Enterprise Resource Planning for Intelligent Enterprises

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INTRODUCTION

Enterprise resource planning systems can be defined as customizable, standard application software that includes integrated business solutions for the core processes and administrative functions (Chan & Rosemann, 2001). From an operative perspective, ERP systems provide a common technological platform, unique for the entire corporation, allowing the replacement of mainframes and legacy systems. This common platform serves to process automation as well as to simplify current process either by an explicit reengineering process or by the implicit adoption of the system 'best practices' (Markus & Tanis, 2000). Finally, the common centralized platform allows the access to data that previously were physically or logically dispersed. The automation of the processes and the access of data allows the reduction of the operating times (thus reducing operating costs) while the latter serves to better support business decisions (see, e.g., Umble, Haft & Umble, 2003, for a detailed review of ERP benefits).

A widespread critique to ERP systems is their high total cost of ownership (Al-Mashari, Al-Mudimigh & Zairi, 2003) and hidden costs in implementation (Kwon & Lee, 2001). Besides, ERP systems impose their own logic on an organization's strategy and culture (Davenport, 1998), so ERP adopters must adapt their business processes and organization to these models and rules. Consequently, organizations may face difficulties through this adaptation process, which is usually carried out without widespread employee involvement. This may cause sore employees, sterile results due to the lack of critical information usually provided by the employees, and also that the new system is delivered late, with reduced functionality, and/or with higher costs that expected (Kraemmeraard, Moeller & Boer, 2003). Additionally, some analysts have speculated that widespread adoption of the same ERP package in the same industry might lead to loss of competitive advantage due to the elimination of process innovation-based competitive advantage (Davenport, 1998). This has been observed, for instance, in the semiconductor manufacturers sector (Markus & Tanis, 2000).

The early stage of ERP was carried out through Materials Requirement Planning (MRP) systems (Umble et al.,

2003). The next generation of these systems, MRP II (Manufacturing Resources Planning), crossed the boundaries of the production functionality and started supporting not only manufacturing, but also finance and marketing decisions (Ptak & Schragenheim, 2000). Current ERP systems appeared in the beginning of the '90s as evolved MRP II, incorporating aspects from CIM (Computer Integrated Manufacturing) as well as from EDP (Electronic Data Processing). Therefore, ERP systems become enterprise-wide, multi-level decision support systems. ERP systems continue evolving, incorporating Manufacturing Execution Systems (MES), Supply Chain Management (SCM), Product Data Management (PDM), or Geographic Information Systems (GIS), among others (Kwon & Lee, 2001).

BACKGROUND

Most enterprise resource planning systems share a number of common characteristics, both from a technological as well as a business perspective. These include:

- **Client/server, open systems architecture.** Most ERP packages adopt an open systems architecture that separates data (database server), application (ERP server), and presentation (user interface/ERP client) layers, guaranteeing cross-platform availability and systems integration. In order to interoperate with existing business applications or information systems, most ERP packages adhere to the majority of common standards for data exchange or distributing processing.
- **Enterprise-wide database.** One of the most distinguishable characteristics of ERP is the strong centralization of all relevant data for the company (Al-Mashar et al., 2003). When physical centralization is not possible, communication and/or replication protocols among the different databases should be implemented in order to ensure data consistency and accessibility throughout the entire enterprise.
- **Kernel architecture.** Some ERP systems support more than 1,000 different business functionalities (Bancroft, Seip & Sprengel, 1998), covering nearly

all relevant business aspects for most of the enterprises. As all these functionalities cannot be loaded in the ERP server at the same time, the majority of ERP systems employ a so-called 'kernel architecture'. In this architecture, most functionalities are stored in the ERP database, usually in the form of source code of a proprietary, fourth-generation, programming language. When certain functionality is required by an ERP client, the ERP server loads it from the database and compiles the corresponding code so the functionality is made available for the clients. Once it is not required, the functionality is removed from the ERP server. Note that this mechanism also allows for an easy enhancement/updating of existing functionalities, as well as for the construction of new ones.

- **Process-oriented, business reference model.** ERP is process-oriented software that has been developed, starting from an implicit or explicit business reference model in order to appropriately describe the relevant business functions covered by the ERP system. For most ERP vendors, this model is explicit and takes the form of the 'best practices' extracted form the ERP vendor experience (Markus & Tanis, 2000). This can be used to analyze and evaluate current business processes in the enterprise prior to the implementation of the ERP package, serving thus as benchmark processes for business process reengineering (BPR).

- **Adaptation to the enterprise.** In order to meet the specific requirements of different enterprises, ERP systems are highly configurable. This potential for customization is considered to be one of the main differences between ERP and other standard software packages (Kraemerand et al., 2003). The customization process may take several months, or even years, depending on the enterprise.

- **Modularity.** Although the term 'ERP system' is usually employed to design a system covering all corporate functions (Slater 1998), generally an ERP system is composed of a set of ERP modules. An ERP module is a group of function-oriented, tightly integrated functionalities, which in many cases can be separately purchased and installed. Typical ERP modules are the financial-accounting module, production-manufacturing module, sales-distribution module, or human resources module. This allows enterprises to purchase only these modules, strictly required, as well as offers the possibility of integrating them with existing information systems.

An intelligent enterprise is an organization that acts effectively in the present and is capable of dealing effectively with the challenges of the future (Wiig, 1999). Since most enterprises operate today in a complex and dynamic environment, characterized by increasing competition and continuous changes in products, technology and market forces, an intelligent enterprise should be proactive, adaptable, knowledgeable, and well resourced (Kadayam, 2002). In order to achieve this behavior, it is expected that all employees in the intelligent enterprises not only deliver the work products that are directly associated with their functions, but that they also innovate to improve customer relationships and enterprise capabilities, and to envision opportunities for new products and services (Wiig, 1999). Therefore, it is clear that an intelligent organization should have timely access to all critical information in order to gain insight into its performance and should be able to provide effective decision support systems. Hence, one of the requisites for the intelligent enterprise is the availability of all relevant data in the organization. Indeed, access to the right information is considered to be one of the key characteristics of intelligent enterprises (Smirnov, Pashkin, Chilov & Levashova, 2003).

FUTURE TRENDS

If we adopt the generic intelligent enterprise architecture by Delic and Dayal (2002), ERP addresses issues of supply chain efficiency and back-office optimization, and provides the basis for Enterprise Knowledge Management (EKM). At the same time, the evolution of enterprises to the form of intelligent organizations requires the cooperation of independent companies into a virtual multi-tier enterprise (Olin, Greis & Kasarda, 1999), the Internet providing the glue for their heterogeneous information systems (Delic & Dayal, 2002). In order to achieve this, one of the main trends followed by most ERP systems vendors is the introduction of the Internet (Chan & Rosemann, 2001; Kwon & Lee, 2001). The adoption of the Internet can be seen from two viewpoints—the user interface viewpoint, and the internal/external communication viewpoint.

With respect to the user interface, ERP systems are transaction oriented. However, the connectionless nature of the Internet protocols (i.e., the connection between the Web server and the browser is not maintained after the former has sent the requested data to the later) makes it not well suited for transactions. Therefore, it is intrinsically difficult to adapt the ERP internal structure to the Internet. As a consequence, most of the ERP vendor's effort is on creating reliable gateways between the ERP system and an Internet server.

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