and receiving email, transferring and printing files, running legacy host-based applications, etc. etc.

So we have to put the following points into consideration

- ERP applications and transactions are probably unlike anything else that you have running on your network. It is not safe to assume that the network will handle them well.
- Every ERP deployment is different. The application modules are customized and the architecture of the system and distribution of computing resources will be unique to your environment.
- It is critical to understand how the applications perform on the network before beginning enterprise-wide deployment.
- Network should be tested in advance to understand how these applications will perform and what impact they will have on existing applications.
- The location of computing resources may have a significant impact on how the application performs, particularly in three-tier environments. Understand the traffic flows between the client and the server as well as the server-to-server communication flows.

Data Entry Issues.

Data entry is one of the basic processes that have larger influence over validity and reliability of data. It is the most important stage that data passes through since it is subjected to human errors. After the computer captures data, it would be preserved on the same form of entry.

To guarantee that data is error-free and represents facts correctly, it should be entered only once and later reviewed more than once. This is a basic and fundamental rule of thumb to be followed in order to make sure data is clean. Applying this rule will dramatically reduce or eliminate the problems, data mismatch, associated with entering data at several locations.

When data is entered once, we guarantee that all the departments of the company deal with the same copy of data, eliminating redundancy and the difficulties associated with it. On the other hand, entering the same data at multiple locations in the company would expose the contradictions resulting from human errors. It is grossly erroneous to suppose that entering data by multiple operators would increase its reliability or by entering the data more then once would double check its correctness. That proposition is based on an ideal user who never commits errors. That type of user does not exist.

Data must also be entered as close to the originating source as possible. This is a strategy for the capture and entry of event-related data close to the place (and probably time) that an event occurs. When this strategy is employed, databases are more current

and subsequent events can occur in a more timely manner. Because data are not transported to a data entry location, there is less risk that inputs will be lost (input completeness). Also, the input can be more accurate because the data entry person may be in a position to recognize and immediately correct input errors (input accuracy). Finally, some efficiency can be gained by reducing the number of entities handling the event data.

Acquisition Strategy

Purchasing Versus Leasing

Computer software and hardware can be purchased. Alternatively, however, the hardware and software can be leased on a long-term financing contract. Each option has advantages. Purchasing generally requires a smaller cash outlay in the long run. On the other hand leasing involves a smaller initial cash outlay, provides greater flexibility, lessen the risks of obsolescence.

Single vendor Versus Multiple vendors

A computer system includes hardware, software, input-output devices, online storage devices, communications lines and equipment, and business forms and supplies. A variety of vendors are available as sources of these resources. An acquiring firm must decide which vendor or vendors can best satisfy its needs. Before determining the particular vendor, however, the firm should evaluate the advantages of dealing with a single vendor versus dealing with multiple vendors.

Using a single vendor simplifies the acquisition process and generally ensures that the various items will be compatible. Also, by selecting a single vendor for all of its needs, a company is likely to receive better and more reliable service. Buying from multiple vendors leads to inconveniencies, incompatibilities, and less reliable service.

In-House Versus Outsourcing Computing Service

In the past most companies had their information system departments develop custom software, because canned software that fit their specific needs was not available. Despite the availability of many good canned software packages today, many companies still develop their own software because their requirements are unique or their size or complexity necessitates a custom package.

Developing custom software is difficult and error-prone, and it consumes a great deal of time and resources. After end-users define their requirements, analysts work with them to determine the format of paper and screen outputs. The analysts then identify the data required for each input and the data to be retained in the files. Analysts also develop detailed program specifications to be interpreted and developed by a programmer. Because of the many and varied development tasks, the process requires a significant amount of discipline and management supervision. Accountants often help develop custom software, either as project supervisors, users, or development team members.

Custom software is usually developed and written in-house. Alternatively, companies may engage an outside company to develop a package or assemble it from their inventory of program modules. These modules are adapted, combined and organized to form a customized product that meets a company's specific requirements.

Information systems consultants tell clients to develop custom software only if it provides a significant competitive advantage. For example Gillette Inc used to develop its own software but recently decided to move from proprietary systems to off-the-shelf software wherever possible. Its rationale is that it gains greater competitive advantage from deciding how software should be used than from determining what software should be used and then creating it.

Outsourcing is hiring an outside company to handle all or part of a company's data processing activities. In a mainframe outsourcing agreement, the outsourcers buy their client's computers and hire all or most of the client's employees. They then operate and manage the entire system on the client's site, or they migrate the system to the outsourcer's computers. Most mainframe outsourcing contracts are for ten years or more. For example, the natural gas producer Enron signed an agreement with EDS to outsource its entire information system. EDS bought Enron computers, software and transmission network. Enron pays EDS a fixed annual fee, plus additional fees based on processing volume. During the ten-years life of the contract Enron expects to save $200 million, which is almost 25% of its computing costs.

In a client/server or a PC outsourcing agreement, an organization out sources a particular service, a segment of its business, a particular function, or PC support. Most Fortune 2000 companies outsource anywhere from 10% to 80% of their PC support functions. For example, Royal Dutch Shell, the international oil company, has 80,000 PCs worldwide and has outsourced most of its

installation, maintenance, training, help desk, and technical support.

Outsourcing was initially used for standardized applications such as payroll, accounting, and purchasing or by companies that were struggling to survive and wanted a quick infusion of cash from selling their hardware. However, in 1989 Eastman Kodak surprised the business world by hiring three different companies to operate its computer systems. Kodak outsourced its data processing operations and sold it's mainframes to IBM. It outsourced its telecommunications function to DEC and its PC operations to BusinessLand. When the performance of DEC began to slip in 1994, Kodak opened those services to new bids. Kodak continues to perform its own information systems strategic planning and development, but the system implementation and operation are the responsibility of the outsourcers. The results have been dramatic. Capital expenditures for computers fell 90% while operating expenses decreased between 10% and 20%. Kodak expects the annual information systems savings to reach approximately $130 million over the ten-year period of the agreement.

In 1994 Xerox signed was then the largest outsourcing deal in history: a $3.2 billion, ten year contract with EDS to outsource its computing, telecommunications, and software management in 19 countries. The company moved to outsourcing to cut costs, to speed up the move from mainframe architecture to client/server computing, and to free management to focus on strategic management issues rather than on day-to-day concerns. However, Xerox did retain control over its IT functions, such as IS strategic

planning and new application development, in order to support its reengineering efforts.

The decisions made by Kodak and Xerox have motivated other organizations to consider outsourcing their information systems. For example, 10 of the top 25 Fortune 500 companies outsource some or all of their information systems.

The Benefits of Outsourcing.

A Business Solution. Outsourcing is a plausible business solution, rather than just an IS solution. Kodak and Enron believe outsourcing is a viable approach, strategically and economically, because it allowed them to concentrate on their core competencies. Kodak believes in focusing its efforts on what it does best, selling films and cameras, and leaving data processing to more qualified computer companies. Kodak treats outsourcers as partners and works closely with them to meet its strategic and operational data processing objectives.

Asset Utilization. Organizations with millions of dollars tied up in information technology can improve their cash position and reduce annual expenses by selling those assets to outsourcers. With technology changing so rapidly, the AIS function can drain a company's cash reserves as it tries to keep up with the latest advancements.

Access to Greater Expertise and More Advanced Technology. Many companies can not afford to retain a staff to manage and develop the increasingly complex networks required in today's businesses.

Washington Water Power Company began outsourcing when the prospect of upgrading and replacing its obsolete computer system seemed too daunting a task.

Lower Costs. Outsourcing can decrease IT costs by 15% to 30%. Out sources can pass along some of the savings from standardizing user's applications, buying hardware at bulk prices, splitting development and maintenance costs between projects, and operating at higher volumes.

Improved Development Time. Experienced industry specialists often can develop and implement a system faster and more efficiently than in-house staff. Outsourcers can also help a company cut through much of the internal politics surrounding systems development.