



**Implementation of Enterprise Resource Planning (ERP)
and especially SAP in the Construction Industry: the case
of Elliniki Technodomiki SA**

by

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**This thesis is submitted in partial fulfillment of the
requirements for the degree of Master of Science in Built
Environment from the University of London.**

**Bartlett School of Graduate Studies
University College London**

September 2002

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ABSTRACT

The last few years many companies have adopted and implemented an ERP system in order to manage their business needs and challenges.

Firstly, this report attempts to gain insight into ERP systems by briefly describing the systems and their possible advantages and disadvantages of having an integrated ERP system, focusing more on SAP.

More specifically, the basic purpose of this study is to investigate the impacts of ERP systems in organizations in the Construction Industry. It also tries to understand the motives for the adoption of an ERP system by a construction company and the possible consequences for taking this decision.

For these reasons, it is presented an analysis on the implementation of SAP in Elliniki Technodomiki S.A., which is the first company in terms of turnover in the Greek construction market. Recommendations, derived from the analysis of the case study, are given. An analysis of the operational and strategic implications of the implementation of an ERP system is presented.

Study findings confirm the importance of ERP implementation in the field of constructions. The study findings could be of interest to managers of these companies, who seek to better understand the issues surrounding ERP systems implementation.

Finally, in the conclusion, further research on the topic is suggested, having the context in which construction companies are doing business in mind.

Keywords: ERP, SAP, Integrated Information System, Implementation, Construction Industry, Elliniki Technodomiki.

Word Count: 10.558

ACKNOWLEDGEMENTS

Upon the completion of my dissertation I would like to express my appreciation and gratitude to all those who in various ways contributed to the realization of this project.

I am extremely grateful to my supervisor, Professor Graham Winch, for his guidance and constructive comments during the preparation of this report, and for his valuable insight into this area of research.

I am very grateful to Professor Graham Ive for his assistance and input towards my comprehension of the Construction Industry.

I would also like to express my gratitude to all the individuals and professionals who helped gathering the necessary information for my research.

In particular, I would like to mention and cordially thank Mr. Konstandinos Papadopoulos, former member of Elliniki Technodomiki, and Mr. Anastasios Kallitsantsis, CEO and technical director of Elliniki Technodomiki for their abundant help and care during my project.

I am very grateful to the employees of Elliniki Technodomiki and I wish to thank them for their assistance and the provision of background literature. In particular I would like to cordially thank Mr. Konstandinos Neroutsos and Mr. Ioannis Korolis for their continuous support and patience during the entire period of my project. In addition I would like to thank Periklis Papadakis, Dimitrios Darmazis, Leonidas Mourelatos and Eleni Douka for the interviews they gave me.

Finally, my deepest gratitude goes to my family, for their continuing support and encouragement during the preparation of this report. They serve as the motivation and inspiration for everything I do.

This dissertation is dedicated to them.

ACRONYMS

AM: Assets Management
APS: Advanced Planning and Scheduling
BPI: Business Process Improvement
BPR: Business Process Reengineering
B2B: Business-to-Business
CASE: Computer Aided Software Engineering
CEM: Construction Equipment Management.
CI: Construction Industry
CM: Cash Management
CO: Controlling
CRM: Customer Relationship Management
DW: Development Workbench
EC: Enterprise Controlling
ECE: Extended Collaborative Enterprise
EDI: Electronic Data Interchange
EFT: Electronic Fund Transfer
ERP: Enterprise Resource Planning
ET: Elliniki Technodomiki SA
FI: Finance Management
HR: Human Resources
IM: Investment Management
IS: Information System
IT: Information Technology
MM: Materials Management
MRP: Material Requirements Planning
MRP II: Manufacturing Resource Planning
PM: Plant Maintenance
PS: Project System
QM: Quality Management
PP: Production Planning
RDMS: Relational Database Management Systems
SAP: Systems and Applications Products in Data Processing
SCM: Supply Chain Management
SD: Sales and Distribution
TEB: Volos' Technical Company SA
WF: Workflow

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1. INTRODUCTION

1.1. IDENTIFICATION OF RESEARCH PROBLEM

In today's competitive and constantly changing business environment, the capability of reaching immediate decisions based on reliable sources and parameters is considered as totally necessary. A modern company produces on a daily basis a huge bulk of information that is distributed to different departments of the company in different geographical sites and in different systems. In this chaos of spread data, valuable information is hiding which could give answers to critical questions, helping the better understanding of the business scenery, supporting better and reliable decisions, and improving the company's performance. The above-mentioned need and the attempt to satisfy it, is explained by the fact that today someone can see the Information Technology¹ in every organization and almost at every workplace. It is responsible for the connections between people and organizations, for the production and quality control, security and financial records. The development and use of the Information Systems² tends to become for many organizations one of the critical factors for surviving.

The accumulation, transformation and processing of the information through different and specialized systems for each department and activity of the company has a high indirect cost. For that reason there is internationally a transaction in organizations from the traditional independent systems that every company uses to the adaptation of Enterprise Resource Planning³ packages. These applications are designed to integrate and partially automate many of the company's business processes.

ERP applications, in general, connect or replace the specialized software products. In addition, by constituting a point of concentration and collection of information for the entire company, they create a unified management environment.

The last few years ERP systems prevailed on an international level. The organizations in the Construction Industry⁴, in spite of showing some delay in

¹ IT

² IS

³ ERP

⁴ CI

comparison with other fields, could not have been an exception, so they eventually adopted and applied ERP systems. One of the reasons is the particular characteristics the CI has, as well as the projects it carries out. Construction projects usually are characterized as “off nature” and even if they look similar, they are never exactly the same. Construction projects are “site-based”, in other words, even if they are the same kind of project, they are taking place in different sites. Additionally, in a new construction project, different technologies could be implemented, and different people, companies or organizations are involved. So, problems in managing a construction project could arise from the increased complexity of a large or innovating project, which demands new or special technology, and from the form and integration of a project coalition, which changes in each project and affects it, because of human factors or different organization’s practices. Uncertainty and change could cause problems in the management of construction projects. Additionally the subcontracting is a main characteristic of the construction industry.

All reasons mentioned above make difficult the adoption of certain business processes, which could be incorporated in a particular ERP system. On the other hand in small CIs, such as the Greek one, which until recently was consisted of a big number of small and medium size companies, the implementation of ERP applications was not possible, due to their size.

However, the last few years many construction companies, on an international level, went ahead with the implementation of ERP systems. Initially the main contribution came from the development of specialized ERP packages with additional operations for each industry, such as the CI, by ERP vendors⁵. In addition, the experience accumulated through the implementation of these systems in the original construction companies, helped and encouraged other companies to do the same. On the other hand, the merging wave, which influenced strongly the last years the Greek construction companies, created big construction groups with expansion across the borders. This situation promotes for the future the use of ERP systems as a basic variable of success. Finally after the birth of e-business and the first steps of e-commerce, construction companies reexamine ERP, as an additional tool to the hands of the construction managers.

⁵ Industry solutions

The interest in implementing and realizing the benefits of ERP systems has been increased in the CI, as we have mentioned above. The adoption and implementation of an ERP system is considered as an important strategic decision of the construction managers. Although this author found no bibliography for the possible problems that a construction company faces in connection with the implementation of SAP, it would be unreasonable to presume that problems do not exist. For this particular reason we believe that the managers in the CI, in order to be better prepared for the reception of ERP systems, is worthwhile to try to study and understand the advantages of the systems as well as the possible problems they might face during their implementation. The installation time needed for an ERP system as well as the implementation cost are both important factors that have to be taken into account. Significant source of information for the above study is the experience of the construction companies which first adopted ERP systems.

In conclusion, construction companies can acquire a competitive advantage with the right use of ERP applications, which will provide them with the ability to better manage a wide range of business requirements. As a matter of fact we can easily speak about real challenges, such as supplies, the work force, project management and the accounting complexities. This is very important in the rapidly changing modern environment. The study, -from the side of the construction managers-, of the implementation of ERP systems in general and particularly of SAP, with the high global market share, is of particular and high interest.

1.2. PURPOSE AND OBJECTIVE OF RESEARCH

The basic purpose of this study is to investigate the impacts of ERP systems in organizations in the CI. In order to accomplish this, several objectives were pursued. Firstly, one of the objectives of this research is to gain insight into ERP systems by briefly describing the systems and their possible advantages and disadvantages of having an integrated ERP system. Then, the research will examine in details the SAP system, which has been selected by more than 1700 companies worldwide in the construction industry in order to meet their industry-specific business and technology requirements. Additionally, the research will investigate the implementation of SAP

and especially the interesting case of implementation of SAP in Elliniki Technodomiki SA⁶, a Greek construction company, which uses SAP R/3 since the beginning of 1997. The study of the implementation of SAP in ET is being carried out in order to obtain a broad view of issues as whether construction companies could gain benefits and competition advantage by using ERP software, as well as whether these applications enable them to manage their comprehensive business requirements and to attempt to record certain problems and future needs for ET. Through this study there will be an effort to understand the motives for the adoption of an ERP system by a construction company and the possible consequences for making this decision.

1.3. LIMITATION OF SCOPE

The scope of this research will be limited to the investigation of ERP systems only and not to other computer applications used by construction companies. The use of ERP systems by construction companies the last years has been increased. The investments on these systems are large enough while the up to now research is really small. For these reasons the focus of this study on the ERP systems as far as the CI is concerned, has been considered as absolutely essential.

Another delimitation in this research paper is the study of the implementation only of SAP software in one construction company. Thus, while in the beginning there is a detailed description focused on the characteristics of the ERP systems, later the research focuses on the implementation of SAP. SAP was chosen as the ERP system of focus because of its high market share and because ET was the first construction company in the Greek market to implement it. As a result, besides the reference on the SAP choice by ET, this paper does not include an evaluation or comparison of ERP systems with other systems, and it is necessary to underline that this paper is neither an advertisement nor a criticism of any system. On the other hand ET was chosen because as it has been mentioned before it was the first company in the Greek market implementing SAP since 1997 in order to cover its business needs.

⁶ From now on we will refer to Elliniki Technodomiki SA as ET.

The implementation of SAP in ET has not been completed yet, but the initial objectives of the company have been accomplished and most basic SAP modules have been developed. Today, some other Greek construction companies have started implementing ERP systems, following the example of ET, but it is clear that they are obviously on an early stage.

Clearly there is a need for further research aiming towards the implementation of other ERP systems as well as the study of more construction companies. This particular type of research however has particular interest because of lack of a similar previous research and it is intended to increase awareness of the issues involved in using ERP systems in the CI.

1.4. VALUE OF RESEARCH

The construction companies plan produce and maintain highly complex products and industrial plants, based largely on customer specific requirements and definitions, so the ERP systems can have a great influence on this process. It is hoped that this research paper will fulfill its objectives and will succeed to explore through the case study of ET the application and the influence of an ERP system in a construction company. At the same time this report aspires to provide the construction managers with a better knowledge of the current and future situation. Moreover it can be of valuable guidance for employers in the CI, when they are forming their future strategies, by providing helpful information and by collecting the up to date experience of SAP'S implementation in ET.

Regardless if this study succeeds in reaching its objectives, it is hoped that it will generate interest, focus on the subject, trigger discussion and promote constructive interaction to develop an increasing interest for further research on this field. Furthermore it is hoped that it will aid in identifying and suggesting other areas for future study.

2. METHOD

2.1. POSSIBLE WAYS TO OBTAIN INFORMATION

It is required for someone in order to examine closely and understand ERP implementation in the CI, to first learn more about ERP systems and their functionality. Thus, there is a description of these systems in the first part of this report.

The written materials available are books, articles on the Internet, and brochures from the largest ERP vendors. Since ERP is relatively a new concept, there are not books written with the intention to describe the implementation of ERP in the CI. There are books describing the ERP system itself, but mostly one can acquire information by reading recent reports, magazines and Internet articles.

Another important part for collecting information about ERP systems and SAP is the interviews with the SAP clients. The sources of the primary information in this study were the interviews, which were performed in ET.

2.2. RESEARCH METHODOLOGY

Initially a review of published literature was the first activity undertaken. Through this review a list of questions was developed to help further guide the research. Upon completion, much was known about ERP systems and SAP, but little was focused on their implementation in a construction company. Additional activities were followed in order to acquire such insights. Initially information was collected from SAP AG itself concerning the implementation of SAP in a construction company⁷. In succession, a series of interviews was administered with members of the IS department of ET, who were responsible for the SAP project. Additionally users of SAP in different departments of the company were interviewed. Finally

⁷ It was originally intended that an interview with an SAP AG representative be carried out to review the subjects of this research. Unfortunately, despite the strong effort, it was not possible to happen neither in Greece nor in the UK. Although useful published information was received, during the different stages of the research valuable help and detailed explanations were received via e-mail from SAP in the UK.

members of the company gave more other information, useful elucidations and valuable help.

Main areas of the questions of the interviews⁸	
	<ul style="list-style-type: none">• Reasons for implementing an ERP system
	<ul style="list-style-type: none">• Choice of implementing partner
	<ul style="list-style-type: none">• The implementation process
	<ul style="list-style-type: none">• How the system works today
	<ul style="list-style-type: none">• The company's ERP needs in the future

Table 1. Main areas of the questions of the interviews.

⁸ The questions of the interviews are analytically cited in the appendices.

3. ENTERPRISE RESOURCE PLANNING

3.1. INFORMATION SYSTEMS⁹ & ERP

It is generally accepted that both the exploitation of technology and informatics are among the main means to create competitive advantages for a modern company. The IS of a company consists of the hardware and the applications it manages, in order to function properly both internally as well as in relation with its clientele. In a company, one of the main operations of the IS is the collection, storage, management, processing, presentation, and spreading of information. Kale [2000, p.23 & p.29] underlines the importance of Information-based organizations for the survival of the companies in the changing global competitive market, since he considers that information is by now the fifth resource¹⁰.

According to Dahlen & Elfsson [1999, p.5], in a company there are usually different types of IS, which can be divided into three areas:

- Systems developed in-house
- Standard application packages
- “Joint-venture”¹¹ systems

As Shields [2001, preface] notices, during the early years most IS were custom developed: each organization designed, programmed, tested and implemented financial, human resource and operational systems to meet unique organizational requirements. Most of these systems were developed by the organization’s in-house IS department. However, according to Chang & Gable [2001, p.1152], lately, organizations worldwide are moving away from developing IS in-house and are instead implementing Enterprise Resource Planning¹² systems and other packaged software.

“An ERP software application package is a suite of pre-engineered, ready to implement, integrated application modules, catering to all the business functions of an enterprise and processing the flexibility for configuring and customizing dynamically the delivered functionality of the package to suit the specific requirements of the

⁹ IS

¹⁰ The first four are manpower, materials, money and time.

¹¹ A “Joint-venture” system is a system that is a combination of a standard application package and an in-house-developed system.

¹² ERP

enterprise. ERP enables an enterprise to operate as an integrated, enterprise wide, process-oriented, information-driven, and real-time enterprise.” [Kale, 2000, p.13]

One of the main reasons companies today prefer packaged software is that several companies can use the same software. With several users, the costs of development, support and maintenance are shared. In addition, each client does not have to “reinvent the wheel” as Shields [2001, p.4] notices. Many existing systems have become so difficult and costly to maintain, inflexible and misaligned with business strategy that firms have taken a clean slate approach towards their IT strategy. [Davenport, 1998]

The Year 2000 problem¹³ and the new common European currency have been also major drivers for many companies to install an ERP system.

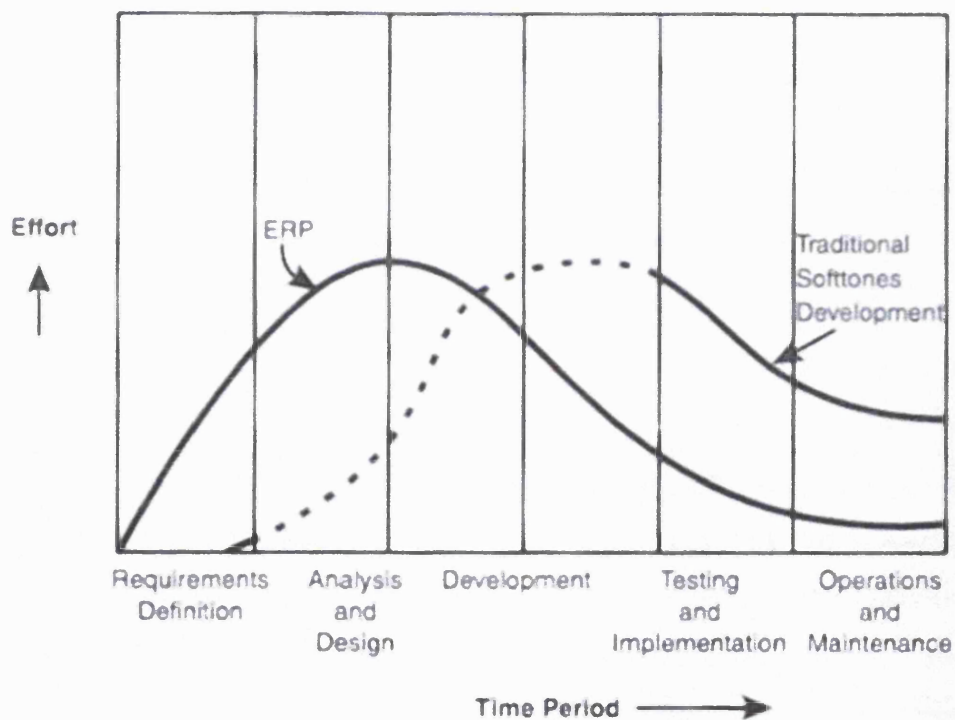


Figure 1. Comparison of effort expended during ERP and the traditional software development life cycle.

Source: [Kale, 2000, p12]

¹³ Y2K

3.2. ERP HISTORY

The term ERP has only been widely used the last few years, but the systems and their predecessors; MRP¹⁴ and MRP II¹⁵ have been actively sold for nearly 25 years [Dahlen & Elfsson, 1996, p.6]. Light & Holland [2000, p.117] summarize the literature on the concept of MRP including the calculation of quantities of materials and the times manufacturing organizations required in order to improve operations. Throughout the 1980's and the early 1990's the concept was extended to examine the engineering and financial implications of future demand on the business and it was renamed, Manufacturing Resource Planning or MRP II. With the development of the standard RDMS¹⁶ models in the 1990's the ERPs have dominated. ERP is the latest and most integrated development of the above-mentioned systems, defining a model of a complete IS. ERP packages differentiate from MRP II in the technical requirements such as the relational databases, the use of object oriented programming languages, the CASE¹⁷ tools, the architecture client/server as well as the open systems architecture for easy communication.

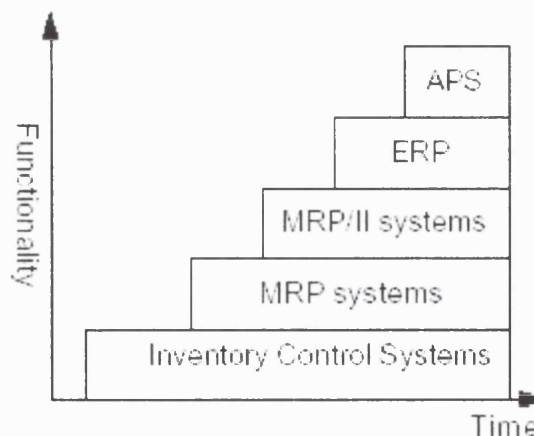


Figure 2. Development of Enterprise Systems

Source: [Kraemmergaard & Moller, 2000, p2]

¹⁴ Material Requirements Planning

¹⁵ Manufacturing Resource Planning

¹⁶ Relational Database Management Systems

¹⁷ Computer Aided Software Engineering

According to Kraemmergaard & Moller [2000] the latest offspring of ERP systems is the APS¹⁸ systems. APS systems extend the scope of the ERP systems from the enterprise to the entire supply chain and the systems are sometimes referred as SCM¹⁹ systems. SCM systems require the integration of vendors, distributors, resellers and customers. They started as stand-alone systems but now they are being integrated in the ERP packages as an APS module. Thus we see that ERP vendors continuously develop solutions for the expansion of their systems not only with the support of Web and e-commerce procedures but also with other additional areas such as SCM, CRM²⁰, B2B²¹ support and virtual enterprises. Additionally we have the intra-connection of the ERP's with each other and their interconnection with other applications creating "smart networks". Therefore while the initial goal was the completion of integration within the company through the ERP systems-as Kale [2000, p.444] notices -"the future of ERP is closely related with the effort to reengineer such inter-enterprise interfaces and foster closer collaborations across multiple enterprises, that is Extended Collaborative Enterprise²²".

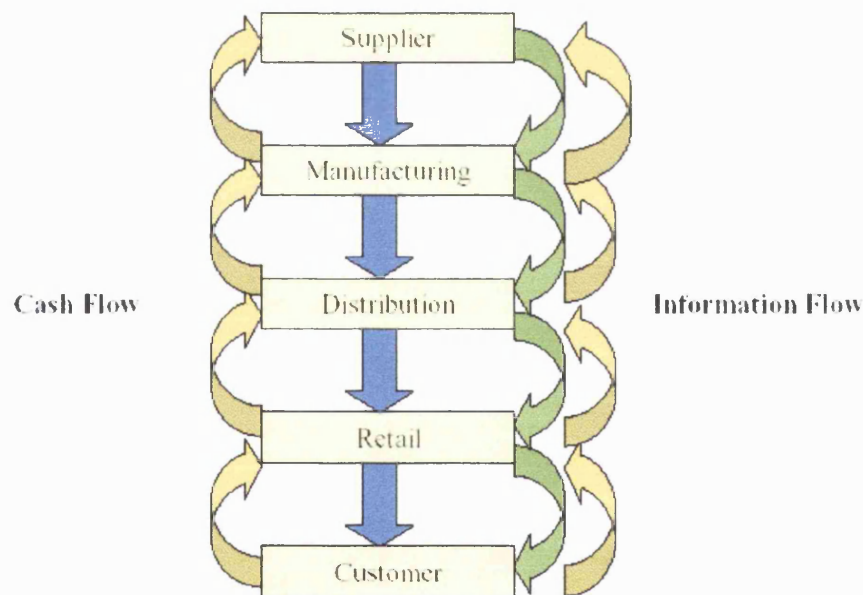


Figure 3. Supply Chain Management
Source: [Dahlen & Elfsson, 1999, p44]

¹⁸ Advanced Planning and Scheduling.

¹⁹ Supply Chain Management

²⁰ Customer Relationship Management

²¹ Business-to-Business.

²² ECE

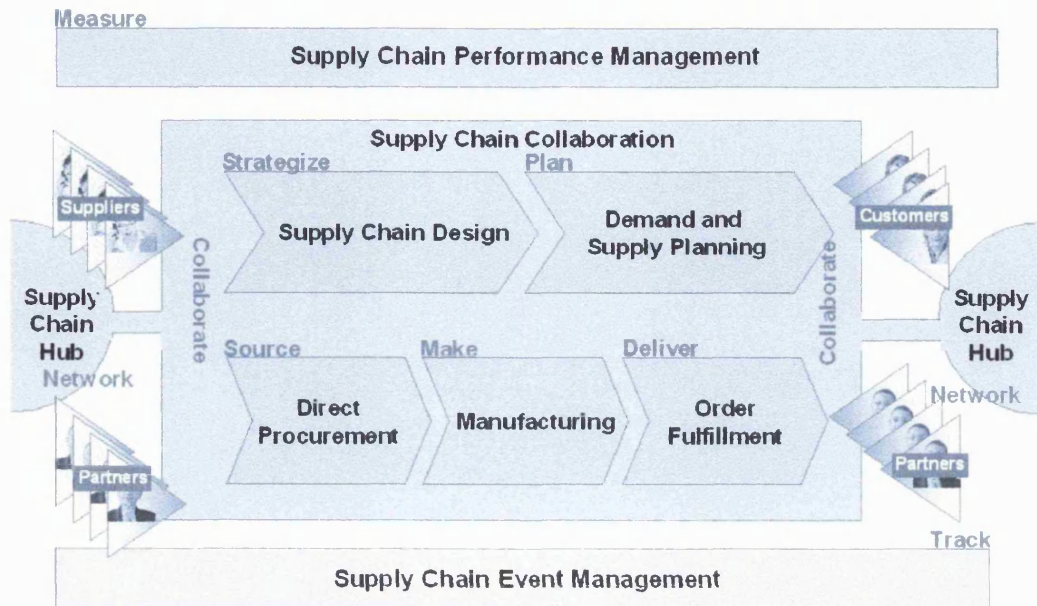


Figure 4. mySAP Supply Chain Management

Source: [SAP Corporate Profile, 2001, p26]

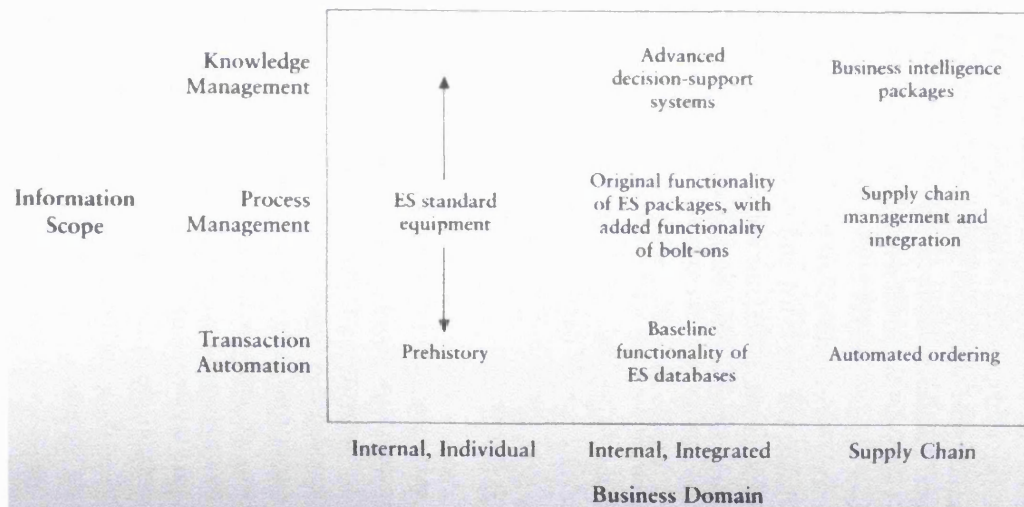


Figure 5. Future applications of ERP systems

Source: [Davenport, 2000, p278]

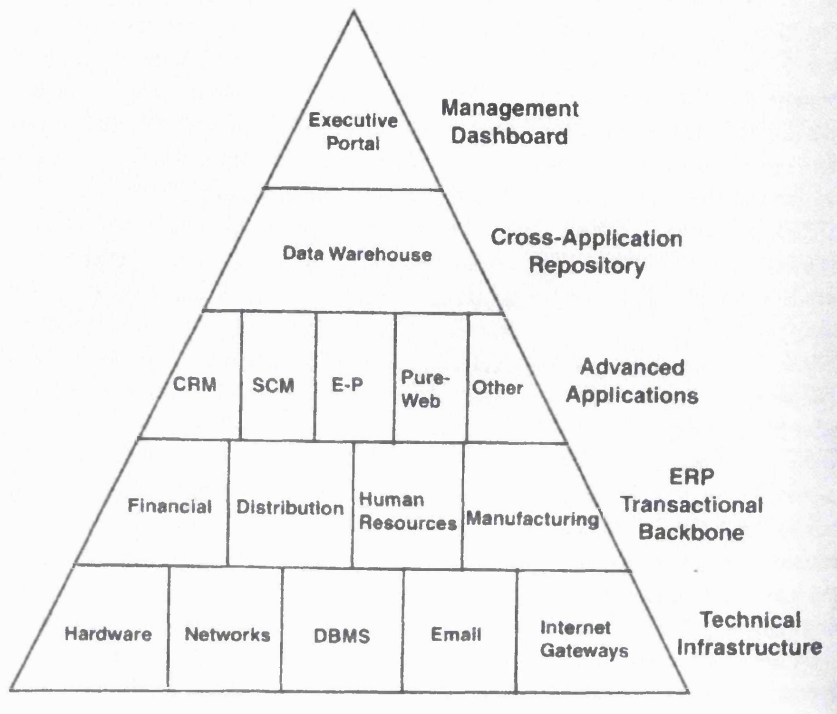


Figure 6. Extended Enterprise System Framework
 Source: [Shields, 2000, p10]

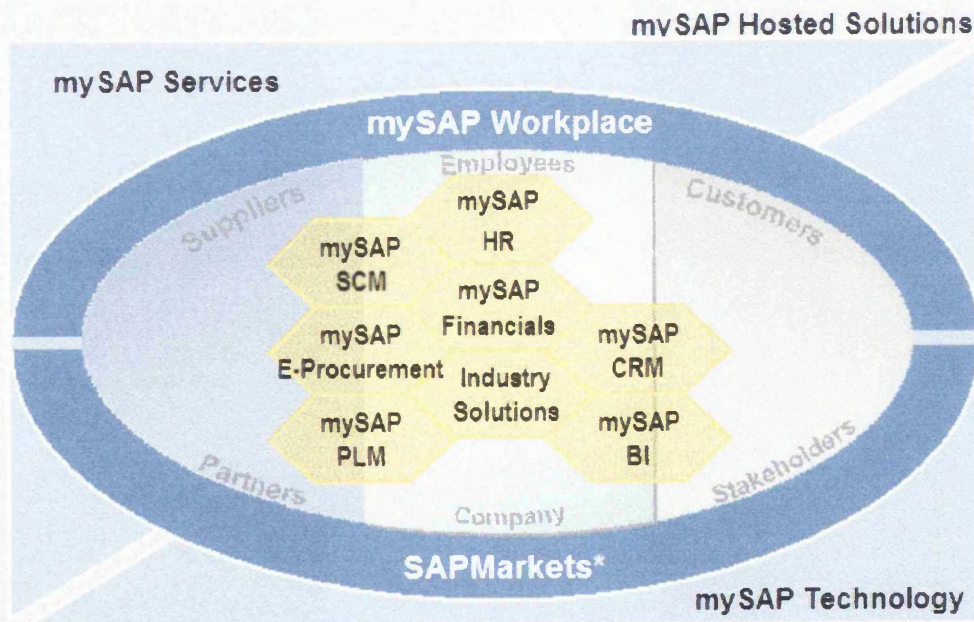


Figure 7. The mySAP.com E-Business Platform
 Source: [SAP Corporate Profile, 2001, p10]

3.3. ERP SYSTEMS

Enterprise Resource Planning as a subject combines technology, business, practices and organizational structures. “ERP system is a software solution that addresses all the needs of an enterprise with the process view of an organization in order to meet the organizational goals and integrate all the functions of the enterprise” [Kumar, 2001, p.2]. In other words it is a common term for cooperating software that manages and coordinates much of a company’s resources, assets and activities. Orders, storage, purchasing, assets, vendors’ contracts, financial and human resources are usually included in an ERP system. We can illustrate the use of an ERP system by the following example: When a store in Italy sells a product, data is sent simultaneously to the finance department in London and to the manufacturing department in Korea. Due to high cost involved, initially, only large multinational companies and Infrastructure companies were using ERP applications. Today many medium size companies have adopted the implementation of ERP.

The role of ERP systems is the integration of all systems and operations of a company under a common IS, where all people interested can have access. This system will provide all the necessary services for each department of a company in a unified environment, through which, the exchange of information from one department to another will be possible. This philosophy comes to replace what was happening until recently, where each department of a company had its own applications and its own IS.

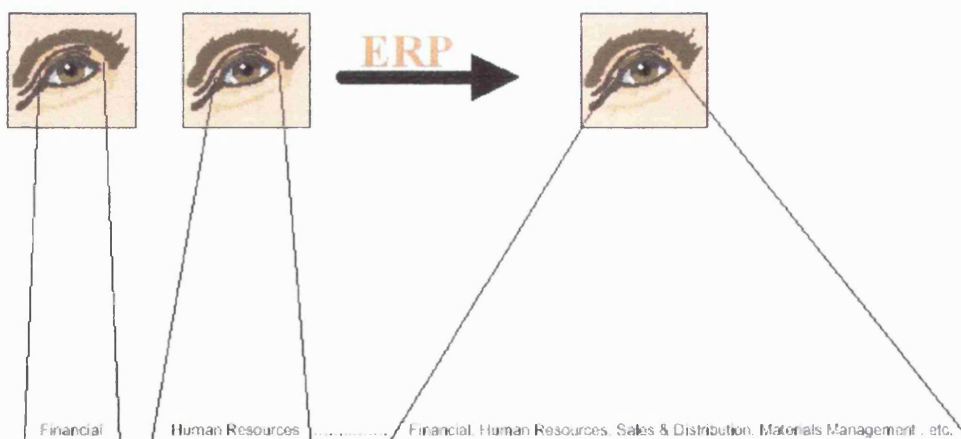


Figure 8. ERP system’s new focus
Source: [Dahlen & Elfsson, 1999, p13]



Figure 9. Integration of Information Systems

Source: [Kumar, 2001, p25]

A functional ERP system is massively complex. According to Davenport [2000, p. 299], several technical capabilities are the key to how an ERP system works, including the following:

- Modular construction
- Client/server architecture
- Configuration
- Common central database
- Variable interfaces

An ERP system is a collection of application modules. Companies can select among the available modules offered and install only those needed. Some of the most common modules of an ERP system are: sales and distribution, materials management, production and planning, finance and controlling, project system, human resources management and so on.

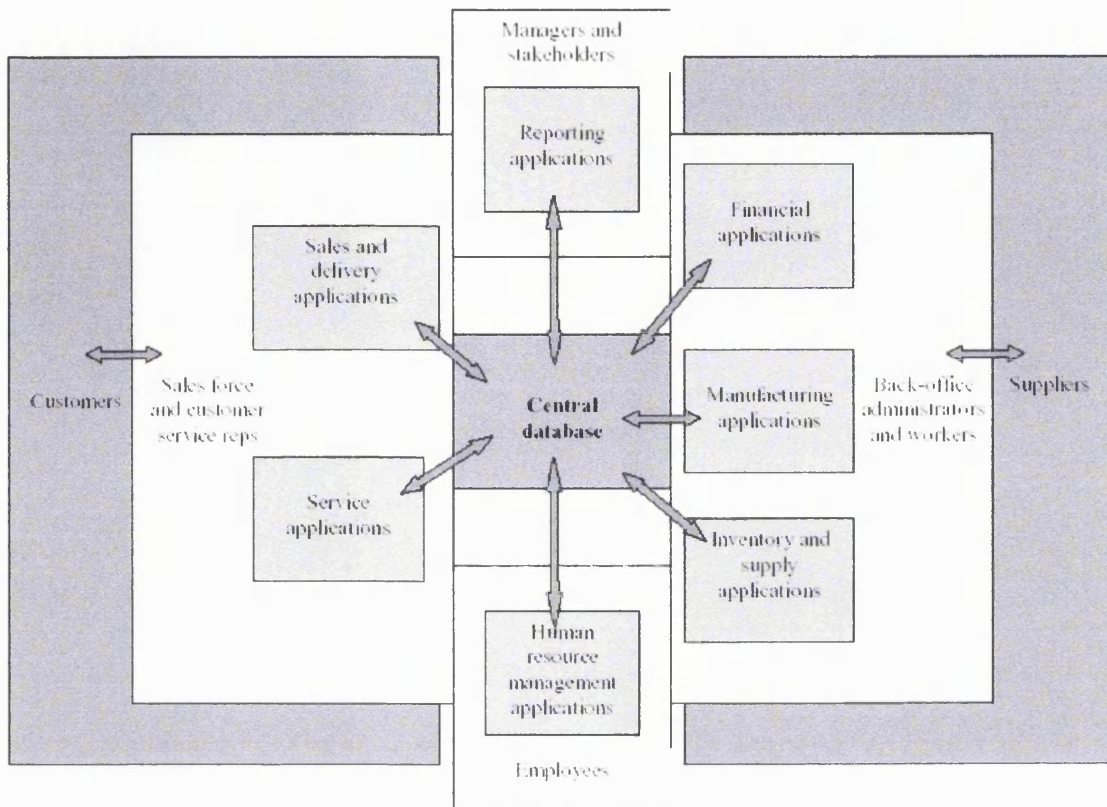


Figure 10. The ERP system

Source: [Davenport, 1998/ Dahlen & Elfsson, 1999, p8]

Advantages of the use of ERP	
	• Facilitates company – wide integrated IS, covering all functional areas.
	• By using it someone can have better control of the company.
	• Performs core corporate activities and increases customer service and thereby augments corporate image.
	• Organizes and optimizes the data input methodologies systematically and avoids data redundancy.
	• Cycle time reduction.
	• Better financial management.
	• It has highly Graphics based User Interface.

• Standardizes business processes across all constituent companies and sites, thus increasing their efficiencies.
• Faster information transactions.
• By using it suppliers and customers can have on-line communication.
• Flexibility. The systems consist of modules, which make adaptations at a later time easier.
• Transfer knowledge between industries, which guarantee innovation.
• It allows automatic introduction of latest technologies.

Table 2. Advantages of the use of ERP

Adopted by: [Kumar, 2001, p.45/ Davenport, 2000, p.8 / Kale, 2000, p.13 and p. 27 / Dahlen &Elfsson, 1999, p. 13]

Disadvantages of the use of ERP	
• It may have high cost for installation and materialization.	
• Could have long implementation periods resulting to a delay of the production procedures.	
• Imposes a hierarchical “command and control” perspective on organizations.	
• Davenport [2000, p.16], notes that ERP systems could be like cement, highly flexible in the beginning but rigid later.	
• It is developed by an external vendor without the company’s knowledge.	
• It has increased the need of external help from consulting firms.	
• It can introduce new routines for the staff.	
• It freezes the system development by the vendor.	

Table 3. Disadvantages of the use of ERP

Adopted by: [Davenport, 2000, p.16 / Dahlen & Elfsson, 1999, p.14]

3.4. ERP IMPLEMENTATION – FOCUS ON CI

In general, the concept of implementation is related to the installation of hardware and software. However as both Kraemmergaard & Moller [2000, p.6] clarify, in the world of ERP systems, the implementation is often used as a term to describe a well-defined project spanning from the choice of the systems through the configuration and the training until going live, where the system is becoming operative. In the companies' view, implementation means a continuous learning cycle where the organizational process supported by the ERP systems is gradually aligned with the business objectives.

Initially, one of the reasons that there is so much discussion about the concept of the implementation of an ERP system is because it is complex and can take long time to be completed. As Davenport [2000, p. 169] claims, the implementation of an ERP system is the most difficult part of the project. According to Kale [2000, p.69], the ERP project duration is dependent upon the characteristics of the company such as its organizational and technical readiness, as well as on the innate complexity of the ERP product. Additionally, cost is another factor that makes the implementation process so important. The implementation cost is usually bigger than the cost of buying the software itself. On the other hand as Bingi et al. [1999, p.8] indicate, the implementation of an ERP system needs to be prospectively managed because of the far-reaching changes an ERP system brings to companies. ERP systems are not mere software systems; they affect how a business conducts itself [Chang & Gable, 2001, p. 1162]. Therefore the implementation of an ERP system requires great attention in order to avoid negative consequences as far as time, money and the ERP system itself are concerned.

Implementing comprehensive IT applications like ERP systems is a knowledge-intensive task. As such, it requires a great amount of experience from a wide range of people such as representatives from business departments, technical specialists from the IT department and project managers within the organization to external business and implementation consultants [Chan & Rosemann, p. 917].

According to Kumar [2001, p. 42], ERP system implementation involves:

- Project Planning
- Business and Operational Analysis including Gap Analysis

- Business Process Re-engineering²³
- Installation and Configuration
- Project Team Training
- Business Requirements Mapping to Software
- Module Configuration
- System Modification and Interfaces
- Data Conversion
- Custom Documentation
- End User Training
- Conference Room Pilot
- Acceptance Training
- Production
- Post-Implementation Audit/Support



Figure 11. Stages of traditional approach to Package Implementation
Adopted by: [Shields, 2001, p34]

²³ BPR

Implementation Approach		
<i>Phase</i>	<i>Tasks</i>	<i>Deliverables</i>
Detailed Discussions	<ul style="list-style-type: none"> ■ Project Initialization ■ Evaluation of current processes, business practices, requirements ■ Set-Up Project Organization 	<ul style="list-style-type: none"> ■ Accepted norms & Conditions ■ Project Organization Chart ■ Identify Work Teams
Design & Customization	<ul style="list-style-type: none"> ■ Map Organization ■ Map Business Processes ■ Define Functions and Processes ■ ERP S/w Configuration ■ Build ERP System Modifications 	<ul style="list-style-type: none"> ■ Organization Structure ■ Design Specification ■ Process Flow Diagrams ■ Function Model ■ Configuration Recording ■ Systems Modification
Implementation/ Prepare to Go Live	<ul style="list-style-type: none"> ■ Create Go-Live Plan & Documentation ■ Integrate Applications ■ Test the ERP Customization ■ Train Users 	<ul style="list-style-type: none"> ■ Testing Environment report ■ Customization Test Report ■ Implementation Report
Production/ Go Live	<ul style="list-style-type: none"> ■ Run Trial Production ■ Maintain systems 	<ul style="list-style-type: none"> ■ Reconciliation Reports ■ Conversion Plan Execution

Table 4. Implementation Approach

Source: [Kumar, 2001, p43]

ERP implementation in a company is based on the choice and parameterization of operations from a common ground. Initially, a company has the choice to obtain a general solution, which under the right transformation incorporates the procedures of the specific company. However, on the other hand the company can find a solution that besides the general ground includes specific operational abilities for a vertical market.

One of the most important issues in planning is the decision about how much of the corporation to take on at once with your ERP implementation²⁴, [Davenport, 2000, p.173]. According to O'Leary [2000, p.151], in a full big-bang implementation, an entire suite of ERP applications is implemented at all locations at the same time. A phased, incremental, approach is one where modules are implemented one at a time or in a group of modules. Phased implementations are sequential implementations that consist of designing, developing, testing and installing different modules. The two key

²⁴ Figure 12

dimensions²⁵ that also differentiate approaches to ERP implementation are the time it takes to implement and the amount of business change and value to which a company aspires [Davenport, 2000, p.14].

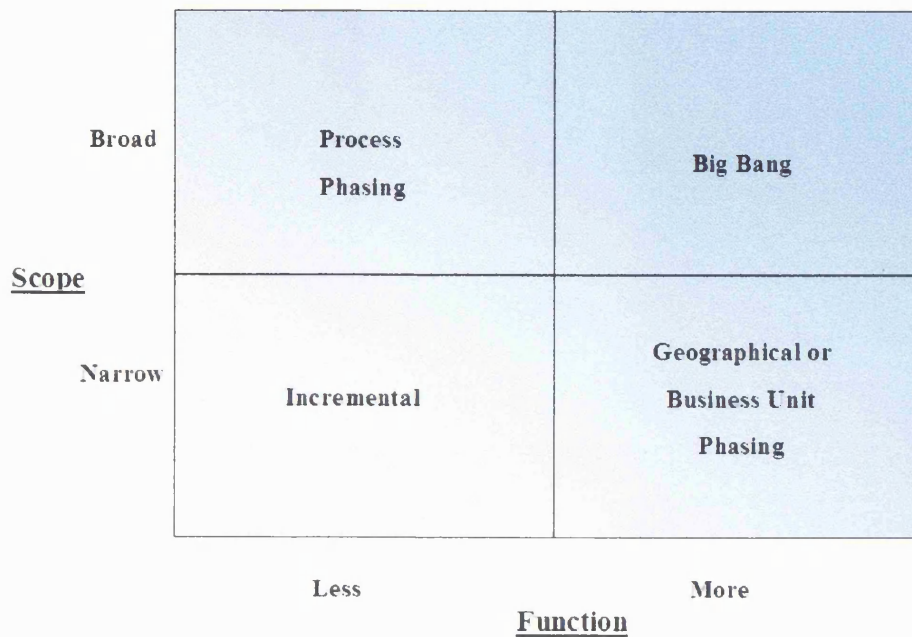


Figure 12. Implementation Options
Adopted by: [Davenport, 2000, p173]

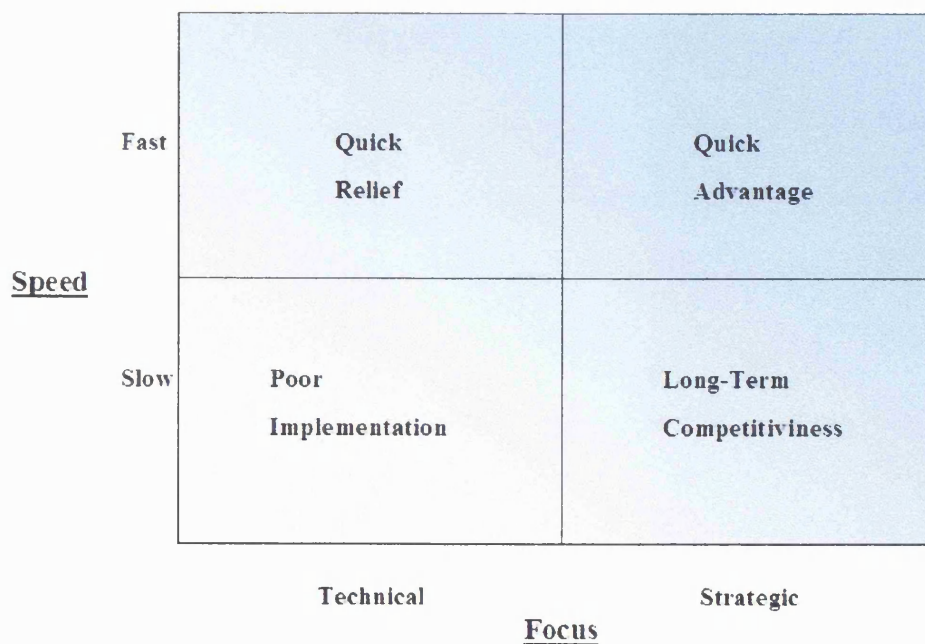


Figure 13. Alternative Implementation Approaches
Adopted by: [Davenport, 2000, p14]

²⁵ Figure 13

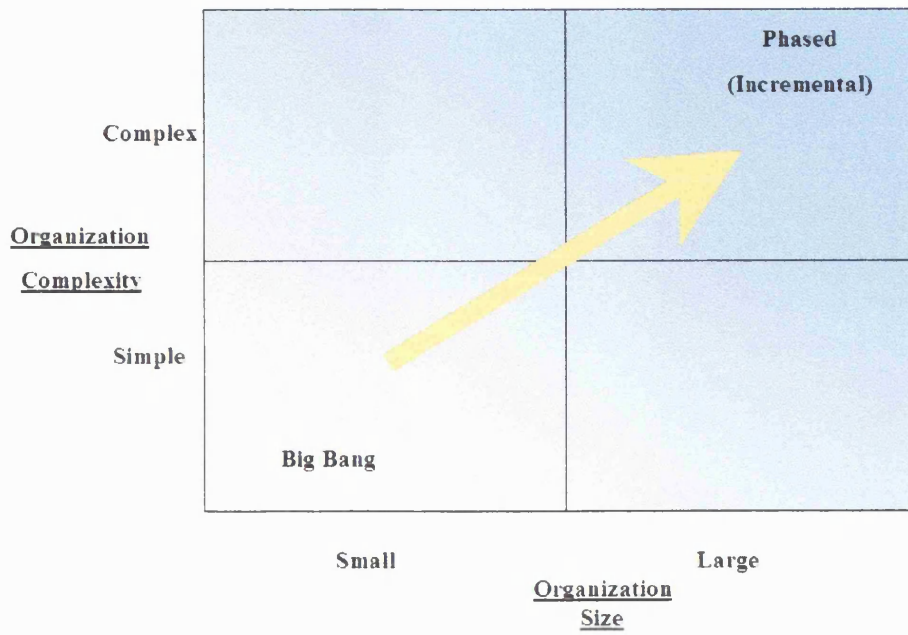


Figure 14. Linkages between organization size and complexity, and implementation approach used.

Adopted by: [O’Leary, 2000, p157]

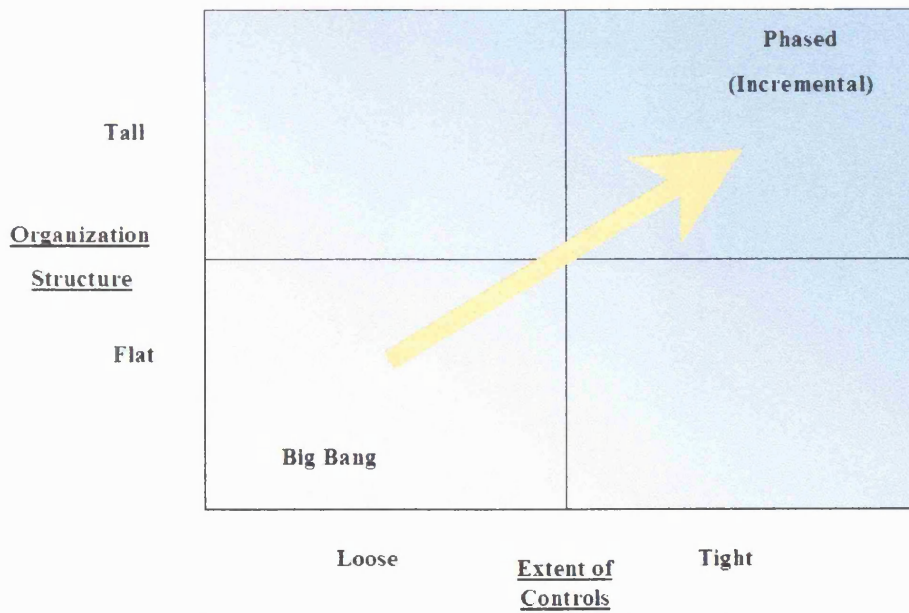


Figure 15. Linkages between organization hierarchy and control, and implementation approach used.

Adopted by: [O’Leary, 2000, p158]

As part of implementing an ERP system, organizations have to make a decision about the organizational reengineering that must be done and the amount of software customization. The decision to reengineer business processes or modify software influences the relevance and use of “as is” and “to be” modeling²⁶.

Before a company applies an ERP system that integrates complex structures, has to carefully examine how it operates. From the diagnostic study many times companies are led to a Business Process Reengineering²⁷. A BPR is a radical and drastic change of business processes. In other words according to Kale [2000, p.132], BPR can be broadly termed as the rethinking and change of business processes to achieve dramatic improvements in the measures of performance such as cost, quality, service and speed. According to Kraemmergaard & Moller [2000, p.11], the examination of the business processes is believed to be one of the important and beneficial results of the implementation of ERP systems. The very purpose of the BPR is to contribute to improvement through radical changes. This also implies that BPR is associated with risks, costs and investments. On the other hand there is the option of a Business Process Improvement²⁸, which is simply the gradual improvement of procedures without a radical change. Some companies will implement an ERP system while trying to duplicate their existing business processes. Although implementing the ERP system will result in some improvements in this case, will not result to a BPR [Kale 2000, p.133].

²⁶ “As is” analysis generates models of existing processes and “to be” analysis generates models of processes that the organization has chosen to implement.

²⁷ BPR

²⁸ BPI

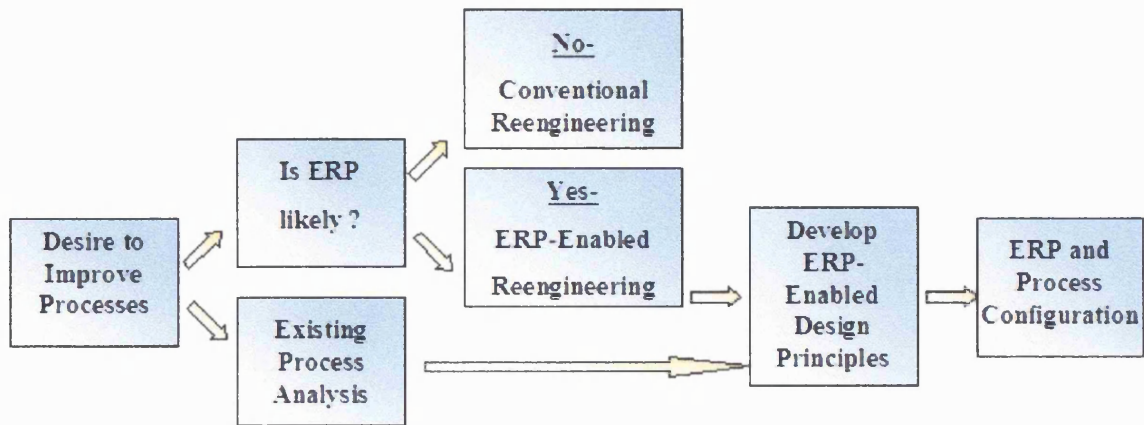


Figure 16. Graphic Overview of ERP-Enabled Reengineering
 Adopted by: [Davenport, 2000, p148]

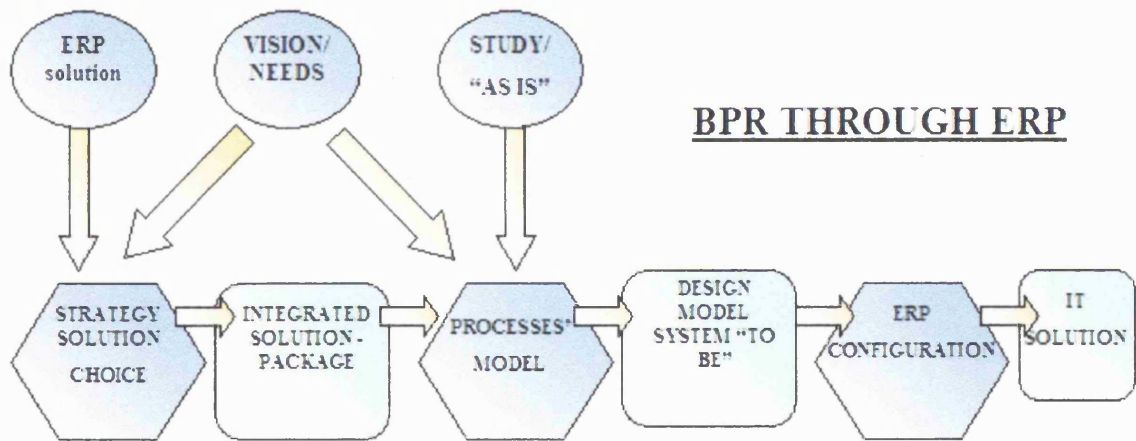


Figure 17. BPR through ERP
 Adopted by: [Motsios, 2000, p27]

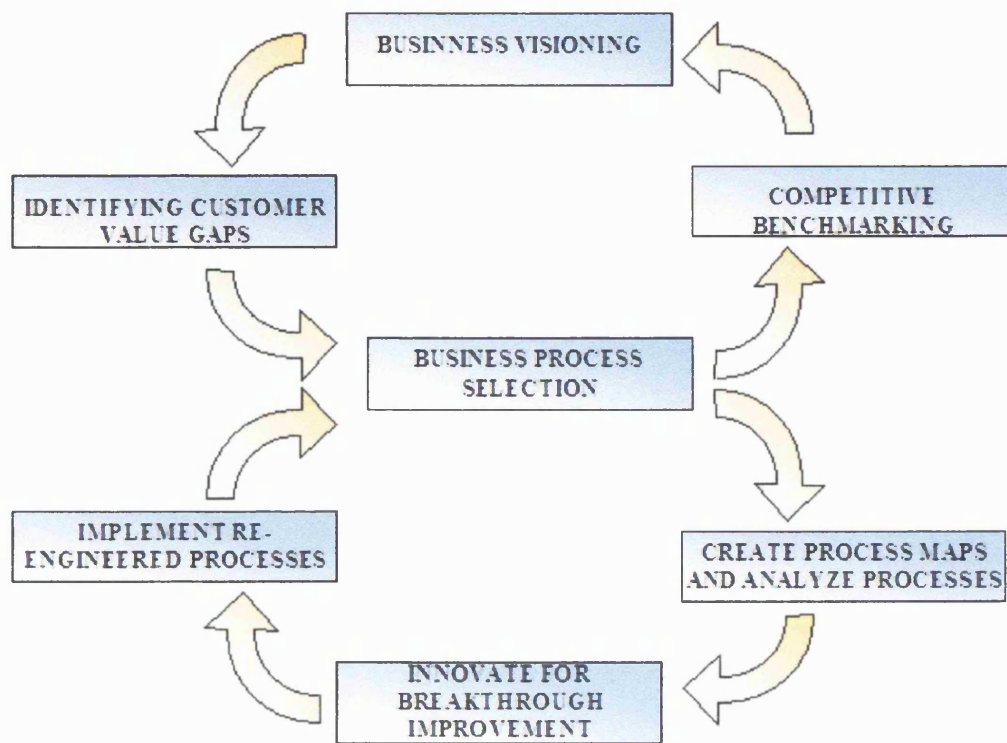


Figure 18. The alternating activities of Business Visioning and BPR

Adopted by: [Kale, 2000, p137]

Since no software is likely to meet all of a firm's needs, some organizations have chosen to substantially customize the software to meet their processes. Customization is the creation, matching and transformation of software according to certain standards. For an ERP solution that can mean:

- Creation of elements from the beginning
- Matching of an already existing solution to the company's environment
- Modification of an offered solution, so that it can meet the needs of the company.

Very often the company cannot really deal with the above procedures by itself. Therefore a need for people is created which the market mechanism covers with consultants. Software vendors offer technical consulting services and implementation techniques to its customers.

Consultants' tasks	
	<ul style="list-style-type: none"> • To help and guide the ERP implementation
	<ul style="list-style-type: none"> • To define and explore problems related to procedures, methods, and organization policies.
	<ul style="list-style-type: none"> • To train the core implementation team of the company.
	<ul style="list-style-type: none"> • To provide methodology relevant to the project by using the knowledge and experience acquired by other companies.

Table 5. Consultants' tasks

3.5. ERP IMPLEMENTATION SUCCESS FACTORS – FOCUS ON CONSTRUCTION INDUSTRY

Findings from the analysis of the interviews of the case study and the related literature concerning the critical success factors of an ERP implementation can be summarized in the following recommendations. Thus, a company and in particular a construction company in order to implement an ERP system needs:

- Top management commitment for the project
- Clear project scope
- Allocation of appropriate budget and resources.
- Instituting a company-wide change management plan.
- To have or to develop good organizational skills.
- To have the ability to clearly map the procedures²⁹.
- Good knowledge of the possibilities of the system.
- Covering as many functions as possible within the scope of the ERP implementation.

²⁹ In other words, to induce its logic and operation to a system in order to make it applicable

- Capability from the implementation team's side for reliable and on time decisions.
- Integrating the ERP system with other systems throughout the organization.
- Training of ERP team and user members.
- The users must have flexibility in using software in general, and the specific systems in particular.
- After the departure of the ERP vendor and the consultants a good "deposit" of knowledge about the implementation has to be left in the company.
- To have the necessary infrastructure and people capable to operate the application in places far away from the central offices such as the construction sites of construction companies.

[Kale, 2000, p.109/Light & Holland, 2000, p.121/Ahlin & Zupancic, 2000, p.6/ case study of ET].

Finally, as we can see in Figure 19 where people issues in unsuccessful ERP implementations are shown, a main barrier for ERP implementation is the resistance towards change.

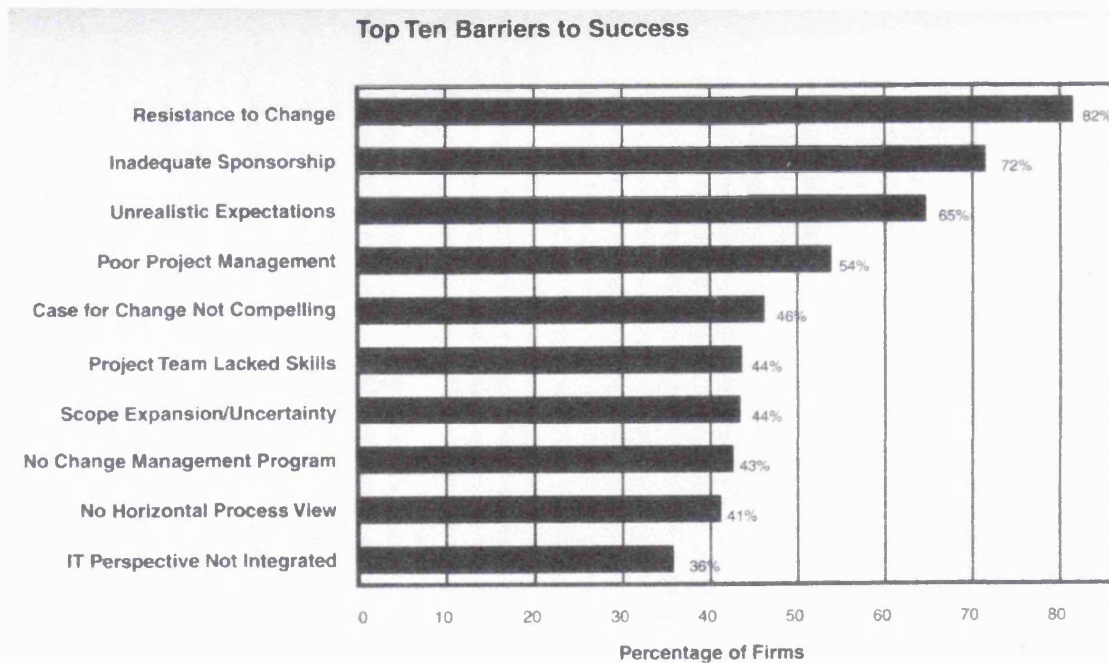


Figure 19. People issues in unsuccessful projects, ERP implementations
Source: [Deloitte & Touche 1998 CIO survey/ Shields, 2001, p125]

3.6. ERP MARKET – ERP VENDOR RANKING

The ERP market, although new, it has been developed drastically the last few years. As we have mentioned above, big companies on international level went ahead and installed the ERP system because of their need for better information integration. Other reasons that led to the rapid development of the ERP market were the globalization of the market, the introduction of the European common currency, Euro, the Year 2000 problem and finally the fact that the ERP vendors are moving into medium sized companies starting to offer industry specific solutions. Dahlen & Elfsson [1999, p.19], accumulating data from studies done all over the world; report that AMR research estimates that the world market for ERP systems had a turnover for 1998 of ten billion US dollars. Additionally, according to the same source the world revenue growth rate for 1997 was over 60 % for the ten largest ERP vendors. Ahlin & Zupancic mention that the ERP market is predicted to grow to fifty billion US dollars in 2004. Finally, as Dahlen & Elfsson [1999, p.19] underline and according to Gartner Group, the ERP market is concentrated to the western countries and therefore there is a great potential in other parts of the world in the coming years.

When it comes to ERP vendors, one company is dominating the world market totally, SAP. Some other vendors are Oracle, PeopleSoft, BAAN, but SAP has emerged as the industry leader both in terms of sales and in the number of enterprise-class installations. SAP occupies approximately 30% of the world market. According to Davenport [2000, p.303] in large organizations SAP, Oracle and PeopleSoft are the market leaders, while in smaller and midsize companies the vendor market is much more fragmented.

The table below briefly presents the five biggest ERP vendors:

<i>Company</i>	SAP	Oracle	Peoplesoft	JD Edwards	Baan
<i>Product</i>	R/3	Oracle Applications	Peoplesoft	One World	Baan IV
<i>Founded</i>	1972	1980	1987	1977	1978

Country	Germany	USA	USA	USA	Netherlands
1996 ranking, ERP software	1st	2nd	3rd	4th	4th
Investment in R&D (% revenue)	16	9	16		11
Growth 1997	58%	83	108	57	100
Growth 1998	41%	42	69	52	15

Table 6. Major five ERP vendors

Adopted by:

[Dahlen & Elfsson, 1999, p20/ Davenport, 2000, p304/ Pinkerton, 2000, p2]

Next, we present a series of figures where one can see graphics with valuable data regarding the ERP market and ERP vendors.

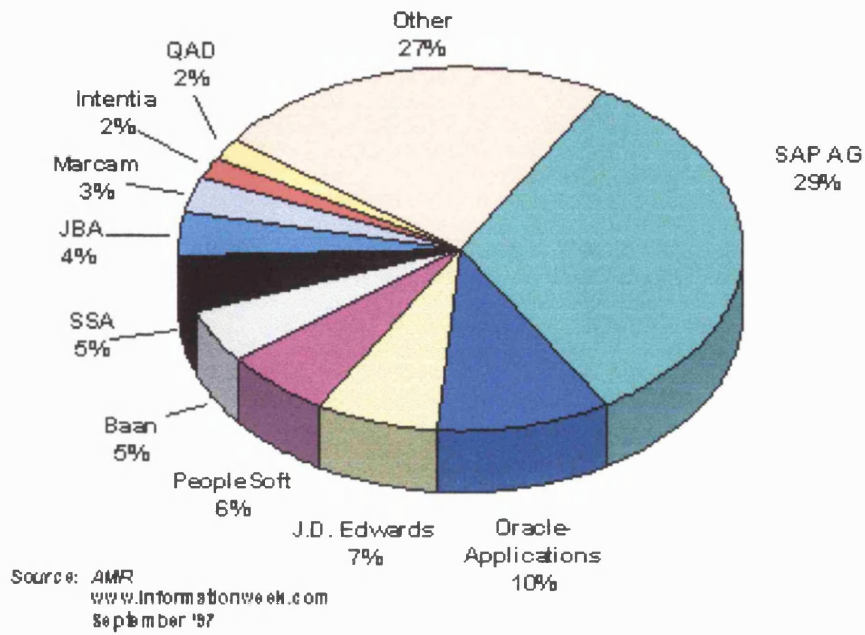


Figure 20. ERP vendors, market share
Source: [AMR research, 1997, www.informationweek.com]

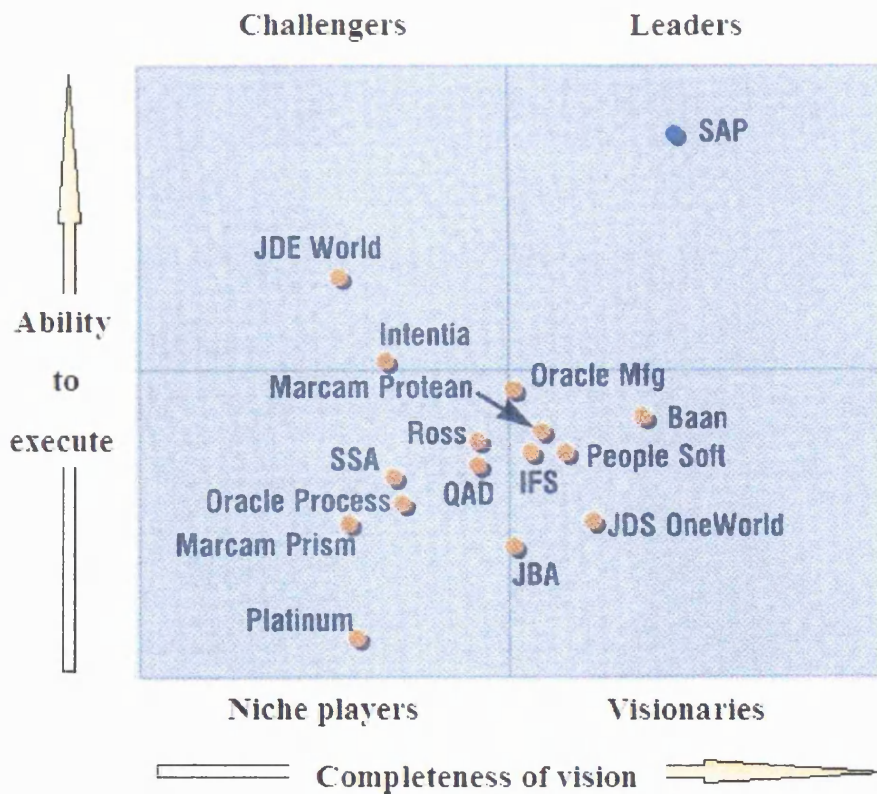


Figure 21. GartnerGroup ranking of ERP vendors, November 1999
Source: [SAP Hellas, 2001, p4]

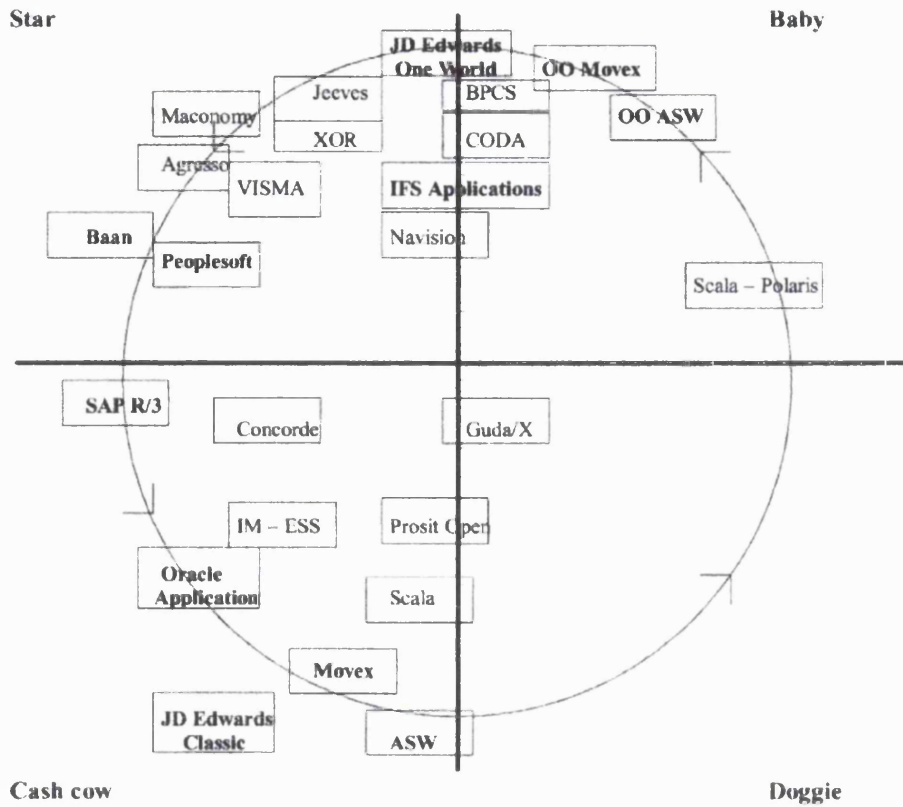
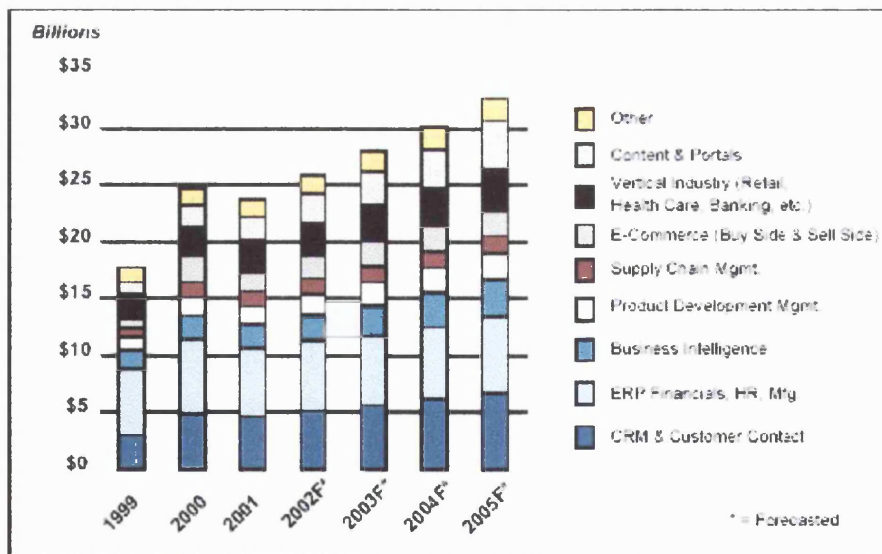


Figure 22. Boston Matrix

Source: [Soren Janstal, DPU/ Dahlen & Elfsson, 1999, p29]



Source: Giga Information Group

Figure 23. License Revenues by Type of Application

Source: [Bartels, 2002, p3]

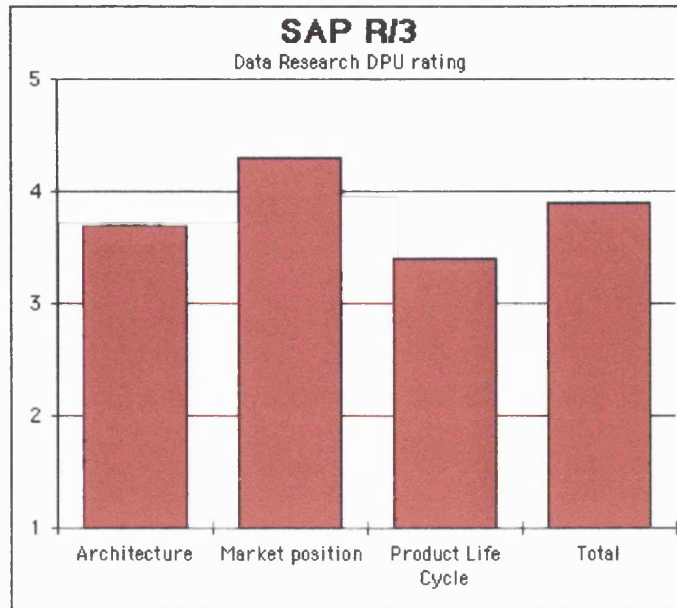


Figure 24. SAP R/3, DPU rating

Source: [Data research DPU, www.dpu.se, accessed 30/06/2002]

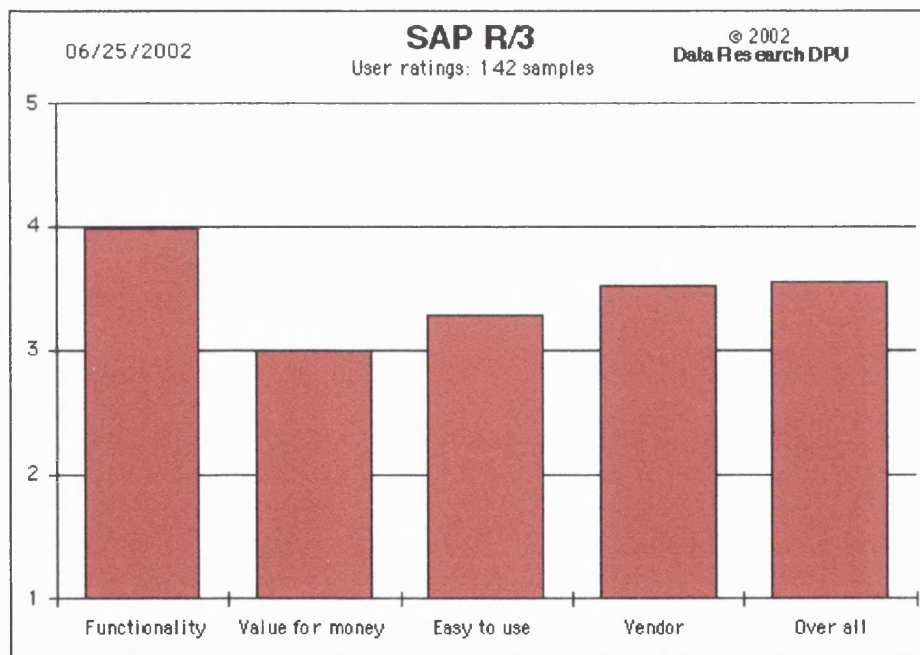


Figure 25. SAP R/3, User ratings

Source: [Data research DPU, www.dpu.se, accessed 30/06/2002]

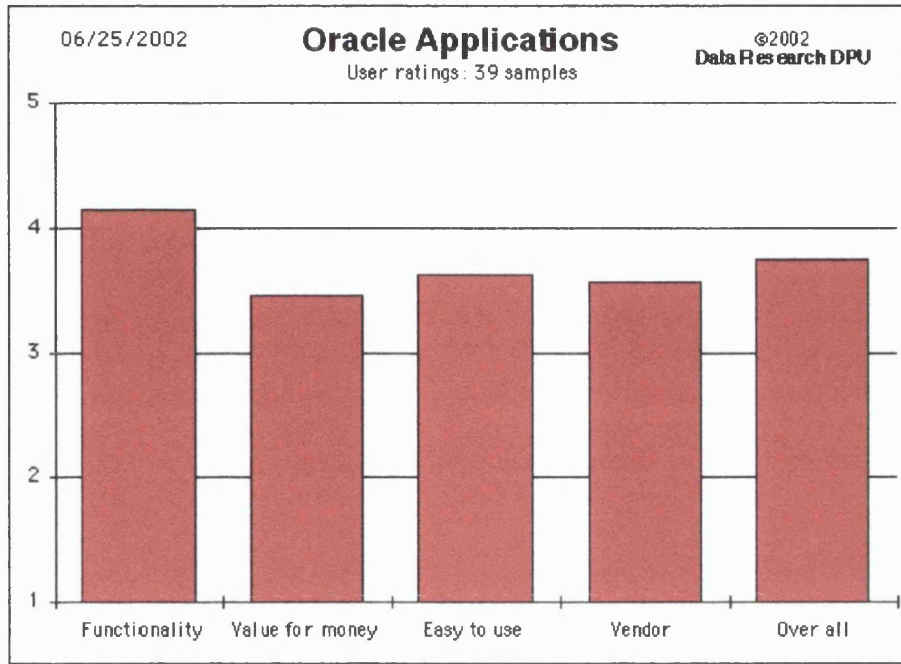


Figure 26. Oracle Applications, User ratings
Source: [Data research DPU, www.dpu.se, accessed 30/06/2002]

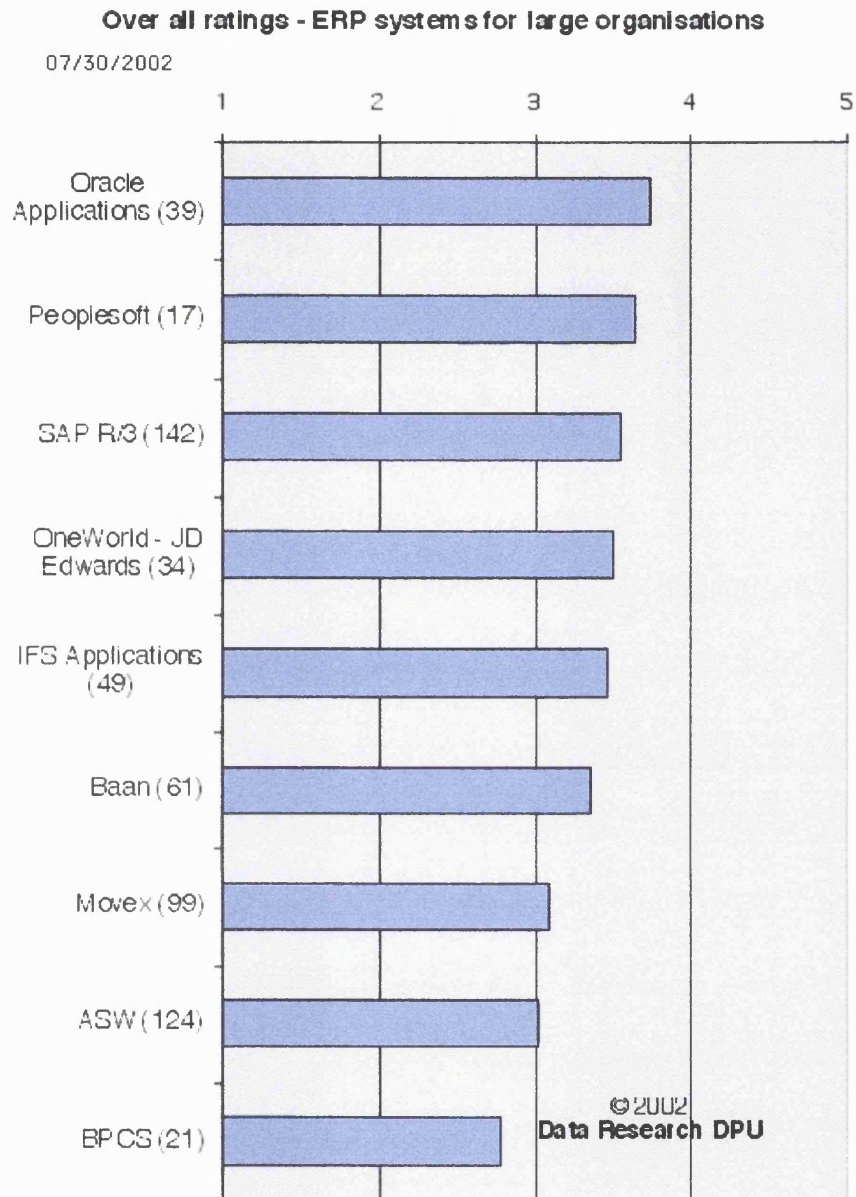


Figure 27. Over all ratings – ERP systems for large organizations.
Source: [Data research DPU, www.dpu.se, accessed 30/07/2002]

4. SAP

4.1. SAP

The name of SAP means Systems and Applications Products in Data Processing³⁰. Five former IBM employees founded SAP in 1972 in the town of Walldorf, Germany. It was the first firm to introduce a broadly functional ERP system. SAP has two main products: R/2, which runs on mainframes, and R/3, which is the client/server variant of R/2, and it was introduced in 1992. The system operates on the platforms Unix, NT and OS/400 and can use most of the established databases. SAP was first to enter the market and thereby gained early market shares. The SAP company today ranks fourth in the world among all software companies in general, while it ranks internationally first, as we have already mentioned, on sales regarding complete applications³¹. Until 1999 they have been more than 21,500 installations of SAP R/3 software in more than 22,900 clients in different production fields.

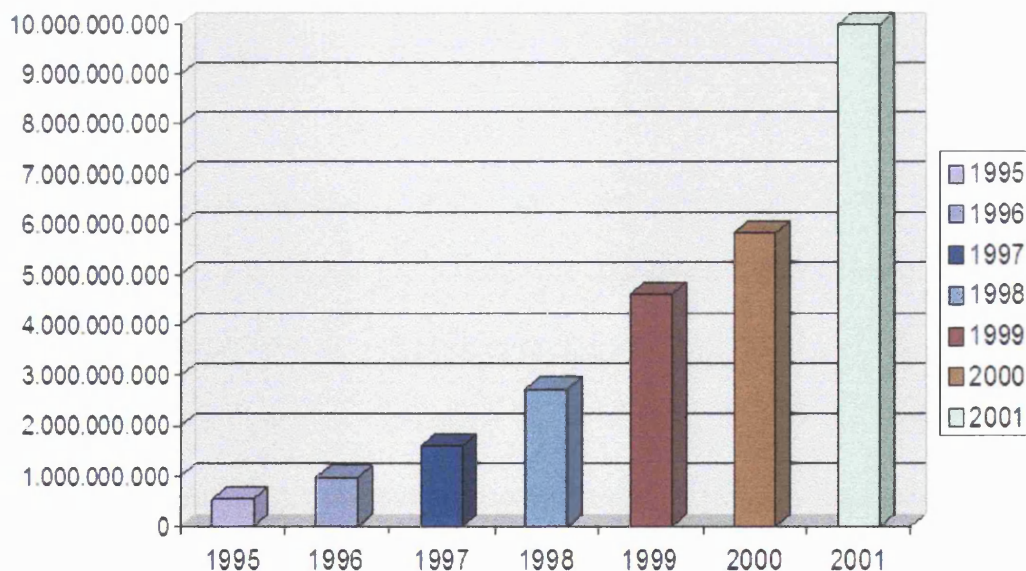


Figure 28. SAP HELLAS SA turnover (Drs)

Source: [SAP Hellas, <http://www.sap.com/greece>, accessed 05/05/2002]

³⁰ In its original German Language: "Systeme, Anwendungen und Programme in der Datenverarbeitung".

³¹ According to the data that the company itself publishes for the year 1999, its clientele includes the ten biggest companies in the world, the 70% of the companies of Fortune 500 magazine, as well as the 80% of the biggest companies in Europe.

The SAP HELLAS SA was founded in 1994 and its initial goals for the SAP application were:

- The use of Greek language
- The adaptation of the system according to the requirements of the Greek legislation.
- The local support by experienced counselors.

The main characteristics of SAP R/3 software are the following:

- Incorporates 20 years experience.
- Highly configurable.
- Multi-currency, multi-language, multi-country.
- Internet/intranet enabled.
- It is “open” with the possibility of being connected also to non-SAP environments.
- Uses relational database.
- Has the possibility of different access of the same archive, depending on the type of user.
- Use of Windows environment friendly to the user.

The main system consists of particular modules, which are part of a unique integrated program. The modules that SAP includes are:

- Finance Management, FI
- Controlling, CO
- Sales and Distribution, SD
- Materials Management, MM
- Production Planning, PP
- Quality Management, QM
- Plant Maintenance, PM
- Human Resources, HR
- Assets Management, AM
- Project System, PS
- Enterprise Controlling, EC, EIS-MIS
- Workflow, WF
- Industry-Specific Solutions, IS

- Cash Management, CM
- Investment Management, IM
- Basis, BC
- Development Workbench, DW

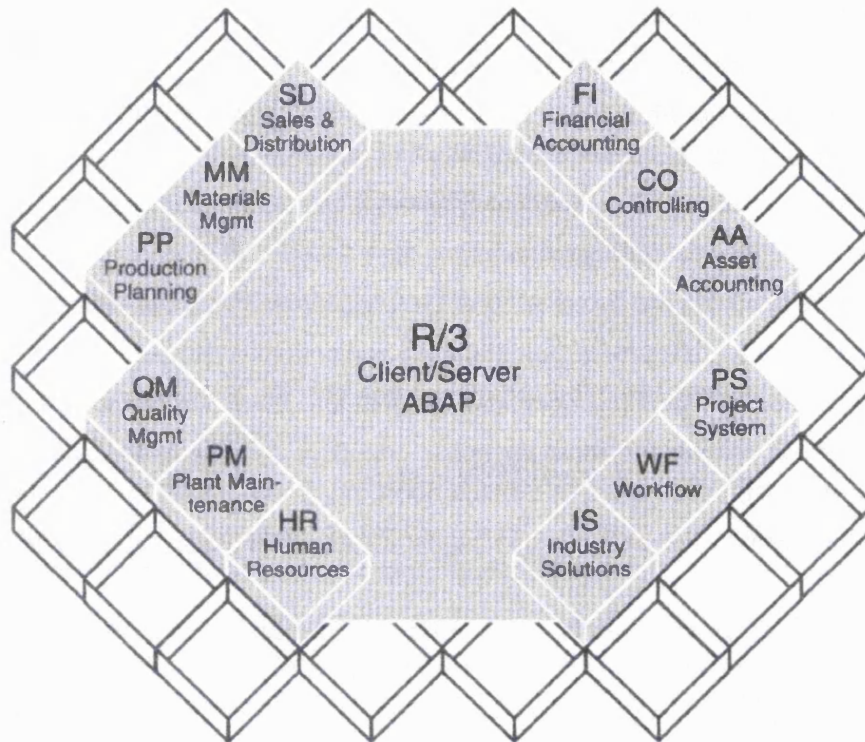


Figure 29. SAP product map

4.2. SAP AND CONSTRUCTION INDUSTRY

Hardly any other industry includes so many complexities as Construction Industry. Working within constraints of time, cost and feasibility firms in CI must meet each customer's goals and specifications. According to SAP E&C leaflet [1999, p.18], SAP R/3 has been implemented in over 1700 engineering and construction companies worldwide.

With SAP Organizations in CI can:

- Manage the entire product life cycle from design through planning, construction, completion and on-going service and maintenance.

- Track the post-construction and service phases.
- Integrate the entire supply chain.
- Deploy it across multiple sites, companies and countries.
- Gain control over the supply chain from suppliers and subcontractors to customers, because SAP supports a range of organizational structures.
- Leverage the Internet
- Increase customer satisfaction.

The companies in each industry field have different characteristics and expectations; therefore ERP vendors have developed industry- specific solutions that can meet the particular needs of specific companies and their activities. A company that plans to implement SAP can either use the general solution of SAP and then modify it in its procedures or it can choose a vertical industry-specific solution. SAP provides a great variety of industry-specific vertical solutions through “industry solutions”, IS, which are complementary to the base R/3 solution.



Figure 30. Industry-specific (IS) solutions

Source: [Kale, 2000, p217]

The SAP Engineering & Construction solution helps engineering and construction companies to focus on core processes and functions. According to Williams [www.sap.com, accessed 31/01/2001], the SAP Engineering & Construction

solution enables companies to manage the comprehensive business requirements in this industry for such challenges as sourcing, labour and project management as well as the complexities associated with accounting and milestone recognition. SAP last year announced also a partnership with Hochtief Software GmbH (HTS) to enhance the mySAP Engineering and Construction offering by integrating the HTS solution for construction-site logistics.

SAP has developed a comprehensive initiative called SAP Solution Maps, which describes the solutions needed for different industries and the corresponding technology and services that are necessary to support these solutions [Kale, 2000, p218]. The SAP E&C Solution Map, in the following figure, summarises how the SAP R/3 meets the specific requirements of the CI.

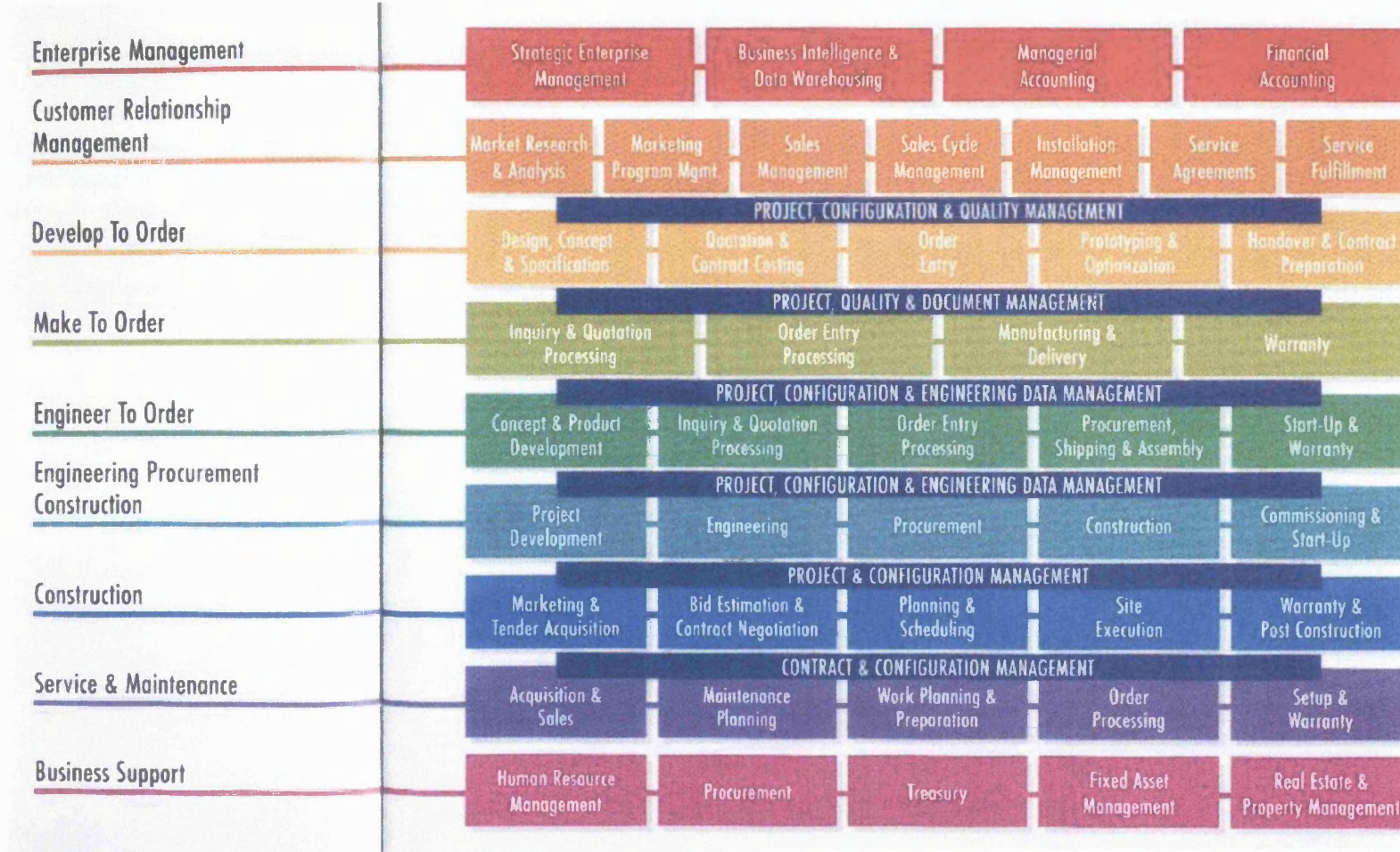


Figure 31. SAP Engineering & Construction Solution Map
 Source: [SAP E&C, 1999, p.7]

SAP R/3 Installations by Industry *

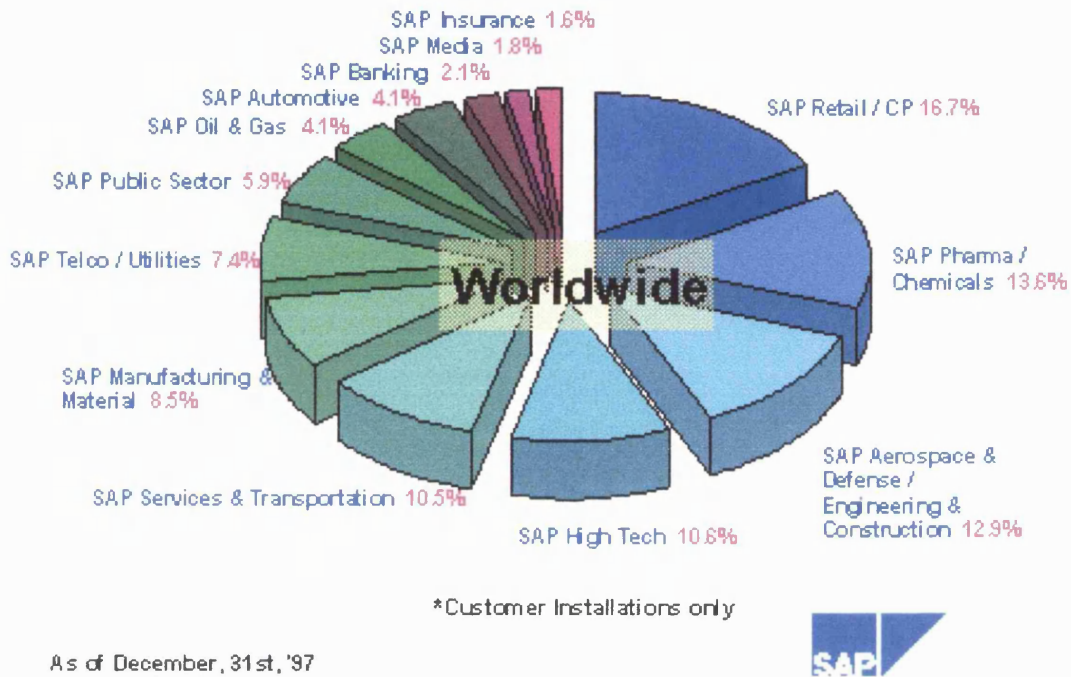


Figure 32. SAP R/3 Installations by industry

Source: [www.mysap.com, accessed 25/01/2001]

4.3 EXAMPLES OF COMPANIES THAT HAVE IMPLEMENTED SAP IN CI

The following tables briefly present examples of companies that have implemented SAP in general as well as companies that have implemented SAP in CI. Additionally, what is worth mentioning is the case of icFox.com, the construction internet hub made up of major industry players including the Davis Langdon & Seah Group and the Paul Y. –ITC Group, which has announced a partnership with SAP to build and operate a collaborative portal for the global construction industry [www.sap.com, accessed 22/07/2002]

<i>Examples of companies that have implemented SAP</i>	
1995	TITAN ♦ Mercedes Benz Hellas ♦ STET Hellas ♦ Osram ♦ Dow Chemicals ♦ Papageorgiou Hospital
1996	Air Tour (TUI) ♦ Ford ♦ Hoechst ♦ Ideal Standard ♦ Unilever
1997	ABB ♦ Greek Aluminium ♦ BDF ♦ Colgate Palmolive ♦ Cyprus Import Corporation ♦ Elliniki Technodomiki ♦ Helais/Algida ♦ Interamerican ♦ Janssen-Cilag ♦ Bosch Siemens Pitsos ♦ Colgate Palmolive ♦ DEPA ♦ DOL ♦ Motor Oil ♦ Papaellinas ♦ Procter & Gamble ♦ Reemtsma ♦ Whirlpool ♦ Vivechrom
1998	Alpha Copy ♦ AVIN ♦ Carlsberg ♦ Carrier ♦ Kosmocar ♦ Diamant Winter ♦ EAB ♦ Francoudi & Stephanou ♦ Henkel EcoLab ♦ Infoquest ♦ KEO ♦ MAKRO ♦ Mobil ♦ BP ♦ Nokia Hellas ♦ S.G. Colocasides cars ♦ B.I.K.H. ♦ Hellenic Quality Foods
1999	AGET Iraklis ♦ Bosch Siemens ♦ Pitsos Courva ♦ Elgeka ♦ Fairways Motors ♦ GCC (GEK) ♦ Yiotis ♦ Iaso hospital ♦ Ira hospital ♦ Inform Lykos ♦ Keranis ♦ Klonatex ♦ METKA ♦ National Bank of Greece ♦ Bank of Greece ♦ Plaisio Computers ♦ Primatech ♦ National Insurance ♦ Halcor ♦ Piaggio ♦ Goodyear
2000	Papastratos ♦ Alpha Bank ♦ Vodafone (Panafon) ♦ Mitera Hospital ♦ Egnatia financier ♦ Hellinika Petrelaia ♦ Mevgal ♦ EBO ♦ Kraft Jacobs Suchard ♦ Travel Plan ♦ Compaq
2001	Intracom ♦ Forthnet ♦ Minoan Lines ♦ Roche ♦ PricewaterhouseCoopers ♦ Pillsbury ♦ Papasotiriou ♦ Popular Bank of Greece

Table 7. Examples of companies that have implemented SAP

<i>Examples of companies that have implemented SAP in CI</i>			
TITAN	Greece		Cement industry
ABB	Greece		Construction company
ABB	Switzerland		Construction company
Elliniki Technodomiki	Greece		Construction company
AGET Iraklis	Greece		Cement industry
GCC (GEK)	Greece		Construction company
Hochtief AG	Germany		Construction company
Ballast International	Nedam Netherlands		Construction company

British Waterways	UK	Inland waterways and canals maintaining
Landis & Staefa GmbH	Germany	Technical infrastructure of buildings

Table 8. Examples of companies that have implemented SAP in CI

5. THE CASE OF ELLINIKI TECHNODOMIKI SA

5.1. A GENERAL OUTLOOK OF THE COMPANY ITSELF AND ITS ACTIVITIES³²

Elliniki Technodomiki SA was founded in 1955 and besides its headquarters in Athens; it keeps also offices in Thessaloniki, Alexandroupoli, Xanthi, Ioannina and Patras. Since its establishment, ET has been active in the private sector, designing and constructing major complex industrial buildings, hospitals, hotels, schools, office buildings, housing units etc. Its activities led the company to the top of its sector in Greece. Twenty-five years later, the Company decided to expand into projects within the public sector. This expansion proved equally successful and added to the Company's assets, with its participation in major public projects and its presence among the contractors for the country's first co-financed projects. At the same time, with a pioneering involvement in project management and real estate development, it continued its dominance in the sector of private projects, using both areas of activities to position itself at the top of technical companies [Elliniki Technodomiki SA annual bulletin, 2002]. On the basis of financial statements published in 2000 and in comparison with other construction companies listed on the Athens Stock Exchange, ET ranks:

- 1st in terms of turnover
- 1st in terms of earnings before tax
- 2nd in terms of equity
- 1st in terms of total assets

ELLINIKI TECHNODOMIKI	
Turnover	254.23
Profit before taxes	36.27
Total Assets	481.12
Shareholders' Funds	418.57

³² More analytical data about Elliniki Technodomiki and the group are depicted in Appendix B.

Cash and Cash Equivalents	31.03
Backlog	383.17

Table 9. Financial Results 2001, in million Euros.

Source: [www.etae.com, accessed 03/05/2002]

Since 1999 ET, AKTOR³³ and TEB³⁴ joined forces in one group. End of 2001 was announced that the structure of the group would be rearranged. According to the new structure of the group, we have the merger of ET with TEB, through the absorption of the second by the first³⁵. It was also decided the spin-off of ET's and TEB's construction sectors and their contribution to AKTOR³⁶.

As a result of the above for the group we have:

- An explicit separation of the construction sector from the Group's other sectors of activity.
- Acquisition of the highest contractors degree (7th class) and also the acquisition of 6th and 5th degree in order to have access in the whole projects' pyramid.
- The merger of ET with TEB creates a powerful bearer for managing participations and concessions in the substructure and land development sectors.
- Involvement in the real estate management and development and other new, profitable activities in Greece.

³³ AKTOR SA

³⁴ Volos' Technical Company SA

³⁵ The merger is estimated that it will be completed until July 31, 2002.

³⁶ The spin-off procedure and the contribution of the construction sectors are estimated to be implemented until June 30, 2002. Until the completion of this research, this procedure has not been finished. During 2002 Aktor SA went forward and implemented the SAP with the help of the SAP team of Elliniki Technodomiki.

5.2. REASONS FOR IMPLEMENTING SAP IN ELLINIKI TECHNODOMIKI SA

5.2.1. REASONS FOR SEARCHING A NEW INFORMATION SYSTEM

The goal for ET was to use an IS that manages and supervises in a unique and effective way all the activities of the company, and not only the activities of the accounting department. The company was, and still is, considering this as an important factor for its successful course and the acquisition of a competitive advantage. In the old days³⁷, an IS that manages and observes all company's activities did not exist. The main IS existed was concerning, mainly, the accounting department. That system was developed in-house and its possibilities were limited compared to SAP. Therefore the most fundamental reason for searching and applying a new IS and particularly an ERP system, was that eventually the company's activities such as the sales department, the marketing department, the department of the projects supervision, the personnel department, and the human resources department, had to use a business operating system such as an ERP system that typically can do all these together.

A second reason related to the first one is one of the main advantages of the implementation of an ERP system. That is, the integration of the different subsystems so that repeated and cut into pieces information is avoided.

Finally, it was the advances of modern technology that also led to the implementation of this system. The previous one was already nine years old, therefore out of date. In conclusion, ET wished to develop a system that had the capabilities of the modern applications such as the simultaneous supervision of the information flow of the company and the highly Graphics based User Interface, as well as the easier future implementation and utilization of applications, such as EFT³⁸, EDI³⁹, Internet, Intranet, Video conferencing, E- Commerce etc.

³⁷ In Appendix C there is a more detailed reference on the older system that ET was using.

³⁸ Electronic Fund Transfer

³⁹ Electronic Data Interchange

5.2.2. REASONS FOR CHOOSING SAP

ET functions with R/3 of SAP since 1997, when the first stage of parameterization of the system was completed. In the decision making process for choosing ERP, certain members of the company played a vital role such as the financial manager, the director of the IS department, as well as other members of the board involved in the technical- financial issues of the company. The basic concept, during the decision making process, was that the system had to meet the needs of the company, within a reasonable time frame and a reasonable cost.

The option of applying “Oracle Financials” was also examined, as well as the possibility of developing an in-house application with the help of Greek software companies, such as “Singular” and “Computer Logic”.

Initially, this option, of developing an in-house application, was rejected because it requires a long time frame to become applicable plus the fact that an uncertainty is embedded as far as the final cost is concerned.

A detailed juxtaposition of the advantages and disadvantages of an in-house application opposite to a ready to use ERP application is presented in the following table:

<u>In-house Development</u>	<u>ERP package</u>
Project Development takes time.	Ready made Projects.
Reinventing the wheel.	Needs only customization.
Processes specific to your industry are implemented.	Best Business practices followed.
Documentation may not be present.	Documentation is part of system.
EDI ⁴⁰ implementation modifications to be taken care of.	EDI Compatible. Universally accepted.

⁴⁰ EDI: Electronic Data Interchange

Enterprise implementation is difficult as each unit follows different S/W option.	The package itself is designed as Enterprise Package.
Latest Developments to be studied as and when they are introduced.	Constant Updates on Technology

Table 10. In-house Development –ERP package.

Adopted by: [Kumar, 2001, p47]

The choice to apply SAP instead of an Oracle Financials application prevailed because of certain advantages. First of all SAP is fully translated in Greek and it is in accordance with the Greek legislation. In addition, it had been already installed in Greece since 1997, in other companies (not construction companies), such as Titan⁴¹ and Telestet⁴².

General advantages of the SAP application also taken into account, was that SAP represents a full package, which can cover all the activities of a company. In addition its late editions have developed additional industry solutions containing specific functions for a vertical market such as the PS module, which particularly concerns the construction companies. Another advantage is that it is constantly developed not only technologically, but also in terms of functionality and availability of different modules. Finally in its latest versions it has incorporated Internet technology that increases the capabilities of all the companies that use it.

5.3.IMPLEMENTATION PROCESS

5.3.2. IMPLEMENTATION PROCESS PLAN AND REENGINEERING NEEDS

ET did not follow a particular implementation plan. The basic goal for the company was the smooth transaction to the new system without creating internal problems⁴³. In essence, the philosophy of the old system was transferred to the new one, concerning the development of the different SAP modules. Their improvement as

⁴¹ Cement industry

⁴² mobile phone company

⁴³ In order to avoid a “Big Bang” implementation.

well as the development of other possibilities and modules was regarded as an ongoing process along with the operation of the system⁴⁴.

In other words, the concept was to chart first the existing situation in the company (model “as is”) and then to analyze the future preferred procedures according to what SAP offers (model “to be”). Thus, all necessary elements the company needed in order to make some decisions concerning the organizational reengineering required and the quantities of the adapting elements of the SAP application were available. Basic concern of the company was on one hand to move on to the SAP application with little additions and improvements and on the other hand to be forced to make only small and “slow” changes in the particular business processes of ET.

5.3.2.1. NEEDS FOR REENGINEERING BEFORE THE IMPLEMENTATION OF SAP

As it has been mentioned before, the plan of the company was to avoid radical changes and a drastic redesigning of the business process (BPR⁴⁵). Contrary to that, SAP was chosen to function on a time frame as a catalyst, for a smoother and gradual BPI⁴⁶.

It was not chosen to become an extended BPR because the actual structure of the company was complying with the basic requirements for the SAP application so that there were no problems from the employees’ side as it usually happens in a company with “any overdose” such as the decision for a radical BPR. Thus, initially, the choice of those modules of the SAP package that were better fitting the company, was implemented, and then through the experience the actual use of the package provided, some modifications emerged that were improving this modules. In a parallel manner, a gradual adoption of new modules was made.

⁴⁴ In the first phase of the implementation and for approximately four months a team of consultants of SAP Hellas was used. The team was working under a contract, which had as a condition that ET has to go live with SAP until 01/01/1997 with particular modules. Today there is no such team from the side of Sap Hellas having an active role in ET. The relationship and the provided services are based according to the needs of ET.

⁴⁵ Business Process Reengineering

⁴⁶ Business Process Improvement

At this point, as an example, we can mention that, while in the beginning procedures for the supervision of the suppliers or the way they were getting paid, were not developed, later on their benefit was reexamined and eventually there were applied. In a parallel manner, in the beginning because of lack of time, personnel and availability of already existed business procedures, modules such as materials management, sales and distributions⁴⁷, were not applied, while others were partially applied such as project systems⁴⁸. Later on though, there was an effort for some of them to be further developed.

It would be useful to mention here that the initial implementation did not need a BPR. In the process, a reengineering was made but this was rather a consequence of a general reshaping of the company⁴⁹ which bought other companies, became a group, got bigger, therefore things changed by themselves rather and not necessarily due to the application of SAP. Subsequently, some changes were introduced within the SAP as business processes.

Today, where these changes are clear, there is an effort to be incorporated to the SAP. Good examples are the procedures followed for the payment of suppliers, for orders and purchases.

ERP without Re-engineering	
	•Advantages
	No visible changes in Functionality.
	Users find it more acceptable.
	Can be completed within time frame.
	Cost can be with in your control.
	Impact on Organization will be moderate.
	•Disadvantages
	Best Business practices would have been ignored.
	Stability of the system is known only in long run.
	May not achieve Corporate wide systems integration.
	New technologies have to be studied your self.
	Some functionality may be lost.

Table 11. ERP without Re-engineering.

Adopted by: [Kumar, 2001, p34]

⁴⁷ MM, SD

⁴⁸ PS, A more detailed reference of the development of the PS module is mentioned in paragraph 5.5.3.

⁴⁹ As we have mentioned above, Elliniki Technodomiki merged in 2001 with AKTOR and TEB forming a new group.

5.3.2.2. NEEDS FOR CHANGES IN STANDARD SAP

Big changes did not take place during the implementation of SAP in ET. However small changes, -or better we should say additions-, were made, additional tables were used, new programs were written, particularly on the reports level, so they could give information in a desirable form. Additionally, small changes were made on the legal field of the Greek legislation and the particularities of the construction sector. The primary goal was to try not to alter the standard system but to exploit it in the best way. In other words there was an effort from the side of ET to approach the SAP and not vice versa.

5.4. PROBLEMS THAT THE COMPANY HAD SINCE NOW WITH THE IMPLEMENTATION

5.4.1. GENERAL

The problems ET faced during the SAP implementation were the typical problems that any construction company faces in the implementation of ERP software. These problems have to do mainly with the particular characteristics of construction companies such as the need for management and supervision of works in progress, which are spread in different construction sites, are decentralized, are local and not central, or the extensive use of subcontractors etc.

In the beginning, ET was functioning in a centralizing way. Initially, that was happening because of the large number of those sites. Additionally, though organization reasons led to that, reasons that concerned the organization of the construction sites and the need for specialized personnel in these sites. At the same time, there were also technical restrictions, since in order to enter the information directly to SAP, locally in the sites, the access of the site to the system is needed, either through the Internet or a dial-up line. It was also important for the system to “mature” centrally up to a certain degree, so that it could be more stable first and then gradually could pass to the users on a local level. In the beginning the respective applications concerning mainly the construction sites had not been developed in SAP

such as had the management of subcontractors and the commissions. This resulted in a delay in entering the actual information in the system, making it not reliable in terms of a time schedule. That way the progress of the works and their cost were moving ahead of the supplied information to the system. This resulted in the cancellation of one of the big advantages the ERP applications provide, which is the on time and reliable access to the data of the entire organization and the possibility of reaching better and faster decisions. During the last year, when most of the above problems were solved, there is an effort for decentralizing the supply of information at the different construction sites. That happened first in the big construction sites and the peripheral units of the company⁵⁰, where there exist offices, organizational and technical support. These units are able to serve the smaller, local construction sites. For this purpose, specialized, experienced personnel are used, familiar not only with the new technologies, the use of the Internet and the company's system but also with the work on the construction sites. That way the part of SAP which concerns the management of the construction sites and deals for example with the development of the project, as a structure and WBS⁵¹ elements, observation of orders and deliveries etc, and does not concern the operations, which would have affected the introduction or alternation of basic data to the system, functions now in a non-centralized manner.

⁵⁰ Interconnection of the Group's buildings in Athens, Halandri, Maroussi and Thessaloniki is obtained through leased lines, whilst sites are connected with the headquarters via the Internet.

⁵¹ Work Breakdown Structure.

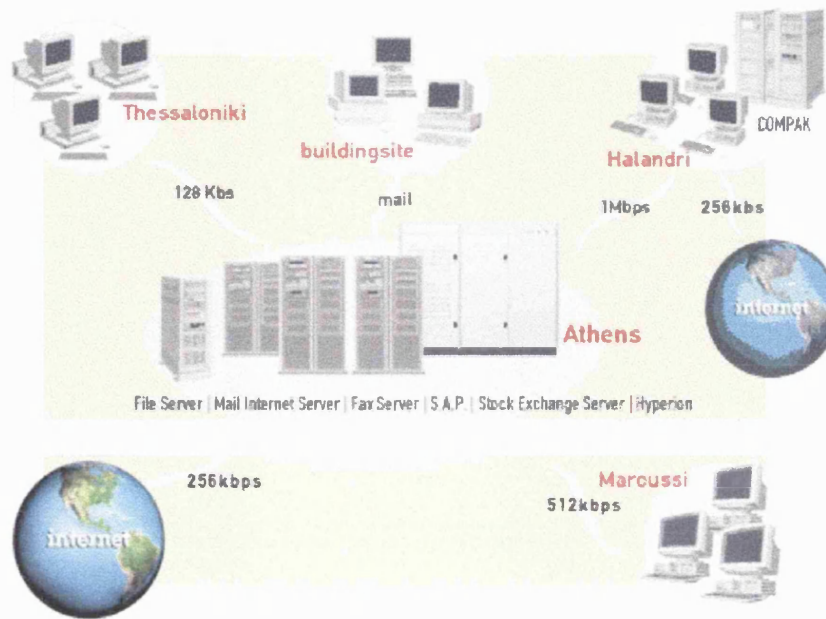


Figure 33. Interconnection of the Group's buildings in Athens, Halandri, Maroussi and Thessaloniki

Source: [www.etae.com, accessed 12/06/2002]

Another problem that appeared during the implementation of SAP was that initially in its 3.1 version it was not possible to have supervision of the subcontractors. The services concerning the subcontractors, that is, a major part of the project, were covered until recently by non-SAP applications that were developed in-house. This led to the repetition of information, which then had to be entered in the SAP in another form. Lately, after the implementation of the new version 4.6c this gap has been filled⁵².

The above mentioned problem is typical in the implementation of ERP, where some modules do not cover particular basic business procedures, resulting to the non application of certain modules and to the expectation of new SAP versions that could perhaps offer a solution. Another example that can be mentioned is the writing of a

⁵² Analytical reference and description of the solution provided for this problem is mentioned in the 5.4.2 paragraph.

contract, where it has been observed that current version of SAP does not allow more than 99 WBS⁵³.

One other problem that ET faced was concerning the quantities survey in the construction sites and the introduction of this information into the system. More specifically, in the process of measuring out, ET functions rather in a summarizing manner, that is, collectively from the very beginning, because the measuring out of a particular period is not practically feasible in the construction field, since it would require the exact “marking” of the ending of the previous measuring. However SAP accepts only period measurements, in the way this is used in the Manufacturing Industry. A temporary solution has been given by using the computer application program “MS Office, Excel”, for the mathematical calculation of the period measurements, which have to be entered in the system.

There are other problems or disadvantages arising from the implementation of SAP that have to do with the organizational plan of the company, with its applied logic, how well the analysis is done, as well as how well the cost supervision is carried out. Finally, it is worth mentioning that ET faced the problem that it was the first construction company, which used SAP in Greece, so no ready solutions existed for every single department of the company. Therefore, the company had not only to solve problems and find solutions concerning the particular characteristics of the construction field but also the Greek business field in general.

In the next paragraph will discuss in more details such a problem. We will refer to the observation of the subcontractors with the older system and with SAP⁵⁴.

⁵³ Work Breakdown Structure

⁵⁴ From the variety of problems that a company can face during the implementation of an ERP system this problem was chosen, to be discussed, because it is tightly related to the construction companies and additionally due to the fact that the SAP team of ET managed to solve this problem when this study was taking place.

5.4.2. THE MANAGEMENT CONCERNING THE SUBCONTRACTORS⁵⁵

As we have already mentioned above, ET was not using SAP for the management of the subcontractors but it was using another application. This in-house application was initially developed in DOS and Oracle-database and was consisted of two parts. One concerned the fiscal observation of the project and the other the observation of the subcontractors. In 1995 it was unified and transferred into Windows environment. This application was used for the development of the project, WBS, in three levels in the construction site concerning the civil engineers, for the cost of the project and in one level in the headquarters of the company for the accounting department. As we have already mentioned initially these two systems were not unified, meaning they required that the information had to be registered twice.

The stages concerning the observation of the subcontractors were the following:

1. Formulation of contracts and Deductions⁵⁶.
2. Quantities survey.⁵⁷
3. Invoice.
4. Bill.⁵⁸
5. Money order.⁵⁹

In order for observing the subcontractors through SAP, an external consultant, in particular the German company BAUCC, was used. One of the modifications that happened in the standard SAP was the embodiment of the idea of deductions, which it did not exist initially. Moreover, the idea of retrospective quantities was added, as far

⁵⁵ In the new version of SAP, Construction Industry solution, there is solution for the management of subcontractors through SD module.

⁵⁶ Advance Payment, Advance Payment Depreciation, Performance Guarantee, Social security, Tax, etc.

⁵⁷ Retrospective quantities per contractor project.

⁵⁸ Cost of works, all deductions are based on a contract.

⁵⁹ Payable debit, equals to the value of works plus advance payments minus the deductions as well as the payments, which have been already made.

as quantities survey are concerned, with the use of MS Office Excel, which can transform them into period quantities, which in this form are automatically entered in SAP. In SAP the stage of bills does not exist while the deductions are made after the invoices.

The differences between the old and the new system that is the observation of the subcontractors through SAP are:

- In the contract, to every subcontractor a standard work code is given according to the Standard Services Catalogue of the system.
- WBS has more levels and is related to both the construction site and the accounting department⁶⁰.
- Due to the fact that the info is unique an analytical registration of all stages must be done in order for a payment to be made. In the older system one could go directly to the payment.
- The info related to the construction sites must be entered only once and locally.

⁶⁰ Therefore the expenses are analytically divided in all aspects of the project and we have a better observation of the subcontractors.

Service Master Edit Copy System Help SAP

Display Service 12503250

Other service Expand all Collapse all

Short text	Activity
ΔΙΑΦΟΡΑ ΛΟΙΠΩΝ ΕΓΚΑΤ. ΑΣΘΕΝΩΝ ΡΕΥΜΑΤ	20915030
ΕΓΚΑΤΑΣΤΑΣΗ ΗΛΕΚΤΡΙΚΩΝ ΡΟΛΟΠΩΝ	20911020
ΕΙΔΙΚΕΣ ΚΑΤΑΣΚΕΥΕΣ ΕΠ. ΤΟΙΧΩΝ ΜΕ ΓΥΦΟΣΑΝΙΔ	12503330
ΕΝΙΣΧ. ΑΝΑΡΤΗΣΕΩΝ ΣΕ ΤΟΙΧ. ΜΕ ΓΥΦΟΣΑΝΙΔ	20915020
ΕΞΟΠΛΙΣΜΟΣ ΛΟΙΠΩΝ ΕΓΚΑΤ. ΑΣΘΕΝΩΝ ΡΕΥΜΑΤ	20915070
ΕΠ. ΤΟΙΧ. 2 ΑΝΘ. & ΠΥΡ. ΓΥΦ. ΜΕ ΣΚΕΛ. 100	12503260
ΕΠ. ΤΟΙΧ. 2 ΑΝΘ. & ΠΥΡ. ΓΥΦ. ΜΕ ΣΚΕΛ. 50	12503240
ΕΠ. ΤΟΙΧ. 2 ΑΝΘ. & ΠΥΡ. ΓΥΦ. ΜΕ ΣΚΕΛ. 75	12503250
ΕΠΕΝΔΥΣΕΙΣ ΤΟΙΧΩΝ 1 ΓΥΦ. ΧΩΡΙΣ ΣΚΕΛΕΤΟ	12503010
ΕΠΙΧΡΙΣΜΑΤΑ ΟΙΚΟΔΟΜΙΚΩΝ-ΕΡΓΑΣΙΑ ΒΟΗΘΟΥ	12313020
ΕΠΙΧΡΙΣΜΑΤΑ ΟΙΚΟΔΟΜΙΚΩΝ-ΕΡΓΑΣΙΑ ΕΡΓΑΤΗ	12313030
ΚΑΛΩΔ. ΕΓΚΑΤΑΣΤΑΣΗΣ ΗΛΕΚΤΡΙΚΩΝ ΡΟΛΟΠΩΝ	20911010
ΚΑΛΩΔΙΟΣΕΙΣ ΕΓΚΑΤΑΣΤΑΣΗΣ ΑΝΙΧΝΕΥΣΗΣ CO	20913010
ΚΑΛΩΔΙΟΣΕΙΣ ΛΟΙΠΩΝ ΕΓΚΑΤ. ΑΣΘΕΝΩΝ ΡΕΥΜΑΤ	20915010
ΚΟΥΤΕΛΑ ΕΠΕΝΔΥΣΗΣ ΤΟΙΧΩΝ ΜΕ ΓΥΦΟΣΑΝΙΔΕΣ	12503300
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ΜΟΝΩΣΗ ΕΠΕΝΔ. ΤΟΙΧΩΝ ΓΥΦ. ΜΕ ΥΑΛΩΒΑΜΒ	12503270
ΜΟΝΩΣΗ ΕΠΕΝΔ. ΤΟΙΧΩΝ ΓΥΦ. ΜΕ ΟΡΥΚΤΟΒΑΜΒ	12503280
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ΣΚΟΠΙΕΣ ΕΠΕΝΔΥΣΗΣ ΤΟΙΧΩΝ ΜΕ ΓΥΦΟΣΑΝΙΔΕΣ	12503310
ΥΛΙΚΑ ΑΝΤΙΚΕΡΑΥΝΙΚΗΣ ΠΡΟΣΤ. ΤΥΠΟΥ ΚΛΩΒΟΥ	20725115
ΥΛΙΚΑ ΓΕΙΟΣΗΣ ΕΡΓΩΝ ΕΞΟΠΛΙΣΜΟΥ	20705120

Activity number: 12503250 ΕΠ. ΤΟΙΧ. 2 ΑΝΘ. & ΠΥΡ. ΓΥΦ. ΜΕ ΣΚΕΛ. 75

Service category: ETAE services

Base unit of measure: M2 m2

Mat'srv.grp: 400

Division: Authorization group

Valuation class: Etsae - Sub contractors

Formula: Tax indicator

Graphic:

Standard serv. cat.

Time mgmt.

Purch. data.

Internal work.

Lang. to be maint.: Greek

ΕΠΕΝΔΥΣΕΙΣ ΤΟΙΧΩΝ 2 ΑΝΘΥΠΡΟΝ ΚΑΙ ΠΥΡΑΝΤΟΧΩΝ ΓΥΦΟΣΑΝΙΔΩΝ ΜΕ ΣΚΕΛΕΤΟ 75 ΧΛΣ

TEC (1) (100) lunar INS

Figure 34. Example of subcontractor's services

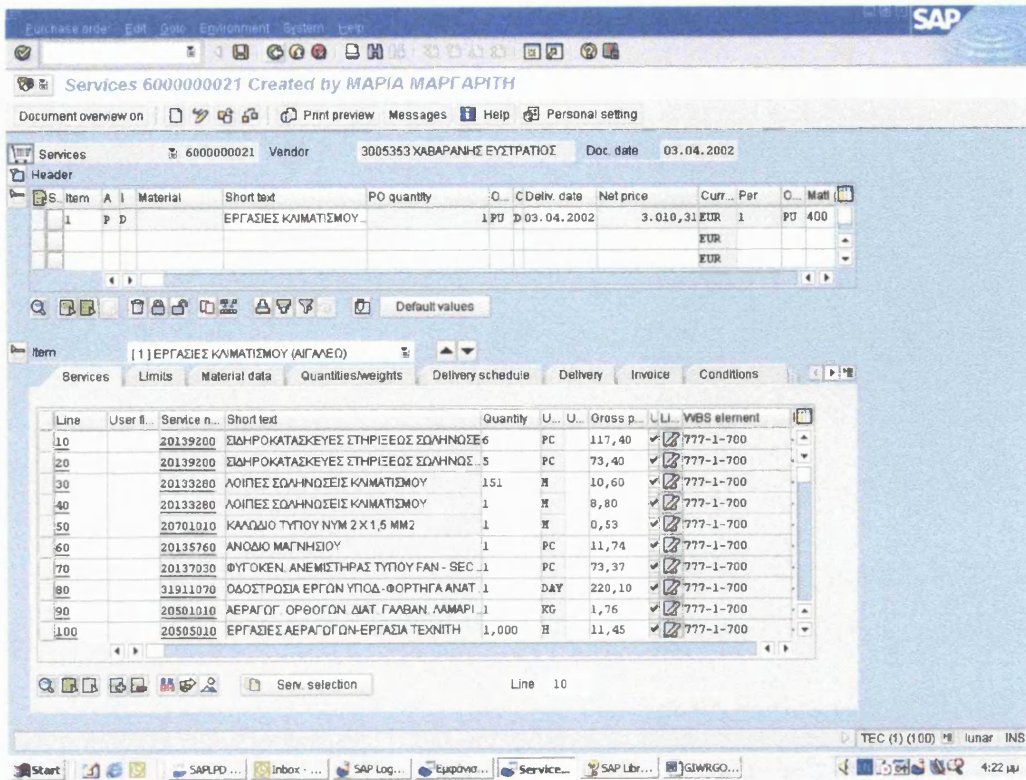


Figure 35. Example of subcontractor's services

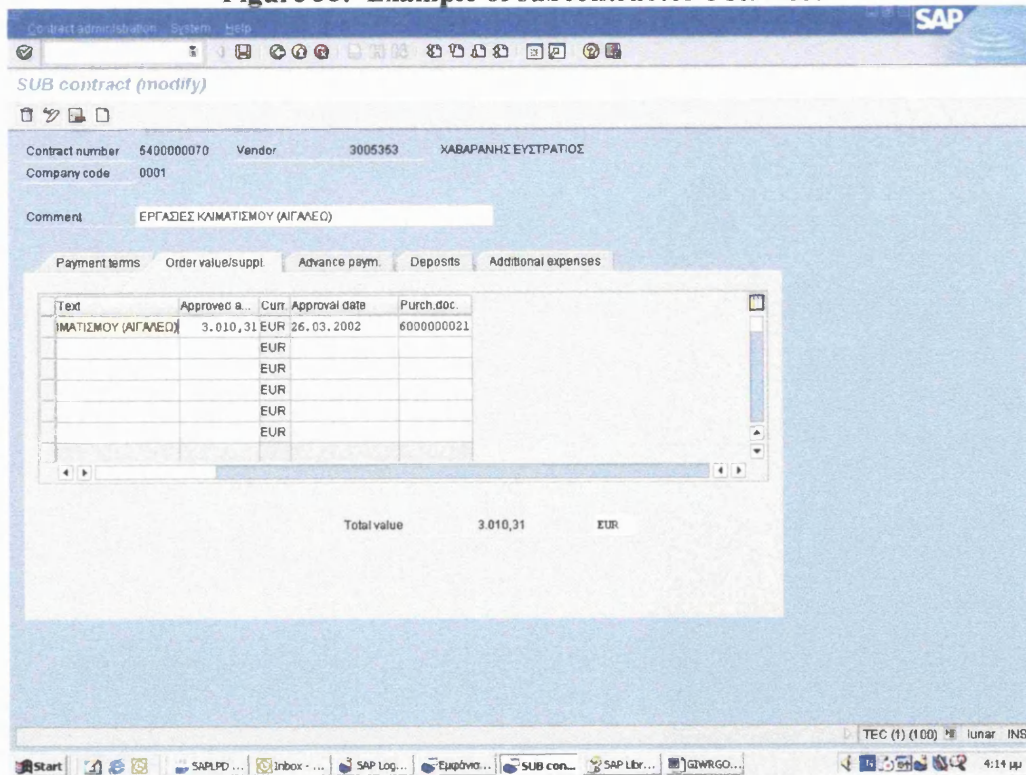


Figure 36. Example of subcontractor's contract

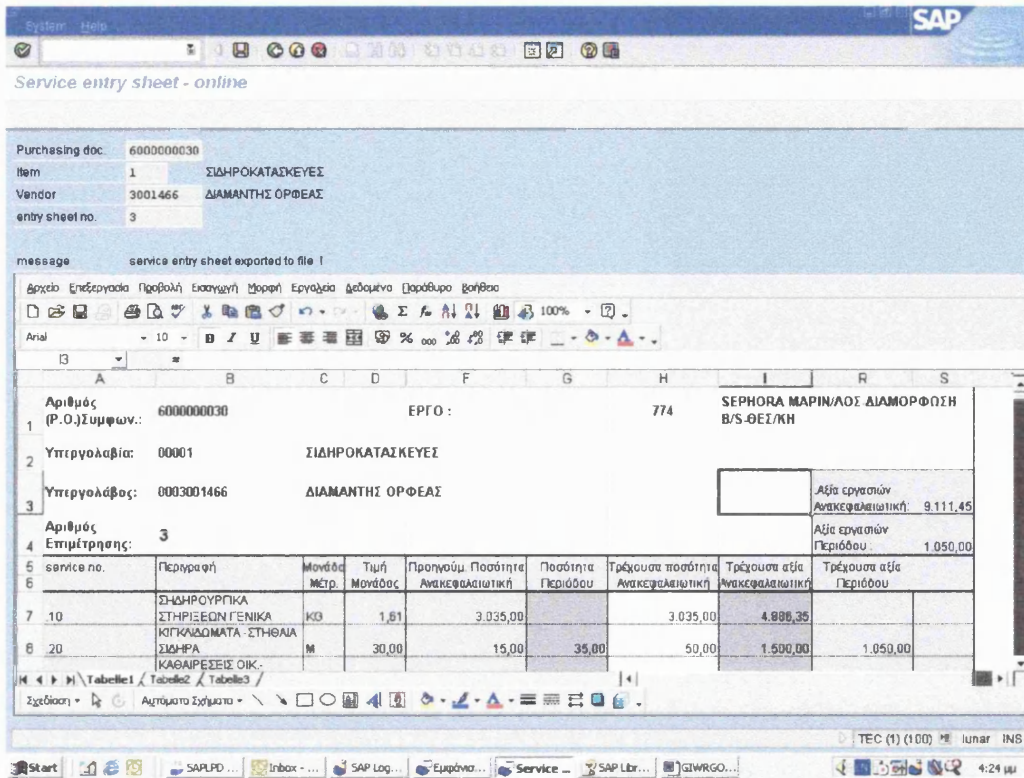


Figure 37. Service entry sheet, use of MS Office Excel

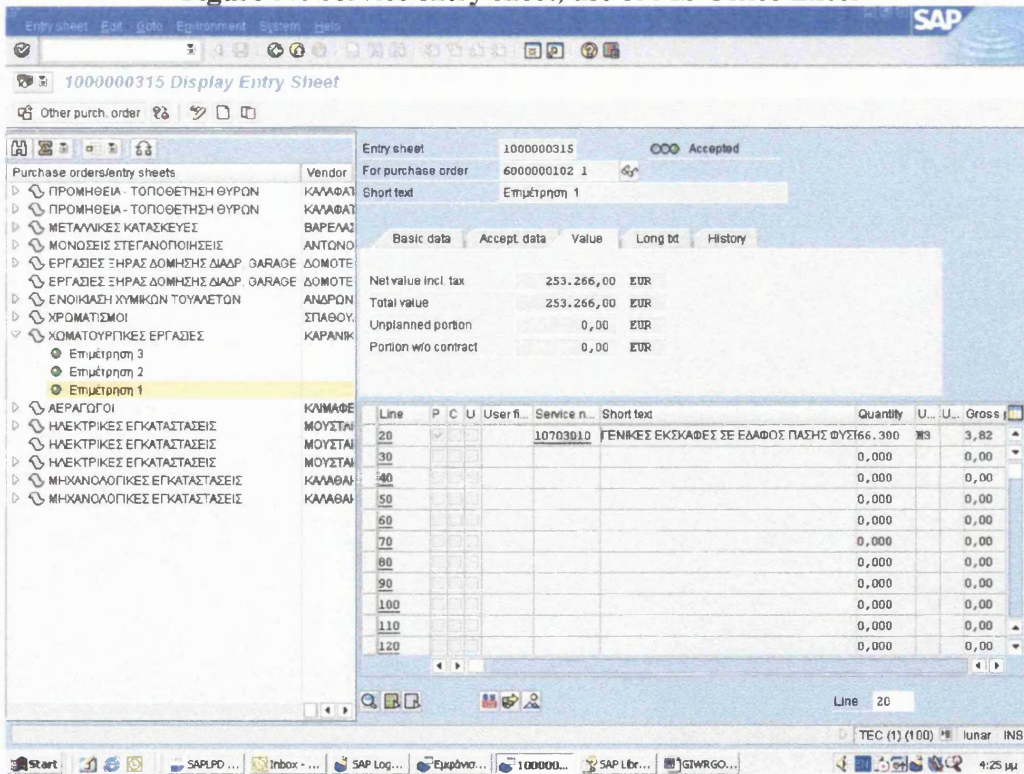


Figure 38. Entry sheets, quantity survey

Purchase order: 4500084092 Order type: MB PO date: 13.05.2002
 Vendor: 1004950 ΠΕΠΠΑΣ ΑΓΓΕΛΟΣ Β. ΑΒΕ Ε Currency: EUR

It.	ID	A/Plnt	Material	Short text	PO quantity	O..	Net price	Per	O..	C	Deliv. date	Matl group	Info rec.
1		P	0045 000000000000100111	ΣΚΥΡΟΔΕΜΑ ΤΥΠΟΥ Β-80	15	MB3	28,511	MB3	D	13.05.2002	006000000	530006678	
2		P	0045 000000000000100122	ΣΚΥΡΟΔΕΜΑ ΤΥΠΟΥ Β-225	81	MB3	42,591	MB3	D	13.05.2002	006000000	5300004803	
3		P	0045 000000000000100914	ΑΝΤΛΙΣΗ ΣΚΥΡΟΔΕΜΑΤΟΣ	93,500	MB3	3,821	MB3	D	13.05.2002	006000000	5300005379	
4		P	0045 000000000000100122	ΣΚΥΡΟΔΕΜΑ ΤΥΠΟΥ Β-225	18	MB3	39,361	MB3	D	13.05.2002	006000000	5300004803	
5		P	0045 000000000000100156	ΣΚΥΡΟΔΕΜΑ ΤΥΠΟΥ C 35/45	12,500	MB3	47,121	MB3	D	13.05.2002	006000000	5300015984	

Figure 39. Example of Purchase Order

5.5. HOW THE SYSTEM WORKS TODAY

5.5.1. GENERAL

Today the edition that is used is the edition 4.6c, which is the latest one of SAP. It is fully translated in Greek and it is used internationally. Besides the above-mentioned reasons, the 4.6c edition was chosen because it offers industry solutions for construction companies like ET. In the IS department of ET 16 people are working today in comparison with 2 people in 1990 and 5 people in 1997, the year SAP was implemented.

Today the system functions satisfactorily in terms of fulfilling the goals that initially were set for this particular time period. The basic goal for ET was in beginning to achieve via SAP the gradual integration and homogeneity of all these procedures that they were operating partially, perhaps, in different applications. In addition, another goal was the gradual introduction to SAP of operations, which remained outside the system, like the management of the construction sites and the

subcontractors. Thus, we had gradually until today the operation via SAP of the accounting department, the supplies, the personnel, the subcontractors etc.

The expectations of the company have not been entirely satisfied; more effort is needed for the complete implementation of SAP, the development of some modules and the operation of new ones. The goal, if possible, is the complete decentralization of the system, in other words, the introduction of more users and the possibility of operating the system, fully, in the construction field, so that the information is direct and on time.

For all these reasons it is clear that the implementation of SAP has not stopped and has not been completed yet.

5.5.2. SAP MODULES COVERED

During the first stage of its parameterization, the system was including the operation of the accounting department, the supervision of costs, the management of assets and the supervision of the construction works. In 1997, the complete analysis and registration of procedures of the personnel department was completed and SAP's use was extended in the management of Human Resources. With the necessary adaptation of the system, parts of contract supervision were covered as well as the determination of the unfinished part of the projects, the planning and the budgeting. Since the beginning of 1999, the materials management department related to supplies is in function. Since 2000 the application of the payment of salaries is in operation for all the categories of employees in cooperation with the subsystem of the personnel's management. Payroll was developed with the aid of an external consultant and more specifically the SAP Hellas.

The application procedure of the system has not been yet completed. Some of the modules are fully functional; some others are going to be developed even further and some others are going to be developed from the beginning in the future. Next, modules, which have been developed fully or partially, are shown:

- Finance Management, FI
- Controlling, CO
- Materials Management, MM

- Human Resources, HR
- Assets Management, AM
- Project System, PS
- Enterprise Controlling, EC, EIS-MIS
- Cash Management, CM
- Payroll
- Equipment Management, EM

In the next paragraph we will refer in more detail to the further development of a module. More specifically we will refer to the development of the PS⁶¹.

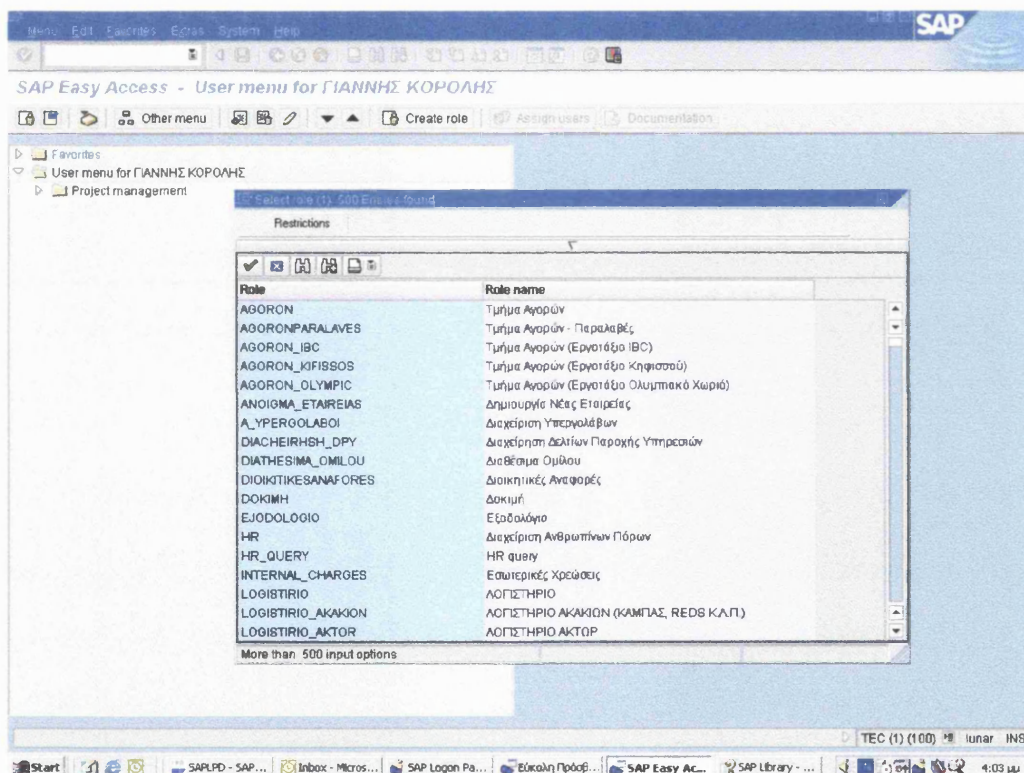


Figure 40. General user menu

⁶¹ From the variety of modules that ET developed this module was chosen to be mentioned because of its relationship to the construction companies and more over due to the fact that this specific module was developed when this study was taking place.

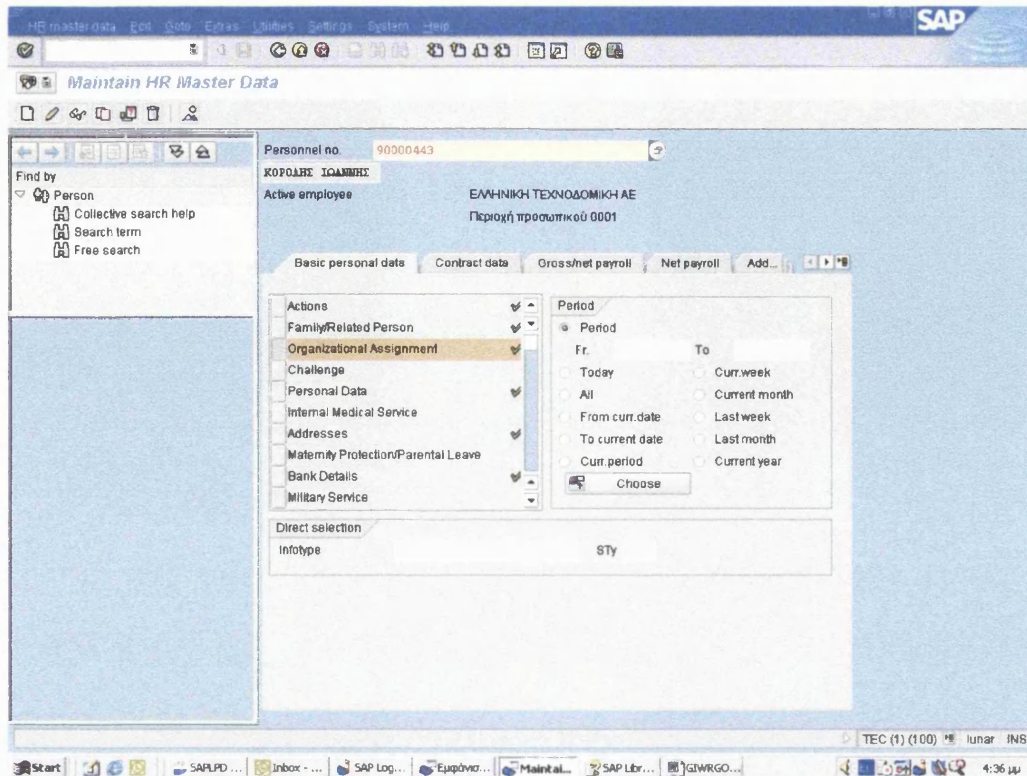


Figure 41. Example of Human Resources module master data

5.5.3. THE DEVELOPMENT OF THE PS

ET for several reasons, procedural, organizational and also because SAP is a very large application to be developed all at once, while it was using the PS module already since 1997 it had not develop and used it yet in its entire capacity. Furthermore it delayed its full operation because the initial edition of SAP did not give the desirable solutions. Today's edition, 4.6c, covers better the issues related to the construction companies and thus ET went ahead⁶² to the further development of the PS.

The PS module is based on the observation of all operational functions as they combine to complete a project with a minimum possible cost, in relation with a specific timetable. From the organization of the project, to the programming of the works, up to the logistics of different functions, the PS provides us with the immediate presentation of the status of a project.

The main operations of the PS are:

- Maintenance of the standard structures of projects.

⁶² January 2001.

- Development of the structure of a new project.
- Budget registration.
- Record of data of supplier/ subcontractor.
- Management of materials.
- Management of subcontracting
- Re-registration / re-accounting of costs
- Information system.
- Printing.

Initially, at the first stage⁶³ of the development of the PS module, the project was developed in one level only. In every project, a code was given and the WBS⁶⁴ was limited to only one level. All registrations⁶⁵ were only referring to this level and there was no further development.

For the second stage⁶⁶ of development of the PS module there was no need of a specialized consultant and only in isolated cases a group of consultants from SAP Hellas was used. Today the development of the project is being done in more levels⁶⁷. Every expense in the project is characterized now at the last level of the code of development. In this manner, they succeed also to introduce the budget of the projects, while at the previous stage such a thing did not even exist at the first level⁶⁸. Thus we have a development of the cost planning. Besides the expenses, the distribution of the materials at different levels of the project becomes possible through the PS. The reports have been developed in-house to a certain degree⁶⁹. Through the PS and the big variety of the printings both the company and the civil engineer of the construction site may collect important information. For the development of the PS did not happen major changes in SAP and there were not significant problems.

However, operations such as the networks⁷⁰ have not been yet developed, mainly because more work is needed for the time connection between the projects,

⁶³ 1997

⁶⁴ Work Breakdown Structure is the hierarchical model of the tasks to be performed in the project.

⁶⁵ Costs/revenue

⁶⁶ Since 01/2001

⁶⁷ From 2 up to 5

⁶⁸ At the first stage such a development was happening outside SAP only in a few big projects.

⁶⁹ They were not covered by SAP.

⁷⁰ They are not going to be developed for the next two years. For those operations that SAP does not cover, because of the non-development of the networks, ELTEX uses applications such as Primavera, MS projects and Suretrack.

therefore a further observation. Additionally, there is no availability control, with the exception though of big projects, due to the fact that the system is slow and because the transcendence of time is something common and the availability control could cause problems in the registrations. Finally, because the networks have not been yet developed, there is no use of the operation of time programming.

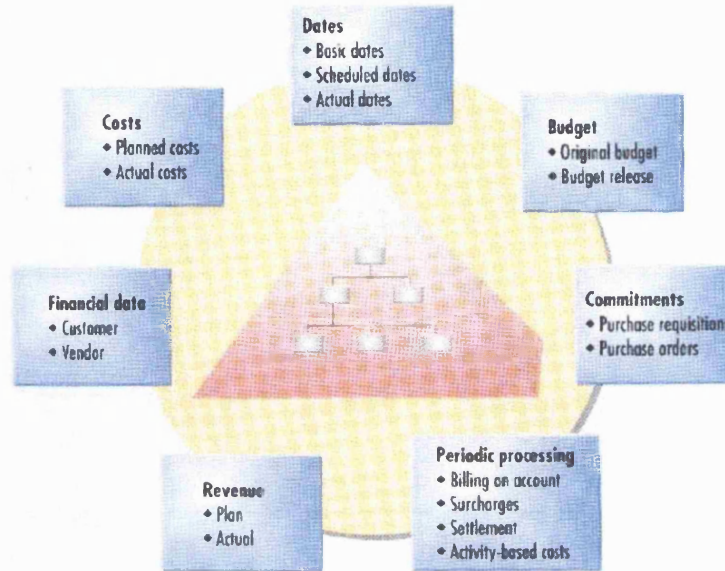


Figure 42. Functions of the Work Breakdown Structure

Source: [SAP E&C, 1997, p1-5]

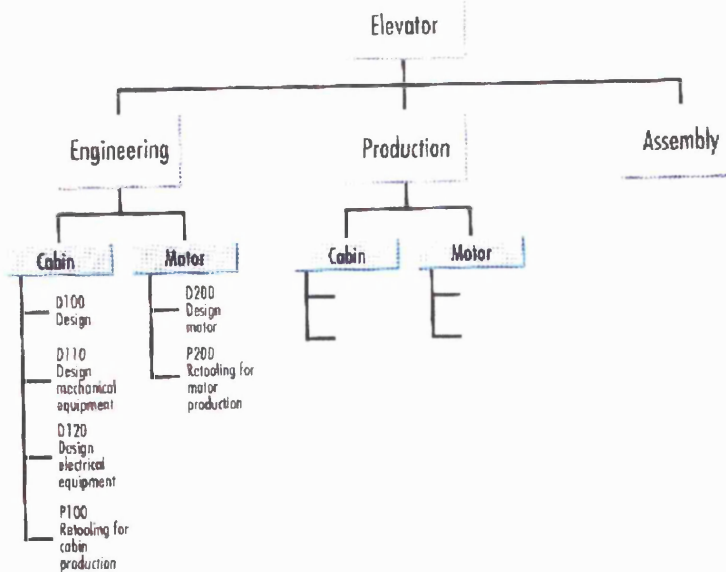


Figure 43. Example of a Work Breakdown Structure

Source: [SAP E&C, 1997, p1-6]

The screenshot displays the SAP 'Display Std. WBS: WBS Elements - Descriptions' interface. The project is identified as 'ΟΙΚΟΔΟΜΙΚΟ ΠΡΟΤΥΠΟ ΟΙΚΟΔΟΜΙΚΟ ΕΡΓΟ'. The table below lists the WBS elements with their levels, descriptions, and various status flags.

S	Lev	WBS element	Description	Typ	Pri	Stu	PE	Acct	Bill
1		00K	ΠΡΟΤΥΠΟ ΟΙΚΟΔΟΜΙΚΟ ΕΡΓΟ			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
2		ΟΙΚ-150	ΟΙΚΟΔΟΜΙΚΕΣ ΕΡΓΑΣΙΕΣ			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3		ΟΙΚ-155	ΚΑΘΑΙΡΕΣΕΙΣ			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4		ΟΙΚ-155-010	ΚΑΘΑΙΡΕΣΕΙΣ ΓΕΝΙΚΑ			<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
3		ΟΙΚ-160	ΙΚΡΙΟΜΑΤΑ			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4		ΟΙΚ-160-010	ΙΚΡΙΟΜΑΤΑ ΓΕΝΙΚΑ			<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
3		ΟΙΚ-165	ΑΝΤΙΣΤΗΡΙΞΕΙΣ-ΠΑΣΣΑΛ-ΔΙΑΦΡΑΓΜ. ΤΟΙΧΟΙ			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4		ΟΙΚ-165-010	ΠΡΟΣΚΟΜΙΣΗ+ΑΠΟΚΟΜ. ΕΞΟΓΑΣΜ. ΑΝΤΙΣΤΗΡΙΞ.			<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
4		ΟΙΚ-165-020	ΔΙΑΤΡΗΣΗ ΜΙΚΡΟΠΑΣΣΑΛΩΝ			<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
4		ΟΙΚ-165-030	ΔΙΑΤΡΗΣΗ ΠΑΣΣΑΛΩΝ			<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
4		ΟΙΚ-165-040	ΕΠΙΒΑΡΥΝΣΕΙΣ ΠΑΣΣΑΛΩΣΕΩΝ			<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
4		ΟΙΚ-165-050	ΑΠΟΜΑΚΡ. ΠΡΟΙΟΝΤΩΝ ΕΚΣΚΑΦΩΝ ΠΑΣΣΑΛΩΣΕ...			<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
4		ΟΙΚ-165-060	ΣΙΔΗΡΟΣ ΟΓΛΑΣΜΟΣ ΠΑΣΣΑΛΩΝ			<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
4		ΟΙΚ-165-070	ΜΟΡΦΟΣΙΔΗΡΟΣ ΠΑΣΣΑΛΩΝ			<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
4		ΟΙΚ-165-080	ΟΓΛΑΣΜΕΝΟ ΣΚΥΡΟΔΕΜΑ ΠΑΣΣΑΛΩΝ			<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
4		ΟΙΚ-165-090	ΑΠΟΣΗΛ. ΕΓΚΑΤΑΣΤΑΣΕΩΝ ΑΝΤΙΣΤΗΡΙΞΗΣ			<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
4		ΟΙΚ-165-100	ΔΟΚΙΜΑΣΤΙΚΕΣ ΦΟΡΤΙΣΕΙΣ ΠΑΣΣΑΛΩΝ			<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Figure 44. Example of WBS elements – descriptions

Εμφάνιση Έργο: Επισκόπηση στοιχείου WBS

Κατάσταση: 360 ΟΡΓΑΝΙΣΜΟΣ ΘΕΣΚΗ '07-MONH ΛΑΖΑΡΙΣΤΩΝ

Βασισμένο: Ημέρες Αποστολ. Ευθύνης Έλεγχος Σύνολο

S	Επ.	Στοιχείο WBS	Περιγραφή	ΣΥ	Προ.	Αδ.	Τιμ.	Κατάσταση συστήματος
1		360	ΟΡΓΑΝΙΣΜΟΣ ΘΕΣΚΗ '07-MONH ΛΑΖΑΡΙΣΤΩΝ	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	REL RYPS
1		360-ΣΥΜΘ	ΣΥΜΒΑΣΕΙΣ ΕΡΓΟΥ 360	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	REL LKD
2		360-Σ01	ΣΥΜΒΑΣΗ 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	REL LKD
2		360-Σ02	ΑΠΟΛΟΓΙΣΤΙΚΕΣ ΕΡΓΑΣΙΕΣ	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	REL LKD

Κάνει έλεγχο.

TEC (1) (100) lunar INS

Figure 45. WBS Element Overview in a specific project, in first stage of the development of the PS module.

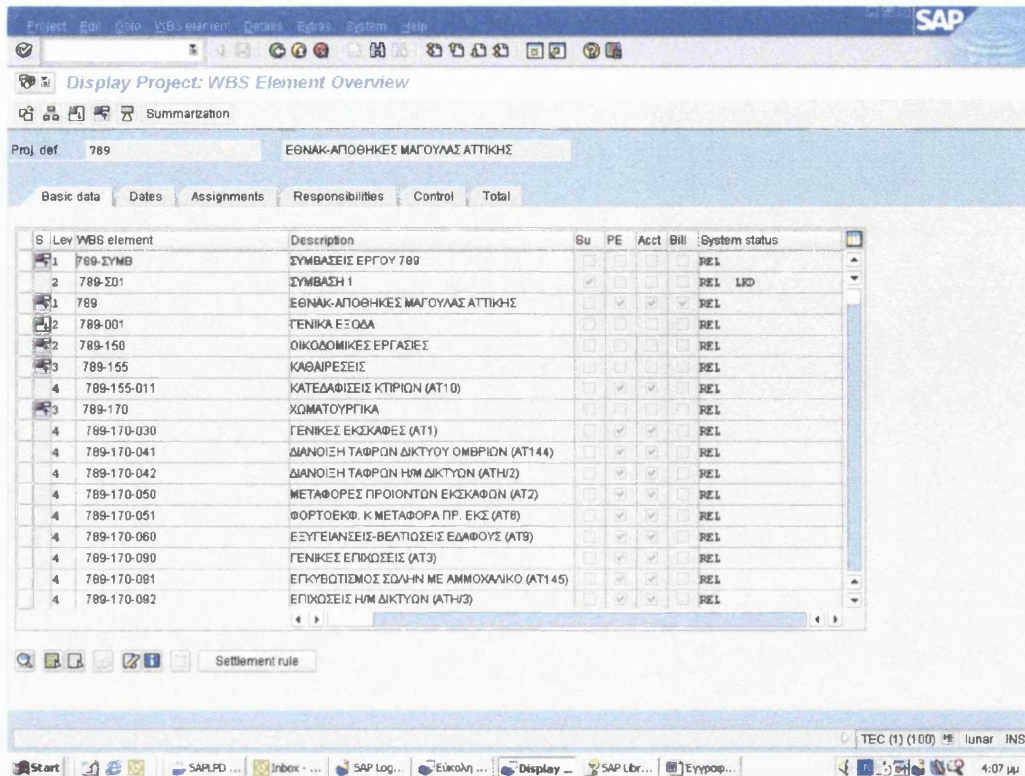


Figure 46. WBS Element Overview in a specific project, in second stage of the development of the PS module.

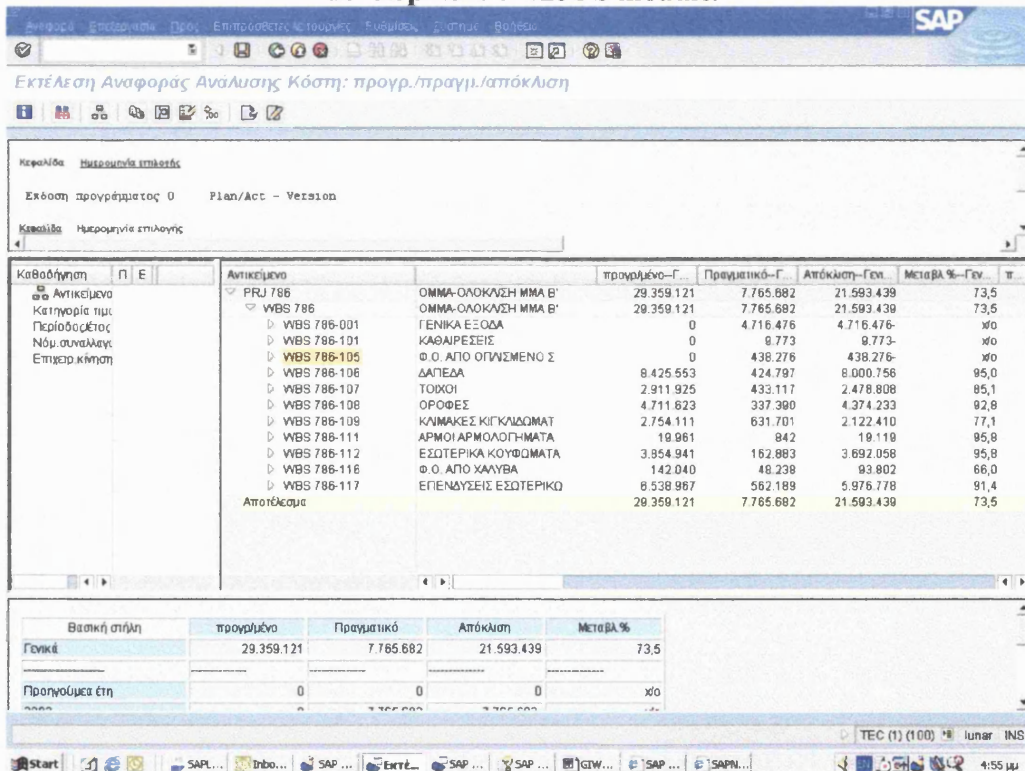


Figure 47. Example of report analysis of costs

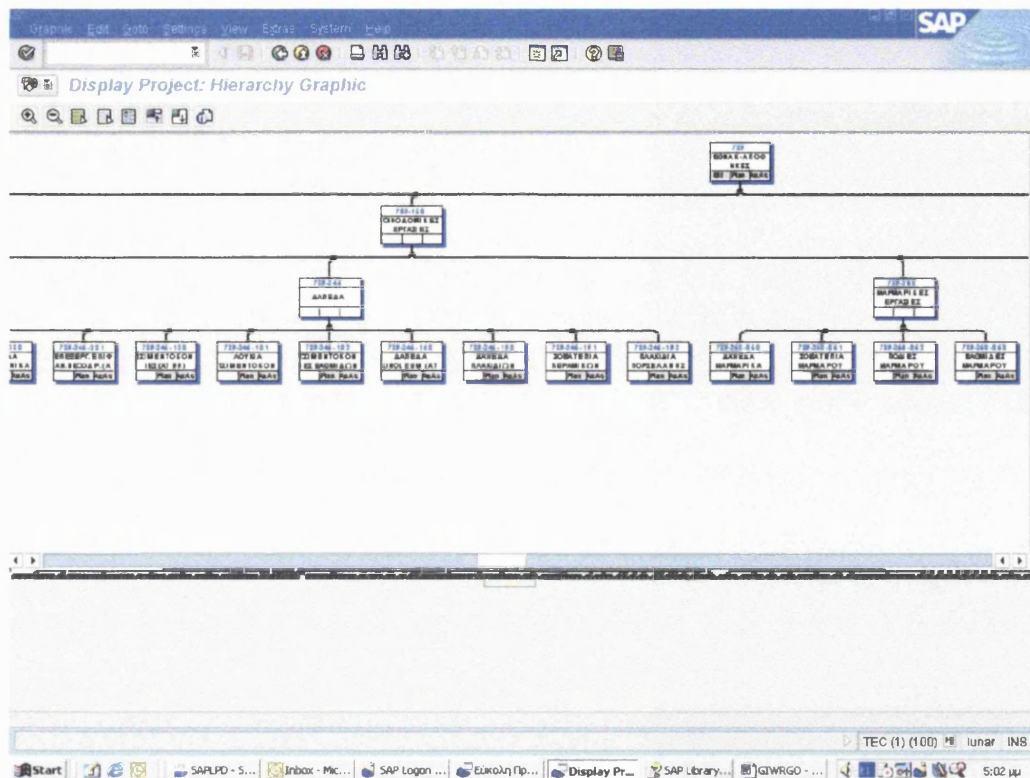


Figure 48. Example of project hierarchy graphic

5.6. THE COMPANY'S ERP NEEDS IN THE FUTURE

5.6.1. MODULES WHICH THE COMPANY WISHES TO DEVELOP IN THE FUTURE

As the implementation of SAP has not been yet completed there are processes of the company that must be introduced to the system with the development of additional modules in the future. These processes are covered by other applications. Such processes were the management of letters of guarantee⁷¹, the observation of equipment⁷², and other processes, which refer to the rest of the activities of the group, besides the constructions.

⁷¹ Financial document in form and content, a letter of guarantee is provided by the bank, which guarantees, against a certain amount of money, the possibility of a company to take over a specific project.

⁷² CEM: Construction Equipment Management.

Next, we will indicate the modules that ET will soon develop either from the very beginning or further from a given stage:

- Sales and Distribution, SD
- Materials Management, MM
- Quality Management, QM
- Plant Maintenance, PM
- Assets Management, AM
- Industry-Specific Solutions, IS
- Construction Equipment Management, CEM

5.6.2. NEW NEEDS AND EXPLOITATION OF THE NEW CAPABILITIES OF SAP AS FAR AS NEW TECHNOLOGIES ARE CONCERNED

The new needs of ET for the future, concern the use, or non-use, of solutions that exist or will possibly exist in the future through SAP or in combination with it related to the use of applications of the Internet, E-Business, CRM and in general new technologies. In other words, there might be the need that these technologies will function either through the SAP or in a parallel way with it. SAP AG has developed several applications related to this environment and ET has not yet used through the SAP application technologies such as portals, marketplaces etc.

Among the intentions of the company are the use and exploitation of such capabilities in the future as well as the active role of ET in this field. More specifically, in May of 2002 the company E-construction SA was founded aiming to develop the first electronic marketplace enabling transactions between businesses⁷³ in the construction sector. The ET's Group provided the 37.5% of the company's capital. The Groups AVAX – J&P- ETETH and GEK – TERNA also participate in the company's capital. E-construction SA will undertake the development of an Internet portal for the procurement of building and services at all stages of construction, simultaneously allowing access to international e-markets⁷⁴.

⁷³ B2B

⁷⁴ The company is expected to function properly till March 2003.

6. CONCLUSIONS AND RECOMMENDATIONS

ERP systems is a relatively new subject, which has grown quickly the last decade, since many companies in an international level went ahead and implemented an ERP system. They are powerful IS that have positioned themselves as a landmark in the evolution of IT. ERP, as a subject, is a very complex one since it marries technology, business practices, and organizational structures. ERP systems can integrate the activities of a company and can give them a competitive advantage.

ERP systems have received much criticism that they are complex, expensive, and difficult to implement and often not appropriate for small and medium sized organizations like many construction companies. There are also different opinions that the existing IS do not follow the changes in the business and that an ERP system is the fastest and in many cases the best way to upgrade the IS of a company contrary to an in-house application. In an attempt to argue for that in the CI, we can say that an ERP system is a good solution for construction companies, since whenever it has been implemented in order to identify and solve certain problems, it has been proved to be a powerful tool for business improvement. On the other hand an implementation of an ERP system is a huge investment in time, money, and resources, and the decision must be considered carefully. Moreover, the ERP vendors have to further develop the systems, which concern the solutions offered covering the particularities of different industry fields, such as the construction industry field.

While several organizations in the CI have committed to use ERP systems in the last few years, researchers have neglected to address issues and problems regarding ERP implementation in construction companies. This research tried to address these concerns by using the interesting case of ET and the implementation of SAP. More specifically, through the case study, the research has identified that ET reached all the major goals, which were set before the implementation. Managers in the company believe that they became more effective and the new system brought them some competitive advantage. Moreover because of the rapid development of the company the last few years in the construction field as well as in other activities, SAP has been proved to be very helpful to manage effectively all the activities of the company. The case study underlined the need of the continuous support of the system

from the information department of the company, and it was suggested that it is necessary, to fully specialize and familiarize the users with the system, as well as to try to maintain this knowledge in the company.

Furthermore, the research has also identified that some important functions of construction companies are either not handled at all from SAP, or not handled well. Such an example is the case of the management of the subcontractors. However, the benefits of a system could be increased as newer releases gain more functionality. With the help of external consultants a company could develop new applications or could improve the system and this happened with ET as far as the above-mentioned problem is concerned. The implementation of an ERP system could cause employees resistance and for that reason a mild BPI⁷⁵ is suggested instead of an expanded BPR⁷⁶ due to the implementation of the new system. Careful attention should be paid to the project's focus and alignment with its organization, team and scope. The whole organization should understand why the project is worth the change.

Several studies have been conducted about the implementation of an ERP system and the impact of such a movement on the company itself. By focusing our interest on the CI, we observe that although many construction companies operate by using an ERP system, there is no adequate research on the subject

Since a portion of the large construction companies already has an ERP system, it is important, through this experience to have more studies focused on this system and its results in the companies of the CI. Due to the fact that these companies are mainly "early users" of such systems, it would be beneficial to develop more studies in this field. It is imperative to make ERP systems more known and to increase awareness of their advantages and disadvantages, especially among the top management of construction companies. That way they will see this new business tool with a more strategic point of view. So, the ones that consider an ERP system, they will see it as a strategic opportunity to strengthen their competitiveness. All the above-mentioned are of particular importance for the Greek market, because of the many mergers that happened the last few years. It is possible that new groups might go ahead and adopt an ERP system.

⁷⁵ Business Processes Improvement

⁷⁶ Business Processes Reengineering

An important element before an ERP implementation is the choice of a system, which will be compatible with the activities of a company and which will cover a major part of its needs. For this reason, it is recommended a good market research of ERP systems and a good evaluation before their adoption and implementation, so that they will meet both the needs of the specific construction company and these of the business market.

It should be noted, that the part of the implementation process of SAP developed here represents only a part of the entire process, which took place or will take place in ET. The implementation of an ERP system is a process that takes time and it would be advantageous to conduct a research when the system is fully implemented in ET in order to compare results.

Additionally, it should be stated that in order to conduct a more detailed analysis further research is needed to retrieve information about the implementation of other ERP systems. This study has focused on SAP system. A similar study of the implementation of other ERP systems in construction companies would provide additional insight and a broader perspective on the functional usability of ERP systems in CI.

Another field that needs future research is the area of new applications that are directly related to ERP, in the areas of knowledge management, supply chain integration and web-enabled innovation.

Finally, the research has identified that ERP are information systems, that are tightly related to the structure and the design of an organization and they are not just an external agent with an impact on an organization. Therefore the construction companies they have to keep that in mind and examine these systems and their implementation as a strategic movement. We should not forget that the acquisition of a competitive advantage is a continuous process and the right use of tools such as an ERP system is of great importance.

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APPENDICES

APPENDIX A

A. INTERVIEW QUESTIONS

A.1. INTERVIEW QUESTIONS FOR ELLINIKI TECHNODOMIKI, SAP TEAM.

- What is the market share of Elliniki Technodomiki in the Greek construction market?
- Would you like to briefly describe your company's activities and if you have more than one branch?
- Which were the reasons for implementing an ERP system?
- Describe your role in the implementation project
- Who was involved in the decision making process for the ERP solution?
- How many people were involved in the implementation process?
- Did you examine the possibility of using another ERP application as well? What requirements did you have for the solution?
- What do you think are in general the advantages of the SAP?
- What are the advantages of the SAP for a construction industry firm?
- Do you think construction companies could gain competitive advantage by using ERP software?
- Which version of the SAP are you using and why?
- What was the implementation process plan?
- Which requirements do a construction firm have to meet in order to implement an ERP software and especially the SAP?
- What are the usual problems a construction firm is facing by trying to implement ERP software?
- What were the problems Elliniki Technodomiki faced by trying to implement the SAP?
- Did you need Business process re-engineering? In other words, did you make any organizational changes in order to implement the SAP?

Appendices

- Did you make any changes in the SAP application in order to successfully implement it to your firm?
- Would you like to briefly describe the main parts of the SAP application you use?
- Do you think that ERP applications and especially the SAP enable construction companies to manage the comprehensive business requirements for such challenges as sourcing, labor, project management and accounting complexities?
- Are there in general any disadvantages by using ERP software and especially the SAP?
- What are the most important factors for a successful implementation project?
- Have you finished the implementation process and if not what have you already done and what is left still out to be done?
- How does the system work today? Has it met your expectations?
- What is your advice to other construction firms regarding an ERP solution?
- Do you think more construction firms are going to use the SAP or other ERP software in the future?
- Do you see any particular needs that you may face in the future?
- Does your company use the Internet and e-commerce? Do you think the SAP helps in that process?
- Would you like to add something that you think it could be useful in my research?
- Do you have any other comments?

**A.2. INTERVIEW QUESTIONS FOR ELLINIKI
TECHNODOMIKI, USERS.**

- Could you describe your role in Elliniki Technodomiki and also in which part of your work you have to use the SAP?
- Did you have the same position before the specific ERP implementation? If yes, what kind of changes, positive or negative has the specific application incurred to your work?
- Would you like to briefly describe the last project in which you took part and you used the SAP?
- What kind of problems did you face using the SAP in general or in a specific project?
- Would you like to briefly describe the main parts of the SAP application that you use?
- Are there in general any disadvantages by using ERP software and especially the SAP?
- Do you use the Internet in your work? Do you think the SAP helps in that process?
- Would you like to add something that you think it could be useful in my research?
- Do you have any other comments?

APPENDIX B
ELLINIKI TECHNODOMIKI AND GROUP'S
FINANCIAL DETAILS

COMPANY	MAIN SCOPE OF ACTIVITY	COMPANY FORM	PERCENTAGE
H E & D SA	ENERGY	ENERGY	33,33%
HELLINVEST CONSTRUCTION LTD	HOLDING CO. OF HELLIN. BULGARIA	HOLDING	50,00%
REDS SA	REAL ESTATE SERVICES	SERVICES	50,00%
TECHNOBAU GmbH	TECHNICAL	TECHNICAL	100,00%
AKTOR SA	CONSTRUCTION, HOLDINGS	CONSTRUCTION	50,31%
ASTIKES ANAPTYXIS SA (URBAN DEVELOPMENTS)	REAL ESTATE DEVELOPMENT	RED	100.00%
ATTIKA DIODIA SA	HOLDING CO. OF ATTIKES DIADROMES	HOLDING	8.48%
ATTIKES DIADROMES SA	SERVICES - TOLL MANAGEMENT	SERVICES	4.32%
ATTIKI ODOS SA	BOT - EXPLOITATION OF ATTIKI ODOS	CONCESSION	8.47%
ATTIKI CAR STATIONS	BOT - REAL ESTATE DEVELOPMENT IN MOTORWAY SERVICE STATIONS	CONCESSION	65.00%
GEFYRA SA	BOT - EXPLOITATION OF THE RION BRIDGE	CONCESSION	7.74%
GEFYRA MARITIME CO.	SUPPORT	MARITIME	7.74%
YIALOU SA	REAL ESTATE OWNER	REAL ESTATE	65.00%
DIETHNIS ALKI SA	REAL ESTATE EXPLOITATION	CONCESSION	65.00%
ETHNIKI AKINTON (NATIONAL BANK OF GREECE REAL ESTATE DEVELOPMENT CO.)	REAL ESTATE OWNER	REAL ESTATE	5.00%
ELL. TECHN. ENGINEERING CONSULTANTS UNLTD.	CONSTRUCTION MGT	SERVICES	87.50%
INTERTASK SA	CONSTRUCTION MGT OF MOLDAVIA TERMINAL	SERVICES	31.00%
KANTZA SA	REAL ESTATE OWNER	REAL ESTATE	83.99%
KASTOR SA	CONSTRUCTIONS	CONSTRUCTION	100.00%
PIRA SA	HOLDING CO. OF DILAVERIS SA	HOLDING	50.00%
POLYCLONOS SA	REAL ESTATE DEVELOPMENT	RED	20.00%
PYRROS SA	COMPANY/IDLE	COMMERCIAL	65.00%
VOLOS TECHNICAL COMPANY (TEB) SA	CONSTRUCTIONS/HOLDING	CONSTRUCTION	44.33%

Appendices

TECHNO SA	REAL ESTATE OWNER	REAL ESTATE	99.70%
TECHNOVAX SA	HOLDING CO. OF TERMINAL SA	HOLDING	26.17%
TECHNOLIT SA	UNDER LIQUIDATION	COMMERCIAL	33.33%
TECHNOSUN	CONSTRUCTIONS	TECHNICAL	100.00%
PSYTTALIA MARITIME CO.	SUPPORT	MARITIME	33.33%
AEOLIKI PANIOU SA	ELECTRICAL POWER	ENERGY	90.00%
AEOLIKI OLYMPOU EVIAS SA	ELECTRICAL POWER	ENERGY	90.00%
AEOLIKI KANDYLIOU SA	ELECTRICAL POWER	ENERGY	80.00%
AEOLIKI ZARAKA METAMORFOSSIS SA	ELECTRICAL POWER	ENERGY	90.00%
WIND FARMS COLOSSOS SA	ELECTRICAL POWER	ENERGY	85.00%
GREEK WIND FARMS TRIZINIA SA	ELECTRICAL POWER	ENERGY	90.00%
AEOLIKI PARNONOS SA	ELECTRICAL POWER	ENERGY	85.00%
ANDROMACHI	BUILDING CONSTRUCTIONS	CONSTRUCTION	40.00%
TOMI SA	CONSTRUCTIONS/ENERGY	CONSTRUCTION	30.00%
A.D.E.Y.P. SA	COMPANY/IDLE	ENERGY	32.00%

Table 12. Participations, Elliniki Technodomiki SA

Source: [www.etae.com, accessed 03/05/2002]

Financial Results 1998 –2000* (in thousand Euro)			
	1998	1999	2000
Company Turnover	49,282.47	88,137.93	95,172.41
Turnover from Joint Ventures	51,738.81	66,022.01	99,600.88
Total Turnover	101,021.28	154,159.94	194,773.29
Less: Cost of Projects implemented ⁽¹⁾	43,677.18	76,921.50	88,337.49
Gross profit from company turnover ⁽¹⁾	5,602.35	11,216.43	6,834.92
(% on company turnover)	11,4%	12,7%	7,2%
Plus: Other operating income	67.50	105.65	211.30
Total	5,669.85	11,322.08	7,049.16
Less: Administrative expenses ⁽¹⁾	2,142.33	2,820.25	3,624.36
Operating Result ⁽¹⁾	3,527.51	8,501.83	3,424.80
(% on company turnover)	7,2%	9,6%	3,6%
Plus: Income from participations ⁽²⁾	5,567.13	11,867.94	25,220.84
(% on turnover from Joint Ventures)	10,8%	18,0%	25,3%
Plus: Income from securities	581.07	1,276.60	663.24
Plus: Profits from sale of participations and securities	0.00	19,286.87	12,416.73
Less: Participation and securities value decline allowances	0.00	55.76	0.00
Less: Participation and securities expenses and losses	237.71	4,410.86	1,435.07
Plus: Extraordinary and Contingent Income & Profits	507.70	176.08	49.89

Appendices

Less: Extraordinary and Contingent Expenses & Losses	431.40	93.91	117.39
Earnings before Income, Depreciation and Tax	9,514.31	36,548.79	40,225.97
(% on total turnover)	9.4%	23.7%	20.7%
Plus: Interest and related income	419.661	1,329.42	768.89
Less: Interest charges and related expenses	249.45	513.57	4,821.72
Earnings before Depreciation and Tax	9,687.45	37,367.57	36,173.15
(% on total turnover)	9.6%	24.2%	18.6%
Less: Normal depreciation included in the operating cost	2,022.01	2,397.65	3,486.43
Less: Depreciation not included in the operating cost	0.00	0.00	2,538.52
Earnings before tax	7,665.44	34,969.92	30,148.20
(% on total turnover)	7.6%	22.7%	15.5%
Less: Applicable income tax	4,117.39	7,151.87	7,815.11
Less: Directors fees	146.74	293.47	440.21
Earnings following tax and Directors fees	3,401.32	27,524.58	21,892.88
(% on total turnover)	3.4%	17.9%	11.2%
Less: Prior period tax audit adjustments	0.00	0.00	2.93
Earnings following tax, Directors fees and prior period tax audit adjustments	3,401.32	27,524.58	21,889.95
(% on total turnover)	3.4%	17.9%	11.2%

* Differences may arise due to the rounding of numbers

1. Prior depreciation

2. Income from participations includes income from Joint Ventures

Table 13. Summary financial data: Elliniki Technodomiki SA

Source: [www.etae.com, accessed 03/05/2002]

	ELLINIKI TECHNODOMIKI	AKTOR	TEB	GROUP (consolidated)
Turnover	254.23	244.56	93.43	593.85
Profit before taxes	36.27	40.45	5.63	77.88
Total Assets	481.12	258.33	129.46	586.78
Shareholders' Funds	418.57	182.93	108.75	437.82
Cash and Cash Equivalents	31.03	73.86	25.29	130.49
Backlog	383.17	505.60	147.93	1,036.70

Table 14. Financial Results 2001 in million Euros

Source: [www.etae.com, accessed 03/05/2002]



Figure 49. Group's Financial results.
 Source: [www.etae.com, accessed 03/05/2002]

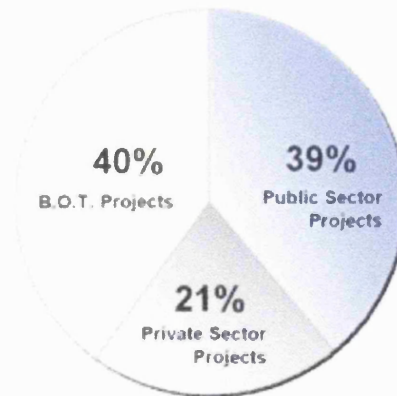


Figure 50. Turnover analysis for 2001
 Source: [www.etae.com, accessed 03/05/2002]

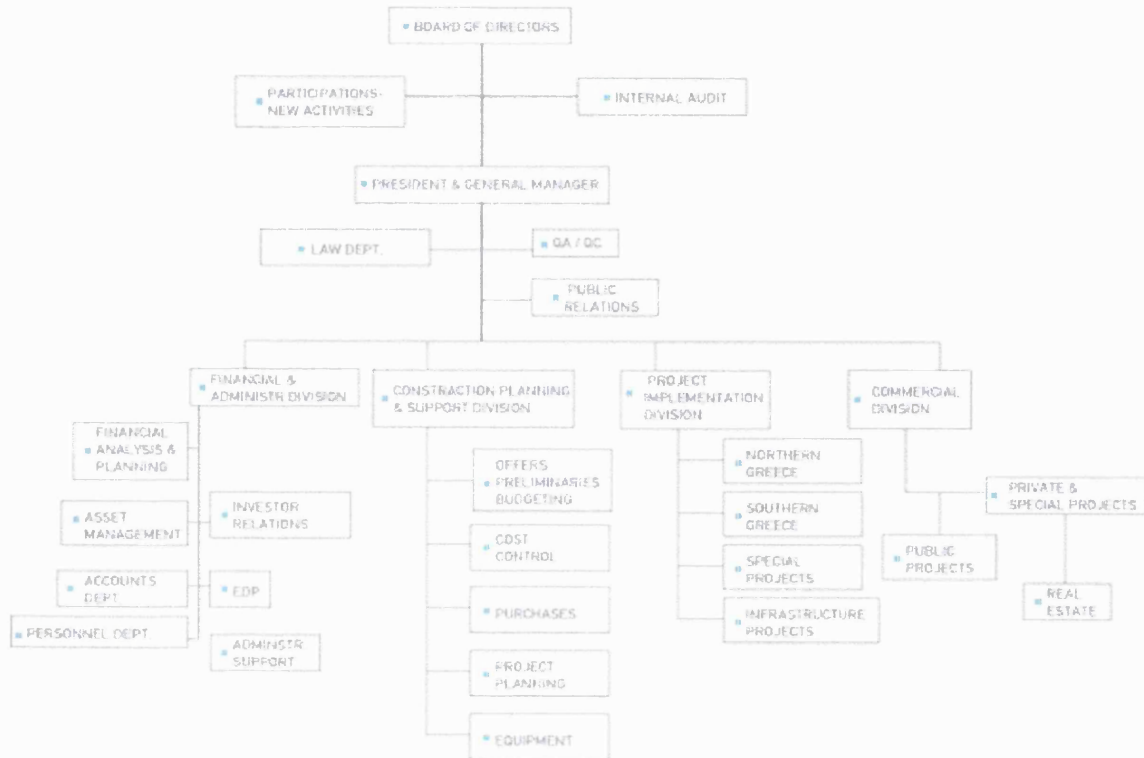


Figure 51. Organization chart, Elliniki Technodomiki SA

Source: [www.etae.com, accessed 03/05/2002]

	COMPANY	Turnover (in million Euro)
	TECHNICAL OLYMPIC SA	258,266.27
	ELLINIKI TECHNODOMIKI	253,548.40
	AKTOR	244,56.35
	AEGEK SA	175,404.00
	J&P (HELLAS)	159,572.65
	AVAX SA	126,271.84
	C.J. SARANTOPOULOS	115,406.57
	GEK SA	112,499.62
	ALTE SA	111,686.63
	TEB SA	93,324.63
	ATTI-KAT SA	87,617.40
	ATHINA SA	87,491.24
	DIEKAT SA	82,623.88
	PANTECHNIKI SA	75,183.05
	THEMELIODOMI SA	71,360.00
	TOTAL	2,054,812.53

Table 15. Turnover of major Greek companies.

Source: [www.etae.com, accessed 03/05/2002]

GROUP'S POSITIONING IN THE LOCAL MARKET
 (amongst the biggest 15 - according to 2001's turnover results)

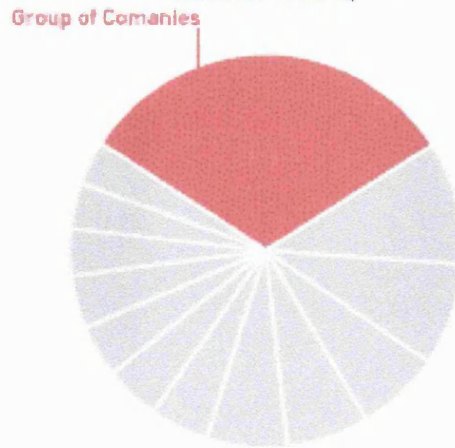


Figure 52. Group's positioning in the local market.

Source: [www.etae.com, accessed 03/05/2002]

GROUP ACTIVITIES:	
	Construction
	Buildings
	Infrastructure
	Industrial & Electromechanical works
	Environmental Projects
	Concessions
	Services
	Project & Construction Management
	Real Estate Development
	Operation and Management of Utility Networks
	Operation & Management of Motorways
	Real Estate Development
	Energy
	Telecommunications
	E-Market

Table 16. Group activities.

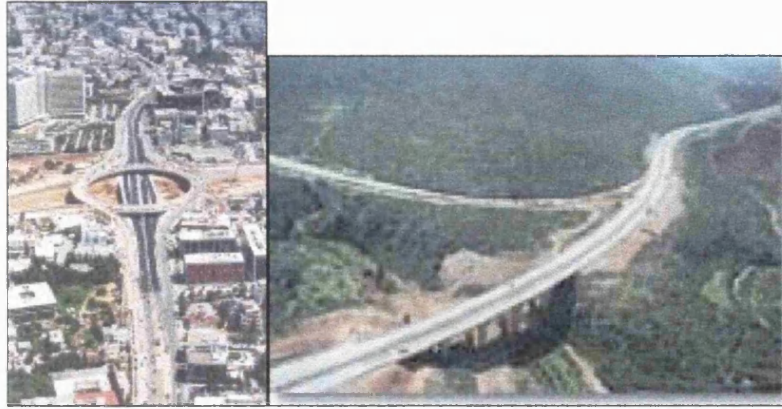


Figure 53. Projects: a. Attiki Odos – Kifissias interchange / b. Motorway PATHE: Kastro-Martino-Atalanti-Tragana.

Source: [www.etae.com, accessed 03/05/2002]



Figure 54. Projects: a. Olympics 2004 International Broadcasting Centre, IBC / b. Athens Olympic stadium, OAKA.

Source: [www.etae.com, accessed 03/05/2002]



Figure 55. Projects: a. Dam Thysavrou Nestou / Rion – Antirion bridge.

Source: [www.etae.com, accessed 03/05/2002]

APPENDIX C
A BRIEF DESCRIPTION OF THE PREVIOUS
INFORMATION SYSTEM OF HELLINIKI
TECHNODOMIKI

The older Information System in Elliniki Technodomiki was an in-house developed system, in Data General machines with the use of relational database in Cobol language. It was not an integrated application such as SAP and also the applications covered were much fewer. Basically, it was covering the accounting part of the activities of the company, the general accounting, the clientele and the suppliers. Contrary to SAP the clients and the suppliers were not developed as a subsystem but they were rather bills from the group of bills from the general accounting. Therefore, the possibilities of that system were substantially lesser than these of SAP. There was not a big spread of data about the works, the works of cost, the clients and the suppliers as it happens today in SAP. Moreover the entered data concerning the personnel were only focused on producing the payroll. This application did not also cover the Asset Management for which there was another separate application.

Besides all the above mentioned, a part of this system was covering the management of the subcontractors as far as the notifications⁷⁷ and their accounting observation is concerned. This part of the application was used for a certain amount of time in parallel with SAP. Another separate application was covering the rest of the activities of the management of the subcontractors such as the contracts, the articles, the quantities of survey and the bills.

This system started being developed in 1987 and operated for the accounting part of the company until the end of 1996⁷⁸. The payroll continued to operate under this system for three years although it has been embodied in SAP in 2000.

⁷⁷ "Notification" of a new contract with a subcontractor in the Inland Revenue authorities.

⁷⁸ SAP has been in operation since 01/01/1997.