# Chapter 11

# A HYBRID MCDM METHODOLOGY FOR AN ERP SYSTEM SELECTION

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## Introduction

In today's world, companies are struggling with the growth of markets and the challenges of meeting of increasing customers' expectations in dynamic and unpredictable environments. In order to compete in such an environment and keep pace with rapid change, companies want to benefit from advanced information systems like enterprise resource planning (ERP) systems and adapt them to their own systems to take an advantage of competition, to increase return on investment, to reduce total costs, to decrease lead times and to satisfy customer demands (Ayağ & Özdemir, 2007; Çakır, 2016). ERP systems which is one of the most important developments of information technologies, are the most used systems for the companies which switch to functional oriented structure from organizational structure (Kılıç, Zaim & Delen, 2014; Kılıç, Zaim & Delen, 2015).

In economies where globalization and competition are very intense, companies have been directed to ERP systems because they pay attention to customer satisfaction which integrates and automates all business operations and has the ability to be customized to meet an operator's needs (Kılıç, Zaim & Delen, 2014; Shirazi, 2018).

A successful ERP implementation provides benefits to companies such as standardizing business processes, timely accessing to management information and managing the supply chain through e-commerce, reducing total costs, production times, inventory levels, increasing product variety, more reliable delivery dates, better customer satisfaction, increasing the quality and coordinating the demands efficiently (Kılıç, Zaim & Delen, 2015). ERP combines the most important and basic activities of a company such as production, supply chain management, production planning, purchasing, stock control, sales, finance and human resources and integrates them with enterprise information systems. As a result of this combination, reliable information can be obtained more easily, avoiding unnecessary information, saving of time and low costs can be provided (Kılıç, Zaim & Delen, 2015; Çakır, 2016). One of the most important characteristics of an ERP system is companies with different units in different geographical regions can be integrated on the same system centrally. An organization's ability to plan, execute and manage all its resources efficiently is possible through the adaptation of ERP systems.

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time having high costs and high risks. ERP systems aim at making companies more efficient by combining all processes through an information system. But a system selection which doesn't fit the company's requirements, qualifications and possibilities, can make them unsuccessful. Therefore, appropriate ERP systems selection among many alternatives is a very critical and important decision for companies.

There are numerous criteria that may conflict with each other during this selection process. For this purpose, MCDM methods are more widely preferred in the literature. In this study, the problem of selecting an ERP system has been investigated for a company operating in the electronics sector. A hybrid MCDM model using fuzzy Dematel, DANP and SMAA-2 methods has been proposed. Dematel method was used to determine the complex relationships between criteria and to form a network relation map, DANP method was used to determine the criteria weights and finally the most appropriate alternative was selected by SMAA-2 method. As a result of literature review and interview with DMs; supplier, software and cost main criteria, and thirteen sub-criteria under main criteria were determined to select the most appropriate system. The consequences of DANP method, the purchasing cost, consulting and training cost and systematic maintenance cost were determined as the three most important criteria, respectively. Finally, , Alternative 2 was found the most appropriate alternative for the company by using SMAA-2 method

The most important limitation of this study is that the model is applied for only a company in the electronics sector. It would be more useful to examine different companies to make a generalization about the sector. Another limitation is that the optimal solution can not be obtained due to the use of MCDM methods in the study. The obtained results can vary according to the priorities, qualifications and experiences of DMs. For further studies, different MCDM techniques can be studied and the results are comparable to each other. All evaluations can also be performed in a fuzzy decision making environment. In addition, this study can be extended to include other sectors as well. To the best of our knowledge, there is no study to integrate these techniques to an ERP system selection problem using fuzzy Dematel-DANP-SMAA-2 approach.

## References

Ayağ, Z. and Özdemir, R.G. (2007). An intelligent approach to ERP software selection through fuzzy ANP. *International Journal of Production Research*, *45*(10), 2169-2194.

Bai, C., Sarkis, J. & Dou, Y. (2017). Constructing a process model for low-carbon supply chain cooperation practices based on the Dematel and the NK model. *Supply Chain Management: An International Journal*, *22*(3), 237-257.

Bakeshlou, E.A., Khamseh, A.A., Asl, M.A.G., Sadeghi, J. & Abbaszadeh, M. (2017). Evaluating a green supplier selection problem using a hybrid MODM algorithm. *Journal of Intelligent Manufacturing*, *28*(4), 913-927.

Buyukozkan, G. & Ruan, D. (2008). Evaluation of software development projects using a fuzzy multi-criteria decision approach. *Mathematics and Computers in Simulation*, *77*(5-6), 464-475.

Çakır, S. (2016). Selecting appropriate ERP software using integrated fuzzy linguistic preference relations-fuzzy TOPSIS method. *International Journal of Computational Intelligence Systems*, *9*(3), 433-449.

Cebeci, U. (2009). Fuzzy AHP-based decision support system for selecting ERP systems in textile industry by using balanced scorecard. *Expert Systems Applications*, *36*(5), 8900-8909.

Chang, T.H., Hsu, S.C., Wang, T.C. & Wu, C.Y. (2012). Measuring the success possibility of implementing ERP by utilizing the incomplete linguistic preference relations. *Applied Soft Computing*, *12*(5), 1582-1591.

Chen, F.H., Hsu, T.S. & Tzeng, G.H. (2011). A balanced scorecard approach to establish a performance evaluation and relationship model for hot spring hotels based on a hybrid MCDM model combining Dematel and ANP. *International Journal of Hospitality Management, 30*(4), 908-932.

Chiu, W.Y., Tzeng, G.H. & Li, H.L. (2013). A new hybrid MCDM model combining DANP with VIKOR to improve e-store business. *Knowledge-Based Systems*, *37*, 48-61.

Efe, B. (2016). An integrated fuzzy multi criteria group decision making approach for ERP system selection. *Applied Soft Computing*, *38*, 106-117.

Gupta, R. & Naqvi, S. K. (2017). A framework for applying CSFs to ERP software selection: An extension of fuzzy TOPSIS approach. *International Journal of Intelligent Information Technologies*, *13*(2), 41-62.

Hung, Y.H., Huang, T.L., Hsieh, J.C., Tsuei, H.J., Cheng, C.C. & Tzeng, G.H. (2012). Online reputation management for improving marketing by using a hybrid MCDM model. *Knowledge-Based Systems*, *35*, 87-93.

Kahraman, C., Beskese, A. & Kaya, I. (2010). Selection among ERP outsourcing alternatives using a fuzzy multi-criteria decision making methodology. *International Journal of Production Research*, *48*(2), 547-566.

Kılıç, H.S., Zaim, S. & Delen, D. (2014). Development of a hybrid methodology for ERP system selection: The case of Turkish Airlines. *Decision Support Systems*, *66*, 2-92.

Kılıç, H.S., Zaim, S. & Delen, D. (2015). Selecting "the best" ERP system for SMEs using a combination of ANP and PROMETHEE methods. *Expert Systems Applications*, *42*(5), 2342-2352.

Lahdelma, R. & Salminen, P. (2001). SMAA-2: stochastic multicriteria acceptability analysis for group decision making. *Operations Research,* 49(3), 444–454.

Lahdelma, R. & Salminen, P. (2009). 'Prospect theory and stochastic multicriteria acceptability analysis (SMAA)', *Omega*, Vol. 37, No. 5, pp. 961–971.

Lin, R.J. (2013). Using fuzzy Dematel to evaluate the green supply chain management practices. *Journal of Cleaner Production*, *40*, 32-39.

Lopez, C. & Ishizaka, A. (2017) GAHPSort: A new group multi-criteria decision method for sorting a large number of the cloud-based ERP solutions. *Computers in Industry*, *92-93*, 12-25.

Masir, R.N., Khalokakaie, R., Ataei, M. & Mohammadi, S. (2017). Structural analysis of impacting factors of sustainable development in underground coal mining using Dematel method. *Journal of Mining and Environment*, DOI: 10.22044/jme.2017.951.

Opricovic, S. & Tzeng, G.H. (2003). Defuzzification within a multicriteria decision model. *International Journal of Uncertainty, Fuzziness Knowledge-Based Systems*, *11*(5), 635-652.

Sangaiah, A.K., Gopal, J., Basu, A. & Subramaniam, P.R. (2017). An integrated fuzzy Dematel, TOPSIS and ELECTRE approach for evaluating knowledge transfer effectiveness with reference to GSD project outcome. *Neural Computing and Applications*, *28*(1), 111-123.

Shieh, J.I., Wu, H.H. & Huang, K.K. (2010). A Dematel method in identifying key success factors of hospital service quality. *Knowledge-Based Systems*, *23*(3), 277-282.

Shirazi, B. (2018). Towards a sustainable interoperability in food industry small&medium networked enterprises: Distributed service-oriented enterprise resources planning. *Journal of Cleaner Production*, *181*, 109-122.

Temur, G.T. & Bolat, B. (2018). A robust MCDM approach for ERP system selection under uncertain environment based on worst case scenario. *Journal of Enterprise Information Management*, *31*(3), 405-425.

Tervonen, T. (2014). JSMMA: open source software for SMAA computations. *International Journal of Systems Science*, *45*(1), 69–81.

Tervonen, T. & Lahdelma, R. (2007). Implementing stochastic multicriteria acceptability analysis. *European Journal of Operational Research*, *178*(2), 500–513.

Tosun, Ö. & Aktan, H.E. (2016). A multi criteria decision-making approach to valuate automated storage and retrieval systems. *International Journal of Applied Decision Sciences,* ol. 9(2), 182–195.

Tseng, M.L. (2011). Using a hybrid MCDM model to evaluate firm environmental knowledge management in uncertainty. *Applied Soft Computing*, *11*(1), 1340-1352.

Tzeng, G.H., Chiang, C.H. & Li, C.W. (2007). Evaluating intertwined effects in e-learning programs: a novel hybrid MCDM model based on factor analysis and Dematel. *Expert Systems Applications*, *32*(4), 1028-1044.

Virmani, N., Saha, R. & Sahai, R. (2017). Evaluation of leagile criteria using Dematel approach. *International Journal of Industrial and Manufacturing Engineering*, *11*(4), 995-999.

Vitorino, S.L., Segger, M.R.R.F. & Camanho, R. (2016). AHP application in the acquisition of a hospital management ERP. *Revista de Gestao E Projetos*, *7*(3), 61-73.

Wu, W.W. & Lee, Y.T. (2007). Developing global managers' competencies using the fuzzy Dematel method. *Expert Systems Applications, 32*(2), 499-507.

Yazgan, H.R., Boran, S. & Goztepe, K. (2009). An ERP software selection process with using artificial neural network based on analytic network process approach. *Expert Systems Applications, 36*(5), 9214-9222.

Zeng, Y.R., Wang, L. & Xu, X.H. (2017). An integrated model to select an ERP system for Chinese small- and medium-sized enterprise under uncertainty. *Technological and Economic Development of Economy*, *23*(1), 38-58.