DETERMINING THE WEIGHTS OF ENTERPRISE RESOURCE PLANNING SELECTION CRITERIA FOR RAILWAY INDUSTRY

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Abstract— This study is about determining the weights of Enterprise Resource Planning (ERP) selection criteria for railway industry in Turkey. It is hard to implement ERP in railway industry because of its characteristics specifications like transactions and operations volume both in inventory and finance. Therefore ERP selection is also as important as ERP implementation. The aim of this study is to determine criteria for ERP selection and then determine the weights of the chosen criteria. The method is going to be Analytic Hierarchy Process (AHP)

Index Terms— Analytic Hierarchy Process, Enterprise Resource Planning, Railway Industry.

I. INTRODUCTION

Enterprise Resource Planning (ERP) is an information system which integrates all departments of company to produce needed products and service by using labor, machines, materials and other sources efficiently. The main purpose of ERP systems is to integrate all data and processes of the company. So, it makes easy to operate complex structures. ERP systems use some different software systems and equipment of the computers. Enterprise resource planning systems are reshaping business and government organizations as they promise to solve challenges posed by portfolios of supposedly disconnect and uncoordinated applications (Davenport, 1998). In today's business environment, it is inevitable not to have an ERP system. In the last decade, there exist many changes on business environment.

Organizations may have some difficulties and challenges about rising customer expectations, increasing competition and expanding markets. So, companies want to decrease total cost about supply chain, shorten throughput times, reduce inventories, expand product choice and better customer service. ERP systems help companies to gain some competitive advantage and to have adaptation changes on business environment. By the last years, usage of ERP is continuously increasing. The aim of the companies that implement ERP or have a plan to implement ERP is to have a competitive advantage in their sector. That's why; many companies that work in different sectors try to implement ERP software to have competitive advantages. In railways industry, ERP would be both a good support and fully utilized. Sector – Industry independent ERP is a necessity now.

II. RESEARCH AIM

Many ERP selection research studies have determined several selection criteria for ERP selections. These studies, however, discussed the selection criteria from different prospective and in different contexts.
The aim of this study is determine weights of the ERP selection criteria for Railway industry. Since railway industry is a complex one, ERP selection criteria is going to be same as others but weights may differ.

III. ERP BENEFITS AND SELECTION

Kumar and Hillegersberg [1] (2000) defined enterprise resource planning (ERP) systems as "configurable information systems packages that integrate information and information-based processes within and a cross-functional area in an organization".
According to Al-Mashari and Al-Mudimigh [2] (2003), an ERP system is an information technology (IT) infrastructure that facilities the flow of information within the organization, with suppliers, and with other members of supply chain.
Also referred to as enterprise-wide systems or enterprise systems due to their enterprise-wide scope, these integrated enterprise computing systems provide seamless integration of all the information flowing through an organization [3], [4] (Davenport, 1998; Markus & Tanis, 2000).
The aim of ERP systems is to integrate all processes and information of the company in an integrating information system. This integrating system concerns about how people in an organization can access, store, report, use and summarize the information in the company. ERP systems use the different components of computers. It integrates software and hardware components to allow information to users. The most important feature of ERP systems is to use an integrated database to collect data for different modules of ERP.. ,ERP provides some benefits to organizations. The most important features of ERP that can be beneficial for the companies are to integrate all data and organizations of the company.
ERP implementation has often led to performance

improvements for organizations, as well as other tangible and intangible benefits [5].

According to researches of Shang and Seddon [6] from 1970's to 2000's, there exist five different dimensions about benefits of ERP systems. They examined the benefits according to IT values of the companies, not only cost benefits. They also expected that all ERP systems will produce that benefits each dimensions and founded five dimensions for ERP benefits may be a good point of start of ERP benefits. These dimensions are Operational Dimensions, Managerial Dimensions, Strategic Dimensions, IT Infrastructure Dimensions, and Organizational Dimensions.

ERP systems are supported by some software modules. The modules that are used in ERP systems are related to marketing and sales, product design and development, distribution, facility management, quality, human resources, manufacturing, finance and accounting, field service, inventory control and information systems etc. So, as seen from types of modules that are used in ERP systems, companies can have a fully integrating system for all information flows in the company. ERP software systems have multiple enterprise modules and customers can purchase them individually. Customers identify the needs and technical capabilities for their organization and choose the related modules according to needs individually.

The most important modules or processes that an ERP system supports are: marketing, sales and distribution, enterprise solution, production planning, quality management, assets accounting, material management, cost control, human resources, project management, financials, and plant maintenance [7].The basic modules that are supported by ERP are Finance (FI), Controlling (CO), Customer Service (CS), Human Resource (HR), Material Management (MM), Production Planning (PP), Plant Maintenance (PM), Project Systems (PS), Quality Management (QM), Sales and Distribution (SD), Product Life Cycle Management (PLM), Warehouse Management (WM)

The aim of the companies while implementing ERP is to have competitive advantage and gain some benefits. The most of the companies that implemented ERP systems gain some benefits after implementation of ERP. The data before implementing ERP and the data after implementing ERP are really different each other. There is a big positive difference between the data before implementing ERP and the data after implementing ERP.

ERP provides two major benefits that do not exist in non-integrated departmental systems: (1) a unified enterprise view of the business that encompasses all functions and departments; and (2) an enterprise database where all business transactions are entered, recorded, processed, monitored, and reported. This unified view increases the requirement for, and the extent of, interdepartmental cooperation and coordination. But it enables companies to achieve their objectives of increased communication and responsiveness to all stakeholders [7]

According to Kay Roman [8] (2009), the companies that implemented an ERP system have high expectations from ERP and benefits of them. Then, he prepared a paper about benefits of ERP by using collected data from hundreds of stakeholders in twelve higher education institutions preparing to implement an ERP solution on their campus. After analyzing collected data, the results of investigation are like that:

Table-3: Top 10 Benefits of ERP [8]

Top 10 Benefits of ERP		
Rank	Benefit	% of Institutions Reporting this as a Top 10 Benefit
1	Enhanced Technology	91%
2	Efficiency	91%
3	Integrated Information	66%
4	Reporting	66%
5	User Friendly	66%
6	Access to Data	50%
7	Customer Service	50%
8	Functionality	41%
9	Communication	25%
10	Security	25%

The first step to start ERP selection is to determine the selection criteria for adequate ERP. According to literature and past researches, the most important ERP selection criteria can be listed as follows;

- Functionality
- Complexity
- User friendliness
- Cost
- Technical Architecture
- Vision
- Service and support
- Implementation time
- Fitting the organization
- Reliability
- Customization
- Compatibility
- Flexibility

In the literature, there is no unique classification of ERP selection criteria [9] Kumar, Kumar and Maheshwari (2002), referring to a practical survey of 20 enterprises in Canada, distinguished four groups of ERP selection criteria. The first group consists of ERP software-related criteria (functionality of the system, system reliability, fit with parent/ allied organization systems, cross-modular integration, best business practices available in the system). All these criteria were mentioned in more than 50% of cases. The

second group includes criteria related to the implementation project manager (project management skills, functional experience, and experience in IT management). The third group consists of criteria related to the implementation partner, and the last one is associated with implementation consultants' criteria (reputation, experience, etc.) [10].

IV. METHODOLOGY

This study is about determining the weights of ERP selection criteria. In order to determine the ERP selection criteria, a survey was conducted on Railway experts. After that the first five has been taken as selection criteria which are: cost, functionality, flexibility, fitting the organization, ease of use.

Analytic Hierarchy Process is used in this study, which is one of the multi criteria decision making methods that proposed by T.L. Saaty in 1977. The analytic hierarchy process (AHP) is a decomposition multiple-attribute decision making (MADM) method. It was developed by Saaty [11] (1977), who proposed a method that can represent human decision making process and help to achieve better judgments based on hierarchy, pair-wise comparisons, judgment scales, allocation of criteria weights and selection of the best alternative from a finite number of variants by calculation of their utility functions [12].

AHP method has 4 main steps to apply. Process of normal AHP is generated as follows;

1. Representation of structure by a hierarchy.
2. Paired comparison between elements at each level.
3. Calculations of weight at each level.
4. Priority of an alternative by a composition of weights [13].

The second step of AHP is pairwise comparison of criteria. There is a table that contains priority scale for the alternatives. This table was generated by Saaty who developed AHP method. Pairwise comparison table should be used by decision-maker to compare alternatives.

Table 2: Pairwise Comparison Scale [11]

Importance	Explanation
1	Two criterion contribute equally to the objective
3	Experience and judgement slightly favor one over another
5	Experience and judgment strongly favor one over another
7	Criterion is strongly favored and its dominance is demonstrated in practice
9	Importance of one over another affirmed on the highest possible order
2,4,6,8	Used to represent compromise between the priorities listed above

The third step of AHP is about calculation of weight for each level. The weights of the elements, which represent grade of importance among each element, are calculated from the pairwise comparison matrix. Firstly, values on each column of matrix are summed and then, each value of the column is divided by summation of matrix column. The results will give us the weight for each level. The calculation of consistency ratio is also done in the third step.

In order to apply the AHP methodology for determining the weights of ERP selection criteria a AHP survey was conducted among the experts. After calculating the geometric mean of the results and checking the consistency of the results the weights are founded as follows:

Table 3: ERP Selection Criteria Weights

Criteria	W
cost	0,163
functionality	0,350
flexibility	0,103
organisational fit	0,323
ease of use	0,061

Consistency Index CI 0,056
Consistency Ratio CR 0,050

Since CR is smaller than 0,1 the results are consistent.

According to Table 3 functionality and organizational fit are the most important criteria among others. Cost is more important than flexibility and flexibility more important than ease of use.

It is specific in railway industry that there is a huge bundle of operations, inventory, maintenance, finance, personnel, passengers, business partners and so on. It is inevitable to be unsuccessful in implementation of the ERP project. Therefore, almost 70% of the weight is from functionality and fitting the organizational fit. If any ERP vendor that could not satisfy those needs, then ERP respective ERP Railway industry project is going to fail

CONCLUSION

In fact railway industry is a challenging one for ERP implementation because of its structure, complexity, volumes and so on. In such industries, selection of the ERP is as hard as implementing it. The aim of this study is just determining the selection criteria and weighting them. The result is different from a conventional Small and Medium Enterprise (SME)

case because cost is in the third place and ease of use in the last one. Although the weights of the criteria differ from SME it is so common in this case. Since the railway industry implementation would be hard and last long functionality and organizational fit

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