

**ENTERPRISE RESOURCE PLANNING REQUIREMENTS,  
APPLICATIONS AND SELECTION IN DEFENCE INDUSTRY**

**A MASTER'S THESIS**

**in**

**Industrial Engineering**

**Atılım University**

**by**

**GİZEM ALAGÖZ**

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**ENTERPRISE RESOURCE PLANNING REQUIREMENTS,  
APPLICATIONS AND SELECTION IN DEFENCE INDUSTRY**

**A THESIS SUBMITTED TO  
THE GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

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**GİZEM ALAGÖZ**

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Approval of the Graduate School of Natural and Applied Sciences, Atılım University.

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## **ABSTRACT**

### **ENTERPRISE RESOURCE PLANNING REQUIREMENTS, APPLICATIONS AND SELECTION IN DEFENCE INDUSTRY**

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This thesis reviews the Enterprise Resource Planning (ERP) requirements, applications and selections in Defence Industry. The ERP program and its usage in Turkish defence industry are mentioned in detail. A brief history of Turkish defence industry is given. In ERP process, there is a step which plays an important role that affects the expensive projects is the Request for Proposal (RFP) and it is presented in detail in this thesis. Since ERP is considerable, the ERP software should be work properly, and for that reason the appropriate ERP software should be selected. In the selection study, Analytical Hierarchy Process (AHP) is chosen in order to give the best alternative in multi-criteria decision making technique. The main selection criterion and depending on these criterion for select the proper ERP software and solution partners had been discussed by Defence Industry Companies' employers and Academic Staff by AHP method.

*Keywords:* Enterprise Resource Planning, Request For Proposal, Analytical Hierarchy Process.

## ÖZ

### **SAVUNMA SANAYİNDE KURUMSAL KAYNAK PLANLAMASI GEREKSİNİMLERİ, UYGULAMALARI VE SEÇİMİ**

Alagöz, Gizem

Yüksek Lisans, Endüstri Mühendisliği Bölümü

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Bu çalışma, Kurumsal Kaynak Planlamasının (KKP) Savunma Sanayindeki gereksinimlerini, uygulamalarını ve seçimini kapsamaktadır. KKP programının Türk Savunma Sanayindeki kullanımını detaylı bir şekilde anlatılmaktadır. Türkiye’de savunma sanayinin gelişimine kısaca değinilmiştir. KKP uygulaması sürecinde, milyon doları bulan pahalı projeleri etkileyen önemli bir bulunmaktadır. Bu adım da Teklife Çağrı Dosyasının hazırlanmasıdır ve tezin içeriğinde bu konu detaylı bir şekilde anlatılmaktadır. KKP programları bu denli önem taşıdıklarından dolayı, şirketler için uygun olan KKP yazılımlarını seçmek çok büyük önem arz etmektedir. Bu seçim konusunda en iyi sonucu verebilecek çok kriterli karar verme tekniklerinden biri olan Analitik Hiyerarşi Süreci (AHS) seçilmiştir. KKP yazılımı ve çözüm ortaklığı seçiminde en öne çıkan kriterler ve bu kriterlere bağlı olarak yapılan uygulamalar, Savunma Sanayi çalışanları ve Akademisyenler tarafından tartışılarak yapılmıştır.

Anahtar Kelimeler: Kurumsal Kaynak Planlaması, Teklife Çağrı Dosyası, Analitik Hiyerarşi Süreci.

To My Family

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## **LIST OF ABBREVIATIONS**

**AA:** Asset Accounting

**AHP:** Analytical Hierarchy Process

**AM:** Asset Management

**ANP:** Analytical Network Process

**ASCP:** Advanced Supply Chain Planning

**BDCD:** Business Development and Contracts Directorate

**B2B:** Business-to-Business

**CFF:** Critical Failure Factors

**CIM:** Computer Integrated Manufacturing

**CO:** Controlling

**CS:** Customer Service

**CSF:** Critical Success Factors

**CTO:** Configure-to-Order

**EDT:** Electronic Data Transmission

**ERP:** Enterprise Resource Planning

**ETO:** Engineering-to-Order

**EUP:** Enterprise Unified Process

**FI:** Finance and Accounting

**FM:** Financial Management

**HR:** Human Resources

**IS:** Information Systems

**IT:** Information Technology

**KPI:** Key Performance Indicator

**MM:** Material Management

**MRO:** Maintenance, Repair and Operating supplies

**MRP:** Material Requirements Planning

**MRP II:** Manufacturing Resource Planning

**NATO:** North Atlantic Treaty Organization

**PP:** Production Planning

**PS:** Project System

**PSP:** Project Structure Planning

**RFI:** Request for Information

**RFP:** Request for Proposal

**RFQ:** Request for Quotation

**R&D:** Research and Development

**SD:** Sales and Distribution

**WBS:** Work Breakdown Structure

**WIP:** Work-in-Process

## INTRODUCTION

In this thesis, the subject is the application, integration and selection of Enterprise Resource Planning (ERP) programmes used in Turkish defence industry companies. The study will begin with the definition of ERP and continues with its benefits, and difficulties on implementation phases.

After ERP section, a detail knowledge will be given about the Turkish defence industry. History of the Turkish Armed Forces and defense industry is going to be mentioned. ERP plays an important role in every sector but it is very important to manage the projects that are very expensive and generally are engineering-to-order in defence companies. ERP reduces the complexity and provides less failure at production phase and other stages which are related with the departments.

Like other sectors, customers satisfaction is the most important issue in defense sector, too. When discussing the defence industries projects, the project steps are going to be mentioned. There is a critical object in projects that will be referred is the Request for Proposal (RFP). It is the primary document which is sent to suppliers to invite them to submit a proposal for providing goods and/or services. In this thesis the steps and usage of RFP and its application is going to be presented in detail.

ERP, has a big role in defence industry companies, therefore the selection of the best ERP software and the best solution partner is the core of the businesses. Because if these selection is wrong, all the projects would have some critical problems. Since the selection is very important, it would be done by Analytical Hierarchy Process (AHP) in this thesis.

In last part, AHP method is going to be mentioned in detail. There are some main criteria for selecting the best ERP and solution partner selection. These criteria are determined with the defence industry companies staff very carefully, since the criteria are the backbone of the companies. By using AHP method, it is going to be given some values for each criterion in order to see the weights of all criteria. The reason of choosing the AHP method is its reliability with its consistency ratio. By looking to the consistency ratio. The consistency ratio's aim is going to be presented in detail. By applying AHP method, it will give the best result about which ERP

software and solution partner is more appropriate for selecting to defence industries in this thesis.

# CHAPTER 1

## ENTERPRISE RESOURCE PLANNING

### 1. Definition of Enterprise Resource Planning

Enterprise Resource Planning (ERP) is an application using computer technology to make a connection between various functions such as human resources, budgeting and accounting and inventory control, across the entire company. The purpose of ERP is information sharing, business planning, and decision making on an enterprise in a wide scale. Large sale companies had changed their organizational structures with ERP in mid of 1990s, and then ERP gained a great popularity. The early ERP systems had been used in various small departments which had a mainframe computer. The cost of earliest ERP systems was too high, and it was taking a long time, such as years to implement. The main market for the systems was Fortune 1000 companies (ERP).

"Throughout the 1990s, most of the large industrial companies installed ERP systems which were massive computer applications allowing a business to manage all of its operations (finance, requirements planning, human resources, order fulfillment) on the basis of a single, integrated set of corporate data." presented by Dorien James and Malcolm L. Wolf (2000) in *The McKinsey Quarterly*. "ERP promised huge improvements in efficiency for example, shorter intervals between orders and payments, lower back-office staff requirements, reduced inventory, and improved customer service. Encouraged by these promises, businesses around the world invested about \$300 billion in ERP during the decade."

ERP systems popularity had decreased towards the end of the 1990s. Manufacturers were complaining about the failures during implementation phase, and others felt that ERP did not live up to its cost as a planning tool. One of the biggest reasons of decrease in ERP's popularity was the economic factors. Then, the manufacturers and enterprises had developed a close relationship with their clients throughout the world. In addition, a growing number of companies came to value of the speed and flexibility of smaller interconnected computer systems, and no longer wanted to rely

on a mainframe to run ERP software. In response to these developments, the vendors of ERP systems have focused on small companies. Furthermore, web-enabled systems have been developed, and spread out their offerings up and down the supply chain (ERP).

In the middle of 1990s, according to Keller (1995), ERP has some characteristics such as:

- ✓ It is an expanded and altered functional model of Manufacturing Resource Planning (MRP II) and an integrated set of financial distribution and manufacturing software.
- ✓ It is a flexible application set that resides in technology which supports it.
- ✓ It is proactive and it implements business rules into the software program. It adjusts the rules of the business.

ERP systems are promoted Information Systems (IS) that reduce the complicated risks in organizations in various business functions. ERP is created from Material Requirements Planning (MRP) and MRP II (Wu and Wang, 2006).

ERP is a complicated, expensive and a large enterprise system that contributes to the establishment of an integrated and real time environment. The ERP system has been invented by the extension of Material Requirements Planning and Computer Integrated Manufacturing (CIM). ERP systems provide the core of organizational and business activities (Nelson, 2011) like;

- ✓ Production Planning and Control,
- ✓ Operations,
- ✓ Logistics,
- ✓ Sales and Marketing,
- ✓ Finance and Accounting,
- ✓ Procurement,
- ✓ Customer Relationship Management and
- ✓ Human Resources.

An organization focuses on improving the agility of customer reply and satisfaction, services, production efficiency increasing product quality. Information Technology (IT) is known the fundamentally change the business (Davenport, 2000). Many

organizations, seek to improve their competitiveness by utilizing advanced IT, such as ERP systems.

ERP software packages generally are composed of integrated modules that enable a company to develop a real-time cross-functional view of business's core processes. Production, Order Processing and Sales, Resources, like; production capacity, cash, raw materials, and people. ERP has significant advantages, but it has also some important disadvantages. One of the most important disadvantages of ERP is the high cost. Implementing the processes in an organization is hard and costly (Biscoe, 2012); therefore this may cause important losses in an organization, and these losses may appear in the backbone departments such as Planning, Development and Re-engineering.

## **2. History of ERP**

ERP begins with the move of MRP in the late 1970's for better integration between the functional enterprise silos that dominated firms throughout this period.

History and Evolution of ERP (Editorial, 2005) is:

- ✓ 1960s: There was Inventory Management and Control System in businesses. That was the combination between IT and Business Processes for maintaining the proper level of the stocks in warehouses. The aim of the Inventory Management and Control System was reporting the status of inventory, assuring inventory balances, monitoring the usages of items, accommodating the replenishment of techniques and options, setting the targets and identifying the requirements of inventory. To address the complexity of the system, IBM developed the MRP.
  
- ✓ In 1972, MRPII had been defined by Oliver Wight, Joe Orlicky and George Plossel. MRPII differed from MRP, which include master scheduling, sales and operations planning and capacity planning. MRP schedules the production processes by running a software program. It develops the schedules for the operations and raw material purchases based on the production requirements of finished goods. Also the structure of the

production system, the current inventory levels and the lot sizing procedure for each operation are coordinated by MRP.

- ✓ In 1985, ERP systems had been invented, which is distinct from MRPII by including human resources and other business functions. ERP uses multi-module application software for improving the performance of the internal business processes. ERP systems often restore business activities such as production planning, purchasing, inventory control, product distribution, and fulfillment to order tracking. ERP software systems include marketing, finance, accounting and human resources distinct from MRPII.
- ✓ In 1990s, APS (Advanced Planning Systems) had been introduced, which contains finite capacity planning and scheduling distinct from MRPII (Ivert, 2009).

### **2.1.The Brief Time Line of ERP History**

ERP's history began with early attempts in calculating machines in the 1940's. ERP was born in the early 1960s through a joint effort between J.I. Case, the manufacturer of tractors and other construction machinery, and partner IBM. Material Requirements Planning or MRP is the initial version. This application software serves as the method for planning and scheduling materials for complex manufactured products (Editorial, 2005).

1970: Initial MRP solutions were big, clumsy and expensive. Large number of technical staff were required to support the mainframe computers for testing.

1972: SAP (System Analyse und Program) had been developed by five engineers in Mannheim, Germany, who created the company. The purpose in creating SAP is to produce and market standard software for integrated business solutions.

1975: Richard and Bill Lawson, and their job partner, John Cerullo had set up a company named Lawson Software. The owners of Lawson Software had recognized the requirements for previous enterprise technology that results as an alternative to customize business software executions.

1976: Production management and control had become the essential concept in the large-scale industries like manufacturing industry by MRP.

1977: Larry Ellison establishes Oracle Corporation.

1978: Jan BAAN set up The BAAN Corporation to accommodate financial and administrative services.

1979: Oracle offers the first commercial SQL relational database management system.

1984: BAAN decides to pay attention to manufacturing industry.

1987: PeopleSoft is founded by Dave Duffield and Ken Morris in 1987.

1988: PeopleSoft's Human Resource Management System (HRMS) is developed.

1990: The term ERP has been introduced in the early 1990's to cover areas like Engineering, Finance, Human Resources, and Project Management in MRPII (Diercksen, 2012).

1999: JD Edwards had more than 4,700 customers with sites in over 100 countries. Oracle has 41,000 customers worldwide (16,000 U.S.). PeopleSoft software is used by more than 50 percent of the human resources market. SAP is the world's largest inter-enterprise software company and the world's fourth largest independent software supplier overall. SAP employs over 20,500 people in more than 50 countries.

2002: Most ERP systems have been expanded to become "Internet Enabled" so that customers worldwide can have direct access to the supplier's ERP system.

2004: Services Oriented Architecture (SOA) becomes a standard that ERP vendors turn their attention. This software architecture allows different systems to communicate between one and another.

2003-2005: Industry consolidation occurs:

Oracle – E-Business Suite, JD Edwards, Peoplesoft, and Siebel

Microsoft – Navision, Axapta, Great Plains, and Solomon

Infor – BAAN, Mapics, and a slew of other products

Sage – Best Software is acquired

### **3. Functionality of ERP**

The ERP functionality has several different categories. Some of them are best practice, obvious, and innovative or powerful customer (Roberts, 2010). Each of these categories will be described below:

**Obvious:** In order to handle other packages, only way is to reach and collect data different from others.

**Best Practice and Innovative:** Has adopted the procedure from companies that have proven to be best practice in the way they perform the process. Innovative has developed a new approach to carrying out the transaction that is faster and more intuitive than the offerings by other ERP vendors and will probably be copied as the new standard approach (and is probably going to become the best practice).

**Powerful Customer:** This functionality has been developed by the vendor for a distinguished customer. Generally it has been developed for the processes which have gone out of focus, and it has responded to a specific customer groups. Often the vendor has included it because the customer insisted that this functionality was to be in the product and it had to be 'standard'. The giveaway signs are hardcoded drop down menus which don't cater for the options that may be needed in a general deployment and labels on fields that use language that isn't common business currency.

There are some typical MRP II Modules (ERP Modules)

- Bill of Materials
- Order Management
- Rough Cut Capacity Planning
- Material Requirements Planning
- Capacity Requirements Planning
- Purchasing
- Inventory Management
- Shop Floor Control
- Forecasting/ Demand Management
- Master Production Scheduling
- Product Costing
- Financials

Functionality added to MRPII to create ERP:

- Product Configuration
- Distribution Requirements Planning
- Quality Assurance/Management
- Customer Service Management
- Human Resources Management
- Flexible Report Writer
- Multi-site and Multi-National

Functionality has claimed in many ERPs but they were usually only partial ("Best of Breed" still dominate these areas)

- Sales and Operations Planning
- Finite Scheduling
- Maintenance Management
- Warehouse Management
- Transportation Management
- Supply Chain Execution Management
- Manufacturing Execution Systems

#### **4. Benefits and Drawbacks of ERP**

ERP was an attractive method for many large companies since it sacrificed so many potential uses. For instance, the same system could be used to estimate demand for a product, order the necessary raw materials, generate production schedules, tracing inventory, assign costs, and project key financial measures. ERP "acts as a planning backbone for a company's core business processes," Gary Forger (Forger, 2000) wrote in *Modern Materials Handling*.

*"In addition to directing many of them, the system also ties together these varied processes using data from across the company. For instance, a typical ERP system manages functions and activities as different as the bills of materials, order entry, purchasing, accounts payable, human resources, and inventory control, to name just a few of the 60 modules available. As needed, ERP is also able to share the data from these processes with other corporate software systems."* (Forger, 2000).

Another important benefit of ERP systems was to involve the complex computer applications with a single, integrated system.

In addition to the benefits of ERP, traditional systems also had a number of drawbacks (Forger, 2000). As an example it can be said that, the early systems tended to be large, complicated, and expensive. Implementation required an enormous time commitment from a company's IT department. It can also be implemented by outside professionals. In addition, because ERP systems affected most major departments in a company, they tended to create changes in many business processes. Putting ERP in place thus required new procedures, employee training, and both managerial and technical support. Therefore, many companies found the changeover to ERP as an arduous process. After the implementation phase was completed, some businesses had trouble quantifying the benefits they gained from ERP.

Finally, as technology was shifting toward speedy Internet connections, Web-based business-to-business (B2B) relationships, and electronic commerce, some companies worried that their mainframe-based ERP systems were too slow and outdated. As it turned out, though, many companies found that their ERP systems provided a solid technological foundation for future growth by standardizing business procedures, facilitating information sharing across the company, and creating an organization accustomed to change. "ERP systems may feel like an albatross to companies that have expensively and painfully installed them," James and Wolf stated (James and Wolf, 2000).

*"Nonetheless, they constitute a valuable foundation for a wide range of new value-enhancing applications. ...In hindsight it appears that much of the value of these large systems lay in the infrastructure foundation they created for future growth based on information technology."* (James and Wolf, 2000).

## **5. Critical Success Factors in ERP Implementation**

In 1980s, John Rockart has developed the Critical Success Factors (CSF) (Rockart, Forster, 1989). The aim of CSFs is to improve the performance of the organization (Rockart, 1979). CSF should need regular and careful attention from management since the results of these needs have a direct relation to the organizational performance (Rockart, 1979).

Since objectives must be clear to choose proper ERP software, selection of ERP is very important before implementation. There are different studies in the literature about ERP implementations. Most popular of them is Umble et al. critical success factors that Umble et al (Umble et al., 2003) had declared as given below:

- Clear understanding of strategic goals
- Commitment by top management
- Excellent implementation project management
- Organizational commitment to change
- A great implementation team
- Successful copying with technical issues
- Data accuracy
- Extensive education and training
- Focused performance measures
- Multi-site issues resolved

ERP implementation is not a low-priced and non-risky step for businesses. Essentially, 65% of executives believe that ERP systems have at least moderate probability of damaging their businesses because of the implementation problems (Cliffe, 1999).

At once, a small business decided to establish an ERP system and selected a vendor. There are a few of steps that the business can take to a successful implementation. In his article, Forger noted that the ERP implementation is more likely to succeed if the company positions it as a strategic business issue and integrates it with a process redesign effort. Of course, the ERP system should fit the company's overall strategy and help customers. It may also be helpful to find an ambitious leader for the project and select a dedicated, cross-functional project team. The small business owner should make certain that these individuals have the power to make decisions about the ERP implementation process (Forger, 2000).

Forger recommends that companies attack the implementation project in short, focused stages, working backward from targeted deadlines to create a sense of urgency. It may be helpful to begin with the most basic systems and then expand to

other functional areas (Forger, 2000). Forger also suggests using change management techniques to manage the human dimension of the project, since ERP requires a great deal of support from affected areas of the company. Finally, he emphasizes that once the ERP system is in place, companies need to interpret the data collected carefully and accurately if the system is to contribute to business planning.

Although ERP systems may seem complex and costly, even small businesses are increasingly finding it necessary to invest in such technology in order to remain competitive. "ERP systems are being implemented today to provide a stable foundation for a growing number of businesses across all segments, from dot-coms to major automotive manufacturers," Dave Morrison (Morrison, 2000) wrote in *CMA Management*.

*"The number of implementations down the supply chain and into small and medium-sized companies is steadily growing as the initial costs are reduced along with the overall cost of ownership. Pre-configured and pretested versions are now effectively slashing the implementation costs while reducing the project complexity and risks. These new systems are providing a clean head start in development and delivering a stable and fully tested product to production. The methodology is continually evolving and the results are very positive."* (Morrison, 2000).

## **6. Critical Failure Factors (CFF) in ERP Implementation**

ERP implementation is a difficult process-based application; therefore there may seem unsuccessful implementations on business performance (Shanks et al., 2000).

Inadaptability between ERP and an organisation may have a serious collision on organizational adoption. The main affect of this could be the failures during ERP implementation (Umble et al., 2003). The ERP software will grow with the need of greater customization; in this case the risks associated with ERP implementation will be higher (Soh et al., 2000). According to Soh et al. (2000), there could be various levels of inadaptability. The potential risk in software adaptability will be reduced by careful selection.

The main CFFs are listed as:

- Idle of consultant effectiveness
- Unfit of ERP Software
- High turnover rate of project team members
- Idle of IT Infrastructure
- Idle of knowledge transfer
- Misunderstanding of users' clear perception may cause unclear concept of the nature and use of the ERP system
- Unrealistic expectations from top management relation with the ERP systems
- Acute project schedule
- Users' resist to change

## **7. Fields in ERP Implementation**

There are four main phases of ERP implementation. These phases are; planning, pre implementation phase, implementation and post implementation phase (ERP Software team, 2010).

The first phase, is to find the link point among distinct processes, and the client's expectations or orders. In the next phase which is the pre implementation, the benefit and the advantages of the new system is to be understood and perceived by stakeholder. Identifying and creating crucial data was done as the company prepares to move the database to the new system (ERP Software team, 2010).

In the implementation phase, the assigned tasks are designed and the implementation team is defined. The new software will be installed if the infrastructure is ready. In the implementation phase, client must be sure that the software works properly. In the testing phase, software is controlled for integration, scalability and robustness with the new data transfer requiring regular careful handling and frequent testing. Because the results will shed light on the future work in whether to continue or stop.

In the last phase which is post implementation phase the software is tested to see if it gives error or not, by documenting continuously (ERP Software team, 2010).

The Enterprise Unified Process (EUP) includes seven enterprise management disciplines that tackle the cross-system issues: (Ambler, 2005)

- **Enterprise Business Modelling:** The scope of the Enterprise Business Modelling is to get the idea of the businesses situation about its customers, supply chains and suppliers, and the activities of the businesses.
- **Portfolio Management:** The aim of portfolio management is to document the new requirements of customer by scheduling. This schedule will contribute a new plan of the organization's all software portfolio in a strategic way. By this schedule the software of that company will not be similar with the other firms.
- **Enterprise Architecture:** In this discipline, it is easy to understand the business's concept model. By this concept model it is going to be easy to check if there occurs a problem, and this will also check the performance of the system.
- **Strategic Reuse:** In strategic reuse, it is important to use assets at once more efficiently. Reusing assets will provide high quality in project developments. By this way, the quality of the project will be improved.
- **People Management:** In a project it is important to motivate the employees to get a successful project. Motivating the employees, organising the process, monitoring the process and coaching have a big role in a successful projects.
- **Enterprise Administration:** This discipline contains executing and setting processes, tools, and facilities which are the backbones of organization.
- **Software Process Improvement:** In this discipline the goal is to manage, improve, and support the multiple processes in the organization.

## 8. Implementation Steps of ERP

As mentioned before, the ERP systems can be complicated and difficult to implement, but a structured and disciplined approach can greatly facilitate the implementation. The authors have compiled a list of 11 recommended steps for a successful implementation. These steps have been compiled from several works (Ptak and Schragenheim 2000; Langenwalter, 2000; Erkan, 2008)

- Review the pre-implementation process to date.
- Install and test every new hardware.
- Install the software and perform the computer room pilot.
- Attend system training.
- Train on the conference room pilot.
- Establish security and necessary permissions.
- Ensure that all data bridges are sufficiently robust and the data are sufficiently accurate.
- Document policies and procedures.
- Bring the entire organization on-line, either in a total cutover or in a phased approach.
- Celebrate.
- Improve continually.

Reasons for the ERP implementations failure are listed as follows (Umble et al., 2003):

- 1) *Lack of definition of Strategic aims.* The goals, requirements, expectances are not defined well in businesses.
- 2) *Top Management is not instructed to the system.* Top management does not see the far-reach new differences or does not actively share in implementation.
- 3) *Lack of Project management implementation.* The businesses are not giving attention to the scope of the project or how it is complicated.

- The development of achievable form or documents and real expectancies are not defined.
  - There is a lack of harmony between the enterprise and the ERP system that are selected.
  - Organisations are forcing to automate existing exuberant or non-valued addition operations and procedures.
- 4) *The organization is not perpetrated to make new differences.*
- Employees are not complaining about the existing system, therefore they do not want to have any change in the system.
  - The new system scares employees causing to be unsuccessful in their jobs.
  - The top departments can see the employees working performance; therefore employees do not feel comfortable in new system.
- 5) *Selection of poor qualified implementation team.*
- 6) *The lack of education and training on employees will affect the system directly to be unsuccessful in projects.*
- 7) *Mistrust in data.* The wrong data will force the company to reuse the previous system.
- 8) *The changes in organisation will defend the new performance measurements.*
- 9) *Multi-site issues are not correctly solved again.*
- 10) *Implementation failures can be the reason of the difficulties which are technical.* The hardness can include “bugs” which are a type of error in the new software; the system must be checked and tested with existing systems, and hardware hardness.

## **9. Project Management Process**

After signing the contract, some ERP modules are used as an ERP system. The follow-up and control of the activities are coordinated by these modules:

- PS: Project System
- SD: Sales and Distribution
- MM: Material Management

- PP: Production Planning
- CS: Customer Service
- CO: Controlling
- FI: Finance and Accounting
- AA: Asset Accounting
- HR: Human Resources
- FM: Financial Management
- QM: Quality Management
- ECM: Engineering Change Management
- DMS: Transfer Documentation

The application of modules in a Project System is given *Figure 1*.

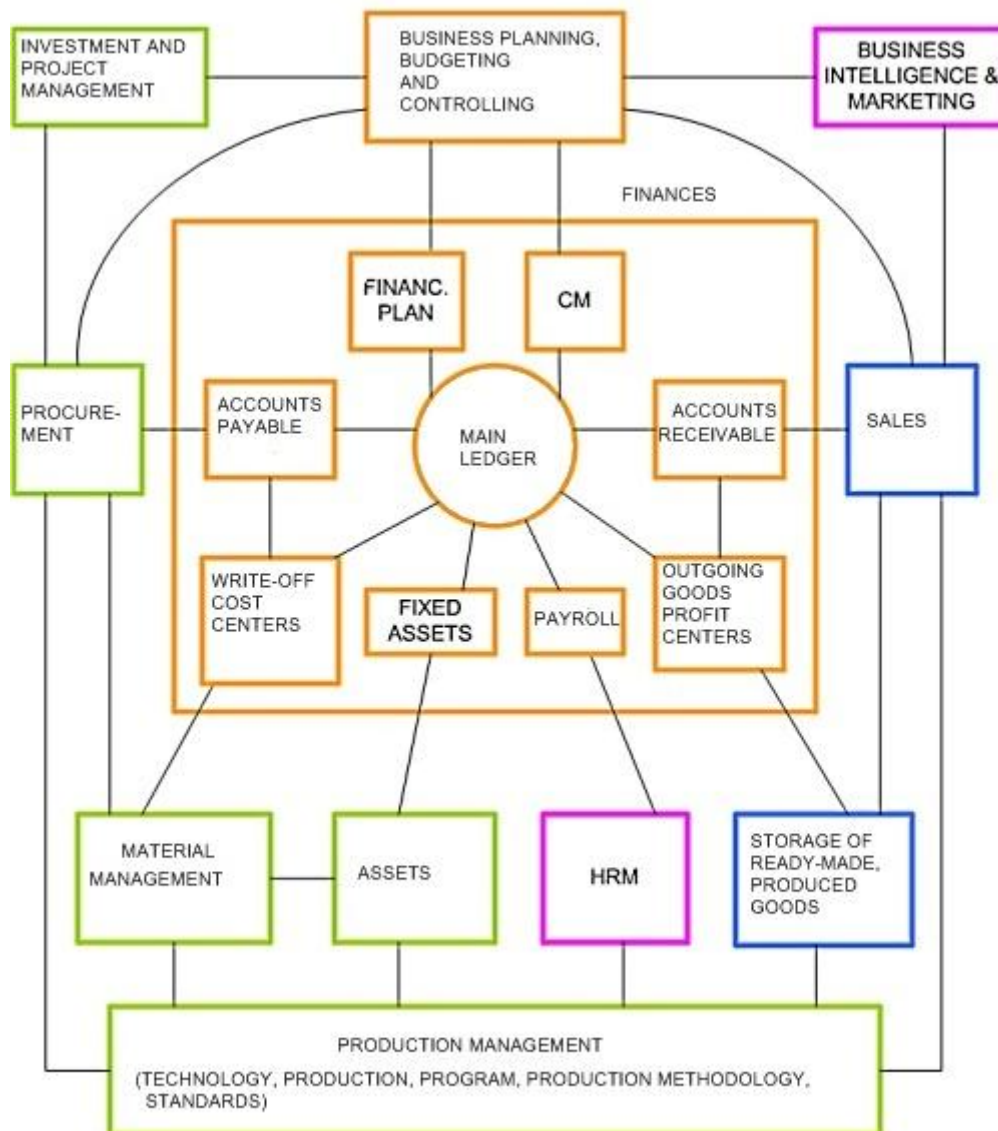


Figure 1. Production Chart of a Defence Industry

➤ **Project System**

Project System (PS) module is one of an operational solution for the system. There are different types of projects such as; Investment Projects, Marketing Projects, Sales and Distribution Projects, Service Projects, Maintenance and Support Projects, R&D Projects and IT Projects. PS does not depend on to only a definite industry and it contains every function in the projects.

Project System provides tools to track project milestone, costs and resources. Defence Industry's Project System module contains tight integration to the Controlling, Human Resources (HR), and Logistics modules. It utilizes personnel records from HR, rolls costs into Controlling and links to materials or customers in the Logistics modules.

**Two key objects that define the Project in system are:**

- Work Breakdown Structure: defines tasks and assign resources to those tasks
- Network: defines the dependencies within the WBS (Work Breakdown Structure).

**Common processes in Project System include:**

- **Tracking costs against WBS elements.** These costs can either be due to personnel time charged against the project, or materials and/or services procured to support the project.
- **Tracking milestones** against key dates defined in the project.

**Project Structure Planning (PSP):** It shows the Project activities in a hierarchical form. It is the basis for expenses, incomes, budgeting and payments of a Defence Industry (Erkan, 2008).

**Activities:** They show the projects flow or represent the processes inside the project. Activities are the basis for planning, checking dates and resources. PSP controls funds for the designated activity.

**Project Plan Table and Simulation:** It is a tool in order to help to integrate the PSP (PSP elements, activities and objects that are designated for them). It simulates the projects in different areas and use as information in planning.

**Resource Planning:** A workforce planning can be made in project planning table. Internal activity planning and determination of capacity for teams can be organized by project planning table. External or Foreign Service planning can be done. At his

situation, purchase order are generating in Purchasing. When the last activity is confirmed, the Purchasing Department will supply the external service.

**Budgeting:** Budget represents the approved charges for the project. While entering the original budget, it will be determined manually for each PSP element. A fund designated to a PSP element will be controlled against another existing fund. If the tolerance limit is exceeded, the system gives warning.

**Conformations:** Conformations document processes the status of the activity and provides a forecast of project progress. By conformations, many different activities can be processed automatically. There exist a record of the actual costs, actual dates and actual workmanship, and if it is necessary the activity situation can be changed.

**Closing:** When the activities of the project (conformations, material output, external purchases vs.) are completed, the project will close.

## **Returns**

- Depending on the characteristics of the project both rough planning (by PSP) and rough planning (PSP + Activity), project tracking can be done.
- It provides more accurate quote in Sales-Oriented Projects.
- Provides capacity planning.
- Provides alternative methods in order to monitoring the project.
- Provides right calculating about cost.
- Provides to monitor project based cash flow.
- Provides an optimum solution by simulating the project.

## ➤ **Sales and Distribution**

There are some functions in Sales and Distribution (SD) module which are:

- Giving Proposal and Proposal monitor process
- Monitoring customer contracts
- Premium agreements
- Discount agreements
- Preparation and utilization of product catalogue

- Free product sales process
- Monitoring the competing products
- Sales and distribution in order to the delivery plan
- Monitoring cost of orders
- Packaging, monitoring the returned packaging materials
- Delivery planning
- Monitoring delivery costs
- Sales

Besides these functions, SD modules can be integrated by ERP technology in different ways for the external systems. Integration with warehouse system, communication with customs, customers and logistics firms, and sales from Internet functions can make a strong sales and distribution substructure by Defence Industry's ERP System (Erkan, 2008).

Customer collateral monitoring can be possible by Credit and Risk Management. Customers are classified by risk analysis and system gives warning about the customers' credit and risk situation during order. For Defence Industries it is very important to sell their product, therefore competitor analysis takes a very important place in that sector. Delivery on time, shipment and order situation is very important to provide customer satisfaction; also it is important to finish the projects or products on time because in Defence Industry the products are too expensive.

### **Returns**

- By Finance and Material module it provides the production processes works automatically and record some accountings.
- By its record system structure, it guarantees to send the right product to the right customer.
- By its multi-currency feature, it is flexible to convert the different countries currency to their currency.
- Pricing structure of the system input is done by defining different policies for each case. By this case, sales departments can spend more time to customers (Erkan, 2008).

### ➤ **Material Management**

Material Management (MM) module contains a company's material requirement planning, purchasing, stock management, and logistics management processes. It optimizes all purchasing processes depending on the workflow. It reduces the cost of inventory and warehouse management and contains bill control.

Like other sectors, the purchasing activities begin with material requirements planning in Defence Industry, too. With the running of the material requirement planning program, the requirements are defined; for meeting the requirements the suppliers are also defined. All the proposals are to be accompanied by a counter-guarantee (like a bank letter). The tender is opened for selecting the vendor offering the best price. The MM module which provides the process an effective and efficient operation, have the following functions (Erkan, 2008);

- Consumption based on the material requirement planning
- Determine the requirements by material requirement planning
- Contract with customer
- Request for proposal and evaluation
- Vendor selection
- Vendor evaluation
- Procedure in order to approve
- Purchase order transactions
- Procurement outsourcing
- Monitoring material which are on way
- Material movement planning, entering and displaying
- Material management based on quantity and value
- Stock management
- Automatic updates related to material movement and accounting
- Electronic data transfer with supplier

### **Returns**

- By material management, all supply and stock processes are integrated with other processes in industry.

- All processes are automated in electronic environment to increase productivity.
- By using such a system in Defence Industry, departments will have access to analyzable information and a decision support system.
- Supplier assessment capabilities prevent the problems before coming to the life during the process.
- The movement of purchasing flow to electronic environment can be shortened significantly during the supply process.
- By the integration of financial modules, budget control, and cash flow will be improved.
- Timeliness and consistency in the actual data of stock can improve the effectiveness of the decisions and reduce the stock costs (Erkan, 2008).

#### ➤ **Production Planning**

Production Planning (PP) is a versatile application that can be stand-alone or integrated with Manufacturing Planning and Execution Systems as opposed to Manufacturing Scheduling which mainly works in conjunction with the manufacturing execution system - Work in Process (WIP). With PP's close loop integration with Advanced Supply Chain Planning (ASCP), shop floor jobs can be best scheduled to both optimize resource planning and maximize service levels (Bist, 2010).

PP with its powerful Key Performance Indicators (KPI) can be used as a tool to ensure that the scheduling scenario is meeting the corporate end objectives. Comparison of different schedule scenarios are instantly displayed in the ERP software Production Scheduling KPIs with Service Level, Inventory, Resource and Manufacturing utilization details. This makes decision analysis rather effortless. Many savvy schedulers using Manufacturing Scheduling had long wished for such powerful functionality.

PP can automatically detect resource floating bottlenecks as they move within a schedule. This understanding helps PP Solver deploy the most appropriate Scheduling strategy to maximize the throughput and optimize the resource utilization (Bist, 2010).

On the other hand, resolving the bottleneck required a lot of constant tuning of the rules in the older Oracle Manufacturing Scheduling.

PP provides a number of views which can provide users with powerful analysis to support their decision making. Some of these views and user interfaces are:

- Production Pegging (Supply/Demand pegging with easy to drill down alert and root causes)
- Resource and Operations Gantt
- Resource and Item Graph
- Resource Gantt and Multi-Capacity Resource Graph
- Operation Editor and Graphical Routings
- Change over editor

Performance: PP uses smarter technology for constraint directed search which achieves the advantages of constraint-based scheduling with much better performance over traditional tools like Manufacturing Scheduling. This is another reason PP becomes a tool of choice when production volume or production constraints are higher.

PP is much simpler to setup yet delivers powerful scheduling strategies to optimize production without much trial and error. This reduces the total cost of ownership (Bist, 2010).

#### ➤ **Customer Service**

Customer Service (CS) enables to record and plan the service given to customers related to maintenance and support service. It monitors cost and billing processes. CS works with sales and distribution, accounting, material management and with other modules in Defence Industry. Rearrangements within MM module can be made to be environmental, technical and functional (Erkan, 2008).

Request or billing processes are realized by integration of sales and distribution modules.

The maintenance and support activities on a regular basis in certain periods can be defined in the system. The desired date or the measured value can be created by the system automatically.

## Returns

- If different departments are involved in receiving the request, and billing, a single system takes up the responsibility.
- CS always inform customer about billing, contacts, warranties and service request.
- Provides capacity planning about team maintenance.
- Minimizes all billings (Erkan, 2008).

### ➤ Controlling

The purpose of the Controlling (CO) module in Defence Industry's ERP System is to provide organizations with a method of slicing and dicing data to view costs from an internal management perspective and provide a view of profitability beyond that of basic financial reporting. This allows the organization to create information in a manner that is tailored for their specific business measurements needs. Controlling allows an organization to:

- Plan and track overhead costs within the company's specific organizational structure.
- Track costs related to specific projects or events and either capitalize those costs or charge them to appropriate departments upon completion.
- Perform "Activity Based Costing".
- Perform Product Costing, measuring production cost and variances.
- Report profitability by product line, division, or other internal measurement.
- Report sales and gross profitability by external measures such as market segments or customer groups.

Controlling involves of all master data, configuration, and reporting required to analyze both spend and revenues, both within and across organizations (Erkan, 2008). This includes the following master data:

- Cost Elements - cost and/or revenue accounts
- Cost Centers - departmental units
- Profit Centers - business lines, product lines or divisions
- Internal Orders - projects or events
- Functional Area - Cost of Sales Accounting

- Statistical Key Figures - non financial statistics for allocating or measuring financial costs
- Activity Types - Labor or other activity costs

➤ **Financial Accounting and Asset Accounting**

The Financial Accounting (FI) Module has the capability of meeting all the accounting and financial needs of an organization. It is within this module that Financial Managers within the business can review the financial position of the company in real time as compared to legacy systems which often times require over night updates before financial statements can be generated and run for management review (SAP, 2011).

The real-time functionality of the modules allows for better decision making and strategic planning. The FI (Financial Accounting) Module integrates with other Modules such as MM (Materials Management), PP (Production Planning), SD (Sales and Distribution), PM (Plant Maintenance) and PS (Project Systems).

The FI Module also integrates with HR (Human Resources) which includes PM (Personnel Management), Time Management, Travel Management, Payroll. Document transactions occurring within the specific modules generate account postings via account determination tables.

The FI Module components: The FI Module comprises several sub-modules as follows:

- Accounts Receivables
- Accounts Payable
- Asset Accounting
- Bank Accounting
- Consolidation
- Funds Management
- General Ledger
- Special Purpose
- Ledger Travel Management

Accounts Receivables records all account postings generated as a result of Customer sales activity.

These postings are automatically updated in the General Ledger. It is within the Accounts Receivables Module that you can monitor aging of the receivables and generate customer analysis. The Accounts Receivable Module also integrates with the General ledger, Sales and Distribution, and Cash Management Modules.

Accounts Payable records account postings generated as a result of Vendor purchasing activity. Automatic postings are generated in the General Ledger as well. Payment programs within Defence Industry's ERP System enable the payment of payable documents by check, or transfers (SAP, 2011).

Asset Accounting (AA) module is utilized for managing the company's Fixed Assets. ERP System allows one to categorize assets and to set values for depreciation calculations in each asset class. Bank Accounting allows for management of bank transactions in the system including cash management.

Consolidation enables the combining of financial statements for multiple entities within an organization. These statements provide an overview of the financial position of the company as a whole.

Funds Management allows management to set budgets for revenues and expenses within the company as well as track these to the area of responsibility.

General Ledger is fully integrated with the other Modules. It is within the General Ledger that all accounting postings are recorded. These postings are displayed in real-time providing up-to-date visibility of the financial accounts.

Special Purpose Ledger is used to define ledgers for reporting purposes. Data can be gathered from internal and external applications.

Travel Management provides management of all travel activities including booking trips and handling of expenses associated with travel (SAP, 2011).

Client, company and company code: Once a business has decided to use the FI Module, there are several Configurations prerequisite steps that must be completed. Determining the organizational structure is one of the first steps in setting up the

business functions in Defence Industry's ERP System as well as the reporting requirements.

The Organizational structure is created by defining the organizational units consisting of the following:

- Client
- Company
- Company Code
- Business Area

A Client is the highest unit within an ERP System and contains Master records and Tables. Data entered at this level are valid for all company code data and organizational structures allowing for data consistency. Company Code - Represents a legal reporting entity. There can be numerous company codes within an organization. Each has its own balanced books and reports itself as a single economic entity. User access and authorizations are assigned to each client created. Users must specify which client they are working in at the point of logon to the Defence Industry's ERP System. A Company is the unit to which financial statements are created and can have one to many company codes assigned to it.

#### ➤ **Human Resource**

Human Resource (HR) module is one of the largest and important modules in ERP software. It referred with the following names:

- HR-Human Resources
- HCM-Human Capital Management
- HRMS-Human Resources Management System

This module is for helping the HR professionals to manage the complete information and processes about the employees in an Organization with high efficiency and low cost (SAP, 2011).

- Organizational Management
- Personnel Administration
- Recruitment
- Time Management

- Payroll
- Compensation Management
- Personnel Cost Planning
- Budget Management
- Personnel Development
- Training & Event Management
- Travel Management
- Environmental Health & Safety

The HR Module has a set of rich features and integrates seamlessly with other module. HR module offers wide solutions for HR department making it possible for other department to access specific employee data. The HR modules covers all the function required in business practice and is flexible enough to optimize the business processes by configuring to suit customer's requirement in Defence Industry.

HR module streamlines the management of human resources and human capitals. It comprises of four broad sections, namely Training, Recruitment, Payroll and Attendance. HR module in ERP routinely maintains a complete employee database including contact information, salary details, attendance, performance evaluation and promotion of all employees (SAP, 2011).

Human Resource Management is a suite of integrated solution, designed to facilitate HR operations by reducing time-intensive administrative tasks and lowering costs by deploying self-service applications. Defence Industry's ERP solution offers many different sub-systems under the HR module. Listed below are some of the most common sub systems (SAP, 2011):

- Personnel Management: The personnel management comprises of HR master-data, personnel administration, recruitment and salary administration.
- Organizational Management: Organizational management includes, organizational structure, staffing schedules & job description.
- Payroll System: Salary management, statutory reporting, attendance management for salary calculation.
- Time Management: Time management includes shift planning, time recording, absence & leave management.

- Personal Development: This section comprises of training and event management, additional training determination and training assessment.

### ➤ **Financial Management**

Financial Management (FM): The Financial Management (FM) is perhaps the most widely used module of ERP software. This module helps in easy accessibility of various financial data along with streamlining the regular accounting processes like budgeting, allocation, cash flow monitoring, accounts receivable and payable, billing and managing the fixed assets. Since most ERP packages are deployed in global markets, it is essential that the FM module should support multiple languages and currencies.

The financial management functionality in Defence Industry's ERP system minimizes manual data input on behalf of the user, thereby freeing the user from tedious, routine tasks and allowing greater focus on other, greater value-added tasks.

As the module is keeping track of every movement in and out of the warehouse, it can deliver at any time clear value of what's in stock. The financial module follows every individual step, including budget planning for production and billing.

Apart from the above functions the FM gather financial data from various functional departments and generates valuable financial reports such as Balance Sheet, Trial balance, General Ledgers, Quarterly Financial Reports, Account Statements, Gross Profit Analysis, Cost Center wise Analysis, Branch wise Profit Analysis, profitability report, Asset and Depreciation Management, Tax Management, ABC Analysis and many more (SAP, 2011).

In Defence Industry, FM module also has the capability of meeting all the accounting and financial needs of an organization. It is with this module that Financial Manager as well as other Managers within business can review the financial position of the company in real time and assist in better decision-making and strategic planning.

- Default charts of accounts.
- Linked accounting. Direct navigation from accounting entries to documents
- Trial balance. General ledger.
- Income statements

- Balance sheets.
- Receivables and Payables
- Generation of debt payments
- Issue of debt payments. Management of accounting documents.
- Bank statements reconciliation.
- Asset Management
- Bank Accounts Management

➤ **Quality Management**

Quality Management as described is a method for ensuring that all the activities necessary to design, develop and implement a product or service are efficient and effective respect to the whole system and its performance. So Quality management is a comprehensive solution that supports the company throughout the full product life cycle and along the supply chain (SAP, 2011).

The Quality Management component (QM) is part of the integrated R/3 System. With the functions of the Quality Management (QM) module, you can implement the most important elements of a QM system, as specified in ISO 9000:

<b><u>Quality planning</u></b>	Creating and managing the master data that is required to plan and execute quality inspections.
<b><u>Quality Inspection</u></b>	Determining whether the units inspected fulfill the predefined quality requirements
<b><u>Quality Control</u></b>	Implementing different preventive, monitoring and corrective activities. These activities are based on the specifications from quality planning and the evaluations of quality inspections and quality notifications.
<b><u>Quality Certificates</u></b>	Certifying the quality of a material or product.
<b><u>Quality Notifications</u></b>	Recording the Non-Conformance of product.
<b><u>Test Equipment Management</u></b>	Managing master data as well as the planning and processing calibration inspections for test and measurement equipment

Defence Industry's QM offers a wide range of functions and collaborative services, which are fully integrated into ERP System, for assuring and managing the quality of products and assets. It also focuses on prevention and continuous process improvement through collaboration and sustained quality control.

QM module supports tasks associated with quality planning, quality inspection and quality control through the enterprise. It sets the specifications for quality and standard testing procedures, controls the creation of quality certificates and manages notifications related to quality. It also stores the quality data for raw materials, goods-in-process and finished goods. QM is a complex module highly integrated with other modules as seen in the picture at the top of this post.

In Defence Industry the quality takes an important role. In projects, the best qualified materials are used, because as mentioned before the projects are very expensive and there is no tolerance in the services or goods. Therefore, Defence Industries have various type of "Quality Certifications" such as; ISO 9000, ISO 9001, ISO 9004, ISO 10002, ISO 140001, ISO 17024, ISO 17025. Every Defence Industry have the related quality certificates about their production (Personel meeting with Defence Industry Employees, 2011).

## **10. Project Management**

Project Management is the application of knowledge, skills, tools, and techniques to project activities in order to meet or exceed stakeholder needs and expectations invariably involves balancing competing demands among:

- Scope, time, cost, and quality.
- Stakeholders with differing needs and expectations.
- Identified/Unidentified requirements (need and expectations).

The term project management is sometimes used to describe an organizational approach to the management of ongoing operations. This approach, more properly called management by projects, treats many aspects of ongoing operations as projects; a detailed discussion of the approach itself is outside the scope (ERP Software team, 2010).

## **10.1. The Project Management Knowledge Areas**

The Project Management Knowledge Areas, describes project management knowledge and practice in terms of its component processes. These processes have been organized into nine knowledge areas as described below (William, 1996):

- Project Integration Management, is the process required to ensure that the various elements of the project are properly coordinated. It consists of project plan development, project plan execution, and overall change control.
- Project Scope Management, describes the processes required to ensure that the project includes all the work required, and only the work required, to complete the project successfully. It consists of initiation, scope planning, scope definition, scope verification, and scope change control.
- Project Time Management, describes the processes required to ensure timely completion of the project. It consists of activity definition, activity sequencing, activity duration estimating, schedule development, and schedule control.
- Project Cost Management, describes the processes required to ensure that the project is completed within the approved budget. It consists of resource planning, cost estimating, cost budgeting, and cost control.
- Project Quality Management describes the processes required to ensure that the project will satisfy the needs for which it was undertaken. It consists of quality planning, quality assurance, and quality control.
- Project Human Resource Management, describes the processes required to make the most effective use of the people involved with the project. It consists of organizational planning, staff acquisition, and team development.

- Project Communication Management, describes the processes required to ensure timely and appropriate generation, collection, dissemination, storage, and ultimate disposition of project information. It consists of communications planning, information distribution, performance reporting, and administrative closure.
- Project Risk Management describes the processes concerned with identifying, analyzing, and responding to project risk. It consists of risk identification, risk quantification, risk response development, and risk response control.
- Project Procurement Management describes the processes required to acquire goods and services from outside the performing organization. It consists of procurement planning, source selection, contract administration, and contract close-out.

## CHAPTER 2

### ERP APPLICATION IN TURKISH DEFENCE INDUSTRY

#### 1. Historical Development of Turkish Defence Industry

Turkish Defence Industry's establishment dates back to Ottoman Empire. The most important war vehicles, war ships and other war equipments were all home-made. Also the production level of war ship and the technological level was more advanced than the European Countries (SSM, 2012).

In the 18th century the Turkish Defence Industry lost its impact during World War I. Because of this, there was not any infrastructure of Defence Industry at the beginning of the Republic. There were limited production facilities near Ankara during the Independence War. During in the Republic era, Defence Industry was established with the primary aim of introducing industrialization in the military sector. Despite all the adversities faced in the economic and technological areas, in the first years in Republic some investments have been made to form the basis of national Defence Industry. There have been important initiatives especially with weapons, ammunition and aviation sectors, especially in Military Factories (SSM, 2012).

In the post World War II era, Defence Systems production came to a complete halt as a result of the foreign military aid received upon improvement of bilateral relations with the United States, and Turkey's entry to the North Atlantic Treaty Organization (NATO).

General Directorate of Military Facilities was set up in 1921. It was discussed for the first time establishing a weaponry and ammunition production capability in the İzmir Congress of Economics. Consequently a number of facilities were set up in Ankara (SSM, 2012).

Instead of improving the local Defence Industry, Turkey depended on foreign aid and met its defence requirements through and in the framework of NATO during this period of Cold War and military and political polarization. Foreign military aid that started pouring in upon Turkey's membership in NATO and soared within a short

period, stalled the development of local Defence Industry which was still at its infancy (SSM, 2012).

Development of weaponry and military equipment was kept on the agenda by the Research and Development Department formed in 1954 under the Ministry of National Defence and in 1970 development studies of Defence Industry would be resumed.

The Armed Forces Foundation were established after 1974, as a result of the national reaction to the arms embargo against Turkey. Turkish Armed Forces Foundation has established enterprises such as; Havelsan, Aspilsan, Aselsan. It was soon realized that the actual need for a contemporary Defence Industry could not be met through the Foundation alone (SSM, 2012).

In 1980s, direction was taken by the establishment of Defence Equipment Directorate as a state enterprise. However, the shortcomings stemming from its inert status blocked its success and before long Undersecretariat for Defence Industries (SSM) was born in 1985 by the Law No: 3238.(SSM, 2012).

The establishment of the SSM with the investments made in land, air and naval systems and platforms on the basis of domestic facility and capability, gained in various fields. In this context, system integration, command, control, communications, electronic warfare and firepower of an infrastructure, has been seriously taken up. Projects initiated to modernize the Turkish Armed Forces, was considered as an opportunity for the development of the domestic Defence Industry. Presently, the contribution of the project activities carried out by SSM, has gained momentum for the development of the Turkish Defence Industry.

## **2. Today's Turkish Defence Industry**

Over the last 25 years since its establishment, the Undersecretariat for Defence Industries has made significant achievements in building the blocks for a modern national defence industry in Turkey, with notable results in certain vital areas. As a result of considerable dedication and efforts, key defence industry institutions have been established to meet the requirements of the Turkish Armed Forces locally, each filling an important void in its field.

The local content ratio, the extent to which requirements are met locally, rose to 44.2% in 2008 and Turkish defence industry has reached the phase where the groundwork has been laid for system integration capability and defence products can be developed locally (SSM, 2012).

In the next phase SSM aims to reduce external dependence in critical subsystems/components/technologies determined in line with the requirements of the Turkish Armed Forces. In order to optimize the resources allocated to improve the technological infrastructure needed for the systems projects that involve procurement by means of indigenous local production, and hence increase local content ratio, worthwhile R&D projects have been determined and prioritized in the Defense R&D Road Map. The Road Map consists of R&D Projects that are compatible with the needs and objectives of main system projects, and that strengthen collaboration among the industry, small and medium enterprises, universities and research organizations (SSM, 2012).

The charts below, based on data gathered by SASAD (Defence Industry Manufacturers Association), illustrate the progress of Turkish defence industry over the years (SSM, 2012).

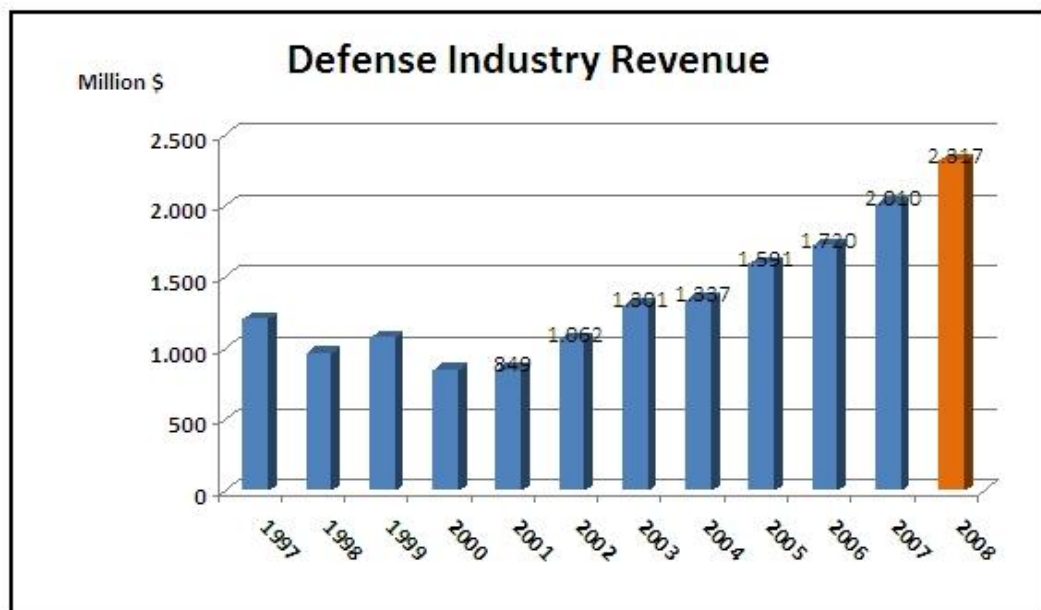


Figure 2. Defence Industry Revenue

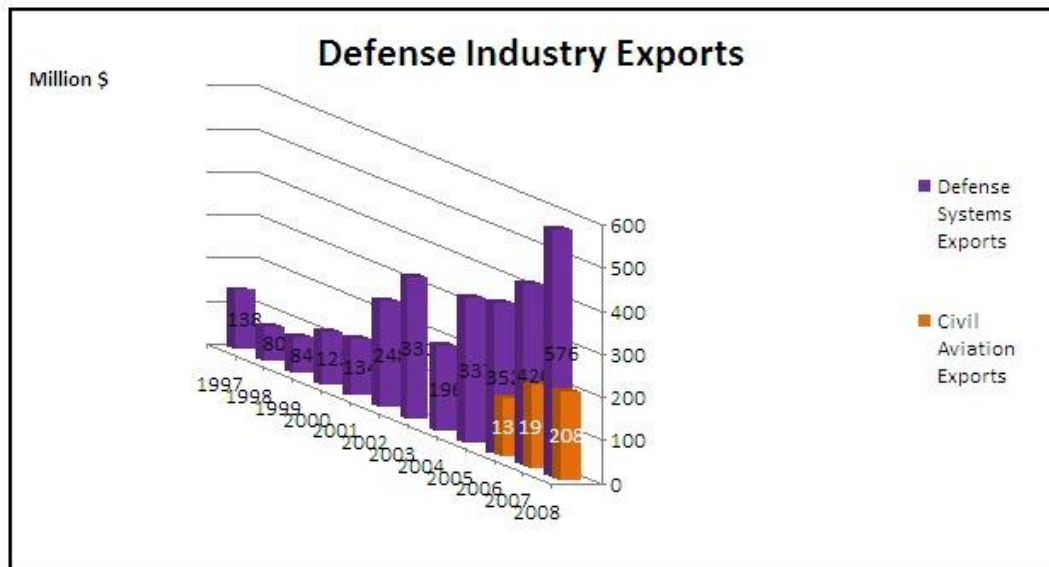


Figure 3. Defence Industry Exports

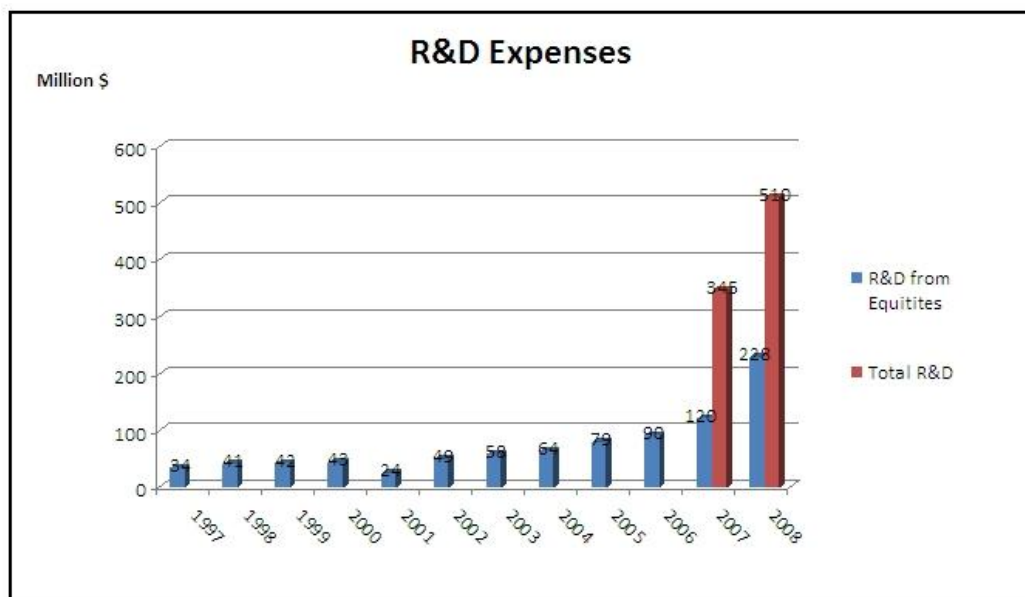


Figure 4. R&D Expenses

The projects of Turkish defence industry is given as:

- Communications, Electronic and Information Systems
- Electronic Warfare and Radar Systems
- Fixed-Wing Platforms
- Helicopters

- Land Platforms
- Naval Platforms
- R&D and Technology Management
- Space and Unmanned Systems
- Weapon Systems

### **3. ERP Application in Turkish Defence Industry**

The strategic positions of companies in the Defence Industry is different from the commercial businesses needs; whether in security, or for compliance with military standards, or high expectations in terms of quality. For example, a commercial firm that is producing an electronic component and a Defence Industry firm which produces almost the same product has very serious differences between quality, traceability, documentation and planning accuracy. While the other companies are working in mass and serial production, in Defence Industry all supply, manufacturing and quality processes related to projects must be planned in-time and be followed. Because in Defence Industry, manufacturing is mainly based on ‘Project’ or ‘Engineering-to-Order (ETO)’ on project.

Land Vehicles, Air Vehicles, Marine Vehicles, Communication Electronics and Information Systems, Electronic Warfare and Sensors, Missiles and Ammunition, and Research and Development (R&D) and Technology Management has been constituted under the Directorates through the project groups. Projects are being developed according to the needs of Defence Industry, are linked to Undersecretary of Defence Industry in Turkey. In Defence Industry, the main priority for the development of technological infrastructures was identified by Department of Defence Quality Management, and the ERP applications are determined.

Two groups will examine the defence sector as the basis of ERP Applications:

- Defence Industry Manufacturers
- Armed Forces

In both groups; similar requirements for quality, documentation and traceability can be seen, but there is an important difference especially in workflow. While Defence Industry Manufacturers are generally producing based on the projects by ETO or

Configure-to-Order (CTO), Armed Forces rather requires effective management in common equipment, vehicles and facilities organizations and maintenance. At that point, Defence Industries give weight rather to Design, Planning and Manufacturing topics, Armed Forces require more to Asset Management (AM) topics. But in both group, integration, control and traceability is an indispensable element.

#### **4. Use and the Beginning of ERP in Defence Industry**

ERP Applications are running with military and civilian experts in order to provide effective solutions and meet all the needs throughout all the life cycle of military equipments, i.e. design, manufacturing; and include the best application for sector when there occur requirements during in-service and operations.

#### **Fores of the Sectoral Requirements**

- Customer Specific Design – Prototype and Manufacture tracing
- Programme, Project Management
- Project-Based Supply Planning, Purchasing and Inventory Management
- Contract Management
- Advanced MRO ( Maintenance, Repair and Operating supplies) and Vehicle Information System
- Service database- After Sales Service Applications
- Warranty tracking and After Sales Service Agreements Management
- Mobile Service Applications
- Quality Control Applications
- Document Management System
- Advance Maintenance Management System (Umble et al., 2003)

#### **5. Benefits of ERP in Defence Industry**

ERP Applications meet the Main Solution Components of Defence & Aviation Enterprises in the sector that is described above. The main requirements of the application is developed specially for the sector. Also, ERP Applications supports modules and integrate end-to-end solutions for the enterprises in Defence & Aviation sector.

## **Defence Industry ERP Main Solution Components**

- ERP Project Management
- ERP Design Management
- ERP Contract Management
- ERP Sales & Support
- ERP Maintenance Management
- ERP Advanced MRO
- ERP Vehicle Information Management
- ERP Manufacturing
- ERP Distribution
- ERP Mobile Wireless Services
- ERP Purchasing Management
- ERP Inventory Management
- ERP Quality Management
- ERP Document Management
- ERP Finance & Accounting Applications
- ERP Human Resources Applications
- ERP Business Performance (Umble et al., 2003)

In Defence Industry it is possible to monitor all the processes of a product's pre-production, production process and post-production by ERP.

Rotary-wing aircraft, fixed-wing aircraft and various transfer units for engines, shafts and components are manufactured. For these products, titanium, aluminium etc. Are used as raw materials.

In Defence Industry Sector the main processes for monitoring ERP are:

- MRP
- Sales (RFQ, Order, Delivery note and Invoice Management)
- Purchasing
- Inventory and Warehouse Management
- Production Planning
- Capacity Planning (base on cells)

- Document Management
- EDT (Electronic Data Transmission)
- Budget
- Cost Analysis
- Human Resources

In addition to these processes, the following solutions to Defence Industry sector emerges:

### **Using External Resource Management**

- The Materials Management (during certain operations made by specialized teams),
- Computation of inventory movements depends on work order,
- Installation costs to suppliers depending on work order according to quality control steps after job completion,
- Supplier performance evaluation

can be done with ERP.

Supplier output, arrival from the supplier, depending on this arrival triggering of quality control processes work order approvals can be done easily from a single display output with ERP.

### **Using Variant Configuration**

By ERP, the remaining stock and the size dimensions of consumables can be tracked easily. Materials come in different-sizes, and are used in different products and different shapes. Therefore the materials are cut repeatedly, and after cutting operation size changes. So the remaining stock can be followed by ERP.

### **Purchasing Bid RFQ Application and Approval Process works as:**

- Supplier evaluation
- Price and delivery comparison based on periods of time and amount.

- The execution of the purchase proposal and purchase offers in ERP environment.

### **Management of Supplier Information**

In Defence Industry every information is considered to be confidential. The changes of the information that is recorded in system can be used after certain check process. For example; a change request in a supplier's information management application must be done by the user , and the updated information can be seen after the check-steps. Otherwise the changes would not be entered in system (Parr and Shanks, 2000).

### **Personnel-Business Centre Expense Mapping**

In business centre, users can enter the system by entering the barcodes on their personnel cards. Therefore in which approval, which personnel has worked on it can be identified easily by ERP.

While the unit price is the basis of calculation on monthly business centre, the real cost of the personnel who worked before can be found from the system and calculated. Therefore changes of piece and bench can be calculated much easier by ERP.

## **CHAPTER 3**

### **REQUEST FOR PROPOSAL**

#### **1. Definition of Request For Proposal**

A Request for Proposal (RFP), is the primary document that is sent to suppliers inviting them to submit a proposal to provide goods or services. Internally, an RFP can also be referred to as a sourcing project, a document, or an associated event (competitive bidding). Unlike a Request for Information (RFI) or a Request for Quotation (RFQ), an RFP is designed to get suppliers to provide a creative solution to a business problem or issue. RFPs should be used with care, since its usage can take a lot of time for both the organization and its suppliers. However, for more complex projects, an RFP may be the most effective way to source the goods or services required.

#### **2. When to Use an RFP?**

Purchasing personnel should not use an RFP when they are only requesting information from suppliers, such as pricing information, or only want to engage in a competitive bidding scenario. An RFP make use of competitive bidding, but an RFP should not be used if cost is the sole or main evaluation criteria. An RFP should be used when a project is sufficiently complex that it warrants a proposal from a supplier. RFPs are helpful when supplier creativity and innovative approaches to problems are needed. It is important to remember that the RFP process can take a significant amount of time to complete and could result in delays in starting the project. Therefore, it only makes sense to use it when the benefits from obtaining supplier proposals are greater than the extra time lost it in preparing the RFP and to manage the RFP process (Bell, 2009).

#### **3. Benefits and Drawbacks**

The primary objective of the RFP is basically to notify suppliers concerning the Defence company's new requirements. It encourages suppliers to do their best in an effort to meet their requirements. The RFP is very specific regarding what products

are required to be used in the venture. By being specific with the budget and other requirements in the RFP, it will likely receive better bids.

A chief RFP advantage is that it provides the chance to alert the providers that the selection process is competitive. The scenario of competitive bidding is usually the best technique accessible for getting the best prices. Apart from good prices, the RFP can help to attain the best services (Daniel, 2011).

Another important RFP benefit is that, if it is well handled, it provides an organization a proper handle with regards to potential risks for complex projects. The firm will comprehend the likely benefits it can gain throughout the project. The RFP also provides project stakeholders and purchasing personnel the capability of visualizing the way a venture will go as well as the method that the providers will use for completing it (Daniel, 2011).

Besides the advantages of RFP, there are several drawbacks to using an RFP, too. It can be extremely time consuming for purchasing personnel and extremely time consuming for suppliers. Some suppliers will look at the RFP and will choose not to participate because it would take them too long to respond. These suppliers may also become discouraged and feel that a low chance of winning refrain them from investing the time required to prepare the proposal. It can often be very difficult to accurately summarize the requirements for the project in the RFP. This can lead to poor supplier responses or poor pricing since the supplier does not really know what the organization was looking for to purchase. Finally, it can be more difficult to accurately score or assess supplier responses in an RFP since they can be lengthy, detailed, or require specialized knowledge to evaluate (Wheaton, 2008).

#### **4. Key Elements**

A well designed RFP has to contain several important elements. Some of these elements can be same in the industry, but can vary across between the public and private sectors. These include an overview of the business issue, a description of the product or services required, detailed business requirements. These also include other information, like proposal format, due date, selection criteria, time line, questions, how to respond and point of contact. Some RFPs will contain information on a cost

breakout, approach suggestions, or other documents that may be required. These RFP elements are outlined in the sections below (Wheaton, 2008).

### ***An Overview of the Business Issue***

There should be a description of the business issue or problem that is driving this particular purchase. It should give suppliers a summary of the sourcing project and the reason of why it was initiated (Wheaton, 2008).

### ***Description of Products or Services***

The RFP should contain a brief but persuasive description of the products or services that are needed. In most RFPs, the goods or services that the company needs are complex and may be difficult to describe in detail. Nevertheless, a good description of these goods or services will greatly assist suppliers in developing an excellent and highly targeted proposal (Wheaton, 2008).

### ***Detailed Business Requirements***

In addition to the description of products or services, with most RFPs there are detailed business requirements that need to be clearly outlined in the document. These can include support requirements, delivery guidelines, design specifications, quality metrics, etc. The purpose of the business requirements section is to give the suppliers details of what is needed by the company for this purchase so that the suppliers can come up with a proposal that meets these requirements. Often times, the requirements section takes up a good portion of the RFP. If the requirements do not accurately reflect the company's needs, suppliers will not present proposals that address the key issues. It is always important to collaborate with the people who are using the products or services for this sourcing project to ensure that the requirements are accurate.

### ***Other Information Needed for Proposal***

Sometimes there is additional information that suppliers will need in order to formulate a proposal. This information is usually the information about the organization's internal operations that the proposal writers will need. This

information can include usage metrics, demand projections, current performance information, internal survey results, etc. The key for this section is not to provide suppliers with too little or too much information. Rather, it is to provide them only with the information that they need (Wheaton, 2008).

### ***Approach Suggestions***

For RFPs in which the purchasing personnel know what they require, it may make sense to suggest an approach for the suppliers. Many companies will not have this section because they are looking for creative ways to approach the problem and to not want to force suppliers into a mold (Wheaton, 2008).

### ***Performance Metrics***

If applicable, some performance metrics will be used to measure supplier performance of the contract in the future. This will help suppliers get a quantifiable idea of what will constitute an excellent performance (Wheaton, 2008).

### ***Proposal Format***

Any RFP needs to specify the format and length of the supplier proposals. A highly structured format for proposals makes it easier to compare the responses from suppliers. It will also encourage clarity and provide focus in the supplier proposals. Some of the best RFPs place their business requirements in a point-by-point format and encourage suppliers to respond to each point. The RFP should state the maximum length of the proposal. Having a maximum length will help to reduce the time needed to review the proposal and will also ensure that suppliers keep unnecessary information to a minimum (Wheaton, 2008).

### ***Due Date***

The due date for the supplier proposals should be clearly stated near the beginning of the RFP and in other relevant places. This makes sure that suppliers know when it is due (Wheaton, 2008).

### ***Selection Criteria***

This is an important section and contains essential information for suppliers. This should clearly state the areas and metrics that supplier proposals will be evaluated on. If possible, the RFP should disclose the weighting that a particular section or topic will be given as a part of the overall proposal score. This weighting is often described as a percentage or in terms of points out of a total possible score. This section more than any other, helps suppliers focus their responses on the criteria on which their proposals will be judged (Wheaton, 2008).

### ***Questions***

Supplier may request clarification or ask question about even the most well written RFPs. Any RFP should clearly specify the mechanism by which suppliers can ask questions. Most good RFPs will set a time period during which supplier questions can be submitted. This time period should not be too close to the deadline for the proposal submissions. The contact point for the RFP will then get answers and provide responses in written form to the suppliers. It is generally helpful to display the questions and answers so all suppliers can see them and to make them a part of the RFP as an amendment. This can bring additional clarity to the requirements and provide documentation for the project (Wheaton, 2008).

### ***Timeline***

The time line should display the RFP creation date, the RFP send date, the time period for questions, the due date for proposals, the selection period, and the projected award date. This should all be communicated as clearly as possible (Wheaton, 2008).

### ***Point of Contact***

The point of contact is the person that handles interactions with the suppliers. This means that all supplier questions and comments about the RFP will be directed to this person. Some companies also include a back up point of contact in case the primary point of contact is out of the office or unavailable (Wheaton, 2008).

### ***Cost Breakdown***

The proposal submission should include a detailed cost breakdown for each item identified in the scope of work. In addition, the cost estimate shall include a detail timeline for achieving each of the deliverables. The costs will be assumed to be firm for acceptance within 90 days of RFP closure, unless otherwise specified (Morales, 2011).

### ***Other Documents***

Some RFPs have other documents that need to be filled out as part of the RFP process. These could be diversity certifications, agreements to certain terms and conditions, or other company specific forms. These should also be included with the RFP if they are part of a company's standard procedures (Wheaton, 2008).

### ***How to Respond***

Response to a corporate RFP can be an extremely time-consuming and anxiety-ridden process. The typical RFP is a significantly verbose document that looks more like a legal document than anything else, and has some very specific requirements. Here's how to examine the basic mechanics of the incoming corporate RFP and how should company respond (Kerner, 2003).

If used correctly and in the correct circumstances, an RFP is an excellent tool that purchasing personnel can use to source the best products or services from among several vendor offerings. While the RFP process is more time consuming and takes more effort, it can provide a company with unique insight into the project risk and can help the company determine the best way to move forward with a complex project. Once a company decides to go with an RFP as the sourcing tool, it is important to follow all of the best practices and to write the RFP in a concise and clear manner to ensure that supplier proposals will deliver the best value possible with the most targeted pricing.

## **5. Application of RFP**

In Defence sector RFP plays an important role in signing contracts. There is a system that must be followed carefully, and step by step. There are different procedures in Defence Sector and one of is Business Development and Request Proposal Procedure. The purpose of the procedure is the relation between Business development activities carried by Business Development and Contracts Directorate (BDCD) and Product Marketing activities ready-made products. In accordance with this relationship, the following points needs to be defined (Personel meeting with Defence Industry Employees, 2011):

- Execution of customer relations
- Tender preparation
- Pricing
- Proposal submission
- Contract negotiations and
- Methods of processing the contract signing

This procedure covers the activities, in order to gain new business as a service to the Company including all research, production and marketing of products ready to test programs and entered into the inventory. A “New Program” should be developed to provide new business opportunities according to the existing or developed/gained programs about the Company (Personel meeting with Defence Industry Employees, 2011).

Like other sectors, business development is very important in Defence Industry, too. In a Defence Company, except the sale of products and specific goods and / or undertaking any obligation to produce the service, the object is to win the contract signing ceremony conducted during the period of activities including the activities of any kind is all new program development. These activities during the time includes ongoing research, investigation, presentation, customer visits, meetings, reporting and execution of customer relations, proposal preparation, pricing, presenting proposals, contract negotiations and contract signing process.

The BDCD has a big responsibility. For a BDCD it is very important to carry out the following tasks:

- Get in touch with potential customers by determining the current abilities,
- Sign Agreements with the Companies for the Protection of Classified Information (NDA, Non-Disclosure Agreement),
- Sign letter of intents,
- Prepare programs for Potential New Business Development Plan for the Project,
- Make pricing in line with other cost information for Technical and Administrative Units from the labor, and materials,
- Prepare file for customer requests / proposals call for proposals in accordance with the preparation,
- Negotiate price and contract,
- Revised and submitted to the approval of management contracts.

The request by the project from the other departments directorates towards carrying out certain tasks within the scope of business developments is to specify project number, or tally number or electronic mail or in writing specifying the work orders are requested by the relevant sections by BDCD (Personel meeting with Defence Industry Employees, 2011).

Internal research and development activities in areas designated by the Executive Board are considered within the scope of R&D projects.

Complete projects and sub-assemblies which require a signed contract for the supply of sub-contractors within the scope of work given in the context of business development and marketing activities will not be treated.

Before beginning a project, making a market research is essential. The developments in the world is followed by the BDCD:

- Taking attention for the developments in Defence Industry with the new products and applications, getting in contact with domestic or international customers by e-mail, telephone, fax, contacts through consultations and visits, and the the requirements will defined.
- Necessary information about the possible areas of need in the form of a report compiled and presented to the customer informing the customer is provided on the subject.

- Introduction of company capabilities and potential customers are made to determine the domestic and international environments, and make presentations and disclosures.

The customer notification and identification is also important in projects. Preliminary discussions among potential customers is accepted as business related subject. Before the detailed negotiations with potential customers, protection of confidential information is intended to prevent third-party administration and mutually NDA is signed.

BDCD will work with the customer when it is necessary to prepare technical and administrative documents required for the project and provides complete preparation of all necessary documents for the tender. At this stage, agreed with the proposal, based on studies conducted file a Request for Proposal (RFP) are generated (Personel meeting with Defence Industry Employees, 2011).

The RFP usage can be seen in *Figure5*. That figure shows the RFP more detailed in Project System during Production (Personel meeting with Defence Industry Employees, 2011).

Capabilities related to a Company, receives a contract or RFP, and then they will be answered by BCDC. In this context, correspondence or meetings arranged as needed for clarification of customer requirements and demand, is clearly determined by the content. The received RFP or contract files will be examined in detail by BDCD, and related to the subject, the points given below are decided:

- Definition of the Project
- Timing of the Project
- Demand amount
- Procurement authority
- Project Model
- Market Analysis
- Business Development Resource Requirement

If the project bidding is proposed for the project, in accordance with the format set for the in-house preparation of the proposal, a Request Preparation Time Plan will be

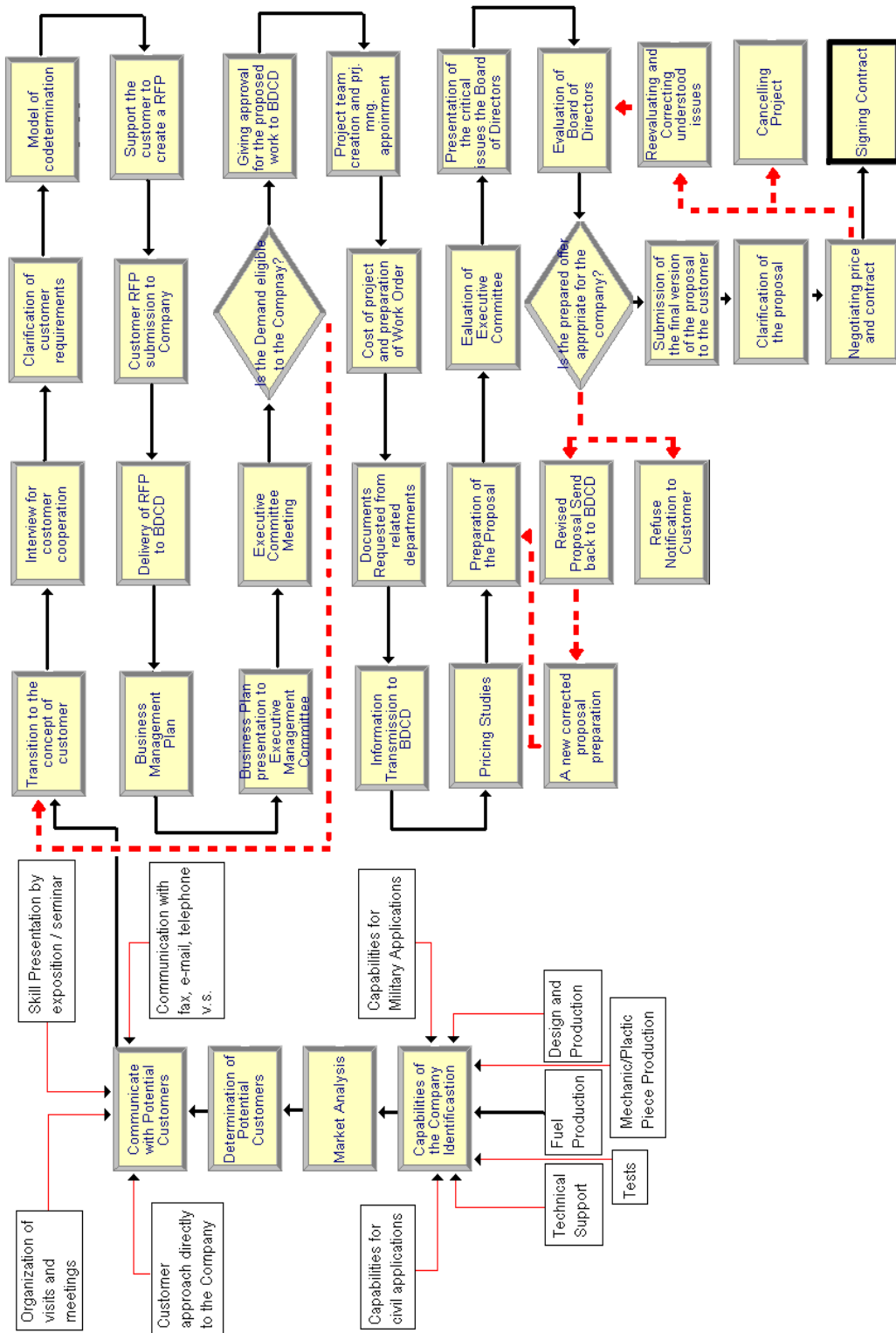


Figure 5. General Flow Chart of Business Development Studies

prepared and it will be added to Business Plan. The prepared Business Plan will be distributed to members of the Executive Board and it will be coordinated. Offers prepared in accordance with the business plan are decided in the coordinated meeting.

A project work plan will be prepared by BDCD for a New Program which is at a level of submission or a required particular labor. The prepared plan will be submitted to the Executive Council. At this stage, it will be decided to start the subject as a New Program or not. Pricing will be offered in accordance with the decision of the Executive Board based on cost information for projects compiled by the Project Manager. Information about pricing which are defined by project managements will be prepared with the defined format. After giving decision to work for new program, BDCD will define a project number about the New Program, and will notify by writing to Cost Accounting and Production Planning and Control Management. All projects expenses are identified by these project numbers. During the New Program development activities, the expenses such as traveling, accomodation, treat, printing and duplicating jobs with direct workmanship will be collected in cost box belonging to New Program.

The excess on the New Programs costs will always be controlled by BDCD. If there is a cost-excess in the New Program, the Finance & Accounting Management will stop the payment. In this case, BDCD will revise the New Program's budget. If a decision is taken to be continued at the end of the year about the New Program, the budget proposal for the next year will prepared and presented to management. Unit labor charges will be based on Cost Accounting Department by BDCD. Pricing is decided based on the average of the fees received for the year. However, taking into account the criticality of the project management fees, labor hours can be changed if deemed necessary by the decision. Profit, risk, finance costs and costs associated with contract pricing by taking into consideration other factors are (Personel meeting with Defence Industry Employees, 2011).

Pricing that is achieved at the end of studies is presented to the Executive Board for control and verification. After that presentation; profit, risk and financial costs, is brought into its final state by revising the bid price. Offer price and details are discussed in the Board of Directors. Proposal approved by the Board of Directors, in

accordance with procurement rules and other legal rules in a bid package and approvals shall be brought to final state by the BDCD. All proposals to be presented to the customer shall be approved by the General Manager and Vice President in the absence of any one of them. Approval of the Deputy Chairman of the Board of Directors will be valid. Converted into a package of proposals, it is presented to the customer by BDCD. Following the submission of Proposals it will be followed by BDCD and customer closely.

Agreement on technical and commercial matters has been provided on the contract negotiations will begin with the customer offer. During the negotiation, BDCD Contract specialist should also be present. If necessary, there will be mutual interviews with the client about agreement on price and contract terms. The coordination in this meeting is done by BDCD, and the contract will be signed. If a consensus cannot be achieved in the negotiations with customers, the subject is transferred to the Directorate General. After the result of the negotiations with customer, the final state of the contract will be examined by the relevant units within the company. It is initiated by BDCD and signed by Directorate General (Personel meeting with Defence Industry Employees, 2011).

There is some project activities given below which are carried out in an integrated way after signing the contract.

- Contract
- Planning
- Material
- Workmanship
- Investment
- Documents
- Change and Quality Management
- Production
- Accounting
- Budget

The Project Management Plan, Project Team Assignment, Creation of Project Plan, Entering the cost data based on the proposal and getting an advance are processed in

ERP software as a part of within signing the contract. At this stage, PS, CO and FI are also activated in the system. For the planning activities PS and CO modules are used. During the project, the necessary materials are supplied from the related suppliers and in values a payment. For this activity it is important to describe the request for purchase and material movements (Personel meeting with Defence Industry Employees, 2011).

As mentioned before, in Defence Industry every process plays an important role in projects. Therefore the information about the material income, material transfer, and consumption of project and stock of projects are required in ERP program. The Related labor that is required according to the Project state is budgeted by the related modules. Design and Project Management, Production, Maintenance and Support are related to these modules. The investment of the project is coordinated by the related departments which are in Asset Accounting and Materials Management. The documents created during the project design and production stages, the changes in project team, and the processes which are appropriate to quality levels that are defined at the contract will be sent to the related departments, therefore to the ERP modules.

In accordance with uniform accounting system, the month-end closing activities transactions must be done in Defence industries. Control of the budget activities by both project and finance traceability can be provided by integrated work with the modules which are CO, BPS (Budget Planning Systems), and FM.

Project period is the period which covers a plan, program, budget, a contract if exists, a design which is developed according to the specifications, development, production and purchase, marketing, sale and guarantee period after sale studies of an aimed product (Personel meeting with Defence Industry Employees, 2011). Actually there are four steps in project management:

- Planning
- Application
- Control
- Closing

In the planning phase, project is created on ERP Software. Work packets are created for workmanship and material planning. If the project is a contractual project, an SD document is created and associated with the project. Project definition document is prepared. Purchase decisions in the project are decided. Project main phases that the project will be tracked are decided. Project communication plan is formed. Reports which will be prepared and meetings which will be done are planned with their periods. Critical decisions to be made in the project extent are planned in Defence Industries. Planning about the risks in the project is done. Planning according to quality demands of the project is done with quality planning (Personel meeting with Defence Industry Employees, 2011).

In the application phase, all plan implementation in the project are being focused. Device/system is developed according to the schedule which takes place in the contract. Product infrastructure is developed after the required infrastructure is formed according to the schedule which takes place in the project management plan.

When the design and product infrastructure of the device/system are finished, it is produced according to the schedule which takes place in the contract. Products which are ready for delivery are passed from the inspection acceptance test, and then delivered according to the delivery scheduling which takes place in the contract.

To ensure the project cost is formed correctly:

- Materials spent for the project,
- Purchase requests and orders which are opened for the project,
- Production and service orders which are opened in the project extent,

are required to be assigned to correct work packets.

Workmanship cost of the project is formed by multiplying the unit workmanship cost and related workmanship cost which is materialized. To ensure that the project cost is formed correctly, it is important that correct amount of workmanships are to be assigned to correct locations.

In the control phase, outputs that belong to all phases are controlled by the customer or the management according to the necessity. In the project development reports, the projects:

- main phases,
- workmanships,
- delivery and cash inputs, cost (material, other expenses, investment)

should be observed as to be planned-materialized.

Risks of the project is observed according to the risk management process. On this phase, progress of the project should be compared to the plans and periodically observed.

In the closing phase, all commitments of the contract are accomplished. At the beginning of the guarantee period, a project closure report is prepared in which the technical and material gains are obtained during the project, taken lessons and prudential job opportunities are explained. Maintenance service is given to the products which are delivered within the guarantee period which is defined in the contract. It is ensured that the project structure in the ERP system with all relevant information and all documents in the documentation system are archived (Personel meeting with Defence Industry Employees, 2011).

## CHAPTER 4

### EMPIRICAL STUDY- ERP SOLUTION PARTNER SELECTION

#### 1. Definition of Analytical Hierarchy Process

An Analytical Hierarchy Process (AHP), according to the Operations Management book which is written by Russell and Taylor (Russell and Taylor, 2003), is a quantitative method for decision making and choice alternatives are sorted by multiple criteria. AHP which is developed by Thomas L. Saaty in the 1970s, is a decision-making process to assist decision makers. Decision-making, according to one or more available resources to achieve the purpose of the problem is to select the most appropriate options (Atlas and Keçek, 2000).

AHP is an approach that compares the quantifiable measures of concrete or abstract criteria and priorities, by calculating the relative importance of criteria (Güngör and Büyüker, 2005). AHP contains many functions such as; fitting complex and non-structural case to basic parts of the allocation function or variables into a hierarchical structure, converting numeric values for each variable subjective review, investigating to see which variables affect the outcomes to determine the highest priority (Saaty, 2001).

AHP is a finite multi criteria decision making method, since there are limited criteria and each criteria are independent from each other. In other words, AHP is a development of numerical values to rank the criteria that the decision maker given according to the degree of capture of every decision alternatives. AHP, gives answers to the questions “Which one is eligible?”, “Which one is the best?” by capturing the best alternative from all criteria which the decision maker gives.

In this study each criteria are independent of each other. If criterias would be dependent with each other, then Analytical Network Process (ANP) method would be applied. The ANP method allows the aggregation of the experts’ judgments on each of the indicators into one Environmental Pressure Index. In addition, ANP is based on utility ratio functions which are most appropriate for the analysis of uncertain data, like experts’ estimations. Finally, unlike the other multicriteria

techniques, ANP allows the decision problem to be modelled using the relationships among the inter-dependent criteria.

AHP uses three main issues that are explained below:

- **Simple Mathematics:** AHP uses simple mathematics, which is summation, subtraction, multiplication and division.
- **Criteria:** Important thing which decision maker will give such as; Cost, Quality, distance, etc.
- **Standard Preference Table:** Contains values for decision maker for how important each criteria.

We all make decisions in our lives, and with the results we can see how successful are the decisions we have made. Usually decisions are given by two ways; heuristic or logical. Heuristic decisions, develops very quickly and they usually are not objective. Logical decisions, requires an analytical method necessarily.

Some studies using AHP methods can be found in the literature. AHP method is used for the evaluation of service quality at airports by Tsaur, Chang and Yen (2002), for determination of cotton fiber quality values by Madumjar, Sarkar and Madumjar (2005), for the development of a performance measurement model for manufacturing companies by Yurdakul and İç (2005), for selecting the best care technology in the textile industry by Shyjith, Ilangkumaran and Kumanan (2008), for customer-oriented product design process by Lin, Wang, Chen and Chang (2008), for the evaluation of service quality in the banking sector by Ustasüleyman (2009). For the supplier selection problem Wang, Cheng and Cheng (2009), used fuzzy AHP and fuzzy TOPSIS methods.

An ERP is an important investment that can significantly affect competitiveness of a corporate. There are many ERP Solution Partners in Turkey. Selecting the best ERP Solution Partner is very important for the Defence Industries; therefore AHP method will help for the best selection of ERP programs (Rouyendegh and Erkan, 2011).

## **2. Decision Making Process**

*“Decision making is the study of identifying and choosing alternatives based on the values and preferences of the decision maker. Making a decision implies that there are alternative choices to be considered, and in such a case we want not only to identify as many of these alternatives as possible, but to choose the one that best fits with our goals, objectives, desires, values, and so on.”* (Harris, 1980).

According to Baker et al. (2001), decision making should start with the identification of the decision maker(s) and stakeholder(s) in the decision, reducing the possible disagreement about problem definition, requirements, goals and criteria.

It is very important to make distinction between the cases whether we have a single or multiple criteria. A decision problem may have a single criterion or a single aggregate measure like cost.

Then the decision can be made implicitly by determining the alternative with the best value of the single criterion or aggregate measure. We have then the classic form of an optimization problem: the objective function is the single criterion; the constraints are the requirements on the alternatives.

Depending on the form and functional description of the optimization problem, different optimization techniques can be used for the solution, like linear programming, nonlinear programming, discrete optimization, etc. (Nemhauser et al.,1989).

## **3. AHP Method**

There are seven steps of AHP implementation:

- a) Creating a hierarchical structure
- b) Identification of priorities
- c) Construction of Binary comparison matrix
- d) Construction of Priority Vector
- e) Calculation of the consistency ratio
- f) Determining the Decisive Order
- g) Sensitivity Analysis

### Step 1: Creating a hierarchical structure

Hierarchy and complex decision making problems are explained in the form of linear chain decomposition of the cause-effect relationships, they are presented in an effective process for analysis. It allows the researcher to understand the problem. The aim of design hierarchy was to determine the effect of the higher-level elements between the lower-level elements (Saaty, 1994).

As the first step of AHP, the available data, opinions, or intuition, as quantitative or qualitative measures are developed in a particular logical hierarchical structure formation as shown in Figure6 given below.

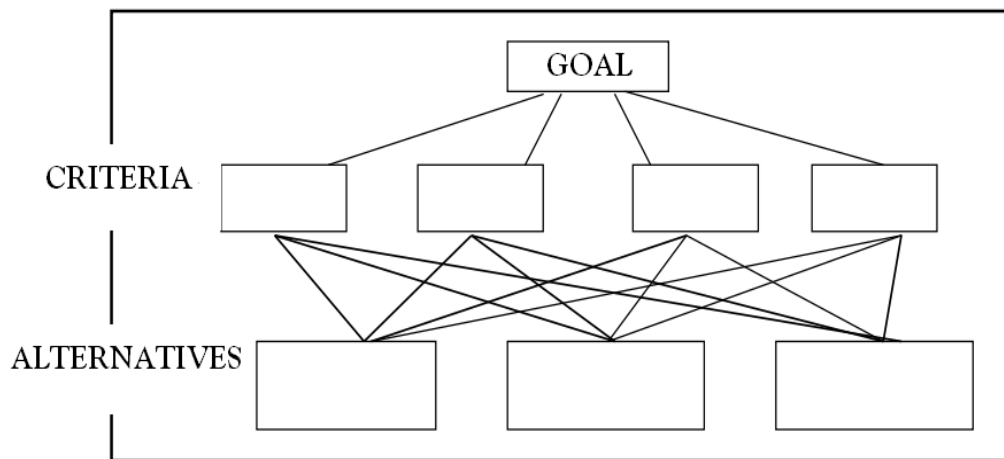


Figure 6. An Analytical Hierachy Model (Saaty, 1994)

Source: Fundamentals Of Decision Making And Priority Theory With Analytic Hierarchy Process, *RWS publications*, Pittsburg.

### Step 2: Identification of priorities

Problem expressed in the form of a hierarchical decision-making process after the model is compared with the elements that make up the hierarchy. After that, the relative weights or priorities (superiority) need to be calculated.

Prioritization, with the help of a series of questions and answers generated binary comparisons between the relative importances of each level, includes identification of elements and determines the contribution of the general purpose of this importance. To achieve this goal in the hierarchy, elements are compared in pairs according to a top level element. For resolving the complexity of interpretation of the

figures a Standard Preference Table is developed by Saaty (1994), where he used a “1-9 Scale” in order to use for this comparison, and minimize and fix errors. It is also called Standard Preference Table and is given below in Table1.

Table 1. Standard Preference Table

Numeric Value	Definition
1	Each of the two factors have equal priority
3	First factor is more important than the second factor
5	First factor is very important as compared to the second factor
7	First factor is strongly important as compared to the second factor
9	First factor has superior importance as compared to the second factor
2,4,6,8	Intermediate values

Decision-makers, selects a binary comparison statement that their ideas about the indicative scale and the numerical value of this expression is used for the calculation.

### **Step 3: Binary comparison matrix**

AHP is a technique to evaluate a combination of quantitative and qualitative variables that takes into account the priorities of decision-making group or individual. Elements are created in the hierarchy according to a criterion in which pairs take over and compares them. During this process, all elements without adding other criteria, processing, provides assurance about the owner of separate jurisdictions.

In the comparison matrix, in terms of these criteria one compares rows with the columns on the basis of the questions like "How much The row element is important

as compared to the column element?"; the answer is expressed in forms of the numbers in the Table1 (Özdamar, 2004).

Weights or degrees of importance given to the basic elements according to the scale size of the  $w_i$  and  $w_j$ , respectively, the ratio of each enables to construct the binary comparison matrix A as a result (Özdamar, 2004).

Mathematical relationship is expressed by;

$$w_i / w_j = a_{ij} \quad (i, j = 1, 2, \dots, n)$$

( $w_i$  : Weight of  $i^{\text{th}}$  alternative;  $w_j$  : weight of  $j^{\text{th}}$  alternative)

A is the double comparison matrix, which is given below:

$$A = \begin{pmatrix} 1 & \dots & a_{1j} & \dots & a_{1n} \\ \cdot & 1 & & & \cdot \\ 1/a_{ij} & & 1 & & \cdot \\ \cdot & & & 1 & \cdot \\ 1/a_{nn} & & & & 1 \end{pmatrix}$$

#### Step 4: Construction of Priority Vector

At this step which is also known as synthesis step, for the calculation of weight vectors, firstly the relationship matrices are normalized. The normalized matrix is obtained by forming each column by inverting the elements in the associated rows. After this calculation, by getting the average row value of the normalized matrix, a criteria, sub criteria and weight of alternatives or priority vector are obtained.

Priority vector is an important paradigm for decision making and obtaining the priorities of double comparison matrices. For each criteria, priority vector is obtained from sub level alternatives' double comparison matrix. These priority matrices are multiplied by weight vectors of the criteria which are at one higher level, for finding the general priority vector for the highest level purpose.

Mathematically;

$n \times n$  sized A matrix consist of  $a_{ij} = w_i / w_j$  values, has the specifications;

$a_{ij}$  and  $a_{ji} \geq 0$

$a_{ij} = 1 / a_{ji}$

$\text{rank}(A) = 1$

$a_{ij} = 1$  (when  $i = j$ )

For obtaining the priority vector which is expressed as:  $w = [w_1, w_2, \dots, w_n]^T$  ;

$Aw = \lambda w$  or  $Aw = nw$

equations are used.  $\lambda$ s which are found from these equations are eigenvalues of A matrix and w vectors are eigenvectors which match this  $\lambda$  .

In the calculations which are made during the Analytic Hierarchic Process, only a vector which has the highest values ( $\lambda_{\max}$ ) of the eigenvalues, is determined as the eigenvector. In an ideal comparison matrix, because of the reason that the rank, which is the independent vector count will be 1, there will be 1 eigenvalue and 1 eigenvector. If a corruption occurs in the judgement, there will be more than 1 eigenvalue and the value of the highest one will be the one which its matrix degree is closest to n (Emel and Emel, 1998; Saaty,1990).

### **Step 5: Calculation of the consistency ratio**

In AHP, consistency is a logical and mathematical relationship of the values which are formed as a result of double comparisons, which are the priorities. Consistency is an important subject for the decision to be made.

Eigenvalue approach has a widespread use since it can tell the CR. As it is showed by Saaty,  $\lambda_{\max} \geq n$  is valid for positive and inverse valued matrices.  $\lambda_{\max} = n$  is valid only when A matrix is consistent. Therefore;  $\lambda_{\max} - n$  is used as an indicator for Consistency Ratio (CR) (Saaty and Vargas, 2001; Yilmaz, 2000).

CR is calculated for each pairwise comparison matrix and for this ratio it is requested that the upper limit should be 0,10. Otherwise, if this ratio is bigger than 0,10, then it refers the decision-maker has inconsistent judgements. In this case, judgements should be improved. To access the value of CR, firstly  $\lambda_{\max}$  has to be calculated by the equation given below:

$$\lambda_{\max} = \frac{\sum_{i=1}^n \lambda_i}{n}$$

Consistency index (CI) is the numerical expression of the consistency concept, which is developed by Saaty for calculating the consistency of the double comparison judgement. Consistency Index (Saaty, 1980) is calculated by;

$$CI = \frac{\lambda_{\max} - n}{n(n-1)}$$

and can be defined as the indication of consistency proximity.

Saaty and his friends created a Random Index (RI) series for calculating the consistency ratio. Random consistency index numbers for square matrices sized from 1 to 15 are given in Table 2. RI values can be calculated for 1 to 15 dimensional matrices. In AHP method there should be at least 3 factors in order to apply a comparison matrix, therefore for n=1 and n=2 the RI values are zero.

Table 2. Index of random numbers

N	Randomness Indicator	n	Randomness Indicator
1	0	8	1,41
2	0	9	1,45
3	0,58	10	1,49
4	0,9	11	1,51
5	1,12	12	1,48
6	1,24	13	1,56
7	1,32	14	1,57

Consistency ratio is obtained by the ratio of consistency index at hand to the random index of a same sized matrix (Saaty, 1980).

$$CR = CI / RI$$

If the consistency ratio is less than 0.10, that matrix is a consistent matrix (Öner and Ülengin, 1995). Consistency ratio is an important paradigm for the final decision. Consistency ratio not only enables reducing the incautious mistakes, but also reveals the mistakes or exaggerated assessments of the managers on 1 or more comparisons (Partovi et al., 1989).

#### **Step 6: Determining the Decisive Order**

At this step the order of alternatives according to the general purpose are determined. Priorities which are obtained from the double comparison matrices are combined and weights are obtained for the alternatives on the lowest level. Decision maker can determine the best alternative by putting the results obtained and alternatives in order.

#### **Step 7: Sensitivity Analysis**

After the orderings of alternatives are formed, results of the constructed model are needed to be observed and reviewed. For this purpose, at this phase of AHP, sensitivity of ordering of the alternatives and the final decision to the changes of judgement are evaluated. Changes such as different judgement of each person for double comparison construction and change of a person's decision for a previous judgement shall be taken into account.

### **4. Implementation Fields of AHP**

There are many real-life application of the Analytic Hierarchy Process. The opportunities of this arises mostly in business life. This method:

- ERP Software Selection
- Project and Portfolio Selection
- Vendor and Source Selection
- Planning and Budgeting
- Market Research
- Performance and Risk Assesment
- Education

It will help us to decide many issues, analytically, and accurately.

One of the important reasons of the popular usage of AHP is the ability to decompose the decision making problem into the smallest detail criteria and by doing this, taking every detail's influence into account. AHP has a wide usage in practice because of its easy implementation, flexibility and easy commanding.

Nowadays top level managers use the AHP method for decision making, and the usage area of AHP is shown in Table 3.

Table 3. AHP fields

<b>Decision Making Problems about Business Administration Organization</b>	<b>Decision Making about Business Administration Management</b>	<b>Decision Making Problems about Business Administration Functions</b>	<b>National Politics – Government Decisions</b>	<b>Folk Management (Federal and Local)</b>
* Advertisement campaigns	* Strategic Planning	* Product Life Curve Analysis	* Nuclear Disarmament Agreements	* Determining Resources
* Customer Relationships	* Planning for Increasing Profit	* Planning of Encouragement for Selling	* Budget Arrangement	* Political Decisions
* Labour and Promotion Decisions	* Partnerships	* Demand Assessment	* International Crisis	* Demand Assessment
* Feasibility	* Marketing	* Judicial Decisions	* Support-Oppose Decisions	* Applicable Projects
* Marketing, Purchase-Leasing Decisions	* Developing New Products	* Time Planning	* Military Decisions	* Legal Decisions
		* Hire/Bounce Employees		* Budget Arrangement
		* Health-Education planning		

## 5. ERP Solution Partner Selection

As of 1998, according to Loizos, there were five leading ERP Solution Partners that accounted for 62 percent of the market: SAP of Germany; Oracle; J.D. Edwards; People Soft; and BAAN of the Netherlands. For the most part, these Solution Partners focused on large business clients and concentrated on automated manufacturing, distribution, human resources, and financial systems. The remaining 38 percent of the ERP applications market was comprised of numerous smaller

Solution Partners which served smaller business clients and focused on niche applications.

Loizos outlined a series of factors for small businesses to consider in choosing an ERP Solution Partner. For example, she emphasized that implementing an ERP system is a major information technology decision which requires time and resources; so companies should avoid choosing a Solution Partner too quickly. Instead, she recommended that small businesses evaluate their needs carefully and come up with a list of business issues they expect the ERP system to help them address. Loizos also suggested that companies research potential ERP Solution Partners thoroughly, looking at their reputations in the industry but also checking references and interviewing previous clients. She recommended avoiding multiple Solution Partners if possible, and ensuring that the Solution Partner chosen is appropriate for the small business's future growth and expansion plans.

Supplier selection problem, with the simplest expression is required for production of raw materials, semi finished goods and other materials to determine from whom and how much can be defined as eligible to attend (Güner, 2005). Working with correct suppliers to reduce procurement costs, improve competitiveness and increase customer satisfaction in enterprise. So in today's highly competitive environment, an effective supplier selection decision is very important in the success of an organization (Liu and Hai, 2005). The purpose of the selection of suppliers is to meet the needs of a business and have the highest potential suppliers to determine an acceptable cost. The criteria used to analyze the needs of companies vary according to potential suppliers (Kahraman et al., 2003). The most popular criteria considered by decision-makers in choosing suppliers are quality, delivery, price/cost, production capability, service, management, technology, research and development, finance, flexibility, reputation, relationships, risk, safety and environment (Ho et al., 2010). This process included the evaluation of different criteria for supplier selection decisions; therefore it is a multi-criteria decision problem (Ho et al., 2010).

In this study, the ERP Solution Partner selection problem is considered for the Defence Industry companies. At the end of the study, the aim is to select the most appropriate supplier for the Defence Industry companies. For this purpose, to solve the problem of selection of ERP Solution Partners, AHP method is used. AHP

method is used to determine the weights of the selection criteria, since each criterion are different and independent of each other. Therefore the best solution of this selection can be given by AHP method.

## **6. Application of AHP for Defence Industry**

There are five major criteria in Defence Industry which comes in the first orders. These criteria are Cost, User-Friendliness, Safety, Functionality and Integrability, which are taking the most important role in this sector.

First of all by AHP method, which criteria is most important will be selected, and then the Solution Partners are also to be selected according to the best criteria to find which one of the Solution Partner is the appropriate for the Defence sector.

Five criterias put in Standard Preference Table as shown below. In the table, numbers are given with the importance of each criteria which is described above with the related Defence Industry workers. In this table it is seen that Cost is the less important criteria in the table. Which one is the weighty criterion is going to be determined by calculation.

This study aims to determine the weak and strong aspects of the ERP softwares that are being used in the companies by the administrators, considering the formerly determined criteria, which can also be evaluated as measuring the success of the method. The evaluation and comparison of the ERP softwares which are being used at the companies is an important issue. Due to the rapidly changing technology, the companies are obliged to choose the most suitable ERP software. This cannot occur by just collecting information but shall be with developed decision techniques. In this thesis, in accordance with the leading criteria, the performance measurements of the ERP programs that are being used in the defence industry companies are shown with the AHP method. Also in this thesis, the election of the ERP solution partnerships are elected with some formerly determined criteria and the AHP method. It is presumed that this study will aid innovations at the defence industry companies.

Table 4. Pairwise comparison matrix for ERP criteria

	Cost	User Fr.	Safety	Func.	Integ.	$\lambda = 5,226; CR = 5\%$ $W = \begin{pmatrix} 7\% \\ 9\% \\ 14\% \\ 44\% \\ 26\% \end{pmatrix}$
Cost	1	1/2	1/3	1/5	1/5	
User Fr.	2	1	1/3	1/4	1/3	
Safety	3	3	1	1/3	1/3	
Func.	5	4	3	1	2	
Integ.	5	3	3	1/2	1	

According to the weights, we see that the most important criterion is the Functionality with 44%. In Defence Industries Cost is the less important criterion; it is consistent with the weight of 7%. This AHP calculation is consistent since CR value is less than 0,10 and  $\lambda_{max} \geq n$  condition is satisfied. AHP Analysis will also be helpful in ERP Selection, and it can be found by the same method. The used ERP Software in the Defence Industries are ERP A, ERP B, ERP C and ERP D.

Table 5. Pairwise comparison matrix for Cost criterion

Cost	ERP A	ERP B	ERP C	ERP D	$W = \begin{pmatrix} 46\% \\ 26\% \\ 16\% \\ 12\% \end{pmatrix}$
ERP A	1	2	3	3	
ERP B	1/2	1	2	3	
ERP C	1/3	1/2	1	2	
ERP D	1/3	1/3	1/2	1	

$\lambda = 4,095; CR = 3,5 \%$

For the first criterion, which is Cost, the best ERP Software is ERP A. It is one of the most popular ERP software worldwide. As it is said before, cost is not an important factor in Defence Industry. The consistency is also satisfied by the CR value.

Table 6. Pairwise comparison matrix for User-Friendliness criterion

User Fr.	ERP A	ERP B	ERP C	ERP D
ERP A	1	2	3	3
ERP B	½	1	4	4
ERP C	1/3	¼	1	1/2
ERP D	1/3	¼	2	1

$\lambda = 4,255$  CR = 9.4 %

W =  $\begin{pmatrix} 46\% \\ 30\% \\ 11\% \\ 13\% \end{pmatrix}$

In the second criterion, the most appropriate ERP Software is ERP A with the 46% weight. User-Friendliness is an important criterion when choosing the best program. It can be said to be consistent with the CR value since it is less than 0,10.

Table 7. Pairwise comparison matrix for Safety criterion

Safety	ERP A	ERP B	ERP C	ERP D
ERP A	1	2	4	4
ERP B	1/2	1	3	3
ERP C	1/4	1/3	1	½
ERP D	1/4	1/3	2	1

$\lambda = 4,093$  CR = 3,5 %

W =  $\begin{pmatrix} 50\% \\ 27\% \\ 10\% \\ 12\% \end{pmatrix}$

ERP A is again the best ERP Software for Safety Criterion. In Defence Industry, Safety is probably the most important thing, because every project identified as top secret. Also, as it is mentioned before, ERP A is a well known ERP software program.

Table 8. Pairwise comparison matrix for Functionality criterion

Func.	ERP A	ERP B	ERP C	ERP D
ERP A	1	3	5	5
ERP B	1/3	1	4	3
ERP C	1/5	1/4	1	½
ERP D	1/5	1/3	2	1

$\lambda = 4,167$  CR = 6,2 %

W =  $\begin{pmatrix} 57\% \\ 22\% \\ 9\% \\ 11\% \end{pmatrix}$

ERP A's functionality is the best in these four Solution Partners. Big businesses prefer to use ERP A, because functionality is also a critical factor. By the AHP method it is appropriate to say that its consistency is satisfied with CR.

Table 9. Pairwise comparison matrix for Integrability criterion

Integ.	ERP A	ERP B	ERP C	ERP D
ERP A	1	½	2	2
ERP B	2	1	3	3
ERP C	½	1/3	1	1/3
ERP D	½	1/3	3	1

$W = \begin{pmatrix} 25\% \\ 46\% \\ 12\% \\ 17\% \end{pmatrix}$

$\lambda = 4,178 \quad CR = 6,6$

In the Integrability criterion, by AHP Analysis, the best software is seen as ERP B System. Because, this ERP Software has been created by analyzing the requirements, needs and expectations of the business. After all these calculations, the best ERP for these criteria can be found by the following linear equation:

$$\begin{pmatrix} 0,46 & 0,46 & 0,50 & 0,57 & 0,25 \\ 0,26 & 0,30 & 0,27 & 0,22 & 0,46 \\ 0,16 & 0,11 & 0,10 & 0,09 & 0,12 \\ 0,12 & 0,13 & 0,12 & 0,11 & 0,17 \end{pmatrix} \cdot \begin{pmatrix} 0,07 \\ 0,09 \\ 0,14 \\ 0,44 \\ 0,26 \end{pmatrix} \Rightarrow W = \begin{pmatrix} 0,4594 \\ 0,2994 \\ 0,1059 \\ 0,1295 \end{pmatrix}$$

As a result of this AHP method, the best ERP Software is ERP A with approximately 46% with the Functionality Criterion.

## 7. ERP Solution Partner Selection with AHP Method

Selection of ERP Solution Partner is very important for every business. For small enterprises the ERP implementation is much easier than the big companies; such as Defence industries. As mentioned before, in Defence Industry every project is very important and there is not any tolerance in failures. Therefore ERP Software

in every Defence Industry should give successful results without any fault. There are some important ERP Solution Partner selection criteria which are, Reputation (R), Technical Capability (TC), Service (S), Warranty (W), Research & Development Capability (R&D) and Implementation Capability (IC). These criteria will determine on what basis the Solution Partner should be selected. There are four different Solution Partners: Solution Partner A (SP A), Solution Partner B (SP B), Solution Partner C (SP C) and Solution Partner D (SP D). These criteria and the Solution Partners are determined by the workers in Defence Industries.

Table 10. Pairwise comparison matrix for Solution Partner Criteria

	R	TC	S	W	R&D	IC
R	1	2	1/3	1/2	1/4	1/4
TC	1/2	1	1/3	1/2	1/3	1/4
S	3	3	1	1/2	1/3	1/4
W	2	2	2	1	1/3	1/2
R&D	4	3	3	3	1	1/2
IC	4	4	4	2	2	1

$\lambda = 4,178; CR = 6,6\%$

$W = \begin{pmatrix} 7\% \\ 7\% \\ 10\% \\ 14\% \\ 24\% \\ 36\% \end{pmatrix}$

The Implementation Capability is the best criterion for the selection of the Solution Partner with 36%. CR value also shows adequate consistency since it is less than 0,10; there is no need for any further justification.

Table 11. Pairwise comparison matrix for Reputation criteria

Reputation	SP A	SP B	SP C	SP D
SP A	1	3	2	2
SP B	1/3	1	1/4	1/3
SP C	1/2	4	1	1/2
SP D	1/2	3	2	1

$W = \begin{pmatrix} 43\% \\ 10\% \\ 20\% \\ 27\% \end{pmatrix}$

$\lambda = 4,219 \quad CR = 8,1\%$

In the selection of Solution Partner the most weighty criterion is the Reputation. Reputation plays a significant role in selection, since for customers it is important to select a Solution Partner which a reliable, and the CR value supports the result.

Table 12. Pairwise comparison matrix for Technical Capability criteria

Tech.Cap.	SP A	SP B	SP C	SP D
SP A	1	2	3	3
SP B	1/2	1	2	2
SP C	1/3	1/2	1	2
SP D	1/3	1/2	1/2	1

W=  $\begin{pmatrix} 46\% \\ 25\% \\ 16\% \\ 13\% \end{pmatrix}$

$\lambda = 4,077$  CR = 2,9 %

In Technical Capability, Solution Partner A is again the best with 46%. Capability of the Solution Partner must be faultless.

Table 13. Pairwise comparison matrix for Service criteria

Service	SP A	SP B	SP C	SP D
SP A	1	1/3	2	2
SP B	3	1	4	5
SP C	1/2	1/4	1	1/2
SP D	1/2	1/5	2	1

W=  $\begin{pmatrix} 20\% \\ 56\% \\ 12\% \\ 12\% \end{pmatrix}$

$\lambda = 4,111$  CR = 4,1 %

Solution Partner B is the best in Service criterion with 56%. When in need of service, it is to be provided as fast as possible.

Table 14. Pairwise comparison matrix for Warranty criteria

Warranty	SP A	SP B	SP C	SP D
SP A	1	1/3	1/2	1/2
SP B	3	1	3	3
SP C	2	1/3	1	1/2
SP D	2	1/3	2	1

W=  $\begin{pmatrix} 13\% \\ 50\% \\ 16\% \\ 21\% \end{pmatrix}$

$\lambda = 4,147$  CR = 5,5 %

Solution Partner B is again the best in Warranty criteria with 50%, and the result of consistency value also supports the result of AHP.

Table 15. Pairwise comparison matrix for R&D Capability criteria

R&D Cap.	SP A	SP B	SP C	SP D
SP A	1	1/2	3	3
SP B	2	1	3	2
SP C	1/3	1/3	1	1/2
SP D	1/3	1/2	2	1

$$W = \begin{pmatrix} 29\% \\ 43\% \\ 11\% \\ 17\% \end{pmatrix}$$

$$\lambda = 4,177 \quad CR = 6,5 \%$$

In Research & Development Criterion, Solution Partner B comes best with 43%, and it is consistent since CR value is less than 0,10.

Table 16. Pairwise comparison matrix for Implementation Capability criteria

Implementation Cap.	SP A	SP B	SP C	SP D
SP A	1	2	3	2
SP B	1/2	1	3	3
SP C	1/3	1/3	1	1/2
SP D	1/2	1/3	2	1

$$W = \begin{pmatrix} 43\% \\ 29\% \\ 11\% \\ 17\% \end{pmatrix}$$

$$\lambda = 4,177 \quad CR = 6,5 \%$$

In terms of the the last criterion which is the Implementation capability, Solution Partner A is the best of them with the weight of 43% and CR is 0,065 which is less than 0,10.

In the last step it is going to be found that for which criterion ERP is the best, by doing matrix calculation.

$$\begin{pmatrix} 0,43 & 0,46 & 0,20 & 0,13 & 0,29 & 0,43 \\ 0,10 & 0,25 & 0,56 & 0,50 & 0,43 & 0,29 \\ 0,20 & 0,16 & 0,12 & 0,16 & 0,11 & 0,11 \\ 0,27 & 0,13 & 0,12 & 0,21 & 0,17 & 0,17 \end{pmatrix} \cdot \begin{pmatrix} 0,07 \\ 0,07 \\ 0,10 \\ 0,14 \\ 0,24 \\ 0,36 \end{pmatrix} \Rightarrow W = \begin{pmatrix} 0,3249 \\ 0,3581 \\ 0,1256 \\ 0,1714 \end{pmatrix}$$

As a result, the most eligible ERP Solution Partner is shown as Solution Partner B with the implementation criterion for Solution Partner selection with approximately 36%.

The ERP programs that are being used at the defence industry sectors, which can be ranked as one of the important sectors at Turkey, are examined in this thesis. These programs refer to the criterias that are considered most important by the companies. The AHP and ERP programs have been compared in this direction and the best ERP program and the solution partnership that are being used at the companies have been chosen upon the results. The AHP method that has been used has formed an systematic evaluation system. The method that has been suggested in this thesis has provided a useful approach to the determination of the performance rank in numbers by the comparison of the ERP programs with each other towards same criteria.

In this thesis, the performances of the ERP programs, in accordance with the formerly determined criteria, that are being used in the defence industry systems have been evaluated with the AHP method. According to the results of this study; the “ERP A” program was chosen the most suitable software and the “Solution Partnership B” was chosen as the best ERP solution partnership.

## CHAPTER 5

### CONCLUSION

In this thesis, firstly the ERP is defined in detail. The history, the functionality, the benefits and drawbacks of ERP are mentioned. While implementing ERP, there are some critical issues for having success in projects which are the CSFs. Besides the benefits, there is also some difficulties, therefore some CFF appears in ERP implementation, so the reason of failure are mentioned in detail. The fields of ERP are mentioned, and elaborated further given seven steps. According to Umble et al, there are ten reasons for failure.

The next chapter was on the Turkish Defence Industry. The history of Turkish defence industry is mentioned, after that the ERP usage in Turkish Defence Industry is given in detail. How and when the ERP begins in Turkish Defence Industry was the other section of ERP implementation. This thesis is about the ERP implementation in Defence Industry. The use of ERP plays an important role in defence industry, because defence industries work as engineering-to-order, therefore every production is based on projects, and these projects processes are too complicated. ERP aims at coordinating the complexity in these projects. As mentioned before, defence industry projects are too expensive, and thus there is no tolerance in failure or in delay. Like other sectors, the customer satisfaction is the most important criterion in defence industry, too. In order to have success in projects, ERP is required. But there are different ERP software in market. The important issue is selecting the best ERP Software and the Solution Partner.

When discussing the defence industries projects, the project steps are mentioned. There is a critical object in projects which is RFP. It is the primary document that is sent to suppliers to invite them to submit a proposal for providing goods and/or services. Internally, an RFP can also be referred to as a sourcing project, a document, or an associated event (competitive bidding). Unlike a Request for Information (RFI) or a Request for Quotation (RFQ), an RFP is designed to get suppliers to provide a creative solution to a business problem or issue. RFPs should be used carefully since implementation can take a lot of time for both the organization and its suppliers.

However, for more complex projects, an RFP may be the most effective way to outsource the goods or services required. An RFP should be used when a project is sufficiently complex to warrant a proposal from a supplier. RFPs are helpful when supplier creativity and innovative approaches to problems are needed. It is important to remember that the RFP process can take a significant amount of time to complete and could result in delays in the launching of the project. The benefits and drawback of RFP is also mentioned in this thesis. The application of RFP in Defence Industry projects is mentioned in detail. If there is an RFP, it is possible to say that there is a project management. A detailed explanation of project management is also identified, and the functions of ERP modules play an important place in Defence Industry projects.

Every project in Defence Industry are important and costly, but the cost is the least important criterion in this sector. As said before, ERP has a big role for success and provide customer satisfaction.

The aim of the ERP Solution Partner selection is to increase the performance of defence industry by AHP method. Since, the ERP Solution Partner plays a crucial role in the companies' production and services. After doing some research about the defence industry companies, some critical problems were identified which need cured. These modifications should be made by empirical study and research.

In conclusion, the selection of ERP is really important. In order to select the best ERP software an empirical study is carried out by AHP method. This method provides the basis for selecting and comparing the other ERP software packages for defence industries. The reason of choosing AHP method is the reliability. As mentioned before, there is a consistency ratio which shows the decision if it is consistent or not. If the consistency ratio value exceeds 0,10 value, it shows that there is a problem on the given decision and it needs one more study. In defence sector every process must be reliable.

There are some criteria which plays the most important roles in defence companies. They are described by the defence industry staff, and the best criterion has found by the AHP method which is the "Integrability". For each criterion the Solution Partner applied the AHP method. As a result, by conducting research and a survey with the Defence Industry employees, the best ERP Solution Partner is selected by the AHP

method. By this method it is easy to see which company uses which ERP Software. AHP method is the most reliable multi-criteria decision making method, because there is a consistency ratio.

Finally, defence industry companies are provided with the results of this study that will be effective for the production and service quality by the selection of correct ERP Solution Partners. ERP affects the production phase of companies directly since it controls the MRP in production, and HRM or CRM (Customer Relationship Management) in service departments. Therefore, during contract phase RFP is also affected by the correct ERP software. Like other sectors, production and service can also be important, too; but as mentioned before, in Defence Industry there is no tolerance in failure, because most of the projects are international. The way to improve performance, passes through the selection of the right ERP Solution Partner.

Along with the technology, ERP is continuing to develop day by day. With regard to this, the ERP programming's first release and the current position can be exemplified. In connection with this prudential thesis, not only the ERP selection at the defence industry companies, but the ERP program's effect on the whole company can be examined. New and more efficient solutions can be created by different methods and criteria that are directly proportional with the technology, which are acquired by the connections that are built between different departments. New studies can be made with the intention of acquiring more efficient and abiding solutions by not limiting the research in one company but expanding it with the suppliers that the defence industry company is working with.

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