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ABSTRACT

• Enterprise information systems (EIS) have developed over the last few decades into a dominant management information systems tool. This paper reviews that development in light of research, discussing identification of new issues. Past cases and surveys have provided a picture of what has occurred within this dynamic industry. Future potential for expansion of market participants is expected to lead to a quite different environment than has existed in the past. The role of globalization in the form of supply chain linkages as well as international development of country-specific systems are expected to be issues growing in importance. Three issues among many others in the field are discussed. First, risk management will become even more important than it has been. Second, the role of upgrade in the evolution of EIS use creates new opportunities/decision dilemmas. Third, the development of open source system development has already had an impact, and is expected to become even more important.

KEYWORDS

• Enterprise information systems
• open source
• upgrades,
• surveys,
• research

Introduction

Enterprise information systems (EIS) have become a dominant means for large organizations to obtain integrated support for managerial decision making. The evolution of these systems is quite interesting, evolving from accounting and inventory control systems to the mammoth integrated systems of today, capable of supporting cross-organizational linkages. From the perspective of operations management, EIS came from enterprise resource planning (ERP), which in turn came from materials resource planning (MRP), as outlined in the following list:

- **MRP-I:** *Material requirements planning with the motive to control inventory i.e. raw materials planning etc.*
- **MRP-II:** *Manufacturing resource planning supplemented with production scheduling activities. The concept of MRP II was to look after shop floor and distribution management activities.*
- **ERP:** E*nterprise resource planning has a broader role and is not confined to one department but has an integrated perspective.*
- **ERP-II:** ERP-II has more emphasis on planning of capital or managing money surpluses.

A less operations-focused view sees ERP arising from the integration of accounting systems and other functional activities in manufacturing (to include MRP and other aspects of inventory management), evolving to EIS with the addition of customer relationship management and supply chain support as integral parts of the software.

This paper will provide a brief overview of the time-line of ERP/EIS development. It will then give a view of academic research. The results of some of this research on the implementation of ERP/EIS will then be given, followed by a risk management perspective of EIS. Some research issues in EIS are reviewed, to include upgrades and open source systems.

Development of ERP

In the early 1970s, business computing relied upon centralized mainframe computer systems. These systems proved their value by providing a systematic way to measure what businesses did financially. The reports these systems delivered could be used for analysis of variance with budgets and plans, and served as a place to archive business data. Computing provided a way to keep records much more accurately, and on a massively larger scale than was possible through manual means. But from our perspective at the beginning of the 21st century, that level of computer support was primitive.

Business computing systems were initially applied to those functions that were easiest to automate, and that called for the greatest levels of consistency and accuracy. Payroll and accounting functions were an obvious initial application. Computers can be programmed to generate accurate paychecks, considering tax and overtime regulations of any degree of complexity. They also can implement accounting systems for tax, cost, and other purposes; because these functional applications tend to have precise rules that cover almost every case, so that computers can be entrusted to automatically and rapidly take care of everything related to these functions.

- **1960s** The focus of manufacturing systems in this era was on Inventory Control. Software packages were designed to handle inventory based on traditional inventory concepts.
- **1970s** MRP systems emerged in this era. This system translated the Master Schedule built for the end items into time-phased net requirements for the sub-assemblies, components, and raw materials planning and procurement. There were many other functional systems developed for other applications, and firms hired large IT staffs to write code. SAP began research to develop their integrated accounting-oriented system.
- **1980s** The concept of MRP I evolved which was an extension of MRP to shop floor and distribution management activities. Industry was so successful at generating independent applications that they found many overlapping data files, leading to potential conflicts.
- **1990s** The term MRP I was extended to come in a new form known as ERP, which covered areas like engineering, finance, human resources, and project management as a whole. ERP systems flourished as large organizations saw the benefits of integrated systems. Toward the end of the decade concerns over Y2K issues increased the acquisition of ERP systems, to the point of near saturation of the large organization market.
- **2000s** The market for original systems was nearly saturated by Y2K fears, leading to decline in demand late in 1999. ERP firms moved to rebuild new markets by developing industry-specific versions, by developing Web-accessible systems, and focusing on supply chain and CRM applications. ERP-II originated with the motive to emphasize on the planning of money investment in an optimal manner. As larger markets were near saturation, greater marketing efforts to support small business enterprises developed. Internationally, country specific software arose. Especially in Europe, open system work on ERP software became a viable competitor.

Prior to 2000, ERP systems catered to very large firms, who could afford the rather high costs of purchasing ERP systems. Even focusing on a selected few modules would typically cost firms $5 million and up for software. After 2000, demand dropped, in part because firms were often concerned with Y2K issues prior to 2000, which motivated many ERP system acquisitions. Demand noticeably dropped off after 2000 came and went. Vendors reacted in a number of ways. First, the market consolidated, with Oracle purchasing PeopleSoft (who had earlier acquired JD Edwards). Microsoft acquired a number of smaller ERP software products, consolidating them into Microsoft Dynamics, which caters to a smaller priced market, thus serving a needed gap in ERP coverage for small businesses. Notably, SAP advertises that they can serve small business too. But it appears that they are more valuable in the large scale enterprise market. There in addition are many other systems, to include open sourced systems (at least for acquisition) like Compiere in France. Many countries, such as China, India, and others have thriving markets for ERP systems designed specifically for local conditions, although SAP and Oracle have customers all over the globe.

The operations focus on MRP, of course, overlooks the important role of accounting information systems, which after all was the basis of the SAP system. Since the focus is on integration, this doesn't matter in the least. ERP is an industry term for the broad set of activities supported by multi-module application software that help an association in the important parts of its business, including product planning, parts purchasing, maintaining inventories, interacting with suppliers, customer service, and

tracking orders. ERP can also include application modules for the finance and human resources aspects of a business. Characteristically, an ERP system uses or is integrated with a relational database system. The deployment of an ERP system can involve considerable business process analysis, employee retraining, and new work procedures.

ERP integrated the old isolated computer systems in Finance, Human Resource, Manufacturing and Warehousing, and replaces them with a single unified software program organized into software modules. Finance, Manufacturing and Inventory all still get their own software, except that now the software is linked together so that someone in finance can look into the warehouse software to see if an order has been shipped. Most vendors' ERP software is flexible enough that you can install some modules without buying the whole package. Many companies, for example, will immediately install an ERP finance or HR module and leave the rest of the system for later.

Enterprise resource planning systems arose from a variety of origins. SAP developed their product around supporting the function of manufacturing, integrating that with financial and accounting functions. Other vendors developed from other sources. For instance, PeopleSoft began by developing a respected human resources software product, which they expanded to include a slate of other modules. Prior to entry into the ERP market directly, Oracle was the leading database software vendor.

Research

As with any developing field, industry proceeds without the need for academic theory. The historical developments in this field are driven by the market, but in an economy molded to a great extent by vendor marketing. Thus the academic research has focused on the basic research tools of case study reports and surveys. Recent case studies include MRP integration within ERP (Berchet and Habchi, 2005), international system implementation (Chen et al., 2008), and many on supply chain impact of EIS (Bose et al., 2008; Dai, 2008; Tarantilis et al., 2008). There are many case studies (Olson, 2004), to include famous reviews of problems with Hershey's ERP in 1999, when they rushed their installation project to add Y2K compliant features, and led to near catastrophic operational performance sending truckloads of candy to full warehouses, and leaving warehouses with low inventories empty after implementing their ERP. There also is the case of FoxMeyer Drug, which implemented systems in the 1990s and went bankrupt, followed by the success of McKesson Drug, who purchased the bankrupt assets and successfully installed a similar ERP system. As with all case research, each provides an interesting glimpse of what happened in one set of circumstances. But while there are lessons to be learned from each case, it is very difficult to generalize, as each case involves so many variable factors.

The next type of research involves surveys of system users. There have been many surveys, but one stream of survey research inaugurated at Indiana University (Mabert et al., 2000; 2003a; 2003b) has taken off and has been replicated in Sweden and South Korea. The results of this stream of research are reported here. This same group has more recently examined EIS features (Watts et al., 2008). Among the many other surveys are studies are Chang (2006) and Boucher et al. (2007). Recent studies of implementation success include Li et al. (2008) and Ifinedo and Nahar (2009).

Ultimately, academic theorists like to think that they can develop a unified body of knowledge that provides a framework to understand everything about the topic that is being studied. This has worked to at least some degree in the physical sciences. But it is much harder to do in those fields of study involving human behavior. Management information systems as an academic field definitely involves human behavior. Thus I do not expect there will ever be a satisfactory unified theory of enterprise information systems. Such theoretical development has taken centuries in the physical sciences. Technology developments happen too fast for development of comprehensive theories. Yet, academics continue to try. I will skip references to avoid argument.

Motivations for ERP

The motivations for ERP/EIS adoption were examined by three studies using the same format.

Mabert et al. (2000) surveyed over 400 Midwestern U.S. manufacturing organizations about ERP adoption. Olhager and Selldin (2003) replicated that study with 190 manufacturing firms in Sweden. Katerattanakul et al. (2006) again replicated the survey, this time in Korea. These studies reported the following ratings with respect to motivation for implementing ERP (see Table 1):

Table 1: Reasons for Implementing ERP

Reason	U.S.	Sweden	Korea
Replace legacy systems	4.06	4.11	3.42
Simplify and standardize systems	3.85	3.67	3.88
Improve interactions w/suppliers & customers	3.55	3.16	3.45
Gain strategic advantage	3.46	3.18	3.63
Link to global activities	3.17	2.85	3.54
Solve the Y2K problem	3.08	2.48	NA
Pressure to keep up with competitors	2.99	2.48	2.94
Ease of upgrading systems	2.91	2.96	3.55
Restructure organization	2.58	2.70	3.33

Rating scale from 1 (not important) to 5 (very important)
Extracted from Mabert et al. (2000), Olhager and Selldin (2003), Katerattanakul et al. (2006)

Initially, fear of Y2K was a major concern. The Swedish survey was later than the U.S., and that might explain the lower rating for this item in the Swedish study. The later Korean study did not ask about this dated issue. The U.S. response was actually neutral (only slightly higher than 3), but Y2K clearly was a factor in ERP adoption in the mid- to late-1990s. However, more important reasons were always present. In the first two studies, replacing legacy systems received a high positive response. The desire to simplify and standardize systems was the second highest rating in the first two studies, and the highest rating in the later Korean study.

There were two other reasons that received relatively high ratings in the U.S. (a bit lower in Sweden). These were to improve interactions with suppliers and customers, which is one way to gain strategic advantage. The supply chain aspects of ERP have led vendors to modify their products to be more open, although work continues to be needed in this direction (and seems to be proceeding). Linking to global activities was slightly positive in the U.S. survey, more negative in the Swedish study, and relatively higher in the Korean study.

Three other potential reasons received low ratings in both studies. Pressure to keep up with competitors received neutral support in the U.S. study. Ease of upgrading systems is a technical reason that received neutral support both in the U.S. and in Sweden. Restructuring the organization was rated lower.

ERP Proposal Evaluation

The three studies we have been tracking asked subjects about expected installation time (Table 2) and expected installation cost (Table 3). These firms for the most part anticipated that the adopted system would serve their organizations over seven years. The time that they expected their EIS installation projects to last was reported as in Table 2:

Table 2: Expected EIS Project Installation Time Requirements

Installation Time	U.S.	Sweden	Korea
12 months or less	34%	38%	49%
13 to 24 months	45%	49%	40%
25 to 36 months	11%	8%	7%
37 to 48 months	6%	4%	2%
Over 48 months	2%	1%	3%

Extracted from Mabert et al. (2000), Olhager and Selldin (2003), Katerattanakul et al. (2006).

The reported times are very similar. Obviously, the scope of the EIS project would be a major factor in this time expectation. Projects implemented in less than one year would have to be relatively small in scope (implementation of one or only a few modules, for instance). But a general trend is indicated, given the different times of the surveys. There clearly is a shift to shorter implementation times.

Gartner Group consistently reports that IS/IT projects significantly exceed their time (and cost) estimates. Thus, while almost half of the surveyed firms reported expected implementation expense to

be less than $5 million, we consider that figure to still be representative of the minimum scope required. However, recent trends on the part of vendors to reduce implementation time probably have reduced EIS installation cost. Mabert et al. also investigated the proportion of total costs by EIS component, with results given in Table 3.

Table 3: EIS Installation Project Cost Proportions

Installation Cost Proportion	U.S.	Sweden
Software	30%	24%
Consulting	24%	30%
Hardware	18%	19%
Implementation team	14%	12%
Training	11%	14%
Other	3%	1%

Extracted from Mabert et al. (2000), Olhager and Selldin (2003).

In the U.S., vendors seem to take the biggest chunk of the average implementation. Consultants also take a big portion. These proportions are reversed in Sweden The internal implementation team accounts for an additional 14 percent (12 percent in Sweden). These proportions are roughly reversed in Sweden with training.

The expectations of return on their investment varied widely (as must be expected) as given in Table 4.

Table 4: Expected ROI from EIS Projects

Expected ROI	US	Sweden	Korea
<15%	**30.5%**	**54.4%**	**59.6%**
16% to 25%	**36.4%**	**30.4%**	**15.8%**
>25%	**29.2%**	**15.2%**	**24.6%**

Source: Katerattanakul et al. (2006)

From these numbers, it appears that manufacturers in Sweden expect a bit less return than did those in the U.S. (much of which might be explained by economic timing). Korean expectations are much more variable. Since the motivations for adopting EIS in some cases was either competitive or viewed as forced for other reasons, some firms expect low payoff from their EIS systems. However, roughly as many adopters expect clearly significant returns on their investment.

Van Everdingen et al. (2000) conducted a survey of European firms in mid-1998 with the intent of measuring EIS penetration by market. The survey included questions about the criteria considered for information systems selection, as well as criteria for supplier selection. The criteria reportedly used are given in Table 5, in order of ranking.

Table 5: Criteria Considered for IT and EIS Supplier Selection

Information Systems Selection Criteria (n=2401)	EIS Supplier Selection Criteria (n=2623)
1: Fit with business procedures	1: Product functionality
2: Flexibility	2: Product quality
3: Cost	3: Implementation speed
4: User friendliness	4: Interface with other systems
5: Scalability	5: Price
6: Support	6: Market leadership
	7: Corporate image
	8: International orientation

Based on Van Everdingen et al. (2000)

Fit with business procedures was selected among the three most important criteria by about one-half of the respondents, and was listed as the single most important criterion by over one-third. While EIS vendors have devoted a great deal of effort to making their packages match existing business processes, the importance of this criterion is based upon the high cost and bother of configuring and implementing EIS systems. Selection of a vendor involved less variance among criteria. Product functionality and quality were the criteria most often reported to be important.

Information systems (IS) projects involve relatively higher levels of uncertainty than most other types of projects. EIS implementations tend to be on the large end of the IS project spectrum. There are many options for implementation of an EIS:

1. Adoption of a full EIS package from a single vendor source
2. Single EIS vendor source with internally developed modifications
3. Best-of-breed: adoption of modules from different vendor sources
4. Modules from vendor sources with internal modifications

5. In-house development
6. In-house development supplemented by some vendor products
7. Application service providers (ASP)

Barring item 7 on the above list, ASP, the easiest method is to adopt a system provided by a single vendor, without modifications (number 1 above). But this isn't necessarily the least expensive option, nor will it necessarily provide the greatest benefits to the firm. The reason to use the best-of-breed approach (number 3 above), using modules from different vendors, is that the functionality obtained from specific modules may be greater in one area for one vendor, but better in another module area (with respect to the needs of the specific adopting organization) from another vendor. EIS systems could be developed in-house (number 5 above). This is not recommended. If this method were adopted, a great deal of IS/IT project management effort would be necessary. As implied by variants numbered 2, 4, and 6, blends of each of these forms of EIS implementation have been applied as well. Finally, EIS could be outsourced (number 7 above), through application service providers. This can result in the lowest cost method of installation. As discussed later in this chapter, that may involve a lot of convenience at the cost of a lot of control.

Mabert et al. surveyed the strategic approach adopted in their sample of manufacturing firms who had implemented ERP systems. ASP implementation was not surveyed. Katerattanakul et al. replicated the study in Korea, reporting only four of these options. Relative use in percentage was given as in Table 6:

Table 6: Relative Use of ERP Implementation Strategies

Strategy	Percentage US	Percentage Korea
Single ERP package with modifications	50	43
Single ERP package	40	
Vendor packages with modifications	5	
Best-of-breed	4	27
In-house plus specialized packages	1	14
Total in-house system	0.5	16

Source: Extracted from Mabert et al. (2000), Katerattanakul et al. (2006)

In the US, the dominant strategy in this sector (manufacturing) was to rely upon a single developer, with a large number of firms supplementing the system for internal needs. The concept of best-of-breed was not widely applied. Few firms developed their own ERP system. One reason for this reliance upon vendor plans for the most part is that it is much easier to control installation by following implementation procedures developed and tested by the vendors. The Korean study saw much greater use of best-of-breed approaches, mixing software from different vendors. There also was much greater use of in-house systems. The difference can be attributed to local conditions.

Implementation

Execution of EIS systems can be accomplished a number of different ways. The extremes are the "**big-bang**" deployment, where on one magic day, the old system is unplugged and the new system turned on-line. Markus et al. (2000) cited use of this strategy by Quantum Corp. which shut down their operations worldwide for eight days to switch systems. This risky approach was motivated by that company's specific circumstances. The other extreme is **phased rollout**, with components of the system brought on-line serially, and operated and observed prior to moving on to implementation of the next phase. Markus et al. cited BICC Cables, which adopted a lengthy process of consensus building in their global operation. The selected EIS system was implemented one step at a time, as BICC Cables wanted no more than three software versions in operation at any one time (old being replaced, new being installed, future version being tested at headquarters). This resulted in an environment with technology changes as often as every 12 months.

Mabert et al. surveyed manufacturing users of EIS for implementation, and found results as shown in Table 7:

Table 7: Implementation Strategies Adopted

Strategy	Time U.S.	Time Sweden	U.S.	Sweden
Big Bang	15 mos.	14 mos.	41%	42%
Phased rollout by site	30 mos.	23 mos.	23%	20%
Phased rollout by module	22 mos.	20 mos.	17%	17%
Mini big bang	17 mos.	16 mos.	17%	20%
Phased rollout by module & site	25 mos.		2%	

Source: Mabert et al. (2000) , Olhager and Selldin (2003)

The Korean study (Katerattanakul et al., 2006) reported over 72 percent of the firms they surveyed utilized a form of the big bang approach. The big bang approach is a dangerous approach for general IS/IT projects, but often makes sense in the context of EIS, especially smaller systems. The alternatives are to roll out a system, or to do a pilot study (here labeled mini big bang). Rolling out a system makes sense for larger firms where geographic dispersion is present, or in conglomerates with diverse functional groups. The data indicates that phased rollouts are often used, sometimes by both module and site. The pilot approach is less reliable in EIS contexts than it is for general IS/IT projects, because scalability is so often a problem in EIS implementations. The pilot test may work quite well, but the server system may be overwhelmed when the full computational load is applied.

ERP Risk Management

Managing risk on an EIS project is crucial to its success. What is a risk? Simply defined, a risk is a potential failure point. There are thousands, maybe even millions of potential failure points on an EIS project, in the form of untested technology (and untested staff), political landmines, and even nature's fury. So, how do you keep the failures at bay? While various risk management books and methodologies offer variations on a theme, there are generally five steps to managing risk.

Five steps to managing risk:

1. Find potential failure points or risks.
2. Analyze the potential failure points to determine the damage they might do.
3. Assess the probability of the failure occurring.
4. Based on the first three factors, prioritize the risks.
5. Mitigate the risks through whatever action is necessary.

One example of risk analysis was provided by Olson (2007), in the context of evaluation of alternative means of acquiring an ERP. That model was a multiple criteria analysis considering criteria such as system reliability, cost, security, and service level (among other factors). Consideration of financial analysis as well as cost categories were considered.

ERP Upgrades

EIS/ERP upgrades are mainly intended to take advantage of new technologies and business strategies to ensure that the organization keeps up with the latest business development trends. Therefore, the decision to upgrade EIS/ERP is usually not driven by code deterioration or anticipated reduction in maintenance costs alone, but by different purposes. According to an AMR study (Swanton, 2004), 55% of upgrades were voluntary business improvements triggered by the need for new functionality, expansion or consolidation of systems; 24% of upgrades were triggered by technology stack changes; 15% of upgrades were forced by de-support of the running version of software to avoid vendor support termination (Craig, 1999); and 6% of upgrades were triggered by bug fixes or statutory changes.

The cost of EIS/ERP upgrades is high (Montgomery, 2004). Swanton (2004) cited the cost of each upgrade including: 50% of the original software license fee and 20% of the original implementation cost per user, which means over 6 million dollars for a 5,000-user system. Typically, each EIS/ERP upgrade requires eight to nine months of effort with a team the equivalent of one full-time employee per 35 business users. The EIS/ERP-adopting organization does not have to develop and re-write the EIS/ERP system itself but rather it replaces (or upgrades) the old version with a readily available new version from the EIS/ERP vendor. However, a lack of experience may cause the costs and length of the upgrade project to

approach or even exceed those of the original EIS/ERP implementation effort. Collins (1999) listed some general benefits for organizations from EIS/ERP upgrades:

- Eligibility for Help Desk Support: Most of EIS/ERP software vendors stop providing technical support 12 to 18 months after the next version becomes available. Therefore, keeping upgrade with the pace of EIS/ERP vendors will guarantee the support for the system from the vendors

- Solutions for Outstanding "Bugs" or Design Weaknesses: It is impossible to guarantee spotless and error-free EIS/ERP systems after the implementations even though vendors will conduct many different testing processes to eliminate the happenings of errors in the system before the leasing time. "The majority of software bugs are resolved and delivered either fix-by-fix, or all-at-once as part of the next release version of the EIS/ERP package." In this case, upgrades will be beneficial to the organizations in problem solving.

- New, Expanded, or Improved Features: EIS/ERP software provides organizations the knowledge and strength (i.e. best practices) from the vendors. EIS/ERP upgrades provide organizations future enhancement from the vendors to give the organizations better opportunities to catch up the current business development, improve their processes and build more efficient business models with new functions, new features and new processing styles provided in the upgraded EIS/ERP versions.

Olson and Zhao (2007) used an in-depth semi-structured interview technique to examine the success factors in EIS/ERP upgrade. Companies who reported that their organization's EIS/ERP upgrade was completed the previous year (some were finishing up their upgrade project) were included. 15 IT managers were interviewed. A wide variety of industries were represented in the responses. These upgrade projects took between 2.5 months (a local system, with no customization) to 11 months (a more complex organizational structure with heavy training requirements). Customization may be needed by organizations, but will incur a cost in time (and thus money). The assessment phase was often quite short, ranging from two weeks to month typically, although larger organizations took longer because of the need to obtain corporate approval. Planning and action phases were relatively consistent. We would conclude that upgrade projects involve lower levels of risk and uncertainty (and thus variance) than initial installations because the organization is very familiar with what the system should do. The renewal phase (putting the system on-line) was very short, typically less than two weeks. With proper project management, overnight or over a weekend was possible.

The reasons for upgrade included eleven cases where some new functionality was desired (to include things like supporting Web access). There were five cases among the fifteen where the vendor had announced discontinuance of service. Two cases cited the desire to obtain better vendor support. Another case cited the need to fix a bug in the existing system, and another to integrate modules.

There were far fewer problems involved in upgrade projects than are typically reported in initial EIS/ERP installations. This is to be expected, due to the experience gained with the system by the organization. Customization was a problem in two cases, one where customization was needed to provide adequate service (case B), and another (case C) where customization to implement a CRM add-on led to dropping this additional desired functionality. A problematic consultant was a problem in case E. There also were problems with a TMS add-on in case J, and needed links to delivery vendors was a problem overcome in case O. Scalability was initially a problem in case A, but was resolved by the vendor. Some repeated testing was reported in one case, and the difficulty of dealing with massive retraining reported in another. Thus a variety of different problems can be expected in EIS/ERP upgrade projects, but for the most part these challenges are easier to overcome than is the case in initial implementation projects.

1. EIS/ERP upgrade projects are easier to control than initial installation projects, because organizations have gained experience (often the hard way) and the organizational users have a better idea of what to expect.
2. Vendor marketing drives many upgrades. Beatty and Williams argue that this is due to vendor product improvement, which we admit undoubtedly plays a role. Vendor greed might

also be a factor. Therefore, organizations should consider alternatives such as application service providers, based upon a sound business case analysis.

3. Upgrade phases are important to consider, with some factors being more important in one phase than they are in others.

Open Source ERP

Web services provide a convenient way to access existing internal and external information resources. They use a number of technologies to build programming solutions for specific messaging and application integration problems (Brenner and Unmehopa, 2007). However, building a new information system is in some ways like building a new house. Web services may be analogous to cement and bricks. Blueprint and engineering knowledge are more important. SOA gives the picture of what can be done with Web services. SOA exploits the business potential of Web services, which can lead to a type of convergence by enabling organizations to access better methods at lower cost through technology.

SOA is a strategy based on turning applications and information sources which reside in different organizations, different systems and different execution environments into "services" that can be accessed with a common interface regardless of the location or technical makeup of the function or piece of data. The common interface must be agreed upon within the environment of systems that can access or invoke that service. A service within SOA either provides information or facilitates a change to business data from one valid and consistent state to another one. Services are invoked through defined communication protocols. The pivotal part of SOA is how communication between different data formats can be accomplished. Web Services, which is independent of operational environment, allow this communication.

The goal of EIS is to integrate and consolidate all the old departments across an organization into a one system that can meet and serve each department's unique needs and tasks. Therefore, every aspect of an organization's business process needs to have a unified application interface, which provides high competitiveness in the market. Enterprises have invested heavily on EIS acquisition while small businesses or entrepreneurs often could not see an affordability of it mainly due to its high upfront prices and lack of resources to maintain the system. To attack this niche market of EIS in the small to medium-sized business sector, vendors has developed transformed EISs by adopting the most advanced information technologies available. The most available business models of EIS include software as a service (SaaS), open source software (OSS) and service oriented architecture (SOA).

SaaS offers EIS as a service that clients can access via the Internet. Smaller companies are spared the expenses associated with software installation, maintenance and upgrades. Mango Network, an Irving, Texas, software and services company is a channel of providing software and services for small and midsize wholesale and retail distributors. It combines the pure open-source business model and SaaS. Compiere which is a pure open-source company provides products and Mango sells them through SaaS. Mango charges annual fees based on a customer's revenue, rather than monthly fees based on the number of users.

The Organization for the Advancement of Structured Information Standards (OASIS) defines SOA as: A paradigm for organizing and utilizing distributed capabilities that may be under the control of different ownership domains. It provides a uniform means to offer, discover, interact with and use capabilities to produce desired effects consistent with measurable preconditions and expectations. SOA driven EIS is not only beneficial to enterprises as many believe but also to SMBs.

OSS EISs allowed small and medium sized businesses' access to EIS. The benefits of applying OSS are as follows (Serrano and Sarriegi, 2006):

- Increased adaptability: Since EIS is not plug and play, implementation processes are necessary to match the company's business processes and local regulations. Having full access to the EIS source code is beneficial.
- Decreased reliance on a single supplier: Proprietary EISs highly depend on the services from vendors and distributors. Upgrading and maintain service can be obtained from single source.
- Reduced costs: Proprietary EIS licenses are expensive. OSS EISs' average implementation costs are at between one-six and one-third of the costs for typical proprietary EISs.

The most common business model of OSS is based on a simple idea – free for use, modification, resale and fee for services including implementation. Most EIS-related open-source software uses the Web for delivery of free software. There is at least one product (OpenMFG) allowing users to participate in software development, but with software vendor filtering. Open filtering models have not appeared to date.

Among the many open-source EIS, Compiere has most often been appeared in many research articles and business reports. Compiere recorded more than 1.2 million downloads of its software and has more than 100 partners in 25 countries (Ferguson, 2008). They don't sell software but sell services – security and support. They do not allow just anyone to contribute code – the majority of code contributors are trained partners who understand company's business model. The EIS software OpenMFG allows community members including customers and partners to get the source code and extend and enhance it. The company, then, bring the enhancements into the product (Ferguson, 2008).

Conclusions

EIS has been an evolutionary field, as new and improved systems continue to be developed. The focus on integrating the multitude of independent applications found in large organizations met a very real need in the 1990s, almost to the point of market saturation given the large price tags associated with 1990s systems. New industry focus in the 21st Century include greater attention to small-to-medium-sized enterprises, country-specific software, more open systems to support supply chain operations, more mobile access, and open systems.

Research in the academic domain is evolving. Initial research by necessity involves focus on cases, glimpses of experience in specific circumstances, which are valuable initial research identifiers of issues in EIS, but do not provide a generalizable theory. The academic literature abounds in case studies of many aspects of EIS. There also are many surveys. We have focused on three related studies, because they focus on the use of EIS in a consistent manner. However, many other good survey studies have been reported. In the future, it may be that something like a unified theory of EIS will arise. Given the dynamic nature of the business, however, this author doubts that an accurate, generalizable unified theory will ever be accepted before the technology moves on to something entirely different than we recognize now.

Among the many issues of importance in EIS, this paper discusses three. First, there are many risks inherent in EIS. This is important, because enterprise information systems are crucial to the organizations operating them, and also because they usually come with very expensive price tags. Second, the evolution of the market has led to upgrades, presenting using organizations with dilemmas as vendors constantly improve their systems, offering their clients better service while discontinuing support to older versions. Clients need to evaluate the economics of these opportunities almost constantly. The third issue introduced was the presence of open source ERP/EIS product development. This emerging area of development offers many opportunities, as well as creating new problems to be solved.

The area of enterprise information systems is clearly critically important, as well as dynamic. Keeping on top of developments will be mandatory for organizational success in the future.

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