Enterprise resource planning (ERP) systems are revolutionizing the way companies streamline business processes, share information within and across businesses, and conduct electronic business (Lee et al. 2003). The ERP acronym is an outgrowth of MRP (materials requirements planning) and MRP II (manufacturing resource planning), older types of manufacturing-specific software that aim to streamline the manufacturing process by devising efficient production plans according to supply and demand, resources, and materials.

ERP systems have the potential to facilitate communication and coordination, enable the centralization of administrative activities, reduce IS maintenance costs, and increase the ability to deploy new IS functionality. Several researchers (Bingi et al., 1999; Holland and Light, 1999; Nah et al., 2001; Nah et al., 2003, Siau and Messersmith 2003) have identified success factors of ERP. When implemented well, ERP brings operational, managerial, and strategic benefits. With all these promises, ERP systems have diffused rapidly among organizations. In 1997, some 20,000 companies around the world paid more than $10 billion to purchase ERP systems.

By 2000, over 60% of Fortune 500 companies had adopted ERP systems in the USA (Stewart et al., 2000). ERP has evolved from a single-site implementation to one that crosses organizational boundaries and incorporates e-commerce, customer relationship management (CRM), and supply chain management (SCM) capabilities.

Though promoted as a “silver bullet” in solving organizational IT integration problems, ERP software does have major shortcomings. ERP systems have been criticized for lengthy and expensive installations, and for being too large and monolithic to support the rapid pace of business change. This is particularly true when facing the revolutionary changes to business practices associated with the Internet and e-commerce. The benefits realized through the integration power of ERP systems come with significant up-front investments, lengthy and error-prone customizations, and mediocre results.

Even when installations are successful, companies now realize that the rate of change in business practices mandates continuous systems development and that the functionalities necessary to operate the business will not come from ERP systems
alone. A study by Deloitte Consulting (1999) indicated that going live isn’t the end of ERP implementation, but “merely the end of the beginning.” The radical changes in business practices driven by e-commerce and associated Internet technologies are accelerating change, ensuring that enterprise systems will never remain static. While ERP vendors are scrambling to advertise their latest Internet offerings, the systems have proven difficult to change and extend into critical areas such as multi-enterprise supply chain management, e-commerce, and mobile commerce (Radding, 1999).

**ERP Implementation Paradox**

One of the major issues in ERP implementation is the ERP software itself. What should come first, the company’s business needs or the business processes available in the ERP software? The fundamental invariant in systems design and implementation is that the final systems belong to the users. Therefore, as professors in systems analysis and design classes, and systems development consultants have long preached, the information systems should be designed with the company’s needs in mind. This, however, is difficult to realize with ERP software.

In ERP implementations, it is very common to see companies changing their internal business processes to fit the “industry best-practices” available in ERP software. Sometimes, this is tactfully termed “business reengineering.” But are we performing business reengineering to make the company’s business processes more effective and efficient, or are we engaging in business reengineering so that the company’s business processes can fit into existing business processes in ERP software? Of course, one can claim that the two need not be mutually exclusive. On the other hand, the two do not overlap 100% either. In most cases, companies need to perform a balancing act of optimizing their investment in ERP software (e.g., SAP/R3, OneWorld) by using as much of the business processes available in the ERP software as possible, while simultaneously trying to incorporate the unique company’s needs and business strategies into the systems. Such a balancing act is, however, not easy.

**ERP Implementation Methodologies**

Because of the uniqueness of ERP implementation, methodologies to support ERP systems implementation are vital (Siou,
A number of ERP implementation methodologies are available in the marketplace. These are typically methodologies proposed by ERP vendors and consultants. We classify ERP methodologies into three generations—first, second, and third generations (see Table 1). Each successive generation has a wider scope and is more complex to implement.

Most existing ERP implementation methodologies belong to the first generation ERP methodologies. These methodologies are designed to support the implementation of an ERP system in an enterprise, and the implementation is typically confined to a single site. Methodologies such as Accelerated SAP (from SAP), SMART, and Accelerated Configurable Enterprise Solution (ACES) are examples of first generation ERP implementation methodologies.

Second generation ERP methodologies are starting to emerge. They are designed to support an enterprise-wide and multiple-site implementation of ERP. Different business units can optimize operations for specific markets, yet all information can be consolidated for enterprise-wide views. A good example is the Global ASAP by SAP, introduced in 1999. This category of methodologies supports an enterprise-wide, global implementation strategy that takes geographic, cultural, and time zone differences into account.

Third generation ERP methodologies will be the next wave in ERP implementation methodologies. The proposed methodologies need to include the capability to support multi-enterprise and multiple-site implementation of ERP software so that companies can rapidly adapt to changing global business conditions, giving them the required agility to take advantage of market or value chain opportunities. Since more than one company will typically be involved, the methodologies need to be able to support the integration of multiple ERP systems from different vendors, each having different databases. The multi-enterprise architecture will need to facilitate the exchange of information among business units and trading partners worldwide. The ability to support web access and wireless access is also important.

Criteria for Third Generation ERP Implementation Methodologies

First generation ERP systems integrate business processes through consolidation of different systems and databases into an integrated whole. The second generation views ERP systems as a global information and transaction backbone for a company. What are the characteristics of third generation ERP systems?

The methodologies to support third generation ERP systems implementation need to address the following:

i) Component-Based Architecture: The third generation ERP will address the integration of heterogeneous components by establishing a component-based architecture. Currently, there is an ongoing initiative to break ERP systems into separate components (componentization). Componentization refers to the act of breaking up large, monolithic ERP systems into components that would work together. With componentization, ERP vendors can easily upgrade their solutions and the customers can easily upgrade their software. In addition, a customer could selectively upgrade some components without having to upgrade the entire ERP software. The component-based architecture will expedite testing by providing consistent modularization
and interfaces definitions. Each component will be incrementally integrated and tested until it can be certified by the framework and becomes part of the repository. This will simplify the development and integration of new components or the adaptation of a suite of components to a new platform.

**ii) E-Commerce:** ERP vendors are also embracing e-commerce. By extending the existing ERP system to support e-commerce, companies not only leverage their investment in ERP solutions, but are also able to speed up the development of their e-commerce capabilities (Siau and Messersmith, 2002). SAP introduced mySAP.com, a suite of e-commerce components for SAP. Oracle has numerous initiatives, including one that will allow its ERP and e-commerce solutions to share the same database.

**iii) Mobile Commerce.** In the coming mobile commerce era, users will want to be able to have access to the right resources and work as efficiently as possible—whether they are traveling, seeing a customer or working at other remote locations—with their ERP systems (Siau et al., 2001). Many ERP vendors are currently researching for means to provide mobility to ERP users. They attempt to connect employees to their work more effectively than ever before by enabling mobile phones and other wireless devices to become a new kind of tool to seamlessly exchange information, automate data entry and perform a range of transactions anytime, anywhere (Siau and Shen, 2003). The aim is to provide seamless integration between back and front offices to ensure that whenever something important happens that affects the enterprise, the right people are informed and appropriate action will take place immediately.

**iv) Customer Relationship Management:** The bottom line for e-commerce is customer service. Customer satisfaction and loyalty are vital to success in cyberspace. The third generation ERP software will be integrated with powerful customer relationship management (CRM) software. CRM includes front-office applications that assist in customer interaction, addition of customer and product information, and has the ability to hook to back-end systems, including financials, inventory, and ERP systems.

**v) Supply Chain Management:** More and more companies are granting external suppliers and customers access to their internal billing, inventory, manufacturing, and scheduling systems. Successful supply chain management allows enterprises to anticipate demand and deliver the right product to the right place at the right time with the lowest possible cost. Other benefits include customer responsiveness, just-in-time inventory, transportation costs reduction, and compressed product delivery cycle times (Siau and Shen, 2002; Siau and Tian, 2002).

**vi) Scalability:** A high-performance third generation ERP system must be able to gracefully handle continuous increase in sites and traffic, and allow companies to easily align business processes with corporate imperatives without custom programming. The ability to adopt changing business rules without extensive programming or outside consultation will allow the ERP systems to integrate seamlessly with other ERP systems and organizational structures created by mergers and acquisitions, reengineering, or ad hoc teams or alliances.

**vii) Availability:** Availability is a measure of uptime. Enterprises require their ERP systems to be operational 24 hours a day, 7 days a week, and 365 days a year for e-
commerce. These systems are no longer backroom systems but are now strategic business systems. Such rigorous demands on high availability require a foolproof mechanism for detecting and recovering from failures, while continuously providing service.

viii) Quality of Service: In the context of information access, quality of service refers to an assured value of the data access time or the transaction rate. Currently, these vary widely with the level of network congestion, existence of other clients, overall load on the server, and other unpredictable parameters. For third-generation ERP systems, quality of service is critical and should be guaranteed.

ix) Maintainability: Maintenance of large-scale multi-enterprise and multi-vendor systems requires skilled expertise in a wide range of software platforms and hardware devices. Third generation ERP solutions that require minimal maintenance and very limited additional training in specialized platforms are necessary.

x) Security: For e-commerce ERP systems, companies worldwide can have direct access to their suppliers’ and business partners’ ERP systems. This “openness” expands the universe of users tremendously. On the other hand, in this global economy, companies may cooperate and compete at the same time. Revealing proprietary (secret) information could be catastrophic. Thus, data and communication security become primary concerns.

xi) Data Sharing and Integration: A flexible architecture that facilitates the exchange of information among business units and trading partners is at the heart of third generation ERP systems. Data sharing is important for third generation systems that link legacy systems to ERP systems, and connect ERP systems from different organizations. To achieve this, we need to provide a homogeneous global Internet-based interface to different databases. Related to this issue is the definition of minimal information set for business-to-business e-commerce. In the supply chain, different parties have different relationships. Hence, the amount and “type” of information that is exchanged varies. The underlying principle is to “make this information set minimal” so that it is just adequate to conduct the transaction. The specification of Minimal Information Set (MIS) would serve to eliminate redundant and outdated information, and minimize updates across the different ERP systems.

Conclusion

ERP has become the cornerstone of many companies’ mission-critical business tools. The revolution from a single-site, single-enterprise ERP to one that is multi-site, multi-enterprise, and web-enabled ERP is only beginning. Combining ERP systems and e-commerce is absolutely critical to most businesses future success, but if badly executed, it could be worse than doing nothing. Implementation methodologies are needed to guide the implementation teams to success.

References


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