Investigating End User Satisfaction in ERP Systems: An Analytical Approach

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***Abstract*—Measuring the end user satisfaction is an important issue reported in many decades in ERP systems success and its implementation. Hence, instead of many success stories the failure is also reported many times about the ERP implementation process. It provides many benefits to the organizations i.e. central storage/backup, modular software, efficiency, easier, and collaboration between various departments. Therefore, it is widely used by many types of organizations to provide a single platform to them. Despite this, its adoption and implementation in not without problems. Ignoring many important factors is also a reason of failure of ERP implementation. So, this paper is focusing on three main factors to investigate the success of ERP systems that are human, technological and organization. A survey tool is used for the study as questionnaire. An analytical approach is proposed to investigate the success of ERP systems by explaining that which factor is more important for end user satisfaction in ERP. Analysis is done on the basis of variance explained by each critical success factor. More variance shows that the factor impacts more the success of ERP system. As a result, three factors are very important for successful ERp implementation which are training and support for users, to facilitate changes in the organizational structure, in the legacy systems and in the IT infrastructure and having external consultants.**

***Index Terms*—ANFIS, ANN, Critical Success Factors, ER, KNN classifier, User Satisfaction.**

I. Introduction

Enterprise Resource Planning (ERP) systems are used as an important Information System (IS) infrastructure across organizations in worldwide [1]. Today, every type of organization is implementing or planning to implement ERP systems. ERP systems integrate all organizational departments into a single platform software system. They provide modular software, efficiency, collaboration, workflow and centralized storage etc. advantages to the enterprises [2]. It is used by the organizations to improve the operational efficiency and business performance. But, its implementation is not so easy, and face many types of problems occurred during its implementation and adoption phase. Hence, its success is very important issue for the enterprises. There are many issues and factors which affects the success of ERP systems and its implementation. Organizations have to pay attention regarding all important factors which contribute more in the success of ERP systems. A successful ERP can lead the organization in the fully competitive advantages for obtaining continuous operational and business performance. Ignoring factors which affects ERP systems success can lead the failure of ERP systems, its implementation and also lose the competitive advantages. Therefore, this paper considered the most important factors from prior studies and proposed an analytical approach. This analytical approach presents the idea that what factor is more important for the success of ERP systems and for which we have to focus during implementation phase. This paper considered 14 Critical Success Factors (CSFs) as input variables and User Satisfaction (US) as output variables. An analytical approach is used to summarize these 14 CSFs in three factors that are human, technological and organizational. Based on the analysis, this study provides guidelines to the organizations that on what factors they have to pay attention for making successful implementation of ERP. This study will help for the enterprises to redirects the projects in better direction. The remaining part of this paper is organized as: section second presents the review of literature, section third presents the research methodology, and section fourth presents the concluded summary of this paper.

II. Histroy & Background

US and factors which affect it and ERP systems success have reviewed many times in literature. Several researchers proposed many analytical approaches to shows that which factors affect more the ERP systems success and its implementation. Lotfy et al. [3] gave a conceptual model to measure user value in the onward and upward phase of ERP implementation. They measure ERP user value on the basis ofthree factors that are technology, organization and environment. Jenatabadi et al. [4] proposed a logit model to predict ERP user satisfaction based on eight factors gender, age, education level, marital, experience, income, computer and constant. They used an analytical approach based on logit regression analysis and validate their model by case studies. Tsaur et al. [5] investigated the success of ERP systems by case studies in three Taiwanese high tech industries. They considered system quality, information quality, service quality, behaviour intention, user satisfaction, benefits of use from end users view and net value from businesss view. Using these factors they proposed the factors that impact more the success of ERP system. They used exploratory factor analytical approach followed by confirmatory factor analysis. And proved that service quality and system quality dimensions play more important roles in comparison of other factors. In 2013, Bhawarkar et al. [6]

presented a theoretical framework that has been developed to show the Critical Success Factors (CSFs) in an ERP system implementation process. All the CSFs were selected from synthesis of relevant literature and performance measures were developed through extensive review of literature. The results of this implementation framework were also tested in a case study and conclusions are drawn. The theoretical framework was represented by four main set of factors that were approach related factors, culture, communication and support related factors, project management related factors and vision, goal and infrastructure related factors. Dezdar et al. [7] investigated the key factors that creates ERP users satisfaction and discovered that whether ERP users satisfaction varies among different users profiles. The research work was based upon two research perspectives. The first was that they measured ERP users satisfaction by using eight satisfaction measure items that were taken from prior research. The second was that to examine the level of satisfaction among ERP users using four different characteristics, that were age, gender, education and IT experience. Rouhani et al. [8] identified the ERP success by using the available models related to ERP post implementation success and the organizational factors/profiles. These factors were classified in 24 as input variables and 30 as output variables. The input variables were related to organizational profiles and output variables were related to ERP post implementation success.

III. Methodology

The research steps including identifying variables, survey questionnaire designing, data collection, data analysis, training and testing of data and prediction are shown in figure 1 and the steps are described as below,

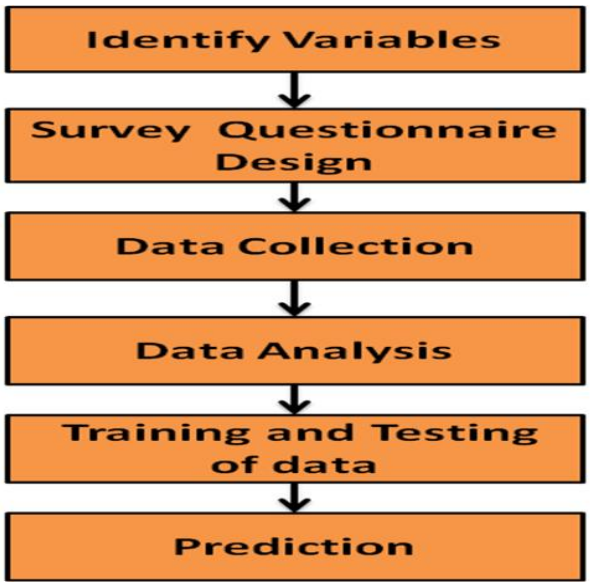

Fig. 1. Steps of Research Model

A. Identifying Variables

In the first step of research method, the input or predictor variables identified in literature given by Bernal et al. [9] for conducting research, survey and prediction. The input variables are the 14 selected CSFs which are taken from prior research as described upon and the output variable is named as ”User Satisfaction” which is aim of our study for prediction. These variables were utilized in the research questionnaire design and prediction model.

B. Survey Questionnaire Design

A questionnaire was developed as given in below table III.A. The objective of the development of the questionnaire survey was to collect information from people directly involved in the ERP implementation process. A questionnaire was designed with preparing questions for each one of 14 selected CSFs. For each CSF factor, a given question asses the level of importance that it has in the process of ERP implementation. A last question also asked from same respondents to assess the level of overall satisfaction from ERP system used. Total 15 questions were used to design survey questionnaire and assess the level of ERP users. This level was provided based on the experience of users of the organization. A seven point likert scale was used in order to determine the importance level of each CSF. A likert scale is a psychological measurement device that is used to assess the attitudes, value and opinion of people. It functions by having a person and complete a questionnaire that requires them to indicate the extent to which they agree or disagree with some statements. It was developed by likert et al. in 1932, so its name is likert scale. In the research, related to survey of users, likert scales are the most commonly used type of scale. The response scale used in this study anchors such as 1- Entirely disagree, 2-Mostly disagree, 3-Somewhat disagree, 4-Neither agree nor disagree, 5-Somewhat agree, 6-Mostly agree, 7-Entirely Agree.

C. Data Collection

The data for this study was collected by a survey using online Google form. Total forty responses were collected from one institute and out of 40, 7 were incomplete and with missing data, so 33 responses out of 40 were used for further analysis and prediction. Total 28 responses were collected from other institute, and out of 28, 4 were incomplete and with missing data, so 24 responses out of 28 were used for further analysis and prediction. The demographic profiles of respondents were as given in below Table II and Table III.

D. Data Analysis

In collective data 14 dimensional data values of corresponding respondents were inappropriate for prediction; hence we need to summarize data logically into three factors for prediction. So, analysis of data is done on the basis of variance explained by each dimension or question of a factor from output variable US as (CSF response-US response). A weight was assigned according to variance to each dimension or question (maximum variance, maximum weight). The factor

TABLE III.A.
Designed Survey Questionnarie

Your Name:	
Your Designation:	
Your Gender:	
Q.1.	What is the level of teamwork composition for the ERP project in your organization?
Q.2.	What is the level of interdepartmental communication in your organization?
Q.3.	What is the satisfaction level of ERP project champion within your organization?
Q.4.	What is the level of End User Involvement in your organization?
Q.5.	What is the level of ERP project management in your organization?
Q.6.	What is the level of ERP system selection in your organization?
Q.7.	Rate the level of training and support provided by organization for users.
Q.8.	Rate the solutions provided for test and problems by vendor.
Q.9.	What is the support level to facilitate changes in the organizational structure, in the legacy systems and in the IT infrastructure?
Q.10.	Rate the top management support for ERP in your organization.
Q.11.	What is the level of Business Process Reengineering in your organization?
Q.12.	What is the level of having external consultants support in your organization?
Q.13.	Rate the level of change management plan for ERP.
Q.14.	What is the level of vision statement and adequate business plan for ERP in your organization?
Q.15.	Rate your overall satisfaction level using ERP.

score was calculated by multiplying each questions response to its corresponding weights and add them.

The steps including in this analysis was as given below,

Step 1: Input variables were $X_{i,m}$ and Y_i was output variable.

Where,

m = Number of Questions in each factor.

i = Number of Responses.

Step 2: Calculate variance for each question of a factor from the output variable as,

Variance $|V_{i,m}| = |X_{i,m} - Y_i|$

Step 3: Add the variance of all the responses to corresponding CSF.

$V_m = \sum V_{m,i}$

TABLE III.B.
Demographic Profiles of Respondents 1

Gender:	
Male	25
Female	15
Total	40
Designation:	
Technical staff	6
Management staff	5
Faculty staff	4
Students	8
Incomplete Responses	7
Total	40

TABLE III.C.
Demographic Profiles of Respondents 2

Gender:	
Male	18
Female	10
Total	28
Designation:	
Technical staff	3
Management staff	4
Faculty staff	5
Students	12
Incomplete Responses	4
Total	28

IV. Result and AND Analysis

A. Survey Response

ERP survey responses were collected by online Google form using 15 survey questionnaires in which 14 questionnaires were taken from 14 most important CSFs given by prior research Bernal et al. [16] and 15 th for overall user satisfaction. 40 responses were collected from first ERP user survey from institute 1 out of which 33 were used for analysis because, 7 of them were incomplete and with missing data. 28 responses were collected from second ERP user survey from other institute out of which 24 were taken for analysis because, 4 were incomplete and with missing data. These 14 questionnaires were reduced in three factors that were Human, Technological, and Organizational on the basis of variance explained by each CSF in the End US. The fourth most important factor End US responses are taken as given by user

in the dataset for checking the prediction accuracy.

B. Variance Calculation for each CSF's

To calculate the variance for each question of a factor the difference is calculated of each CSF from the End US output variable responses as, Variance $|V_{i,m|} = |X_{i,m} - Y_i|$

Now add the variance of all the responses to corresponding CSF of a factor and also calculate total variance explained by a factor, $V_m = \sum V_{m,i}$

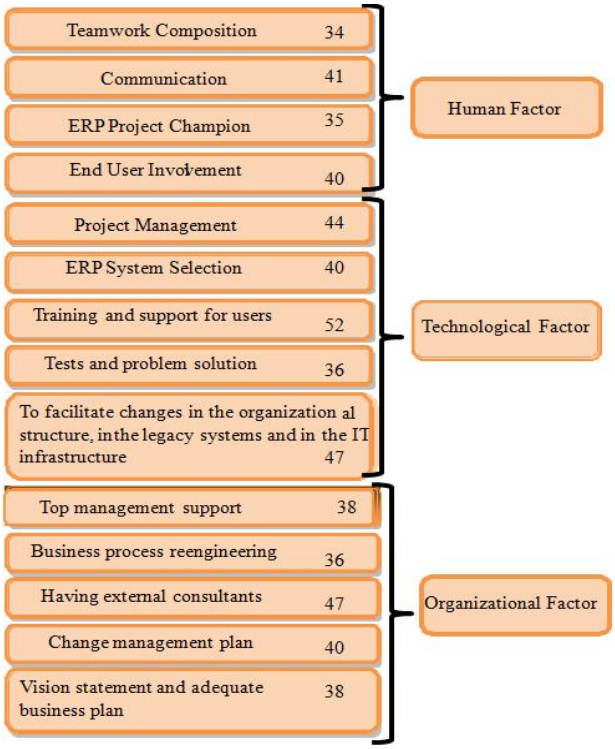

Fig. 2. Variances of each CSF's for Data Set 1

Figure 2 and Figure 3, shows the variances calculated for two different datasets. These figures also clearly showing that which CSFs affecting more the success of ERP or users satisfaction, and also that which factor more affects the ERP success. In figure 2 for data set 1, by comparing variances of all CSFs training and support for users (52), to facilitate changes in the organizational structure, in the legacy systems and in the IT infrastructure (47) and having external consultants (47) gives more variance. Hence these factors affect more the success of ERP and play more important role in the success of ERP. Therefore, the corresponding organization can reduce the possibility of failure by improving these factors. As also shows in figure 3, for data set 2, by comparing all CSFs variance training and support for users (42), to facilitate changes in the organizational structure, in the legacy systems and in the IT infrastructure (44) and having external consultants (41) have more variance. Hence clearly these factors affect more the success of ERP and users satisfaction. So, overall among three main factors in our case study technological factor plays more important role in the successes of ERP system.

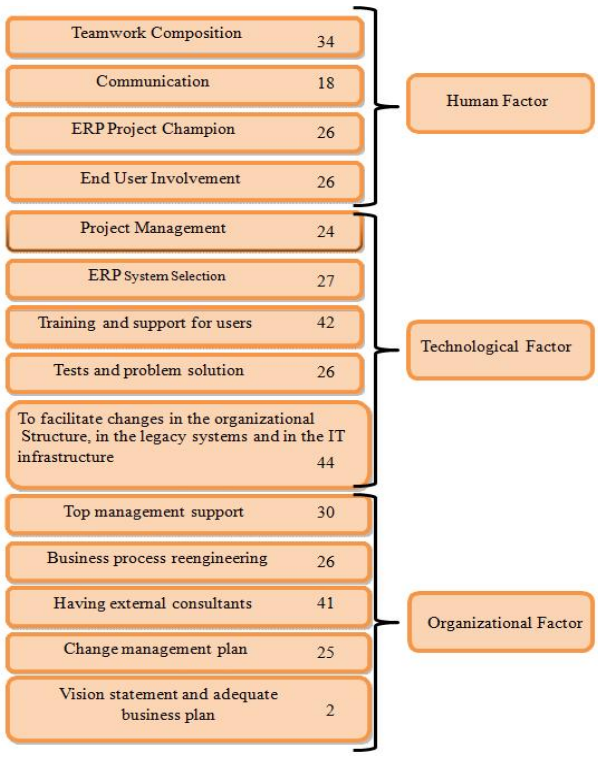

Fig. 3. Variances of each CSFs for Data Set 2

V. Conclusion

The proposed analytical approach shows that, with using ERP systems today in wide range in many organizations, it is also very important to focus that what we need to do for success of these ERP systems and users satisfaction. Hence this analytical approach shows the important factors on which we need to focus for getting successful ERP implementation with users satisfaction.

In this approach the survey is done on the live data from two organizations and after collecting data analysis is performed. After analyzing the data on the basis of variance it is concluded, that technological factor is very important factor which plays vital role in the success of ERP implementation. And by applying these types of analytical approaches organizations can improve their oper

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