Leading Edge Information Technologies for Energy Industries

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History of Information Technologies

Information technologies are not new. They have evolved hand in hand with computer technology. They began over 50 years ago with mainframe computers and EFI (electronic fund transfer) and EDI (electronic data interchange) on VANs (value added networks) when banks and large corporations wanted a cheaper, safer and faster way to track and transfer funds and information. The first business packages were used for accounting in the 1960s and others soon followed. First generation office information systems included Digital Equipment's Decmail, IBM's Display Writer, and Wang's Office Information System in the late 1970s.

Supervisory control and data acquisition (SCADA) systems, which remotely controlled processes for pipelines, offshore oil and gas production, and electric utility production, transmission and distribution, were early energy applications of information systems. For example relays, which are electromechanical devices to turn on and off current, were used as early as the 1930s to control remote power stations in Sweden. Through the 1950s and beyond, systems were transformed from relays, to transistors, which had no moving parts and were faster and more reliable. Custom built SCADA systems were used to remotely measure and collect data on pressures, pump status, compressor status, temperatures, tank levels, valve status, possible leaks, and current levels among other things. Telephone lines, microwaves and radio waves were used to transmit data back to a central control station. SCADA systems could also be used to control processes through starting and stopping equipment and opening and closing valves. These central stations, often with banks of screens and dials, were monitored by humans who could then control an entire system from a central location. Early applications were run by mainframes, then minicomputers and finally microcomputers beginning in the 1980s.

With the proliferation of all these disparate computers systems each doing their own thing, communication between them became more and more complex. As a result, software companies such as SAP, which was launched in 1972, arose to provide customized business software to run on these various systems. Packages included accounting, provisioning, MRP (manufacturing resource planning), ERP (enterprise resource planning) and CRM (customer relationship management).

The apple cart was further upset when the Apple II appeared in 1977 and IBM developed its personal computer in 1981. Again disparate PC systems emerged and a need for cheap off the shelf operating systems and standard applications such as word processing, spread sheets, and data bases became a necessity. Moore's Law accentuated the problem with computing power doubling every 18 months. For example, the first computer ENIAC was 10 feet high, 150 feet wide, could do 5000 operations per second and cost millions of dollars to build. It used so much power to run its vacuum tubes that the lights in Philadelphia dimmed when it was turned on. However, by 1971, Intel had produced a 2 millimeter chip that was 12 times as powerful and cost only around $200.

As a result of increased software needs, software companies such as Microsoft, which was launched in 1975, arose to provide off the shelf business software to run on PCs. Sun Microsystems, launched in 1982, provided a replacement for the mainframes by using a modular framework that can grow as a company does. Sun provided powerful Unix based workstations, which could be connected to different classes of servers depending on the users computing needs. Landmark Graphics founded in 1982 built the first workstation for geoscientists to analyze seismic data, which had formerly been done on very large mainframes such as the Cray computer. Landmark was committed to integrated open systems for geophysical, geological and reservoir engineering analysis.

Mainframe second generation office systems beginning around 1983 evolved into third generation systems by the end of the 1980's. Digital Equipment's All in One became All in One Phase II and IBM Profs became Office Vision and both had moved to a client/server mode with PC's hooked to a centralized server. The server provides basic services and stores data for the client and might be located and maintained at the vendor's site. The client processes the data locally and may be connected to the server by the Internet or a private network.

If the client's system is very limited, it is called a thin client. In such a case, called an application service provider, the server provides the application, the data, and the computing power. Coffman (2000) lists the following services that ASPs provide to energy industries – data integration and interpretation, security, wideband network access, messaging and directories, web servers, document management, shared applications, network monitoring, and data management, storage and retrieval. An example for the oil industry is Geonet Services (www.geonet.com) started in 2000. Geonet offers almost 300 applications on their server from a range of vendors. Clients only pay for the time they use on an application.

Networks evolved in parallel with computers and provided powerful tools for connecting users to each other. Networks became ever more powerful as the number of connections increased — the value of the network increases, according to Metcalfes's Law, as the square of the number of connections. The Internet, with a burgeoning number of connections, was initially sponsored by the US and later other

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governments to enhance communication within research institutes, and speed nuclear research. It came to connect military, research, and educational institutions with commercial access allowed in 1991. The military split out onto its own network early on in the late 40's. The invention of the worldwide web (www) in 1989 at CERN in Geneva allowed people to access documents over the Internet easily.

Mosaic developed at the University of Illinois by Marc Andreasson and others in 1991, became the first commercial grade Internet browser available in 1993. With the new appealing graphical interface, the Internet became so popular that the government privatized it in 1995. Its use has mushroomed as a communication tool among businesses, consumers, and the government. By 2000, just over half of US households had a computer and just over 40% of them had Internet access. By 2001, it is estimated that over 60% of the US population had Internet access. The top 66 countries that represent over 90% of Internet connections are estimated to have an average connect rate of 10% of the population.

In the mean time at the enterprise level, so many different applications had been implemented to solve so many different problems - procurement, logistics, accounting - that communication between these applications became a critical problem. J.D. Edwards estimates that over half of Fortune 500 countries have more than 2 computer platforms that need to be linked together and to outside trading partners. Making these applications communicate with each other is called EAI (Enterprise Application Integration). One of the key events that triggered EAI was the 1996 Telecom Act. The Baby Bells were forced to open their systems and had to provide gateway solutions to enable access. The companies that required access (competitive local exchange carriers) also needed new tools to access, absorb, and use customer and telephony usage data. Companies such as Vitria, Tibco, and BEA were instrumental in providing these EAI software tools.

These same changes outlined above occurred in energy industries. Grinpelc and Siegfried (2001) outline how the transition towards using information technology has evolved in the oil and gas industry. Originally mainframe computers were employed in analyzing data and field samples. Special customized engineering applications were developed for their mainframe platforms followed by customized applications for back office activities, which include financial, human resources activities and distribution functions. Later desktop personal computers and portable field computers allowed work to be carried on independently of any central platform or even in the field. Customized software gave way to packaged software while stand-alone applications have become increasingly networked on Intranets or attached to client-server technologies. More recently there have been moves toward integration across the enterprise, data and technical platforms.

In the front office, which includes sales, marketing, and core business activities, there have been advances in seismic, engineering, geological tools, and e-commerce activities, while back office enterprise resource planning (ERP) is being used to develop enterprise wide information systems that tie front office, back office, customers and suppliers together in productive ways. ERP allows real time integration, analysis, and reporting of the enterprises activities, data and transactions.

Standardized information business packages with versions focused on the energy industry have been developed for information applications including enterprise resource planning (ERP), Customer Relationship Management (CRM), Human Resource Management (HRM), data warehousing (DW) sometimes called business intelligence (BI), and supply chain management (SCM), which provides links between the internal systems using ERP and outside suppliers and customers along the whole supply chain. Early or prominent leaders in developing these kinds of packages included SAP for ERP, Peoplesoft for HR, Siebel for CRM, CommerceOne and Ariba for E-Procurement and MicroStrategy, Cognos, and Sap BW for Data Warehousing DW. Armature, i2, and Manugistics are leaders in SCM.

As other industries such as energy industries have started de-regulation and as the Internet has become more acceptable and pervasive in enterprises, EAI is becoming even more powerful by creating a next generation EDI renamed B2B (Business to Business). However, B2B even though powerful is still a bilateral relationship. Therefore, EAI offers another level of transaction management, through Trading Partner Networks (TPN) which uses a hub or brain to connect the partners (businesses) to each other through the Internet. Only the best EAI tools can provide such an advanced infrastructure. Classic examples include ANX, which began by connecting auto-part suppliers and industrial users but has been extended into chemical, logistics, manufacturing and other industries, and Rosettanet, which connects computer part manufacturers and computer builders to each other. Transaction costs and inventories are reduced using these TPNs rather than the earlier dedicated private value added networks (VANs).

In addition to inter-application communication, a good EAI tool will provide a brain at the enterprise level that captures all the necessary business processes by controlling all the software applications. For example, Exxon hires a new geologist. The brain contains a rule based business process for new hires. It will instruct each application (e.g. accounting, HR (human resources), etc.) to perform sub processes to incorporate this employee's user data and needs into the system. Applications then communicate with each other through the brain.

The brain along with communication software are off the shelf applications designed to securely control the flow of information. Connectors, which interface between the brain and each application, translate data between the brain and the applications languages. Thus, the applications communicate through the brain. Most connectors can also be obtained off the shelf, however, for non-mainstream applications, they need to be custom designed.

These applications, which began with the telecoms, are becoming more and more popular in energy industries especially because of energy deregulation. So how are these technologies evolving and changing the way we do business? Schumpeterian notions of creative destruction suggest that the old will give way to the new. Almost ¾ of Fortune's 500 companies in 1955 no longer existed forty years later. The same thing will continue to happen with technologies as the old is absorbed, destroyed and replaced with the new. The old information technologies required writing, typing, printing, mailing and telephones with low bandwidth capacity. The new technologies require typing, electronic publishing, transfer, and customizing of products for users. They rely on the current telecommunication infrastructure, which is a mix of fiber optics, coaxial cable, copper wires, satellites, microwave and cellular spectrum with increasing moves to wider bandwidths.

It is interesting to consider how these technologies are being used, how they and their infrastructure evolve and diffuse, and how they will affect business structure in the energy industries. Technological determinism suggests that such groups of inventions influence many aspects of daily life including social change, income distribution, individual and social rights, employment, migration, privacy, sense or lack of community, and appropriate management styles. In the next section, we consider what business functions EAI will need to have.

EAI Business Functions

An EAI platform is expected to have the following three main areas of functionality:

- Internal Data Integration addresses internal data exchange. It typically involves a solution with messaging and data conversion.
- External Data Integration is mostly business-to-business integration. It typically involves a solution with messaging data conversion across the Internet, private networks or through an EDI VAN (Value-Added Network). However, Virtual Private Networks (VPNs) with strong encryption to protect the privacy of the data on the Internet are more and more replacing private networks.
- Business Process Management enables companies to manage and coordinate their business processes or procedures and must be able to perform workflow automation, that does not require decision making, as well as business process automation, which may require automated decision making. An additional aspect of business process management is to be able to analyze business data as it relates to business processes.

Companies typically first start looking into EAI solutions when they have a simple data conversion problem to solve. For example, an electric utility company may want to look at a data-oriented EAI solutions to consolidate information from some of their internal systems into a full view of their electricity provisioning capabilities and supply for customer service purposes. Or a utility may want to look at internal data integration solutions for sending provisioning orders to a power generator. Ideally, as companies see their business requirements becoming more complex, they want to be able to extend the integration work they've already done for their simple integration problems. Companies thus require platforms that scale well — in terms of both complexity and raw performance — as their business environment changes.

An energy company can use an EAI platform to integrate its software applications within their network, integrate with the supply side and demand side partners outside their network, and automate the business processes across the enterprise. With a successful EAI implementation, an energy company may realize the following benefits:

- Seize new business opportunities and create entirely new categories of businesses, such as trading hubs and electronic exchanges.
- Respond to change rapidly-before competitors.
- Form closer, more profitable relationships with partners and customers.
- Increase the efficiency of operations and lower operating costs by automating and analyzing business processes in real-time.
- Model and automate the business process to bring new products and services to market quickly.

Successful energy companies of the future are those who can integrate and automate their supply and demand chain globally. Companies that embrace eBusiness face unprecedented opportunities as they define new markets, unearth expanded revenue opportunities, as well as achieve higher levels of efficiency, customer loyalty, and customer satisfaction. EAI enables energy companies to capitalize on these opportunities.

The tools discussed below allow automation of manual processes within the organization or with trading partners. They allow legacy (previously installed) systems that did not talk to one another to now communicate. Reshaping or encapsulating the data into customized business objects enables legacy applications to communicate with the EAI infrastructure. In fact the whole legacy application can be encapsulated and integrated into the new system. Reshaping also provides a robust set of common services that guarantee business transactions, security, and data integrity.

EAI Software Components

To perform the previous EAI functions, the following software categories are used

1. Middleware.
2. Application Integration Software.
3. B2G Gateways and Trading Partner Networks.

Middleware is a piece of software that allows different software applications within a company to talk to each other. It involves mostly data conversion and data transfer. A benefit of middleware is that two different applications can behave as one from the user's perspective.

Application Integration Software uses middleware to create a live link between different applications within a company to ensure that transactions are completed successfully (transaction integrity). Components of this software include middleware, message brokers, applications servers, remote data-shapers and other integration software. A benefit is a smarter link that is in charge of data conversion, data integrity, and assures that the transactions "commit" in all integrated systems. Another benefit that these tools present besides letting internal applications talk to each other is to web-enable those same applications in the same effort.

B2B Gateways and Trading Partner Networks process business transactions between companies and take electronic interconnection to a whole new level. More than simply making connections, they provide a framework for establishing and enforcing industry standards that allow understanding the data that is being exchanged. Further, they allow agreement on the process that will be used to perform the transaction or to process the data being exchanged. For example, an oil trading TPN will contain data elements such as price, quantity, and grade and process elements such as how to convert currencies and or grades.

B2B Gateways and a central hub, both with similar software technology, form a TPN. TPNs generally follow two business models. In one model, a single company owns, operates and controls the business rules (standards, processes, legal environment, etc.) governing the transactions on the hub. For example, Dynegy has a TPN for energy trading.

In another model, an alliance of companies forms a trading community that operates through a hub. It differs from the first model because the alliance jointly determines the rules of conducting business and the owner of the hub merely operates according to the defined rules. With TPNs, the partners have the infrastructure for electronic connectivity and process automation among all market participants, including entities along the supply chain, to enhance operations and speed performance.

There are numerous benefits of TPNs. For example, they allow energy companies:

- to offer new services through aggregations of services,
- to reach new markets,
- to automate the energy supply chain (forming internal and external eCommunities), and
- to facilitate outsourcing of selected functions.

Utility.com provided a practical application of a TPN. Through its membership in Vitria's TPN, Utility.com was able to bond electronically with its key partners and suppliers, as well as other pre-existing e-Communities. Thus, it could bring new products and services to market faster, streamline its delivery chains, and lower its transaction costs. Alternately, Dynegy, mentioned above uses a TPN to streamline its supply chain from upstream oil and gas exploration to the distribution of electricity.

Comparison Criteria to Evaluate and Choose Technologies

Choosing an EAI technology can be done in house or by relying on a trusted consulting company, for whom references have been checked and who has a portfolio of similar successful implementations. Remember that bigger is not always better in this case.

Your first step in implementing your EAI project is to define requirements. Once you define your requirements you will need to select a vendor and a product. You derive a set of minimum benchmarks from your requirements that the vendor's product will have to meet. These benchmarks are based on the following:

- Vendor Expertise in EAI software technology as well as in the technology and structure of your industry segment.
- Maintenance and Cost of Ownership:
- the resources required to keep your system running,
- the resources required to keep adding features and functionality.
- Technology:
- support for XML is compulsory, as XML has become a de facto inter-application communication standard
- internal architecture based on CORBA, which is a sophisticated communication framework developed and maintained by the Object Management Group (OMG), may lead to higher efficiency,
- for legacy EDI connectivity, external CORBA support is required.

Having selected a short list of vendors using the above benchmarks, the final decision should be based on the following criteria. The technology should

- be flexible with the capacity to adapt to complex situations. For example, the more platforms an EAI tool can effectively support, the more valuable and flexible it is likely to be,
- be popular with a reasonable level of penetration for interoperability and support,
- minimize complexity of implementation for your given requirements,
- maximize expected success rate.

Some of the more prominent vendors that you might consider are: Vitria Technologies, BEA Weblogic, Tibco, and Web Methods. Also some smaller companies have good products which might perform better for some needs. They include Linguateq, Orchid Systems, Inc. and Jacada.

EAI Implementation Guidelines

For the implementation, you have the choice of in house staff versus outside consultants. In general, the staff required for the implementation stage is from 10 – 50 people. After implementation during the maintenance stage a smaller staff will suffice typically from 1 – 10 people. Typically in house implementation is cheaper but takes longer. Therefore, most of the EAI solutions are done with the help of a consulting company. Prominent examples of such companies include Accenture, AMS, BusinessEdge, CGEY, J.D. Edwards, KPMG, and PWC. All have major IT consulting branches that are capable of handling up to turnkey EAI integrations.

Whatever you do, we recommend that the main expertise should come from the vendor, who should provide training and provide senior subject matter experts that validate design decisions, check in at the milestones, and provide continuous mentoring. If you have hired consultants to perform the implementation you should still make sure that the consultants follows the guidance and design suggestions of the vendor's experts. However, if you believe that the vendor did not send a senior enough person, feel free to send that person back and request a more senior person.

Pitfalls of EAI Integration Learned from Telecoms

The uses of EAI in the energy industry have a lot of similarities with the Telecom industry. Although the details of the requirements of the information systems used by the utilities are different, the high level requirements stay the same:

- Provisioning
- Order Management
- Billing
- ERP
- CRM
- HRM

Therefore, it is no surprise that the major EAI vendors for the telecom industry also have a significant role in the electricity industry.

The Telecoms were at the forefront of the EAI experiment beginning with the Telecom Deregulation Act of 1996. This act started a process that entirely changed the telecom market. With the provisions of the Telecom Act, Competitive Local Exchange Carriers (CLEC) could form. The main need of a CLEC was a streamlined provisioning system that tied in with a billing system capable of rating usage in sophisticated ways, abide by complex taxation rules, and communicate with an order management system. Very soon after a new piece was added, customer relationship management (CRM).

The telecom experiments showed that new information technologies may require reengineering of processes. You may need to step back and take a look at your processes. Ask yourselves "Do we really need EAI now?" "Are we solving the right question?" "Can our processes be simplified?" There are also some cautions to consider. If processes are broken into too many pieces, no one can see the big picture. There may be too many hand offs resulting in too many potential failure points. If processes are broken into too few pieces, you may lose the effects of specialization and may not be able to take advantage of parallel rather than sequential tasking. Note whether information can be better used at any point in the process chain. Since opportunity cost is still an essential piece of information, you will need to understand cost trade offs at all levels. For more information on re-engineering your business in the information age, see http://www.speed-of-thought.com.

The first and perhaps most important of the above questions is "Do we really need EAI now?" The most prevalent mistake made at this point is that the total cost of EAI integrations is underestimated. One reason for such underestimation is that the initial requirements are incomplete or poorly defined. In addition vendors have a vested interest in making costs appear lower in order to sell you the project. As a rule of thumb, you need to expect such an integration to cost more than $10 million dollars. Related to the underestimation problem is an overestimation of the financial benefits. Here natural optimism and vendors interest in making the projects appear attractive add to the over estimation. All the hype surrounding information technologies add to their glamour, while fears of being left behind may inflate their attractiveness.

An example of underestimating costs and overestimating benefits comes from FirstWorld, which filed Chapter 11 in March of 2002. Initially they wanted to be a CLEC and an ISP along the lines of what today is Qwest. FirstWorld started by building an EAI infrastructure including a billing system, a CRM tool, and a provisioning system even though at the time they had no customers. As their marketing did not go according to their projections, they acquired other companies for their customers. However, those companies had their own infrastructure. These new systems added additional requirements to FirstWorld's EAI infrastructure changing the scope of the effort considerably. At that point they had already spent on the order of $10 million with no functioning system. Accenture, which was in charge of the project, made recommendations that would have resulted in roughly an additional $10 million even though FirstWorld still had very few customers. Shortly after Accenture's recommendation, FirstWorld cancelled the whole project. To recover, FirstWorld decided to only be an ISP. Even being an ISP, however, was more than they could manage given their remaining finances. They further consolidated into a data center provider role. However, both these recovery decisions came too late to save FirstWorld from bankruptcy. The truth is that FirstWorld had not yet needed the heavy duty EAI framework chosen because their client base and revenue base had not justified it.

So what can energy companies learn from FirstWorld's example? New energy startups as a result of deregulation should be careful that their IT infrastructure expenses are aligned with real revenues and not wishful thinking. EAI is not necessarily a panacea for all ills. As with any business decision, especially expensive ones, basic business principles still prevail. Careful up front analysis of the costs and benefits of the technology must be made to determine whether the cost of the project and the cost savings will provide an acceptable rate of return.

Another lesson that can be learned from the telecoms comes from one of the cornerstones of the Telecom Act. This cornerstone was the obligation of the Incumbent Local Exchange Carriers (ILEC) to allow CLECs to resell telco services. Hence, the need for a streamlined communication process between the ILEC and the CLECs. Companies like Quintessent created gateways to talk more efficiently with the ILECs legacy ordering and provisioning systems. However, the high complexity of the telco products and standards makes the integration with these gateways extremely difficult. A similar challenge might face the energy industry while trying to integrate these new systems into established systems, which currently use mostly EDI and have very rigid operating rules. What happened in the telecom industry is that vendors overstated their interoperational capabilities, which mislead IT managers and caused significant unforeseen expenses that could be measured in millions of dollars.

One of the pitfalls in creating TPNs can be derived from another telco example. A TPN requires a strong driving force that will entice its partners to active trading. Active trading will provide the liquidity that a successful market needs. Given the nature of the basic telecom products (phone line, services through phone line such as voice mail) trading partnerships had no driving force behind them. Since it wasn't practical to trade such basic services, TPNs could not be successful if they were relying on trading them. However, as the telecom world turns towards new media more and more, and data transmission prevails, bandwidth trading will be a new driving force to create trading communities. Similarly energy industry companies seeking to form TPNs need to ensure that there are strong driving forces behind the products chosen for trade and that there is room in the market for them.

Besides the physical costs, every investment in information technology has human and organizational costs. The physical costs are the hardware and the software. The human costs are for training and other adjustment costs. In neoclassical economics, we assume that consumers maximize utility and producers minimize cost and maximize profits. In a complex systems approach, we consider the psychological, social, and institutional factors that go into decision-making. With the new information technologies, neoclassical assumptions may not be enough and we may need to consider complex systems. Users may not be able to make the psychological adjustment in the same amount of time that technology has changed. Human psychological costs include stress from feelings of helplessness, never getting anything done, always being busy, having a lack of control, being acted on by the system, and responding rather than initiating.

The organizational costs of new technologies are the costs of reengineering. For a business process reengineering effort brought on by EAI to be effective, it is imperative to include the end-users of the system at every milestone and design decision. If end users don't buy into the changes, the integration may be doomed from passive or even active resistance. A problem that occurs often is the development of unreasonable requirements (also known as overkill) by the marketing team or the IT staff, that leads to a disconnect between marketing people using the technology and the IT people who implement the solution. Having the client (usually the marketing/sales department) and the provider (usually the IT staff or outside consultant) meet often and discuss the root problems that need to be solved is the only way to arrive at a reasonable set of requirements. Also, both parties have to be prepared to compromise. This will result in the senior marketing and technical staff being on the same page and ensuring that the client gets what they really need, not what they think they need.

The following examples illustrate the above points.

- A Chevron-Ariba alliance was originally announced in April 1998 as a procurement portal for the entire energy industry. Named Petrocosm, it was launched in January of 2000. Texaco joined the alliance in March of 2000. However, the driving forces were not there and Petrocosm folded just over a year later from a lack of liquidity.
- Shell partnering with BP Amoco, Conoco, Dow, Mitsubishi, Occidental, and Phillips Petroleum and using CommerceOne as a key technology provider built TradeRanger to link its purchasing people with the partner's many suppliers. These founding partners have subsequently allowed other players to join them. In so doing, they are providing a liquid marketplace for buying and selling anything that energy developers or providers need leading to the success of this TPN so far.
- Peace Software has built Energy™ Version 6 using BEA's WebLogic Server. The solution is designed to streamline customer and commodity management for the retail energy industry. BEA WebLogic also powers Energy B2C (business to consumer) communication and transactions for Internet self-service, providing customers with online access to account information and other data. Currently several major energy players such as Xcel Energy use this platform. Peace, in business since 1984, has been able to leverage their knowledge of the energy market to succeed by creating the appropriate EAI tools for the retail energy market.
- Enron deployed a new credit management and Power Trading System (PTS), a Gas Management System (GMS) and a Risk Management System (RMS) using Vitria as their EAI backbone. This implementation was a success and would likely have still been in production had Enron's executives followed better business practices.
- Utility.com, founded in 1998 and subsequently named the Best-Performing Utility Web Site in the World by Accenture, wanted to change the utilities marketplace by offering a range of energy and telecommunications services for consumers and small businesses. Its information technology (IT) platform included several disparate systems. They also needed to easily communicate with customers and partners. Leveraging Vitria's EAI tools, Utility.com wanted to improve customer service, generate additional sales, and strengthen relations with its partners. This was their business strategy at the height of the EAI hype. When this strategy turned out to be a failure, they jumped onto the next hype in late 2000, which was the ASP model spending an additional 6 million dollars. Their goal was to provide their services and software tools to other utilities. Little did they know at that time that they had only 6 months to live. Their's is a classic example of hopping from hype to hype and investing in overrated technologies. This example is sadly similar to that of FirstWorld.

These five examples show that the new complicated and expensive EAI technologies may be enabling when handled well, but disabling when handled poorly. Further, basic economic and business principles that were thrown out with the euphoria of a new world order, need to be brought back – the sooner, the better.

Conclusions

Electronic information technologies have been changing ever since the advent of the telegraph. What is different now is that the pace of change seems to have quickened requiring rapid adjustment to new technologies. Also the information age revolution brought new technologies that enable us to handle business problems that were not possible before. As bricks and mortar give way to clicks and mortar, business models are changing to take advantage of the increasing ease of connecting and transferring information. To integrate across systems initially software systems were linked to each other. Now more and more internal systems are being linked backwards to suppliers and forward to customers blurring the boundaries between firms. These systems need to be able to manage business processes in an efficient way as well as integrate data across and within companies.

Enterprise Application Integration is the technology that provides such interconnectivity allowing the digital transfer of information. It requires middleware to allow internal applications to talk to each other, application integration software to verify the integrity of the transactions and trading partner networks to allow the transfer, security and understanding of data across companies. EAI when done properly may allow businesses to decrease costs, create new businesses such as trading hubs, allow companies to beat their competitors off the mark, decrease product cycle times, and allow companies to form better customer relationships. However, care must be taken in choosing these expensive technologies as the recent dotcom meltdown has shown.

Usually expensive consulting companies are used to help pick these multimillion dollar technologies in conjunction with expertise from the vendor. However, even then success is not assured. Many a company has been parted from its dollars and been disappointed with the EAI system they have acquired. As with any business project to truly get what you need, you must carefully define what you need. Avoid the hype and make sure the latest and greatest product satisfies your particular needs within your budget. Otherwise don't get it. Pick technologies that are flexible, are popular enough to ensure the interoperability and connectivity that you need, are not overly complex to implement and operate, and maximize your expected success rate.

Examples from the Telecom industry and increasingly from the energy industries demonstrate the pitfalls that have been encountered. First you must make sure you need the EAI now. The most common mistakes that companies make at this point is to underestimate the costs of the project due to poor requirement specification or to overestimate the benefits. These big and expensive projects are complicated and as Murphy has so aptly pointed out, if things can go wrong they will. Even with carefully thought out requirements and the correct choice of systems, the physical and human dimensions of the implementation and operation of the project must still all come together to ensure a successful project. Further, information projects and technology are like any other projects or technologies and should be subject to fundamental economic and business principles.

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