



## Selecting “The Best” ERP system for SMEs using a combination of ANP and PROMETHEE methods



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### ABSTRACT

Enterprise Resource Planning (ERP) system, which integrates all of the units within an organization at the information level, plays an important role for a successful enterprise. With the right ERP system, it is easier to provide coordination between the units, eliminate waste and make faster and better decisions. Adopting an ERP system is a significant investment decision for a firm, therefore a great deal of attention should be given to the selection of the right system. Since there are a large number of criteria to consider in selecting an ERP system, the process itself is regarded as a complex multi-criteria decision making problem. In this study, two prevalent multi-criteria decision making techniques, Analytic Network Process (ANP) and Preference Ranking Organization Method for Enrichment Evaluations (PROMETHEE), are used in combination to better address the ERP selection problem. First, ANP is used to determine the weights of all criteria, and then, the obtained weights are used in the PROMETHEE method for optimal ranking of the alternative system choices. To demonstrate the viability of the proposed methodology, an application case is performed on the ERP selection problem for the Small Medium Enterprises (SMEs) in Istanbul, Turkey. The proposed hybrid methodology successfully ranked the alternatives and identified the best ERP system based on the information obtained from a number of SMEs participated in this study.

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## 1. Introduction

ERP systems can be regarded as the backbone of the information systems in organizations (Yang, Wu, & Tsai, 2007). The roots of ERP systems date back to 1980s, on enterprise information systems like Materials Requirement Planning (MRP) and Manufacturing Resource Planning (MRP II) (Kumar, Maheshwari, & Kumar, 2003). ERP systems present the opportunity to rapidly adapt to the changes at the management levels by integrating and disseminating information to decision makers on an as needed basis (Park & Tran, 2012). The increase in the use of information systems has affected the computing applications in the organizations. Moreover, the complexity of the processes in the organizations has also increased, largely due to the increasing competition at the global scale. Because of these developments, ERP systems have gained

importance and popularity as a solution and an enabling technology (Karsak & Özogul, 2009).

As enterprises have gotten bigger and become geographically distributed, the integration of their main activities and processes has become a necessity (Kulvatunyou & Wysk, 2000). Different and diverse pieces of information coming from different processes can be unified by ERP systems for better support of managerial decision making. Main corporate activities such as manufacturing, supply chain management, human resources and finance are integrated and automated by these ERP systems, providing many benefits such as easier reach to trustable information, the elimination of unnecessary information, time saving and low cost can be provided (Baki & Çakar, 2005).

ERP systems are common in large enterprises. Almost all of the big enterprises in the world have implemented some type of ERP system. Only recently (in the last ten years), ERP systems are being used in the small and medium enterprises and being considered as a way to improve efficiency to be (and to stay) competitive. With the use of ERP systems, information in different parts of the organization is combined and stored in a centralized database, by doing so, eliminate multiple data entries/storage, offer a single version of the truth, and provide a much better data visibility (Deep,

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Guttridge, Dani, & Burns, 2008). Recently, ERP has become a strategic tool for providing effective and efficient supply chain management operations in complex and uncertain global supply networks (Xu, 2010).

The ERP system life cycle consists of mainly three phases. These are selection, implementation and use. The activities in the ERP selection phase, which is considered to be the most critical (and perhaps the most time consuming phase) for a successful adaptation, are problem identification (i.e., a detailed analysis and characterization of the business system, which would also include a need analysis), requirements specification (i.e., identification and explicit specification of the constraints in which the ERP system has to function), evaluation of options (i.e., identification of the alternative systems and their detailed characterizations) and selection of system (Forslund & Jonsson, 2010).

Numerous techniques such as scoring, ranking, mathematical optimization and multi-criteria decision analysis have been proposed for selection problems. Scoring and ranking methods are regarded as simple. However, within mathematical optimization, goal programming, 0–1 programming and non-linear programming have been used (Wei, Chien, & Wang, 2005). In addition to these analytical techniques, during the selection process a number of criteria need to be taken into consideration. Some of these criteria, as stated by Baki and Çakar (2005), include functionality, technical criteria, cost, service and support, vision, system reliability, compatibility with other systems, ease of customization, market position of the vendor, better fit with organizational structure, domain knowledge of suppliers, references of the vendor, fit with parent/allied organization systems, cross-module integration, implementation time, methodology of the software and consultancy.

Building on the previous research, this study makes a number of unique contributions to the extant literature. First, to the best of our knowledge, there is no research hitherto been recorded employing the ANP weighted PROMETHEE multi-criteria decision making tool in the selection of the ERP software. Our findings show that the combination of the two methods provides pleasingly surprising results where an optimal mapping between the needs/wants and the possible system alternatives can be achieved. Secondly, again to the best of our knowledge, this is the first study to apply ANP weighted PROMETHEE method to the ERP selection problem for SMEs. Lastly, as opposed to solving the selection problem for a single organization, in our study we applied the proposed methodology to a group of organizations (a number of SMEs within a region—Istanbul, Turkey).

Since the adoption/implementation of an ERP system is a costly and risky endeavor, the selection of the “right” ERP system is a critical and difficult decision for any organization. A combined methodology, which is based on ANP and PROMETHEE, is proposed in this study to mitigate this problem. Each of these decision analysis techniques brings capabilities to address specific characteristics of this decision situation, including it being a highly complex multi-criteria decision situation that requires the involvement of a group of decision makers and evaluation of network structure among the decision making system factors. The rest of the paper is organized as follows. A literature review is provided in Section 2. ANP and PROMETHEE methods are briefly explained in Sections 3 and 4, respectively. The proposed methodology and the application case are provided in Section 5. The final discussion and the conclusions are given in Section 6.

## 2. Literature review

Although the roots of the ERP systems go way back to MRP and MRP II (Kumar et al., 2003), the current manifestation of these systems has emerged in the 1990s. Therefore, the studies that dealt

with the adoption and real-world implementation of ERP systems are not very old. As Aloini, Dulmin, and Mininno (2007) stated, the extent of literature review about ERP systems can be allocated into four main groups: ERP selection, ERP implementation, ERP risk management and general ERP projects. In order to stay within the scope of this study, in this literature review, we mainly focused on the previous studies that dealt with ERP selection problem, while partially covering other, somewhat indirectly related studies, in order to make a complete yet concise presentation of the state of the art.

The research literature that reports on ERP systems is quite large and rather fragmented; while many have dealt with the pre-adoption problems, many more have studied problems during and after the adoption of ERP systems. Few have tried to build simple taxonomies to better understand the extant literature on ERP system studies. For instance, Umble, Haft, and Umble (2003) presented the implementation procedures and determined the critical success factors for ERP systems and Genoulaz, Millet, and Grabot (2005) provided a literature review about ERP systems, where they have analyzed and categorized the literature into six groups: implementation of ERP, optimization of ERP, management through ERP, the ERP software, ERP for supply chain management and case studies. On a somewhat limited study that applies specifically to the pre- and during adoption of the ERP system, Ziaee, Fathian, and Sadjadi (2006) proposed an approach that consists of two stages. In their approach within the first stage the project teams are established, information about the possible ERP providers is gathered and all relevant ERP system properties are determined. In the second stage, a binary mathematical optimization model was proposed to minimize the total cost related to the expenses of procurement, implementation and integration of the system.

One of the key components in ERP system selection is the identification and assessment of the main factors to include in the decision making process. Sun, Yazdani, and Overend (2005) proposed a methodology about the critical factor assessment for the success of ERP adoption and implementation. Accordingly, they identified management/organization, process, technology, data and people as the most critical success factors. Similarly, Yang et al. (2007) determined and discussed a set of factors for the successful implementation of ERP systems. The factors that they have identified were coding system, working process reengineering, priority of ERP functionality, implementation, customization, participant roles, consultant role and performance level of the subcontractors. Olson (2007) looked at the problem slightly differently; instead of focusing on the procurement of the ERP system, he focused on outsourcing of these services. He analyzed and evaluated inherent factors of outsourcing option of ERP system and showed how multiple-criteria decision making techniques could be used for making such decision. Velcu (2007), on the other hand, looked at the after the adoption stage of the ERP systems by investigating the impact of ERP systems on the performance of the organizations by conducting a survey among the Finnish companies.

Use of analytical techniques for the selection of ERP systems problem has been a focal point of ERP studies since early 2000s. For instance, Ayağ and Özdemir (2007) used fuzzy ANP as the methodology for the selection of ERP software and presented a case study in a firm in electronics sector and Perçin (2008) also proposed ANP as a viable decision making tool for ERP selection problem. The criteria used in the study are divided into two groups: system factors (i.e., functionality, strategic fitness, flexibility, user friendliness, implementation time, total costs, and reliability) and vendor factors (i.e., market share, financial capability, implementation ability, R&D capability, and service support). With this study, they showed the utility and versatility of ANP for this complex selection problem. Similarly, Ünal and Güner (2009) and Cebeci (2009) proposed a methodology based on AHP and fuzzy

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