



# Implementing ERP Systems using SAP

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## ABSTRACT

*This paper commences with a brief description of Enterprise Resource Planning (ERP), followed by a description of SAP, the largest ERP enterprise software provider in the world. SAP's flagship software program, the R/3 system, is portrayed in more detail. The capabilities of the R/3 system, the three-tier client/server technology it employs, its hardware and software, and several problems associated with its implementation and use are discussed. The two R/3 implementation tools – namely, the Accelerated SAP and the Ready to Run systems – are also described. Finally, the paper concludes with several important issues that managers must consider before implementing any ERP system.*

## INTRODUCTION

Since first envisioned in the 1960s, integrated information systems have expanded tremendously in scope, evolving from inventory tracking systems, to Materials Requirements Planning (MRP), and finally to Enterprise Resource Planning (ERP) (Brady, Monk, and Wagner, 2001). Today, almost every organization integrates part or all of its business functions to achieve higher efficiency and productivity. Since its conception in 1972, SAP has become the largest developer of enterprise software applications in the world.

The purpose of this article is to provide readers with a general understanding of ERP and a more detailed description of SAP and its flagship product, the R/3 system. The bulk of the article is devoted to describing SAP R/3's capabilities, its three-tier client/server technology, the hardware and software needed, and some problems with the R/3 system. Two implementation tools – namely, the Accelerated SAP and the Ready to Run systems – have been developed by SAP to expedite the lengthy system implementation process, and both are described in the next section of the article. The last section discusses several critical issues that managers must consider before making the final decision to integrate all the business functions in the organization.

## ENTERPRISE RESOURCE PLANNING (ERP)

Enterprise Resource Planning (ERP) is the process of integrating all the business functions and processes in an organization. It achieves numerous benefits. First, a single point of data entry helps to reduce data redundancy while saving employees' time in entering data, thereby reducing labor and overhead costs as well (Jacobs and Whybark, 2000). Second, the centralization of information, decision-making, and control leads to increases in efficiencies of operations and productivity, as well as coordination between departments, divisions, regions, and even overseas operations. This is especially true for multinational corporations, for which global integration could result in better communications and coordination around the world and the global sourcing and distribution of parts and services could provide appropriate benchmarks for worldwide operations. Third, the sharing of a centralized database provides business managers with accurate and up-to-date information with which to make well-informed business decisions. Further, it reduces data redundancy while improving data integrity. Fourth, functional integration consolidates all sorts of data, such as financial, manufacturing, and sales, to take advantage of bulk discounts. ERP is especially important for companies that are "intimately connected" to their vendors and customers, and that use electronic data interchange to process sales transactions electronically. Therefore, the implementation of ERP is exceptionally beneficial to businesses such as manufacturing plants that mass-produce products with few changes (Brady, Monk, and Wagner, 2001). ERP provides companies with a competitive advantage.

With the rapid growth of e-commerce and e-business in recent years, coupled with the growing popularity of concepts such as supply-chain management, customer relationship management, e-procurement, and e-marketplace, more and more organizations are integrating their ERP systems with the latest Business-to-Business applications. This new challenge is often referred to as Enterprise Commerce Management (ECM). The major enterprise software providers are Oracle, PeopleSoft, J.D. Edwards, and SAP.

## SAP AG

Systemanalyse und Programmentwicklung (SAP) was founded in 1972 in Mannheim, Germany, by five former IBM systems engineers. In 1977, the company was renamed Systems, Applications, and Productions in Data Processing (SAP), and the corporate headquarters was moved to Walldorf, Germany. The primary goal of SAP is to integrate all the business functions in an organization, so that changes in one business process will be immediately and spontaneously reflected by updates in other related business processes. Designing revolutionary and innovative software packages implemented on a multilingual (in more than 20 languages by 2000), multi-currency, and multinational platform, SAP is the world's largest enterprise software provider of collaborative e-business solutions (Buck-Emden, 2000).

Initially, the R/1 system (abbreviated for "runtime system one", indicating real-time operations) was developed in 1973 to solve manufacturing and logistics problems. Over time, it expanded into other contemporary markets such as services, finances, and banking, and added more business functions; for instance, the Asset Accounting module was added in 1977. The more integrated, mainframe-based R/2 system was launched in 1979. The first version of the R/3 system was released in 1992, while the Internet-enabled Release 3.1 was completed in 1996. By 2001, SAP had annual sales of \$6.4 billion, making it the third largest software vendor in the world (behind Microsoft and Oracle). Currently, SAP employs over 27,800 people in more than 50 countries, has 1,000 partners around the world who have installed 50,000 systems, serves 10 million users at 18,000 organizations in over 120 countries, and specializes in 21 industries. SAP has established seven "bleeding edge technology" research centers around the world. The latest, at Queensland University in Australia, conducts research on voice recognition and mobile computing. The other corporate research centers are located in Palo Alto, CA; Karlsruhe, Germany; Brisbane, Australia; Sophia Antipolis, France; and Johannesburg, South Africa (SAP Corporate Research, 2002). These centers conduct research on E-Learning, mobile computing, intelligent devices, e-collaboration, advanced customer interfaces, and technology for application integration.

## THE R/3 SYSTEM

The R/3 system is a powerful enterprise software package with several significant updates over the mainframe-based R/2 version. The R/3 system has three major function modules: SAP Financials, SAP Human Resources, and SAP Logistics (Larocca, 1999). The financials module is an integrated suite of financial applications containing submodules such as financial accounting, controlling, investment management, treasury cash management, enterprise controlling, and real estate. All issues regarding recruitment and training are managed using the human resources module, which contains personnel administration and personnel planning and development submodules. The logistics module manages issues related to sales and distribution, production planning, materials management, quality management, plant maintenance, logistics information systems, project systems, and product data management.

The R/3 Reference Model is equipped with more than 8,000 configuration options (Jacobs and Whybark, 2000). The newest version of R/3 is the SAP R/3® Enterprise, which has new and continuously improved functions, provides flexibility and optimization, and utilizes innovative technology to manage collaborative e-business processes.

#### Capabilities of the R/3 System

While designing the R/3 system, SAP developers choose the best, most efficient ways in which business processes *should* be handled, and incorporate these “best practices” into the system (Brady, Monk, and Wagner, 2001). Therefore, clients of the R/3 system may need to redesign their ways of conducting business to follow the practices dictated by the R/3 developers. In some situations, organizations may need to reengineer their business processes in fundamental ways, revamping old ways of conducting business, redefining job responsibilities, and restructuring the organization. R/3 systems can, however, be customized to address global issues where different countries have different ways of doing business; country-specific business practices pertaining to accounting, tax requirements, environmental regulations, human resources, manufacturing, and currency conversion rules can be built into R/3 systems.

Unlike the R/2 system, the R/3 system requires only a single data entry, and it provides users with immediate access to and common usage of the data. This new system was designed around business processes and applications such as sales orders, material requirements planning, and recruitment. An important advantage of the R/3 system is its ability to run on any platform, including Unix and Windows NT. R/3 also utilizes an open architecture approach, so that third-party software companies are allowed to develop add-on software packages and integrate hardware equipment such as bar code scanners, PDAs, cell phones, and Global Information Systems with the R/3 system (Buck-Emden, 2000). Sophisticated and more advanced users can design customized graphical user interfaces (GUI) screens and menus and/or create ad hoc query reporting trees and customized reports using the ABAP Workbench tools (Larocca, 1999). The object linking and embedding (OLE) technology allows files from other applications such as Microsoft Office and Corel Office to be easily integrated with the R/3 system. The SAP On-line Help Documentation, available in both standard and compressed HTML, is contained on a separate CD-ROM.

In 1996, in order to better streamline the R/3 system, it was broken down into the following five categories of components as part of the SAP Business Framework: industry-neutral, industry-specific, Internet, complementary, and custom. SAP continues to develop software components such as the SAP Advanced Planner & Optimizer (SAP APO), SAP Customer Relationship Management (SAP CRM), and SAP Business Information Warehouse (SAP BW), to form the technical foundation for the <http://www.mysap.com/> e-business platform.

#### The Three-Tier Client/Server Technology

It was the advent of inexpensive hardware and the improvement of client/server technology in the 1990s that propelled SAP to develop the SAP R/3 system, which was designed for the client-server environment. The client/server distributed computing architecture allows users to access the system via any computer that is connected to the network, even working from home. The R/3 system utilizes the same three-tier hierarchy configuration as the Relational Database Management System (RDBMS). The user interface layer refers to the GUI of the client computer, which serves as a means for the end user to communicate with the applications and database servers. The business logic layer consists of the application server, which performs all the administrative functions of the system, including background processing, printing, and process request management. The innermost layer consists of a central computer that contains the database server, the data dictionary, and the Repository Information System, which is used to retrieve information on the objects in the data dictionary. An improved version of the three-tier architecture is the four-layer client/server configuration, with an additional layer for Internet service (Buck-Emden, 2000).

#### Hardware and Software

The hardware components of an SAP R/3 installation include the servers that house the databases and software programs, the client workstations for

user interfaces, and the network communications system that connects servers and workstations. The software components of an SAP R/3 installation consist of the network infrastructure, the operating systems, the database engine, and the client desktop. Several application programs are installed onto the servers: the main function modules, the customized as well as the interface programs, and the ABAP/4 (Advanced Business Application Program) developer's workbench programming tools. ABAP programmers use ABAP/4 to develop regular application programs that are included with the R/3 system as well as customized software programs for their clients (Buck-Emden, 2000). Some commonly used ABAP/4 tools are: the ABAP List Processing, used to list reports; the ABAP Query, used to develop queries; the Screen Painter, used to design screens; and the Menu Painter, used to create menus. Third-party vendors are permitted to develop customized add-on software programs to be linked with the R/3 system. The data repository for the RDBMS and the basis module (as a prerequisite for all application modules) are also installed onto the servers.

#### Problems With SAP R/3

Although SAP touts its R/3 system as a revolutionary, efficient, and innovative software program, the system does have a few drawbacks. Because of the complexity of the R/3 system, many assumptions must be made in order to confine the number of configuration options available. However, once the system is configured, all the options are fixed and cannot be changed. Further, users must enter all the fields before they are allowed to proceed to the next screen or activity (Jacobs and Whybark, 2000). Consequently, many people find the R/3 system to be relatively rigid. Nevertheless, the flexibility of the SAP system can be improved by installing specially designed customized applications developed by ABAP programmers.

A second potential problem with R/3 has been mentioned above. In order to increase the efficiency of doing business, SAP developers incorporated “best practices” into the R/3 system. Basically, they decided how clients *should* conduct their businesses. However, not all businesses agree with this philosophy, and this approach may not be acceptable or applicable to some organizations. In such instances, it may be extremely important for organizations to continue with their usual ways of doing business and hence for the system administrator to configure the system according to these established practices (Jacobs and Whybark, 2000). These simply may be incompatible with the R/3 system.

SAP attempts to incorporate all business practices, including environmental and other regulations into the R/3 system. However, three types of misfits (relating to data, process, and output) can occur due to incompatibilities between software functionality and organizational requirements (Soh et al., 2000). Major multinational corporations that installed similar R/3 systems in several different countries could experience any of these mismatches in the systems due to differences in cultural and regulatory environments. The unique context of each country in which an organization operates must be carefully enmeshed into the traditionally Western-biased business practices inherent in the R/3 systems. Further, there is the problem of migration between software versions, in which the newer version is sometimes not backward-compatible with the older version.

When using the SAP On-line Help Documentation, the version number listed on the Help CD-ROM must correspond with the version of the SAP GUI (Larocca, 1999). However, even when the two versions correspond, incompatibilities may be present, because changes and upgrades in a higher version of the software are not updated in the Help CD-ROM of the same version number. Further, the Help CD-ROM has limited searching capabilities on some concepts, rendering the help feature an inefficient support tool. In addition, not all materials are properly translated from the original German version, and not all the help documentation has been translated.

#### TWO R/3 IMPLEMENTATION TOOLS

R/3 system implementation is both expensive and time-consuming; a complete implementation can cost between one and several million dollars and can take more than 3 years. Only Fortune 500 corporations can afford such extensive deployment of ERP as R/3 systems represent. In an attempt to target small and medium-sized companies as well as large organizations that are interested in only partial ERP integration, SAP developed two implementation alternatives: the Accelerated SAP and Ready to Run R/3 programs.

The Accelerated SAP (ASAP) program is a rapid implementation tool designed to install the full R/3 system quickly and efficiently by focusing on tools and training and utilizing a five-phase, process-oriented strategy for guiding successful implementation (Larocca, 1999). The five phases are project preparation, business blueprint, realization, final preparation, and go live and support.

Designed for small to medium-sized companies, the SAP Ready to Run R/3 (RRR) program complements the ASAP system by bundling the server and network hardware systems with a pre-installed, pre-configured base R/3 system, an operating system, and a database management system (Larocca, 1999). This approach yields significant cost and time savings by reducing the implementation schedule by as much as 30 days. The RRR solution includes a specially developed online tool called the System Administration Assistant, which allows a minimally trained system administrator to manage the system effectively. A RRR system can be purchased through any SAP hardware vendor partner such as Hewlett-Packard, Compaq, IBM, NCR, Siemens, or Sun Microsystems. It can be supported by operating systems such as Microsoft Windows NT, IBM AS/400, and Unix. The databases supported by the R/3 systems include Microsoft SQL server, DB2, Informix, Oracle, and Dynamic Server. All the options in the SAP system are configured using the SAP Implementation Guide (IMG).

### IMPORTANT ISSUES TO CONSIDER BEFORE IMPLEMENTATION

Before integrating business functions, managers must consider several important issues that will help them decide whether an ERP integration using the SAP R/3 system is the right choice for their organization. First, managers must consider the fundamental issues of system integration by analyzing the organization's vision and corporate objectives (Jacobs and Whybark, 2000). For instance, does management fully understand its current business processes, and can it make implementation decisions in a timely manner? Is management ready to undertake drastic business process reengineering efforts to yield dramatic outcomes? Is management ready to make any changes in the structure, operations, and cultural environment to accommodate the options configured in the R/3 system? As in any type of system implementation, active top management support and commitment are essential to the success of the project. Next, management needs to decide on the key related implementation and business issues and how to proceed. Certainly, ERP is not suitable for companies that are experiencing rapid growth and change in an unstable environment that are undergoing change in the corporate management and philosophy, or that will be experiencing merger or liquidation in the near future.

Another important question for managers to consider is how much to implement. For instance, is the organization embarking on an ambitious journey of revamping the whole enterprise using a complete integration, or is the organization employing a franchising strategy of implementing a partial integration across a few divisions with uncommon processes (Koch, 2002)? The bigger the organization, the more complex the business processes are and the greater the difficulties in implementing the SAP system (Brady, Monk, and Wagner, 2001). On the other hand, organizations considering a partial implementation must deal with the problems associated with using multiple vendors. They also need to consider simultaneous versus piecemeal implementation because of the ripple effect caused by decisions made in one module (Brady, Monk, and Wagner, 2001). In general, in order to maintain a smooth transition of the business processes and operations, simultaneous integration of the whole system, instead of functional or departmental integration, is highly recommended.

People-related issues such as corporate philosophy and leadership style can play an important role in the implementation process. Employees can be

quite wary of any kind of change in the business processes, particularly during periods of economic downturn. In order to reduce users' resistance to change, employees must be educated about the ERP installation. Such educational endeavor should include a concise introduction to the basic concepts and architecture of ERP systems, including actual screen shots of the function modules. During these training sessions, it is important to discuss the managerial issues involved and to build a basic understanding of the integration concepts prior to the actual installation of the ERP system.

Several activities must be performed before and after an ERP implementation. For instance, managers must conduct a feasibility study of the current situation to assess the organization's needs by analyzing availability of hardware, software, databases, and in-house computer expertise, and make the decision to implement ERP where integration is essential (Buck-Emden, 2000). Further, organizations need to exploit future communication and computing technology to integrate the ERP system with e-business applications. Oftentimes, additional new hardware and specialized professionals are needed to run the powerful software system. Depending on the size of the company and the modules installed, the cost of implementation can range from one million to five hundred million dollars, and will take as long as two years for a mid-size company and seven years for a large, multinational corporation to complete.

### SUMMARY

This paper provides readers with a general understanding of Enterprise Resource Planning (ERP); of SAP, the third largest software vendor in the world; and of SAP's R/3 system. The capabilities of the R/3 system include complete system integration, global accessibility, scalability, and open architecture. The three-tier client/server technology refers to the user interface layer, the business logic layer, and the database server layer. The hardware elements for an R/3 installation include the usual servers and client workstations, but the software requirements are more elaborate. Some of the problems associated with the R/3 system include the adopting organization's need to reengineer business processes, the misfits and mismatches between system functionality and organizational requirements, and inadequacies in the SAP On-line Help Documentation. The Accelerated SAP and Ready to Run systems are two implementation tools designed to expedite the implementation process. Several critical issues that managers must consider before making any SAP implementation decision are discussed. Some of these issues are: the organization's readiness and ability to accept and implement major installation; the size of the implementation; and users' resistance to change.

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