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The next generation: A look at where today's enterprise resource planning (ERP) systems came from and where technology is heading

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THE NEXT GENERATION: A LOOK AT WHERE TODAY'S ENTERPRISE RESOURCE PLANNING (ERP) SYSTEMS CAME FROM AND WHERE TECHNOLOGY IS HEADING.

A Project
Presented to the
Faculty of
California Sate University,
San Bernardino

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Of the Requirements for the Degree
Master of Business Administration:
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ABSTRACT

In today's society, efficiency is everything. Maintaining competitive advantage and staying attuned to the market is the key to success. Any credible market analyst would concur with the above statement. However, companies have struggled to stay up to date with technology in order to achieve excellence.

Currently, the largest barrier to any given market usually involves capital. If a company does not have enough investment capital to start with, it could fail before it even gets started. However, there is a new component that affects some of the largest corporations in the world. The problem relates to being able to sustain current internal processing, as well as adapt and grow in new markets with higher volumes. There are systems out there today that claim to address these issues along with e-commerce and other electronic sharing of information.

The systems referenced above are known as Enterprise Resource Planning (ERP) systems. These systems allow companies to instantly obtain information, which previously took weeks or even months to compile. The promise of these systems is that companies can obtain real-time information and

be able to react quickly to problems that arise. Only recently has technology advanced enough to have the last statement become a reality; but it comes at a high price.

The technologies and architectures that promise this sharing of information are called "Client-Server" and "Inter/Intranet Transaction Servers". The former primarily means that there is a central server that contains all of the data, the main operating program, and other smart-terminal interfaces that take the data from the main system and extract, compile, arrange, and output the information. Regarding the latter, while the promise of Internet transaction architecture is great from the outside, we will touch on how complicated and, at this point in time, very expensive it is to obtain, operate, and maintain.

Many of the points made in this text are opinions made by me based on my education, experience, and external readings. At my current place of employment, I have recently participated in a major system replacement and several major upgrades and modifications to that system. During this process, I have been responsible for the implementation of several financial elements, as well as being a team participant in many other areas of the company.

One of the main items you should realize from reading this text is that accounting and financial functions are no longer just "bean-counters". In many companies, these functions are also responsible for the internal processes of the company in general and for how the system accommodates the accounting and finance functions accordingly. Many people who have not experienced an upgrade of an Enterprise Resource Planning system do not understand this concept. The experiences of colleagues and my own initial ignorance have made it clear to me that understanding the entire system is vital if an individual really wants to succeed in this new century. If you do not understand how the information reaches you, you will not be able to identify, understand, or rectify problems in the real world. Let us face reality, anyone can present information that is readily available. What the world needs are more people in the accounting and finance profession who can understand how and why the information is wrong and, most importantly, how to fix it.

In concluding, my goal is to persuade your thinking regarding what the accounting and finance profession will do in the future and point out areas that are important in order to succeed in our changing roles. Traditional Accounting or Finance no longer impresses employers or guarantees a position

in these functions. It is important to understand that experience is only half the battle when it comes to advancement and that more interactive training is required. In my opinion, the majority of the problem is not that the instructors are not teaching what is needed, but that the school system is not providing the instructors with adequate tools to teach.

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CHAPTER ONE

Where Did We Come From?

Well before IBM created the first computers, the need for automation tools had been one of the main driving factors behind the advancement of technology. Although, traditionally, the U.S. Government has also been a great motivator of invention. IBM saw this need as a huge opportunity and seized it with the invention of computer technology. While the architecture of this machine is not important, it is important to note that this new machine revolutionized the way the human race traditionally saw our limitations.

This new machine was different from most machines in that it was not designed to satisfy a specific purpose, but rather to be applied for many purposes. The people involved in this creation from the beginning knew what the potential was for any company that could afford the technology, as well as store the physical machine. Computers opened up the doorway for the human race to no longer have to rely on their own minds for basic needs. For example, in one of man's greatest feats of stepping on the moon on July 20, 1969, the computer eliminated countless errors in human judgement that would have prevented us from being able to get there.

While one may say that everything seemed to still be very manual compared to today's standards, you must realize that computers at that time helped develop the formulas, which the engineers of the project used in order to succeed. Those computers also helped the engineers automate the timing of certain steps that many of us will never even know about, much less understand if we did.

Getting back to how computers have evolved for accounting and finance professionals, it is important to understand that computers, from day one, have been changing peoples' lives and their roles in business no matter what the profession. For the accounting and finance professional, it has allowed them to automate a large portion of their work and has allowed them to focus on more crucial business issues.

Back in the 1960s, the world was starting to become a world economy. However, it was hampered by communication boundaries. With the invention of the computer, today's society thrives in a world economy, dependent on the success of all countries that participate. Because of this New World economy and the need for instant access to information, members of the accounting and finance profession must move more quickly, and they must become smarter in dealing with more complex issues.

Because of the diminishing need for professionals to deal with the day-to-day issues and their increasing ability to focus their time on much more complex issues, the need for faster and simpler systems always exists.

Hardware and Software Limitations

At first, the computer hardware was the obstacle. The original systems were called mainframes and physically required rooms the size of a department store. To put that in today's perspective, the microcomputer that I am typing on right now has more processing power than the systems of the 1960s, but it is not much larger than a dictionary. Although, it is not just the hardware today that makes computers so successful.

Quickly, visionaries like Bill Gates and Steve Jobs saw that software was going to be the major obstacle that would prevent computer systems from being able to realize their true potential. It was perceived that hardware technology can only be pushed so far and that software will need to make up the difference. For accounting and finance, these programs did not even exist. Many business people did not accept the new technology because the software did not completely accommodate

their needs, and the hardware was big, bulky, and, most importantly, expensive.

With the invention of mini-computers, a lot of this traditional thinking changed. The physical size of the computer changed drastically, and they became increasingly affordable. At the same time, mainframe software programs were beginning to be built to handle business needs. Some visionaries saw that having a computer system run the business offered a competitive advantage because they could slash labor costs within the administrative functions, as well as the manufacturing area. This would then lead to higher margins on their products and would eventually lead to a decline in the cost of whatever service or product the company offered.

There were not many software manufacturers in the mainframe community at that time. Again, IBM took the lead in offering a complete business solution, for which there was no direct competition. The cost of entrance into the market was declining slightly, but IBM had most of the technology and patents on how these systems functioned.

The next evolutionary step occurred in the late 1970s with the personal computer. This allowed individuals the ability to conduct work separately from the main system, without interrupting the entire day of the employee. Most of

the systems like this were also expensive and slow. There was very little software available, which is not the case today. However, the spreadsheet application by Lotus Corporation, helped change that. This is when the accounting and finance profession really began to accept the new technology. Up until that point, and even for a while after, people continued to complete calculations on traditional 13-column paper spreadsheets that were too large for normal people to comprehend.

It has been documented that both IBM and Hewlett Packard did not see the potential of the personal computer as its role in business would take shape early on. IBM still saw itself as the leader in an established industry, which they had created, and they were not ready to change to a more user-friendly environment. Hence, the entrance of Apple, Microsoft and Intel Corporations. These companies were started by, what we would consider today, hackers. Microsoft looked to support IBM in entering the PC era because IBM was the biggest of the day, while Apple was already succeeding to expand in the market IBM and Hewlett Packard previously ignored. Because of these two new corporations, IBM witnessed the creation of a huge market, which was traditionally theirs, become a market that had better performing products, more user-friendly

computing environments, and the ability to link an entire world together to help create what we call today, "The Information Age".

Intellectual Limitations and Training

With any new great technology comes the inability or unwillingness of people to change. It is also a fact that, as humans get older, it becomes more difficult to learn new things, which often causes resistance to change. I often see business professionals who do not understand how systems work, nor do they try to understand. This unwillingness to learn is to the point that it costs the company a substantial amount of expense for these people on the project in addition to purchasing and implementing the system. People become lazy to the extent that they feel the company owes them training, and they offer no initiative on their part to try to learn how to use the system themselves.

The above statement is the true premise of this project. I feel that this is where the education system of yesterday and today has failed, and is continuing to fail, its customers. From this point forward, I will refer to customers instead of students, because universities need to change their perspective of what their purpose is.

It is my experience in going through several system implementations that professionals are not able to adjust to change as well as they should. Some try, but do not really think about what they are doing. Others do not really try, and they place the blame for their ineffectiveness on the lack of training or the poor quality of the system. Technology is changing rapidly, and the people who are not able to keep up will find themselves unable to cope with business. Sure they will be able to find work, but without this knowledge, they will have very little chance of being promoted to a high position within a business. If the educational systems of today do not teach this, then where will the professionals of tomorrow obtain it? Will they get it through experience? There are not many cases in which companies care only about your education and not about your experience. However, I believe this is because there is a lack of faith in the institutions providing the education.

Granted, technological changes do require some training in most situations, but the intellectual limitations that we are imbedding in up-and-coming professionals is alarming. In conducting recent personnel interviews for both professional and non-professional positions, I have found that people who do not have a formal education beyond high school, or people

who have been working while going to school, seem to be better able to adapt to change. These individuals also seem to have more initiative because they have had to teach themselves on the job and not take only what the education system brings them.

CHAPTER TWO

Economic Influences

Domestically in the United States, economies of scale make a huge impact on a corporation's ability to keep up with leading edge technology. Because of this cost, it is my opinion that we are seeing an increasing number of mergers between high tech companies and traditionally mature companies. An example is the recent merger of AOL and Time Warner. This merger is a prime example of a company, Time Warner, that does not have the technical knowledge and capital to be able to move to the next level of Internet entertainment delivery. One of the advantages AOL offers Time Warner over their competitors is the ability to distribute their products over the Internet directly. Paramount, Viacom, and other entertainment corporations are missing this essential component for delivering their products in the coming decade.

Domestic market pressure is pushing to have television, computer, radio, and all forms of media integrated within a single system. Economically speaking, consumers are tired of having to purchase individual pieces of equipment in order to enjoy all the different entertainment options available. It is becoming too expensive for consumers to purchase these products; so more efficient and economical means of delivery

must be created. The above mentioned merger is a prime example of two mature companies leading their industries taking a proactive role in trying to accommodate these pressures.

At what price? It all boils down to how much does it cost? Services that can be bundled together will ultimately cost less to produce, deliver, and consume because the one piece of equipment can control all. Consumers want the best possible product for the lowest price. As a consumer, I would like the ability to choose what program or movie I want to see, when I want to see it, and where I want to see it. With the Internet expertise of AOL, and the entertainment bundles that Time Warner offers, that is becoming more of a reality. Soon, hopefully, our televisions, personal computers, and other accessories will all have separate Local Area Networks (LAN) within our own homes. With this type of power, people will be more pleased with the services they are receiving, and the companies will be delivering these services on a more efficient basis.

Domestic Competitive Advantage

In the United States, competitive advantage is one of the key driving influences for technological advances. In

order to survive, U.S. corporations must offer products and services that no other company can provide. However, competitive advantage is not limited to just the products and services they provide; it also includes the delivery system and how quickly a corporation can get the product to the market. For example, assume there are two competing companies, one in California and one in Taiwan, and a customer located in Nevada. Although the market is closer to the California company, if the Taiwanese corporation can deliver the product sooner, the customer will probably purchase from the company that is thousands of miles further away.

Today, the Internet is the competitive advantage of successful corporations in delivering to and communicating with the market (customers). Arguably, the most recognized name using Internet technology as its primary business feature is Amazon.com. While debatably the most pronounced Internet-based company, Amazon.com is not the only company providing these services. Amazon still needs to pay attention to pricing, marketing, and packaging of their products. Internet technology, while allowing customers and companies to communicate more easily, does only just that. The Internet does not speed up the receiving of the goods and services or

improve the quality of the goods and services provided. ERP systems help in these areas.

In the past ten years, the United States has economically superseded the economy of any other nation in the world. Because of this, American-based corporations and international corporations whose primary market is the United States have experienced increasing pressure to upgrade to these new ERP systems. This is primarily because corporations can no longer compete without the efficiencies of these new systems. This obviously comes at a high price, because this technology is innovative and is very expensive. Not only is it expensive to obtain and implement, but it carries with it a long-term level of overhead. This means companies must now hire additional personnel and purchase expensive hardware and/or software in order to support this system so that it continues to run without interruption because it is becoming the backbone of the entire organization.

Hardware Breakthroughs

Over the past twenty years, drastic improvements have been made to personal computers and laptops, which are replacing the older, larger mini-computers. The performance of today's personal computers matches or exceeds many mini-

computer functions, with the exception of volume. While the architecture is still different between mini-computers and personal computers, we are seeing that systems are no longer limited to just completing any one specific task well. [1]For example, Sun Microsystems, the most popular system in the Geographic Information System (GIS) industry, is popular because their hardware architecture is designed to handle large amounts of data and complete complex mathematical calculations. While Hewlett Packard, Digital Corporation, and Data General systems say they offer the same functionality and claim to offer the same performance, they use software to achieve similar results, which requires faster processing power.

Because processing speeds alone do not always determine which machine is better, hardware vendors are using different architectures in their systems, which can seriously affect the performance of the overall system. As an example, over the past few years, Intel Corporation has made substantial improvements in the speed of the personal computer processing chip.

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[1]Conversations with ESRI users that have switched from one brand of machine to Sun for their specific needs.

We have seen systems that were state-of-the-art at 33Mhz back in 1994 followed by whopping 1000Mhz chips currently available. This burst of technology requires, among many things, serious re-thinking of how the system should function.

Until recently, the bus of the motherboard, which is used to pass data between the processor and the rest of the system, was limited at 100Mhz. What this means is that even if you have a computer running at 500Mhz, you can only pass data from your processor to the rest of the system at twenty percent of the capability of the processor. While it would require huge amounts of data for this to be a problem, most people do not recognize the performance degradation and do not expect anything better. The same is true with RAM memory, which is the space that the processor accesses when processing data. Until recently, this component had the same limitations as the bus in that it was only operating at 66Mhz to 100Mhz. Again, you would run into the same performance problem if you were required to access huge amounts of data.

Today we have 200Mhz buses and 400Mhz RAM memory components, which drastically help the processor with what it can do. For graphical display and raw data manipulation, these two enhancements have a more serious impact on today's

system than the move from a 450Mhz processor to a 700Mhz processor.

With all of these enhancements to the personal computer over the past ten years, technology called "Client-Server" in today's modern business systems has really taken off. Granted, the fear of the Y2K bug in the older systems provided a strong push toward implementing the latest technology, but client-server applications have really come a long way. Traditional mainframe systems would only allow display or input of data from the main computer. All of the processing and storing of data was on the main computer, which of course required huge or more powerful computers to support these architectures. A true client-server architecture requires personal computers at the end-user side in order to process and store some data. This places less demand on the main system and allows people to work without the system up and running in some cases.

In a mainframe system, the interface to the system is driven completely from the main server. No input can take place unless the system is up and running, and users usually do not have ad-hoc query capabilities. New reports or data analysis require programming and often limit people's access to data. The client-server architecture consists of separate

hardware and software components connected/communicating together, creating a more user-friendly, and flexible, way of sharing information. While today's mainframe systems are much more flexible than what they used to be, they still do not offer the flexibility of a client-server system. About the only thing that they can offer at this point, which should not be discounted, is the stability of the system. Since mainframe technology has been available for so long, IBM, the leader in this technology, is still selling this product well because of their record of stability.

CHAPTER THREE

International Influences

In the previous sections, we have been focusing domestically in the United States regarding technological advances in business. However, ingenuity is not enough. The ability to manufacture goods and services is just as critical. In the last few decades of the 20th century, we saw the majority of the United States' manufacturing facilities move to international third world corporations. Why? The first and foremost reason is cost. It is simply cheaper to produce large quantities of products in these countries.

In the past and present, labor cost is the primary reason why products are manufactured less expensively overseas. However, it is my opinion that technology can overcome physical human labor. As we are seeing in automobile manufacturing plants, with robotics and integrated ERP systems we are building products with minimal physical labor. However, we now require a greater level of intellectual resources in order to operate and maintain these systems. Internationally speaking, populations are now realizing that the people in other countries who are consuming the products they are creating are living quite a bit better than they are. Therefore, this same population is demanding more benefits and

a better working environment to increase their standard of living. While there is still a huge gap in labor wages between the United States and European communities compared to third world economies, the gap is shrinking rapidly. Before too long, companies will find that the cost of building a factory, shipping the product back to the market, and paying better wages to increase international economic standards of living will exceed the cost of upgrading the current ERP systems and producing the product closer to market by more efficient means. Factors to include in this equation are the quality of the product, the faster distribution to the market, and the ability to more quickly and easily change the product specifications.

Global Competitive Advantage

In what is commonly referred to as global competitive advantage, integrated ERP systems are allowing corporations to run more seamlessly than in the past. Because it is necessary to have a physical presence across continents, the requirement for systems to be able to consolidate themselves quickly and automatically has risen. What traditionally was considered competitive advantage, just because of the physical presence, is no longer the case in most industries.

For example, most large or global corporations provide 24-hour technical support globally. SAP accomplishes this 24-hour support by providing support staff around the globe. All support calls placed after 8:00pm Eastern Time are routed to the Singapore office, which is operating during their business hours at that time. This allows SAP to use global resources to handle calls that occur outside of normal business hours locally. This is a great global competitive advantage in that this company does not need to hire staff to cover the quieter off-hours to support their client base. They can save costs by allowing their telephone system, which is wired to their ERP system, to automatically transfer support calls to areas around the globe that are currently operating their normal work schedule.

Client-server systems have allowed this automation of work to be so successful. They allow people to communicate globally without having to be on the main system. Other sub-systems can integrate seamlessly into one, which allows a much quicker response time to good or bad news. Companies such as Boston Scientific have reduced their consolidation efforts from one month to a few days by using these types of systems. It is also easier to manipulate or extract data through ad-hoc

data queries, which traditional mainframe systems can not provide.

By far the two biggest success stories of today are SAP and Oracle. Both of these companies have had huge impacts in today's marketplace and have brought stable, more integrated client-server technology to the world. They have also allowed better flow of information between corporate entities, which allows quicker responses to the market. With companies all across the globe, it is increasingly important that the individual entities be able to communicate more efficiently.

Today's ERP systems like SAP and Oracle are client-server systems, which utilize the fast growing communication superstructure. The communication superstructure that I refer to is the Internet. Speeds across the Internet have substantially increased, which has allowed client-server technology to take off. In the past, it was very costly and painful to support dedicated communication lines between trans-continental systems. The main controversy of using the Internet over a dedicated line system is security. The Internet is too open to hackers.

CHAPTER FOUR

Today's Enterprise Resource Planning (ERP) Systems

What is an ERP system? An ERP system replaces the traditional corporate systems by having one central database that contains all corporate functions. Over the years, companies have evolved to create separate individual systems to accommodate the specific needs of specific departments. Through custom programming and modification of these sub-systems, attempts are made to allow each sub-system to communicate to a central system in an organized fashion. A complete ERP system does all of this within the same framework or model for each module or area it addresses, from personnel issues in the human resources department to financial statements and cash management in the accounting department.

My experience with SAP allows me to comment on the integration aspects of the new ERP systems of today. Companies like SAP, Oracle, and JD Edwards try to develop a generic model that will fit, or can be customized to fit, a wide range of company standards. The weakness of this approach is that the result is a system that requires many up-front expenses in configuring and customizing the standard model to fit a specific company. The benefit is that this

software package can be implemented for many different uses in or out of the same industry.

As mentioned earlier, with these systems comes an enormous amount of expense during implementation. While this is significant as a short-run issue, what many companies, including my current employer, overlook to some extent is the amount of expense that is continued with on-going support. Also, once implemented, there are many functions that the main system package still does not handle well or at all. This opens a new area of post-implementation support from the systems administration group in finding products that "bolt-on" to the main system.

For example, in my opinion, one of the biggest weaknesses of the SAP model is document retention/retrieval. This refers to the way in which SAP "archives" data once the company defines how long it wants to keep the information in the online system. Another issue that has become more popular in the past five to ten years is document scanning, storage, and retrieval within the online system. For example, our company is looking to eliminate the mass amounts of hard-copy document storage in off-site sheds. One of the larger contributors to this problem is accounts payable, with the hundreds of thousands of invoices paid annually. Gaining

access to invoice information and invoice storage in prior years has been tedious at times.

A "bolt-on" product working with SAP directly has created a semi-integrated solution for this document-scanning problem. However, while it allows us to scan these invoices and "attach" them to the internally generated document number, the following issues must be taken into consideration when analyzing whether it is cost beneficial to use this solution: 1) Increased time is required to complete the invoice payment process, which now includes the scanning and shredding of hard-copy vendor invoices; 2) A quality and audit (Q & A) function is now required to audit whether or not the documents being scanned are being scanned in a legible format and whether the scanned invoice is properly "attached" to the correct internally generated document number; 3) In the event of an audit, which occurs annually for our company, if there is a problem with a scanned image and the original has been shredded, then the possibility of not being able to defend your position, whatever the case may be, is imminent. To qualify that, however, it should be stated that in most cases, outside auditing firms or entities will often be understanding of these situations and not penalize the company; they will simply choose another document for their sample; 4) Expenses

are increased in upgrading or acquiring hardware technology that will support the use of this new tool. In our case, it has required the purchase of moderately expensive flatbed scanning equipment and the upgrade of all active users to higher end twenty-one inch monitors in order to scan and view the documents. The hardware requirements in order to access the information are not as extreme for the rest of the company. However, desktop technology must be above average in order to use the tool. While this may be immaterial for some companies, other companies cannot afford it.

Getting back to the ERP system itself, and not addressing any other "bolt-on" type of tools, let's start with more traditional manufacturing company areas. In the education system, with regards to manufacturing and operations, Material Resource Planning (MRP) has been the buzzword for many years. During my educational experience, I have found that the teachings in books do not come remotely close to explaining how MRP/MRP2 systems really work. Granted, they do address an overview or overall scope of the design and how the system is supposed to benefit the company. However, I found that this was not enough in trying to understand how an MRP system works.

Because my professional focus is not in manufacturing or costing, my exposure to this aspect has been limited. What I can tell you is that MRP systems can be customized to fit a myriad of different manufacturing models, which the education system did not even hint about during the past ten years that I have been a student. A true MRP system is actually a sub-system using many if not all aspects of an ERP system. One of the more in-depth details that are critical to an MRP system functioning properly is job scheduling. In a fully integrated ERP system, the MRP sub-system can and will access the personnel module to define and assign workloads by individual/sub-groupings. What this means is that you have a sub-system that will use information in a completely unrelated module in order to complete its tasks as intended.

One of the more complex examples of this that has been implemented by my current employer is within our project management system. This system starts with the entering of a contract. The user specifies what products or services are being consumed; what the output is; who or what types of labor are required to complete the project; and "milestones", which are tracked within the contract to define percentage of completion. This process, while it appears to exist only in the project sub-system, actually exists in five separate

systems. It uses the contract management system for document imaging, online access to contracts with optical character recognition (OCR) technology for searching capabilities. It uses the project management functionality for job tracking. It uses the sales and distribution system for billing. It uses the human resources system for work scheduling and job balancing among our consulting group employees only. In addition, it uses the materials sub-system, integrated with MRP, to schedule shipments of product to a contract site based on the milestone completion percentages or dates. In addition to all of this, there is another system we have not completely implemented at this time. It is a planning and budgeting system, which will monitor expenses among all of these different components for completion of this one contract.

For example, we want to restrict who within the consulting organization can work on this contract. We have a wide range of salaries, and we only want to allow people with salaries between $10 and $15 per hour to work on it. The system will only allow those individuals to perform the work. Perhaps you want to limit how much sub-contracting expense you incur on a particular project to equally balance in-house work performed on the project versus outside work performed on the project. Among other things, it can also prevent cost

overruns on a project by notifying the project manager when expenses hit a predetermined limit.

Technological Breakthroughs

Probably the three most controversial technological breakthroughs that have allowed client-server applications to proliferate are: 1) Obviously, the Internet with expanded bandwidth within communication lines; 2) Desktop PC performance, without which the "client" portion of "client-server" architecture would not be able to support its role; 3) Multi-parallel processing computers.

To address the first, in communication, the amount of data that is being transferred from site to site is enormous. The requirements in order to accommodate this transfer of information have taxed many communication vendors. Some of the not-so-new technologies to combat this are fiber-optic cable and coaxial cable. Another, more expensive means, which has really come to light only in the past five to ten years, is wireless satellite communication lines. While satellite offers a quicker response and a more diverse transfer area, it is very costly. The key to all of this is bandwidth. How much data you can push across the communication line at one

time, as opposed to how fast you can send a single stream of data across that same line.

Probably the most recognized advancement in technology is the increased performance of the desktop personal computer (PC), which we see advertised every day. Moreover, every day there is some piece of that technology that has been enhanced. In the past, client-server technology was hindered by the fact that the personal computer could not handle complex local computations of data. The server portion of that architecture was still required to complete the calculations of the data and pass the information to the PC for further analysis. Only within the past five to ten years has the PC become powerful enough to take more complex calculations off the server end of the system and push them onto the desktop end. What this means is less demand on the server to perform complex calculations, which allows increased specialization in transaction handling and data storage/retrieval. As an example, use a common ad-hoc query of customer information. With the system of today, the query is executed on the end user desktop, which sends instructions on how to get the data to the server. However, the server does not compute how the end report will look or how the data is manipulated within the report. All the server does is gather the necessary data that

was required in the instruction set. Once this task has been completed, the server will send the entire data set back to the PC for calculation and format. Nevertheless, it is not only the hardware that allows this to occur. Software plays an essential role in the instructions that are passed between the two points. Without sophisticated software on the PC (client) side, this architecture would not perform as described.

One of the more complex advancements in technology, which requires very sophisticated and complex software, is hardware architecture that supports multi processors that complete parallel processing tasks. Parallel processing technology is still in its infancy. There are many hardware vendors claiming to support parallel processing capabilities. While I do not deny that this architecture exists today, the problems lie within how the software operating systems are built and how they address the instruction sets to use this functionality. Many current operating systems do handle parallel processing instructions. However, only limited instruction sets are accepted. For example, the application end of SAP has versions of their software that are parallel processing compliant. However, benchmark tests indicate that the additional problems in configuration, support, and the

purchase of compliant hardware technology outweigh the benefits. Because software has advanced so much on the client side of these applications, less multi-function tasks are being demanded from the server. While I feel parallel processing is going to become better and cheaper in the future, it has shown very little progress at this time.

Implementation Considerations

Implementation of these systems is a great undertaking in itself. While the systems themselves offer many areas of complexity when up and running, the scope, understanding, training, and executing of implementation take on a whole other meaning. As discussed in an earlier section, a client-server system that companies like SAP and Oracle offer requires excellent communication and understanding among all team members.

The first step in designing a system is to identify the scope that the implementation phase is going to cover. In many instances, several phases outline separate segments of the implementation process, which usually result in the implementation of major components. In our situation, the existing order processing system was beginning to fail and was beginning to reach the limits of its originally programmed

design. Therefore, contrary to most system implementations, we decided to implement the sales and distribution components of the system first with minimal configuration taken into consideration for accounting functions. The idea was that we could continue to maintain our accounting system by manually posting journal entries into the legacy system from the transactions that were being accumulated in the newest part of the sales and distribution system.

The biggest hardship that we incurred was trying to find out standard strategies from SAP on how to accomplish this order of implementation. Our phases were going to be: 1) Sales and Distribution with minimal materials management. 2) Financial Accounting; Purchasing; several reporting modules; and activation of the remaining integration points between Sales and Distribution, Financial Accounting, and Materials Management. 3) Post-implementation support along with configuring and launching additional modules in the system for reporting needs.

In starting the first phase, the system was designed to bring up the Financial Accounting modules first to establish an accounting structure for testing and recording transactions. Because we were not following this order, it was difficult to find other companies that had gone against

this methodology, thereby requiring much more effort in configuration and testing than had originally been estimated. Documentation was scarce, and consultants were reluctant to support any implementation that was contrary to the standard SAP model. Because of the surge of companies upgrading their systems, we were not always able to get the most experienced consultants, and they definitely were not cheap for the services we received.

In order to combat this problem, my employer decided to utilize a large portion of personnel who were already in the company. This would allow people who understood the company to work more quickly in identifying the functions that needed to be performed by the system. The problem then was training for these individuals on how the system looks and feels. The company decided to send everyone who was involved in this first phase to what was called "Boot Camp". More than twenty people from several different departments were involved in a process that lasted more than three months. These people attended several classes within their areas and, to help expedite the learning curve, a couple of classes that were designed to touch on integration aspects between modules.

In my opinion, looking in retrospect, this training up front was probably a push when it came to a cost-benefit analysis. One of the major mistakes that occurred was choosing whom to send to these classes based primarily on rank in the organization, rather than who was actually going to perform the work. Many of the individuals who went to the training and were to become instructors upon their return did not understand systems. These people did not understand database theory, which seriously inhibited their contribution to the implementation team. While these people are highly intelligent, they just did not have the technical knowledge up front to use the training they received.

Additional training was constantly being conducted outside of the installation because the technology we were implementing was still new, and we were one of the only software companies to try to install this system. In retrospect, the path we chose was probably the correct one for our company. Although we spent more money on the installation than we probably needed to, the implementation was successful on several levels and exposed people to new facets of the business that they otherwise would never have been exposed to.

The second phase of the implementation was designed to bring the Financial Accounting/general ledger system with integration aspects for various other modules into operation. For example, we activated the Purchasing module to integrate with Accounts Payable. We eliminated some previously modified code to reactivate the integration link between the Project System and the rest of the SAP modules. We also brought up more enhanced functionality of the Materials Management module to integrate with Financial Accounting. While we do not use all functionality that these modules have to offer, we still had to be aware of it and configure for the possible use of additional functionality in the system as the company grows and changes.

One of the toughest issues that we had to deal with was that phase two was interrupted by many different tasks that had to be performed before going live. To start, we implemented phase one on R/3 version 2.2e. This version had many bugs and many limitations within the Sales and Distribution system, which required many programmed work-arounds. We went live with this release and with phase one on May 1, 1996. We then undertook a major upgrade effort to get us on the more user-friendly and functionality enhanced version 3.0d. This effort began around June, 1996, and

continued until November, 1996. Our original intent was to complete the upgrade around the end of September so that we could begin implementing and configuring components of phase two. However, we had some hardware delivery delays, which set our "go-live" date way behind. Fortunately, we were able to get an additional server that was adequate for configuration and testing, which allowed us to proceed with learning and documenting configuration during the down time.

When we finally received the server, we were able to put the configuration into the live system and launch within a six-week period. We received the server in late October, installed the upgrade, made the documented modifications to make it work, and launched 3.0d during the month of November, 1996. Once the upgrade was complete, we immediately reloaded our configuration client with the latest copy of our live system and began implementing the documented configuration. The "go-live" date of January 1, 1997, was approaching quickly, and holidays were going to impact people being at work. Because we did not have backup personnel with expertise within the different modules, many meetings were incomplete because the necessary people were not there to interject their integration issues.

Before getting to the "go-live" date, we had several meetings regarding what we called "showstopper" items. Showstoppers are tasks or functions in the system that have to be available in order for the launch to be successful. One of the showstoppers we were running into was payroll. While we outsource the payroll function concerning payments and filings, we do gather, audit, and submit the data internally. As it turned out, most of the functionality we were using in the Human Resources module was new in release 3.0d. For example, we elected to reimburse employees' travel expenses through the payroll system, rather than pay them through Accounts Payable. To this day, we are not aware of more than two or three companies doing this the same way, and we all had and continue to have similar problems.

Something that I have not explained is how these newer systems work in relation to updating the several different systems that are often maintained. Traditionally, and also with the SAP standard model, the company is to have three separate servers with separate instances of SAP running. An instance is an individual SAP program running on one server. Within that instance, you may have several clients to perform different functions. At our company, we do everything through one client in each system. The first system is used as a

"sandbox" or playing area. This instance usually resides on a separate SAP dedicated server and is designed for testing and configuration of different scenarios. This system has no real transactions going through the system, only test transactions.

The second system is what we call a transport system. When configuration changes are made in the configuration client, the system records the change and encloses it in a transport object. These transports are used to move configuration changes from one system to another. The transport system is used to test the transport itself and to test the result before the changes go into the live system. Often, the transport that was created in the configuration client is not complete, or the configuration was not sent over to the new system in the correct order. If the latter occurs, sometimes it may be possible to just re-transport in the order that was needed, but often a new transport must be created in the configuration system and moved again.

Finally, the end system is known as the production system. This system contains the day-to-day transactions of the business. The transport that was created and sent to the transport system is then moved to the production system for use during business functions. If the transport does not work as intended, which sometimes can bring the entire system down,

emergency transports are created and transported instead of configuration being performed directly in the system. A lesson we learned the hard way was a couple of instances where configuration was completed directly in the system and no records of when, by whom, or why the configuration was done were left in the system. When you have configuration in the production system that is not in the configuration or transport systems, you are configuring changes around existing configuration and assumptions that are not represented where the testing is occurring. This has caused problems in several instances in the general ledger (G/L) module of the system. When setting up G/L accounts, you are able to create and maintain the master data directly without having to go through transport. However, if you make a change to a G/L account configuration in production and do not update the other clients as well, when testing functionality, you may get different results than what you expect in production.

In concluding, the most important aspects of implementing a system as complex as today's ERP systems are integration and communication. It is important that everyone acts as a team and informs everyone else in the implementation effort of what they are doing. Too many times, information is not communicated to the right individuals or is not

communicated at all for technical or political reasons. Do not assume anyone knows what you are doing. In addition, do not assume that someone is not impacted by what you are doing, unless you have a very good understanding of what they are doing. One of the hardest lessons that I have learned directly is when I moved some programming code into the production system and caused invoicing to be held up overnight. I did not communicate enough to the people who were directly involved in setting up the customer master data that was affected by this new programming code. Although I thought I had talked to enough people, I realized that I should have spoken in more detail and to other individuals before proceeding.

Post-Implementation Support

One of the more costly aspects to implementing today's ERP systems is the support cost of maintaining the system. While the implementation effort takes on a short-term intense cash flow drain, so does the on-going support. The only part that will usually relieve some of the high cost of implementation is the reduced use of outside consultants. Maintenance of the system itself is not so bad, except that you need to have good business analysts in order to solve

problems. Many times, it is several months, or even years, before someone notices that a report or function is not working properly

A good business analyst will work with the individual to identify exactly where the problem is occurring. Often times it is an end-user who has performed something different, or wrong, which has brought up the issue. Other times, there appears to be a definite program issue that needs to be researched for a fix or ultimately reported to the company that created the software. SAP provides a good solution to communicate with their business analysts and programmers in an attempt to solve problems. Their system is called OSS (Online Support Service). It is accessed through their front-end program, to which you login. It has many features that include searching messages or notes that address fixes for your specific problem. You can look up notes by error message codes, program titles, release identification, and many other ways.

In recent experiences, I have communicated with several programmers of different specific modules from SAP Germany. After logging in a new problem, a business analyst will communicate to you if they have found a note that may address your problem, or they may research more specifically what the

problem is. If it is more than they can support, they will refer the message to the appropriate SAP programmer. This programmer with then call or respond to you in the message asking for additional details or requesting the ability to log into the system that contains the problem. If it is more involved, they will usually contact you directly and find out what is going on or instruct you systematically over the telephone on how to correct the problem. While communicating directly is always best, it is sometimes difficult to understand a native German individual with limited English skills.

Other issues become the prioritization of requests flowing in from end-users to perform changes or to add functionality that was either overlooked purposefully or missed during implementation. Traditional systems support reports to the financial side of the business so that financial needs are met first, then the remainder of the company is dealt with. Because the hi-tech company has so many more requirements on the systems department, we restructured so that the systems group reports to the operations side of the business. While this is not an ideal position for the finance department, it appears to work. Many of the times when the finance department has had emergency

needs, the systems department has pulled through. The problem remains that we have very few business analysts who have any accounting background and no programmers who do. This requires the accounting department personnel who are in charge of the area that needs the help to stay involved and familiarize themselves with the systems group's work.

I have had to learn how to program in Visual Basic and the SAP programming language, ABAP/4, in order to get the job done. In many cases, the systems group does not have the expertise to handle the request, so they put it off until a future date. In some instances, the project takes less than a couple of hours, but operations have taken all available resources, which puts finance in a hard spot. Accounting professionals may find themselves in similar situations in the future, which requires them to understand database theory and be able to understand how business systems work. Without this knowledge, and with a systems group reporting to the operations side of the business, finance personnel may find themselves unable to provide information during critical times of the business.

Data-Warehousing

In order to combat the learning curve associated with understanding how the ERP system works when trying to obtain data, companies have implemented data-warehousing systems as well. These systems usually contain summary subsets of data in pre-defined reporting formats that users can query and manipulate. These data-warehouses allow everyday tools like Microsoft Word, Microsoft Excel, Lotus 1-2-3, Microsoft Access, Paradox, and Dbase to query against the data in the system. This allows end-users to begin using and manipulating data with minimal training and support because these tools are tailored for use without a lot of training.

Some of the latest and greatest data-warehouses allow Internet based browsing tools to interface as well. In the latest release of SAP, they have their own data-warehouse, which allows Internet Explorer and Netscape to access the data. At a recent SAP support user conference, Microsoft representatives showed a demonstration using Internet Explorer to access actual vs. plan reporting from an external data-warehouse. They used Excel templates in the design with pivot table functionality, which gives users a pseudo three-dimensional view of the data. While the setup is complex and

expensive at this point in time, it is becoming cheaper and easier as Internet accessing tools improve.

While I can spend a lot of time talking about the benefits and controversy surrounding data-warehousing and the different techniques, I only want to touch on the fact that data-warehousing is the technology that a lot of companies are using to make up for inadequacies in current ERP reporting. In most cases, ERP systems are efficient in handling large volumes of transactions and attempt to do so in a way that minimizes data redundancy. However, because of this lack of data redundancy, a lot more programming is required in order to retrieve data into usable information. The data-warehouse is the epitome of redundancy in that it is storing data that is identical to the data already in the online system. The difference is that the data is organized in predefined schemas that allow reports to be written more easily and with tools that are optimized for reporting against the data-warehouse system.

CHAPTER FIVE

Future Expectations

In my opinion, at some point, the desktop PC will need to go through a complete re-engineering phase. The desktop computer, even with the major software enhancements, is still archaic in how it handles and transfers data within itself. While we can increase speed to overcome these inefficiencies, at some point the materials that make up the system will be unable to be pushed any further. This is similar to the need for moving from vacuum tube architecture back in the 1960s toward transistors that are still being used today. The next step may be some form of biological component where adaptation to its environment is possible. While I realize this is bordering on "Trek-ism", many things that were at one time thought to be impossible are a reality today. Take for example Bill Gates' statement made in the early 1980s that predicted that modem speeds of 14.4bps would be adequate for the data transmission requirements of the future.

End user friendliness, with regards to software programming, will be critical. While software has become much more sophisticated over the last two decades, it still contains, in my opinion, too many inefficient executions. In order to utilize most of the hardware horsepower, software

must be smart enough to anticipate a user's needs and habits. It should be able to adapt to the user's requirements as the user continually works. For example, if a user is doing nothing more than writing e-mails all day, the software should be able to disengage all of the integration links at the time the e-mail program is being used so the software package is not constantly looking to see if there are any software calls external to e-mail. The same applies if the user is constantly all over the place; the software should be able to place more hardware resources with the more complex software requests than with the others. If I am working with a database in the background and e-mail in the foreground, the database work should receive the majority of the processor requirements and enough RAM memory to where no degradation of composing e-mails is noticed. This would maximize the resource calls to the programs that are being used at the time.

Integrated Technologies

In order for systems to become more efficient, technologies must become more integrated with each other. For example, Microsoft and Intel work together to maximize the performance of the processor for new programming techniques

and, in reverse, to communicate new processing technology to allow for new ideas in programming. This relationship has allowed the desktop PC to become as powerful as it is today. In order for other companies to benefit from this relationship, they must be willing to share technology.

Technology sharing is a common practice. While some people may not realize it, some software is available for free as a way to create user bases. Good examples of this are the Java script language from Sun Microsystems and the Linux operating system from Red Hat Corporation. This represents the sharing of technology to encourage new products and boost performance of existing products. Coming from a hi-tech software company, it is becoming much more expensive in today's environment to create all technology for your product as the business grows. There is simply too much technology needed at some levels to be able to afford creating your own. In many cases the technology already exists at some level, and embedding this outside technology into your own to get a working product becomes much more cost effective. This often requires sharing of technology both ways. However, contracts do not always prevent secrets from becoming exposed.

Training

Accounting and finance students must be trained with better tools, not pictures and simple software spreadsheets. The school systems must focus more on bringing in actual computer systems and allowing the students to experience simulations of real life scenarios. It is important for students to understand how to configure current systems and actually affect outcomes. With today's ERP systems, it is also important for instructors to engage students in class projects where the students of the entire class interact in the same system. Students need to understand how changing the system in their area affects the outcome in another area. Integration becomes the concept to learn in these projects, because that is the strength of a strong ERP system.

With all of my college experience focusing in Accounting and Finance, I had only one class that focused on Accounting Information Systems (AIS). Now, AIS is sort of a generic term used for almost any standard computer system that is designed to perform operating functions. These functions include processing all company functions, from a simple sales order to a human resources employee change request. In fact, in my opinion, AIS is no longer a valid term. Today's systems and the systems of tomorrow will not contain only accounting

functions, but will in fact encompass all corporate-wide functions.

Some of today's most advanced ERP systems, namely Oracle, SAP, and People Soft, all have strengths and weaknesses. A shared weakness is that they try to incorporate all corporate-wide functions, when the technology of today does not currently support this effort. My experience with SAP has shown that this system's strength focuses on integration between modules and functions and the flexibility of allowing different companies to customize the same modules to perform different functions. With this, however, comes an extensive need for training on how to accomplish these modifications for both the Information Systems (IS) department and accounting and finance professionals. Training comes at a high cost and, because of the different needs among various companies, tends to be vague regarding how to solve specific problems.

CHAPTER SIX

"Learn How to Learn" Concept

Due to the fact that some people do not have a creative nature, learning how to learn is difficult. I have been training employees for several years now with this technique and have had some success. I believe one of the main factors for failure is the inability of individuals to apply learning tools to new problems as they occur. Some of this problem is that these same people do not have the fundamental knowledge of how systems work, which would help them in their efforts.

In many instances, troubleshooting a technical problem with computer software is all the same. It usually requires the person experiencing the problem to look at the end result and begin backtracking to the source of the problem. What I have found in many cases is even if a person knows the tool or specific software program, they just do not understand how to troubleshoot problems. I am the type of individual that explains and works through the problem with the individual. However, in most cases involving troubleshooting problems in an ERP system, integration with modules outside of the module you are working in often confuses people to the point that they cannot continue on their own.

I am finding that there seem to be two extremes of people when it comes to troubleshooting problems; those that can and those that can not. It seems like a simple philosophy, and it is. Out of the ten to twenty people that I have attempted to train with this concept, I have had only one individual who is actually able to begin troubleshooting on their own. This person still has a way to go, but is able to start on their own and only comes to me when unfamiliar integration issues arise.

The tools of this philosophy are not new. In fact, I believe that most professors in math oriented classes try to teach this philosophy when attempting to teach problem solving techniques. The difference that I promote is that the fundamental premise is not memorization. In most mathematical problem solving techniques, a great deal of memorization is usually required. For example, when talking about solving geometric solutions, formulas like the Pythagorean theory and pie come into play.

With this modified concept, there is nothing more than having to know the steps to problem solving itself. There are two steps, that I emphasize, which are just as important to one another. However, many people do not feel comfortable going from one step to the other. Many times, they become

stuck at the first step and look to someone else to solve the problem. Many people also think that just explaining what happened after the resolution is found means that they can learn to solve the problem if it occurs again. This assumption is false. Unless you work through the problem yourself or with someone, you will not learn how to solve problems on your own. There are too many thoughts and ideas that are reviewed when trying to diagnose problems.

In beginning, you look at what result is given (the problem). In modern day ERP systems, this usually results in error messaging, which attempts to explain what has caused the problem. Sometimes, these messages are misleading, but with my experience using SAP, the messaging is pretty good. This messaging gives the troubleshooter a giant head start on where the problem lies. If there is no message feature, then you may need to go through testing on a different system to see if you can recreate the problem. By recreating the problem, you may identify what is actually wrong.

In talking about a system that has very little messaging, like Microsoft Access, the person must actually perform the functions as the macro or programmed code is executing them. I have created many different applications using Microsoft Access using macros and Visual Basic

programming to automate tasks within the application. Usually the order in which these tasks are executed is documented, so it is as simple as starting from the end result and working your way back to the raw data that was imported or entered into the system. It is critical that people understand database theory before they begin to work through an application. Without this fundamental knowledge, they will not be able to understand the relationships inherent within the application.

The next step involves understanding why it went wrong. This is usually where people tend to get lost in diagnosing problems. Understanding what went wrong can get very technical, which means those people who do not want to be technical should not even attempt to go here. This often requires the troubleshooter to re-create the scenario in a test system in order to understand what happened.

We have many business analysts in our company who are good at finding the problem and finding resolutions, but some have a problem when trying to understand why it went wrong. SAP offers an online solution system where you can enter problem symptoms, and the system will bring back potential solutions for you. Often in these solutions are comments such as, "This is the result of a programming error". This means

that SAP has decided not to explain the details of what the code was doing, but rather give you the replacement code that will fix the problem. If you are not programming oriented, or cannot read programming code, then you will never understand why the error occurred. In these instances, no learning of the system takes place. All you become at that point is an extension of SAP telling you what to do without any explanation.

Preparing for the Future

People that we have been interviewing for the past two to three years have all suffered in PC skills. Most of these individuals have business degrees, which have very little technical training included in these degrees. PC skills are more than just being able to operate a spreadsheet using the preprogrammed function buttons. PC skills involve database theory and some minor programming knowledge. Neither of which are currently taught within the Accounting or Finance concentrations. It seems as though most educational institutions are happy with only requiring one or two courses within the entire undergraduate program that concentrate in this area.

Directors of these institutions need to understand that people are doing more work today than what they used to do ten to twenty years ago because of the computer. Management is no longer surrounded by large amounts of staff to support the once manual efforts that companies endured for so long. Now management has to be able to perform the work if the computer system goes down, or at least be able to monitor and identify when something goes wrong.

The secret of my quick success at this company is that I was able to follow through step two of the discussed "learn how to learn" process. I did not rely on some other technical person to solve the problem for me. I took the time to learn it on my own. I also took additional courses on my own, so that I would be more knowledgeable about what I am working with. If I had not done this, it is quite possible we would not have half of the automation that we now have in the department. SAP has opened up many doors, but individuals still have to walk through them.

It is apparent that directors of Accounting and Finance departments still do not understand the importance of systems knowledge, because of the lack of requirements for these types of classes. If the education system wants to really help their students succeed in the real world, they will start

paying attention to the requirements of employers. We want people who have good business knowledge and good to excellent PC skills. These are the people who should bring innovation to business. These are the people who should introduce change, rather than just adopt existing procedures.

CHAPTER SEVEN

Conclusion

In concluding this document, I wish to emphasize that we are just beginning to utilize what potentials computers offer today. Know that the hardware architectures are faster. This has allowed us to develop more complex software to handle multiple scenarios at once. Technology has moved to where communication from system to system between companies is an everyday occurrence for big business. Although I am not confident the benefits have outweighed the expenses at this point, it is clear that communication with integrated ERP systems is the future.

Big business will not be able to survive unless they spend the money and commit to this infrastructure. IBM, for example, is forcing some of its high-volume suppliers to electronically submit all invoices to them using their format. We are currently fighting this, since there is no uniform EDI format for submitting invoices. If every big company had this requirement, you would probably see a different format for every invoice, which would require many hours of additional programming. The point is that businesses need to be ready to deal through modern means of communication and not race to catch up.

E-commerce and E-business are terms that we hear frequently these days. These terms are synonymous with ERP systems in that E-business cannot function without integrated modules to handle orders, production, and shipping. SAP is an E-business application within its related releases. There are links from almost every module to the Internet to communicate with your suppliers, customers, and internal staff. One of the best examples of an E-business solution utilizing an ERP system is located on the website http://www.dell.com. This website is the home page for Dell computers. If you ever place an order with Dell, you will get a better idea of exactly how E-business is designed to work. The customization menus, the order, the production status, and shipping are all integrated with their ERP system that extracts and publishes data on the web as it takes place.

Having worked for my current employer for the past seven years and only being on SAP for the past four years, I cannot imagine still working with our older mainframe system. It was inflexible for customization and would not allow any Internet integration without serious expenses for middleware to connect the system. ERP has given the company new life and the ability to adapt to just about any environment imaginable at this time. While it has cost the company millions of dollars,

it has already more than paid for itself by handling the additional demands we put on it to satisfy our customers' and internal needs.

I would expect to see much more Internet enabled functions coming in the near future, which should allow our company to communicate in a more standardized format. With communication between companies and different systems patched together to work, I would expect to see more standards developed, which will eliminate difficulties in communication between companies using different systems. This should bring about a new level of communication and allow the Internet to realize its ultimate potential as the communication link for everyone everywhere.

GLOSSARY

Middleware - Software that is developed to allow two non-integrated systems to communicate with each other.

E-Commerce - Also known as "Electronic Commerce". This technology allows people and companies to interact in a paperless environment. Many tasks that were previously completed by human interaction are now done automatically through electronic transfer of information.

Ad-hoc - This term is used when someone is trying to obtain information when there is not standard mechanism of retrieving it. This term is often used when trying to find information in a database of one form or another using an "ad-hoc" or custom query.

EDI - Electronic Data Interchange. This term is used mostly in the banking or financial markets where people or businesses are transferring money electronically from one financial institution to another.

Macro - A macro is a series of commands and functions that are stored within the application and can be called upon to automate previously completed tasks.

Schemas - These are predefined data sets organizing the information in a way that users querying the data understand. Schemas usually contain all of the background information like how the tables should be joined. Often times there are relationships between products and different costs associated with each. A schema will take into account what product you are querying and associate only the costs that are relevant for that product. (Data-warehousing query tools that companies like Business Objects, Brio, and Cognos provide use schemas to allow easier querying of data.)

Data-warehouse - This is a separate system from the main system which stores summary or detail transaction data from the main system. Normal data-warehousing techniques show that older data is removed from the main system and transferred to a data-warehouse to more easily obtain historical information. In some cases however, because the volume of transactions are so large, companies do not want to see performance degradations in the main-system, they constantly copy the data from the transaction system to the data-warehouse for customers/end-users to query or report against.

Legacy system - This is the original system the company was using before migrating or replacing it with the new system. Usually companies will run both the legacy system(s) and the new system(s) concurrently to make sure the new system(s) is stable and does not fail. Once the new system(s) has proven itself, then the legacy system(s) is usually discarded.

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