

## **Research Analysis for successful functioning of ERP system in Construction Industry**

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### **Abstract**

*This research is carried out over two construction firms to identify the major and supporting factors which are required for successful function of ERP system in Construction Industry. Questionnaire was designed to measure these factors using Likert Scale. With the help of SPSS tool the responses of the employees from these two firms were measured. The outcome of SPSS tools facilitated to identify major & supporting factors in successful functioning of ERP system in Project oriented Construction firms.*

### **1. Introduction to ERP system in Construction Industry**

ERP is a computer based system that attempts to unify all systems of departments together into a single integrated software program based and uses a single database so that various departments can more easily share information and communicates with each other. The process of ERP systems includes data registration, evaluation, and reporting.

ERP systems can support a construction company's work in many ways. Since ERP systems integrate all parts of a company seamlessly, more proper control is possible. ERP systems are able to minimize redundancy of data, control the data produced by different departments and reduce data registration errors.

Construction Companies will be able to manage a number of project sites at a time with minimum losses. The interconnectivity among all the modules of ERP systems reduces the time to perform the different operational tasks, so the company's efficiency can be increased. ERP systems enable users to access timely information and accurate reports can be produced at any time.

### **2. Factors for successful functioning of ERP system in Construction Industry**

In this study we are trying to identify the major and supporting factors or variables for successful functioning of ERP in a construction firm which has already implemented ERP or a Construction firm which is planning to implement ERP system.

#### **2.1. Identifying the Variables**

For carrying out the research analysis in order to identify the major and supporting variables or factors for successful functioning of ERP system in construction industry, we have considered information collected during literature review, from personnel working in ERP, also from personal who use ERP system on daily basis and who have used ERP in their previous research works.

### **3. Questionnaire Design & Data Collection**

Based on the identified variables, a questionnaire was prepared in order to analyse these variables. We have used Likert scale to measure the responses from the employees of the construction firm.

Likert scale is a psychometric scale commonly involved in research that employs questionnaires. It is most widely used approach to scaling responses in survey research. When responding to a Likert questionnaire item, respondents specify their level of agreement or disagreement on a symmetric "agree-disagree" scale for a series of statements. The Likert scale is the sum of responses on several Likert items.

### 3.1. Data Collection

The survey was conducted between July 2013 and November 2013, and a total of 55 responses were received. The targeted respondents of the survey were either directly or indirectly using ERP system in the construction industry.

We have considered the two construction firms from Pune, India i.e. Kolte Patil and Kalpataru Builders and our respondents are employees of these firms who are directly or indirectly using ERP system. We have used Non probability convenient sampling as the sampling technique, since our target is to consider a sample where respondents will be directly or indirectly using ERP system and restricted to these two construction firms.

**Table 1: Respondents Details**

Number of Respondents from Kolte Patil	30
Number of Respondents from Kalpataru Builders	25
Total Sample Size	55

### 3.2. Likert Items used in Questionnaire

Likert can be distinguished between a proper scale which emerges from collective responses to a set of items and the format in which responses are scored along a range. The Likert scale is the sum of responses on several Likert items.

The identified variables were measured using Likert scale where the respondent's agreement of statement was measured between the ranges of "Agree to Disagree".

In the following table variables used as Likert items are briefly explained and the various statements for measuring these variables were further designed in the questionnaire.

**Table 2: Description of Variables measured using Likert Scale**

Variables	Brief explanation of these variables
Output	Output quality of the ERP system based on the reports and outputs like invoice, purchase order etc...
Job relevance	Respondent's perception that ERP system is applicable to his or her job
Image	Use of the ERP system is perceived to enhance respondent's image or social status
Result demonstrability	Respondent's understand the results of ERP system and will be able to explain the same to others
Compatibility	ERP system is compatible with legacy and other 3rd party system for

	exchanging data
System reliability	ERP system ensures reduction in data redundancy and better data security
Internal support	Respondents believes that internal support for successful ERP functioning like top management support & necessary trainings required
Consultant support	External consultant support helps to run the existing ERP system and also make ERP implementation successful
Perceived usefulness	Respondents believes that using ERP system would enhance his or her job performance
Perceived ease of use	Respondents believes that using ERP system is user friendly and easy to use

### 4. Analysis of Likert Scale

In this research we have taken two construction firms as two individual groups for analysis purpose. Since there are only two groups to measure these variables the use of ANOVA is not possible. Instead we have used t-test to measure the responses of the employees from two groups.

#### 4.1. t Tests method – Introduction

The family of t tests (one sample t test, independent samples t test, and dependent samples t test) are all parametric tests used at the bivariate level and all compare means between two groups. Hence, to help remember when to use t tests, think "t for two."

The **independent-samples t test** compares the average values of a characteristic measured on a continuous scale between two subgroups of a categorical variable.

The **dependent-samples t test** compares the average values of a characteristic measured on a continuous scale between two conditions of the same group.

The **one-sample t test** compares two average values: the first generated from your sample compared with a second known from another study or in the population.

#### 4.2. Independent Samples t-test

The Independent-Samples t-test procedure compares means for two groups of cases. Ideally for this test, the subjects should be randomly assigned to two groups, so that any difference in response is due to the treatment and not to other factors. Usually this test is used when the population mean and standard deviation are unknown and two separate groups are being compared.

In this analysis we have considered unequal sample sizes, since we received 30 responses from Kolte Patil

& 25 responses from Kalpataru Builders but equal variance is being measure using Independent samples t-test. This test is used only when it can be assumed that the two distributions have the same variance.

#### 4.3. SPSS Data Entry & Output

The responses received from these two construction firms were entered into SPSS tool as per the format. Independent Samples t test method was calculated using SPSS software. The result of SPSS output has been represented under Table 3:-

**Table 3: SPSS Output for Likert Scale Variables on applying Individual Samples t-test analysis**

Variables	Levene's Test for Equality of Variances - Sig. [A]	t-value based on the Levene's Test [B]	t-test for Equality of Means - Sig. (2-tailed) [C]
Output	0.789	-0.647	0.52
Job relevance	0.375	2.594	0.012
Image	0.375	1.397	0.168
Result demonstrability	0.082	1.42	0.161
Compatibility	0.335	-0.109	0.914
System reliability	0.277	0.732	0.468
Internal support	0.789	-0.647	0.52
Consultant support	0.082	1.42	0.161
Perceived usefulness	0.086	1.25	0.217
Perceived ease of use	0.086	1.25	0.217

## 5. Analysis of SPSS Output

### 5.1. General

t-test technique make the assumption that samples are obtained from populations of equal variances. This means that the variability of scores for each of the groups is similar. To test this, SPSS performs the Levene test for equality of variances as part of the t-test analysis. The results are presented in the output of this technique. If we obtain a significance value of less than 0.05, this suggests that variances for the two groups are not equal and vice versa. Therefore we have violated the assumption of homogeneity of variance. For t-tests SPSS provides two sets of results, for situations where the assumption is not violated and for when it is violated.

### 5.2. Interpretation of t-test output

SPSS output on applying Independent samples t-test for various variables were separately analysed as follows:

#### 5.2.1. Output

In the SPSS output received for Output variable, the significance level for Levene's Test is 0.789. This is larger than the cut off of 0.05. This means that assumption of equal variances has not been violated, therefore t value which represents equal variances assumed will be considered for t value. i.e.  $t = -0.647$ . In order to assess the differences between two groups we need to further refer the value from column Sig (2-tailed) from the Independent Samples Test Table where the value is 0.520. Since the Sig (2-tailed) column is more than 0.05 there is no significant difference between the two groups. So we can conclude based on responses from both Kolte Patil and Kalpataru Builders that there is significant similar expectation of output quality of ERP system which is measured using various management reports and outputs generated from ERP system.

#### 5.2.2. Job Relevance

In the SPSS output received for Job Relevance variable, the significance level for Levene's Test is 0.375. This is larger than the cut off of 0.05. This means that assumption of equal variances has not been violated, therefore t value which represents equal variances assumed will be considered for t value. i.e.  $t = 2.594$ . In order to assess the differences between two groups we need to further refer the value of column Sig (2-tailed) from the Independent Samples Test Table where the value is 0.012. Since the Sig (2-tailed) column is less than 0.05 there is significant difference between the two groups. So we can conclude based on responses from both Kolte Patil and Kalpataru Builders that there is no common perception of employees that usage of ERP system is relevant for their job.

#### 5.2.3. Image

In the SPSS output received for Image variable, the significance level for Levene's Test is 0.375. This is larger than the cut off of 0.05. This means that assumption of equal variances has not been violated, therefore t value which represents equal variances assumed will be considered for t value. i.e.  $t = 1.397$ . In order to assess the differences between two groups we need to further refer the value from column Sig (2-tailed) from the Independent Samples Test Table where the value is 0.168. Since the Sig (2-tailed) column is

more than 0.05 there is no significant difference between the two groups. So we can conclude based on responses from both Kolte Patil and Kalpataru Builders employees perceive that their image or social status will improve if they use ERP system.

#### 5.2.4. Result Demonstrability

In the SPSS output received for Result Demonstrability variable, the significance level for Levene's Test is 0.082. This is larger than the cut off of 0.05. This means that assumption of equal variances has not been violated, therefore t value which represents equal variances assumed will be considered for t value. i.e.  $t = 1.42$ . In order to assess the differences between two groups we need to further refer the value from column Sig (2-tailed) from the Independent Samples Test Table where the value is 0.161. Since the Sig (2-tailed) column is more than 0.05 there is no significant difference between the two groups. So we can conclude based on responses from both Kolte Patil and Kalpataru Builders employees understand various results generated from ERP system and they will be able to explain the same to others.

#### 5.2.5. Compatibility

In the SPSS output received for Compatibility variable, the significance level for Levene's Test is 0.335. This is larger than the cut off of 0.05. This means that assumption of equal variances has not been violated, therefore t value which represents equal variances assumed will be considered for t value. i.e.  $t = -0.109$ . In order to assess the differences between two groups we need to further refer the value from column Sig (2-tailed) from the Independent Samples Test Table where the value is 0.914. Since the Sig (2-tailed) column is more than 0.05 there is no significant difference between the two groups. So we can conclude based on responses from both Kolte Patil and Kalpataru Builders employees agree that data exchange from ERP system happens seamlessly with legacy system & other 3<sup>rd</sup> party system.

#### 5.2.6. System Reliability

In the SPSS output received for System reliability variable, the significance level for Levene's Test is 0.277. This is larger than the cut off of 0.05. This means that assumption of equal variances has not been violated, therefore t value which represents equal variances assumed will be considered for t value. i.e.  $t = 0.732$ . In order to assess the differences between two groups we need to further refer the value from column Sig (2-tailed) from the Independent Samples Test Table where the value is 0.468. Since the Sig (2-tailed)

column is more than 0.05 there is no significant difference between the two groups. So we can conclude based on responses from both Kolte Patil and Kalpataru Builders employees agree that ERP system provides better data security and there is no data repetition or data redundancy.

#### 5.2.7. Internal support

In the SPSS output received for internal support variable, the significance level for Levene's Test is 0.789. This is larger than the cut off of 0.05. This means that assumption of equal variances has not been violated, therefore t value which represents equal variances assumed will be considered for t value. i.e.  $t = -0.647$ . In order to assess the differences between two groups we need to further refer the value from column Sig (2-tailed) from the Independent Samples Test Table where the value is 0.520. Since the Sig (2-tailed) column is more than 0.05 there is no significant difference between the two groups. So we can conclude based on responses from both Kolte Patil and Kalpataru Builders employees believes that Top Management support and internal trainings in relation to ERP system needs to be provided for successful function of ERP system.

#### 5.2.8. Consultant support

In the SPSS output received for Consultant support variable, the significance level for Levene's Test is 0.082. This is larger than the cut off of 0.05. This means that assumption of equal variances has not been violated, therefore t value which represents equal variances assumed will be considered for t value. i.e.  $t = 1.42$ . In order to assess the differences between two groups we need to further refer the value from column Sig (2-tailed) from the Independent Samples Test Table where the value is 0.161. Since the Sig (2-tailed) column is more than 0.05 there is no significant difference between the two groups. So we can conclude based on employee's responses from both organizations that external consulting support for ERP system is required for successful functioning of ERP system.

#### 5.2.9. Perceived usefulness

In the SPSS output received for Perceived usefulness variable, the significance level for Levene's Test is 0.086. This is larger than the cut off of 0.05. This means that assumption of equal variances has not been violated, therefore t value which represents equal variances assumed will be considered for t value. i.e.  $t = 1.25$ . In order to assess the differences between two groups we need to further refer the value from column Sig (2-tailed) from the Independent Samples Test Table

where the value is 0.217 for both variables. Since the Sig (2-tailed) column is more than 0.05 there is no significant difference between the two groups. So we can conclude based on responses from both Kolte Patil and Kalpataru Builders employees that ERP system helps in enhancing their job performance.

**5.2.10. Perceived ease of use**

In the SPSS output received for Perceived ease of use variable, the significance level for Levene’s Test is 0.086. This is larger than the cut off of 0.05. This means that assumption of equal variances has not been violated, therefore t value which represents equal variances assumed will be considered for t value. i.e. t = 1.25. In order to assess the differences between two groups we need to further refer the value from column Sig (2-tailed) from the Independent Samples Test Table where the value is 0.217 for both variables. Since the Sig (2-tailed) column is more than 0.05 there is no significant difference between the two groups. So we can conclude based on responses from both Kolte Patil and Kalpataru Builders employees trust that ERP system is user friendly and easy to use.

**6. Effect Size for t-test**

Effect size either measures the sizes of associations or the sizes of differences. Cohen provided thumb rule for interpreting these effect sizes, suggesting that if Eta2 of 0.01 represents a 'small' effect size, 0.06 represents a 'medium' effect size and 0.14 represents a 'large' effect size. In Cohen's terminology, a small effect size is one in which there is a real but which can be only see through careful study. A 'large' effect size is an effect which is big enough or consistent enough that may be able to see with the naked eye. Reporting effect sizes is considered good practice when presenting empirical research findings in many fields. In statistics, an effect size is a measure of the strength of a phenomenon. An effect size calculated from data is a descriptive statistic that conveys the estimated magnitude of a relationship without making any statement about whether the apparent relationship in the data reflects a true relationship in the population.

**6.1. Eta squared (Eta<sup>2</sup>) calculation**

For identifying the degree of difference between two groups we need to calculate the Effect Size for Independent sample t-test. With the help of Eta<sup>2</sup> we can calculate the effect size for independent samples t-test.

SPSS does not provide Eta squared (Eta<sup>2</sup>) for t-test so we can use the following equation to calculate the same:-

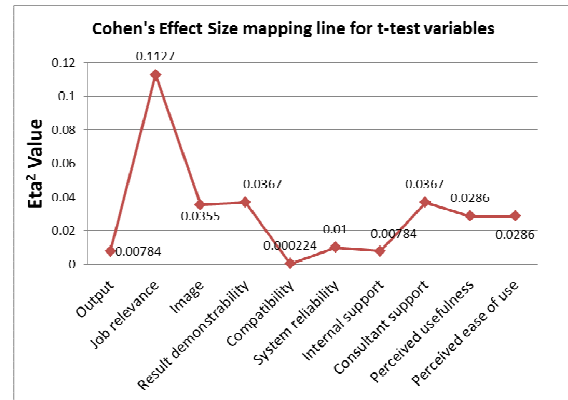
$$Eta^2 = \frac{t^2}{t^2 + (N1 + N2 - 2)}$$

where **t** = t value from Levene’s test  
**N1** = No. of Kolte Patil  
**N2** = No. of Kalpataru Builders

**Table 4: Eta<sup>2</sup> formulae applied on SPSS output result of t-test**

Eta <sup>2</sup> calculation for identifying effect size	Eta <sup>2</sup>	Applying Cohen's Terminology for finding effect size
Output	0.00784	Very Small
Job relevance	0.1127	Large
Image	0.0355	Moderate
Result demonstrability	0.0367	Moderate
Compatibility	0.00022	No Effect
System reliability	0.01	Small
Internal support	0.00784	Very Small
Consultant support	0.0367	Moderate
Perceived usefulness	0.0286	Small
Perceived ease of use	0.0286	Small

In the below figure 1 we have tried to represents the effect size line mapping based on the Eta2 value for various t-test variables or variables measured using Likert Scale as initially mentioned in this research paper.



**Figure 1: Cohen's effect size mapping line**

From the above table 4 and figure 1 we have created a matrix which represents various effect sizes along with the variables being measured in this research. We have called this matrix as Cohen's effect size matrix for as shown in the Table 5.

**Table 5: Cohen's Effect Size Matrix**

No Effect	Compatibility		
Very Small	Output	Internal support	
Small	System reliability	Perceived usefulness	Perceived ease of use
Moderate	Image	Result demonstrability	Consultant support
Large	Job relevance		

We can interpret from the above matrix in the following way:-

- Difference between the two groups is negligible enough for Compatibility variable.
- Difference between the two groups is very small enough for Output & Internal Support variables.
- Difference between the two groups is small enough for System Reliability, Perceived usefulness & Perceived ease of use variables.
- Difference between the two groups is large enough for Job Relevance variable.

## 7. Conclusion

This paper tried to identify the major and supporting factors that affect successful functioning of ERP in construction firm. Based on the responses received from Kolte Patil and Kalpataru Builders through a structured questionnaire and analysed using independent sample t-test research technique, it has been concluded that factors or variables like output, image, result demonstrability, internal support, consultant support, system reliability, perceived usefulness and perceived ease of use can be considered for successful functioning of ERP system.

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