

Applying of Fuzzy Logic Modeling for the Assessment of ERP Projects Efficiency

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Abstract. ERP software is one of costly and crucial projects for business investment. It is known that nowadays Enterprises can rarely afford to implement long-term projects, in most cases the duration of implementation varies from 3-4 months (automation of individual store retail chain) and 1-1.5 years when it comes to big projects. Only successful combination of analytical tools and methodologies will allow the project to realize and implement ERP-solutions for commercial enterprises on time and according to set business requirements. This paper proposes a practical assessment model which applies both the fuzzy analytic logic approach and the Expert Judgment method to evaluate whether the ERP software implementation project has succeeded or not.

Keywords. Modeling, Efficiency, Project, Information Technology, Implementation, Enterprise, ERP

Key terms. Model, Methodology, Process, Management, Approach

1 Introduction

Today it is especially important for Ukrainian Enterprises to be capable to analyze all the environmental aspects within they operate and be able to plan all needed resources with the most possible accuracy. To gain such competitive advantages within changing economy and unstable markets, for particular Enterprise is not enough just to have the most modern production lines or good educated personnel it also requires to possess some advanced technologies and modern information management systems that will quickly allow to react and adapt all the further changes. That is why more and more Enterprises in Ukraine from different sectors of economy are choosing to implement the Enterprise Resource Planning (ERP) system.

ERP plays an important role to integrate organization's information and functions in all areas of enterprise activities and within the variety of departments and finally results in successful operation on the market. However ERP implementation as a project itself is costly and time consuming, it also can lead to loss of many valuable resources of the company in case of wrong approached and not efficient way of imple-

mentation. So it is critically important for the Enterprises to understand and clearly realize all the value achieved from ERP initiative [2].

Many factors are essential in determining the efficiency of the ERP projects. Since most of these factors are qualitative and relations between them are very complicated, determining their exact quantitative values is quiet difficult. Using the combined methods of Expert Judgment and Fuzzy logic can be helpful to simplify the calculations and finally leads to a more precise result to determine generalized efficiency value of the implemented ERP-project. In this research, we intended to gather optimal KPIs values from different Enterprise activities and departments based on Experts Judgment data and design a combined Fuzzy Model to assess the efficiency for ERP-project [4].

2 Problem Statement and Goals of the Paper

The most common aspects and issues related to ERP systems development and implementation methods of ERP-projects seems to be widely discovered observed and investigated in works of many foreign as well as Ukrainian researches and scientists [1], [2], [4], [5]. However the problems related with particular to the efficiency of such projects are not enough covered. In view of this subject of the research is still topical.

The main aim of the paper is to present a model for evaluating the effectiveness of ERP-project implemented on the markets of underdeveloped economic systems with involves a combination of fuzzy logic and expert judgment methods. Because the initial data for measuring the effectiveness of ERP-project is mostly inaccurate and variable so the use of fuzzy logic techniques to enhance the data gathered from the expert is really feasible here.

3 Proposed Model and Approach

In order to develop the model for the assessment of ERP-project efficiency first of all it was conducted a set of related Expert Judgment questionnaires sessions, for the proposed assessment methods and optimal performance indicators or key performance indicators (KPI) values, in other words KPI is a type of performance measurement. An organization may use KPIs to evaluate its success, or to evaluate the success of a particular activity in which it is engaged. Sometimes success is defined in terms of making progress toward strategic goals, but often success is simply the repeated, periodic achievement of some level of operational goal (e.g. zero defects, 10/10 customer satisfaction, etc. Accordingly, choosing the right KPIs relies upon a good understanding of what is important to the organization [9]. The basics input data of our research are KPIs of ERP-projects that were received from managers of ERP-projects, and classified according to the criterion of "trend change".

Determination of further scope of KPIs and the major ERP success factors also is based on variety international consulting agencies reports KPIs values, and ERP-projects

statistics obtained from such reports was additionally verified with the involved experts [6], [7], [8].

As the result it has been allocated four main groups of indicators: 1) X - performance "increase group of KPIs" (the actual value of which increased for the Enterprise after ERP implementation), 2) Y - values "reduce group of KPIs" (the value of which decreased for the Enterprise after ERP implementation) 3) W – project financial and investments indicators. 4) Z - Generally optimized qualitative KPIs for different process aspects within Enterprise.

To be able assess the effectiveness of ERP-project we developed a structural combined model (depicted on Fig. 1). The model contains of methodological approaches and structure of key performance indicators to determine the effectiveness of ERP-project. Summarized decision tree inference, which is presented at the bottom of the model, reflects the hierarchy of input variables.

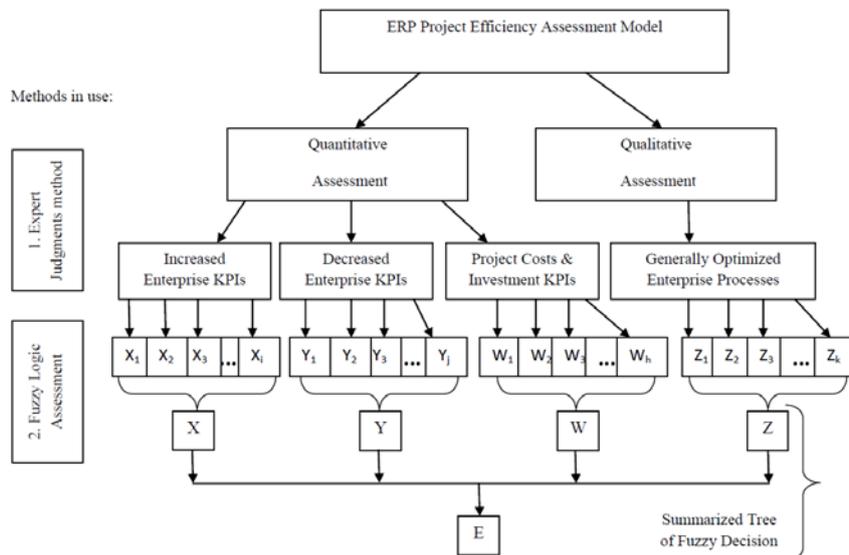


Fig. 1. Combined Model of ERP Projects Efficiency Assessment

Developing a questionnaire for determining the Fuzzy (if-then) Rules with respect to the three optimal KPIs values obtained from Experts as inputs and ERP project efficient value as output. Validity and reliability of the questionnaire was confirmed and they were distributed among the ERP practitioners. Fuzzy rules as the basis for determination of the conditions of the company KPIs have been formed and entered into Fuzzy system through MATLAB software.

Currently there are variety of software tools and system for applying the fuzzy logic calculations available on the market (CubiCalc 2.0 RTC, CubiQuick, FIDE, Flex Tool, FuziCalc, FuzzyTECH, JFS, MATLAB - Fuzzy Logic Toolbox, RuleMaker etc). Each of these products has its own strengths and weaknesses, however as software platform for our research it was decided to go with MATLAB Fuzzy Logic

Toolbox (FLT) as most appropriate tool in particular because of the integrated nature of the MATLAB environment that also provides functions, applications, and a simulative block for analyzing, designing, and simulating systems based on fuzzy logic, widely used not only in academic and research institutions but by industrial enterprises as well.

To determine the value of each factor, different questionnaire was prepared to collect related information for the KPIs values. Also validity and reliability of mentioned questionnaire was confirmed and it was distributed among managers and experts in that domain. Calculated means obtained from questionnaire, results has been inputted to the Fuzzy System (see fig. 2). Final results were analyzed and the efficiency of the implemented ERP project was determined by this software.

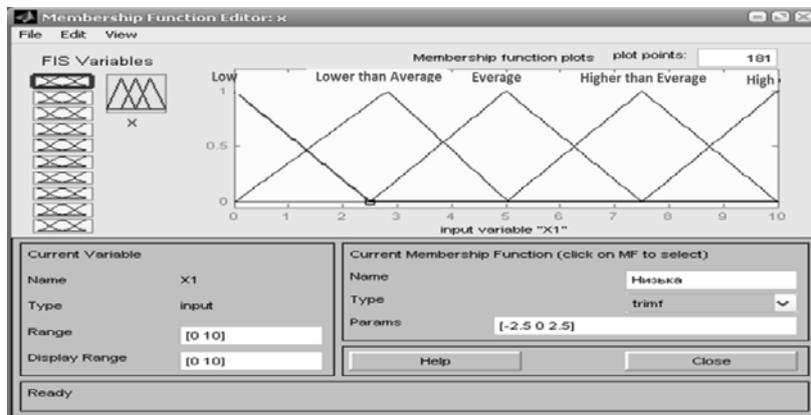


Fig. 2. Identifying the membership functions for each input and output variable

To design a Fuzzy system by MATLAB following: X, Y, Z, W are lingual values that also represents an organizational major KPIs groups and E is the lingual value of summarized project Efficiency (see fig. 3 and fig. 4).

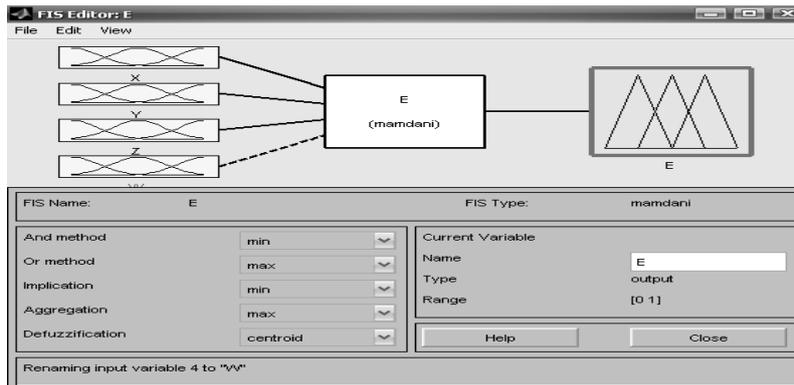


Fig. 3. The Fuzzy system of assessing the efficiency of the ERP implementation in MATLAB software

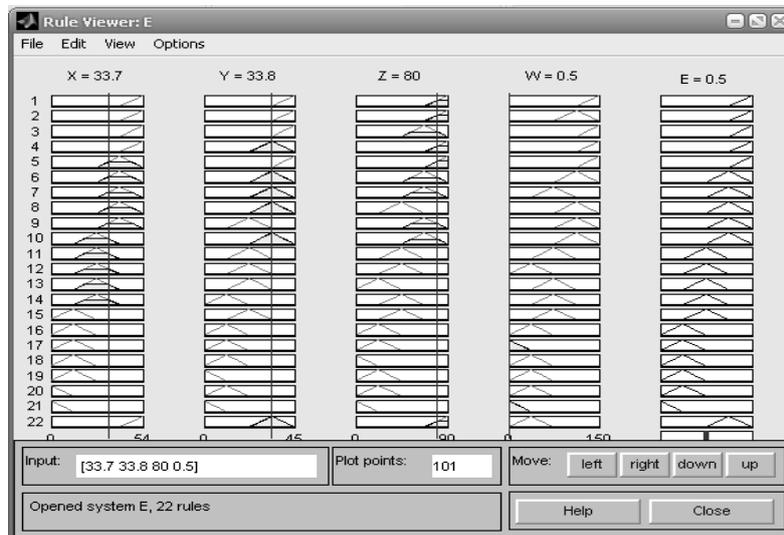


Fig. 4. Drawing a conclusion in Fuzzy system

4 Conclusions

Proposed approach and model of determining the efficiency level of the implemented ERP-project with fuzzy logic can be used by variety of ERP practitioners, project managers, top management personnel of Enterprises that implements ERP-system for advanced analysis of the actual project results. Fuzzy rules should be further validated and formed by consulting with ERP practitioners and their results will be entered into knowledge base of Fuzzy system. Methods of fuzzy logic computing combined with provided expert judgment aimed optimize the speed of the decision-making on project efficiency level and simultaneously provide more accurate assessment abilities.

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Appendix A. Example of ERP User Satisfaction Survey

New ERP-system user satisfaction survey

Dear user ERP-system! This survey aims to study and evaluate employees opinion on the quality characteristics of the new ERP system, and the effectiveness of project implementation in the enterprise as a whole. The data collected will be used to study and model building performance evaluation ERP-project methods of fuzzy logic (in the environment of MATLAB) within Research "Development of methods for managing ERP-projects in the trade." In the expert group of the survey include: managers and consultants ERP-projects, IT department heads, managers, independent experts on the use of fuzzy logic models and scientists). Answer the following questions.

* Required field

Questionnaire

1. Are you satisfied generally introduced official ERP-system *

1 2 3 4 5
 Very dissatisfied (a) Very satisfied (a)

Is there compared to the previous system (s), the new ERP is better? *

- Much better
- Slightly better
- The difference is not felt
- A little worse
- Much worse

2. Please please, how much you agree or disagree with the following statements *

	Yes, I agree (a)	We can say that he agrees (a)	More than agree (a) than disagree (s)	We can say that disagree (s)	I do not agree (s)
The system is generally higher quality and more efficient than the previous	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
High level of comfort in working with documents	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A much simpler and more intuitive interface	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Simply and quickly find the information needed by the system	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Use, and the process of the new system leaves a positive impression convenient and intuitive interface allows you to quickly open and view the desired report, table, directory, document, etc.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

It appeared in the new system funtsional, and tools that help simplify the execution of your daily work and routine tasks? *

- Yes
- No

Do you agree with the statement that it is possible in the new system some processes and workflow seem more complicated, but also become accessible and more useful for information, and generally operate more effectively become the new ERP-system? *

1 2 3 4 5
 Yes, I agree No, I do not agree

Your Comments

Appendix B. Example of ERP Expert Judgment Questionnaire

Questionnaire. Evaluation of the effectiveness of ERP-projects

Dear expert! This expert survey aims to study and evaluate opinions of experts on ERP systems and projects for their implementation. The collected data will be used to conduct research and build models evaluating the effectiveness of ERP-project methods of fuzzy logic (in the environment of MATLAB) within Research "Development of methods for managing ERP-projects in unsteady economic systems." In the expert group of the survey include: managers and consultants ERP-projects, IT department heads, managers, independent experts on the use of fuzzy logic models and scientists). Answer the questionnaire. We guarantee that your information will be used only for research purposes.

* Required field

1. Please fill in the following personal and contact details: *

Name and Surname:

Title:

Degree:

Contact E-mail address:

2. According to independent international consulting companies, news agencies and collected statistics presented in analytical surveys were selected X, Y, and Z groups, and relevant performance indicators ERP-projects (see Appendix A). Along with the name parameter specified level of performance achieved after the implementation of ERP, in% (based on analytical reviews.) Do you believe that the introduction of ERP-systems on the Ukrainian commercial enterprise segment of small and medium-sized businesses will have specific features that will change the list of indicators in each group?

- Yes
 No

2.1. A few wholesalers of the city, based on key indicators presented in Appendix A, when assessing the effectiveness of ERP-systems have been identified a number of additional indicators relevant to the activities of domestic commercial enterprise. Do you agree that when assessing the effectiveness of ERP-systems according to the commercial enterprise of the list should be supplemented these indicators?

Select the desired parameters, or specify your own version, which indicators should be added, replaced, or removed from the list)

- Turnover (sales)
 Number of new customers
 Number of orders
 AVG orders
 Number of customer orders
 The average order amount
 Turnover by customer
 Number of invoices per month for commodity
 Other:

3. Fill in the fields with indicators, selecting the group, which include the corresponding figure (X, Y, Z or W), and if you have experience and practical knowledge of ERP-systems to provide commercial enterprises - in the likely values of the effective proceedings (eg turnover (sales, thous.) - Group A / 10%).

Turnover of sale, thous. (Group / probable value for the effective implementation of,%)

Number of new clients (group / probable value for the effective implementation of,%)

Number of Orders (group / probable value for the effective implementation of,%)