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Analyzing Cost Estimation Model to Optimize COCOMO II for Enterprise Level Software

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Abstract

The stimulus to carry out this research is to find out the best ERP cost estimation model while implementing ERP in the context of Pakistan. For this purpose study has utilized qualitative and quantitative approach. Initially the comparison of existing several cost estimation model has been done through literature review. On the basis of substantive literature review, one ERP cost estimation mode has been chosen i.e. COCOMO. In second phase, in order to validate this model in the context of Pakistan, the study has adapted a questionnaire from relevant study and survey has been done of the IT companies operating in Pakistan which are also involved in ERP implementation. Sample has been collected from 27 companies and data analysis is done in a statistical software (SPSS). On the basis of results obtained from the SPSS and with the support of literature findings has been extracted. Findings indicate that COCOMO II is the best model to estimate the ERP implementation cost in the context of Pakistan. Moreover it is recommended to validate his model in the other countries. Findings would be beneficial for the future studies and contributes in the knowledge of scientific community. Moreover, results of this study can be helpful for other companies in Pakistan who are involved in ERP implementation process and looking for best model to estimate cost of ERP implementation.

***Keywords*:** ERP; ERP implementation; software engineering; Cost estimation model.

1. Introduction

Nowadays, a large number of businesses, finances and many other organizations which has been performing different tasks linked with several industrial and academic domains adopted by different software applications [15].

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These software applications have been simulated in the real time environment so that the organization can perform their required task efficiently and effectively. Number of Mobile and software applications are utilized by different organizations such as “Customer Relationship Management, Enterprise Resource Planning, Word processing, Document management system and many others” [13].

Enterprise Resource Planning solution can be utilized to perform number of business management activities such as Employee records [10], Resources management [16], Product planning, cost and development [17], Marketing and sales activities [20], Inventory management, Manufacturing or service delivery, Shipping and payments [3]. ERP solutions are highly complex information system and are interlinked with number of modules.

Cost is considered as one of the core variables in production, retail, and accounts. Demand and need of the software application is increasing day by day. Software companies has been utilizing different software models for the Cost Estimation [2]. There are number of existing software engineering cost estimation models such as “Analysis Effort method, COCOMO, COSYSMO, Function Point Analysis and many others models” [10]. The cost estimation of any software application is considered as one of the challenges and time consuming. It have been analyzed from different research studies that a large number of companies have failed to analyses and identify the correct cost estimation for the software application [18]. One of the main reasons of the wrong software cost estimation is the selection of the inappropriate methodology which results into the erroneous cost [10]. There are number of parameters which are involved in the software cost such as “Hardware and software costs, Travel and training costs, Effort costs, Licensing, Line of code (LOB)”.

Cost estimation is considered as the process of forecasting excepted value in the development of the software applications. Cost estimation is based on number of different parameters and these parameters are always predicated at the initial stages of the software development. However, it have been analyzed that most of the software development methodologies have defined the cost estimation in the initial phases [18]. There are number of mechanisms which are defined by different companies to control the cost, once the project is executed but there are several stages in which the unpredictable cost element of the software solution may lead in some sort of financial deadlock [14].

1.1 Problem statement

The software development companies have being facing the cost estimation issue. The cost estimation is one of the main reasons of the failure of the software application in ERP Implementation projects. This research study will be conducted to analyze and identify the different cost estimation, Models and perform different tests to identify that which software engineering cost estimation Models fits best of the Enterprise Resource Planning Projects Implementation.

1.2 Research question

The research question developed for this research study is as followed:

1. Identify the best cost estimation model for the Enterprise Resource Planning Projects Implementation and conduct a close comparison between the existing cost estimation models within the perspective of cost as a main variable?

2. Literature Review

Software methodologies are always considered as one of the critical aspect in the software engineering during the design, development and implementation of the software application. There are number of critical parameters which are involved in the design and development of software application [5].

There are number of cost estimation models which have been utilized for different project costs. The cost estimation model is built on the calculation and is mathematically approved formula. These models predict and forecast the value which can occur in the future. The research study presented by [8] conducted to analyze the software development effort and cost estimation based on the utilization of the Neuro-Fuzzy Model. Neuro-Fuzzy Model is considered under the umbrella of the artificial intelligence. Neuro-Fuzzy Model are built on the Fuzzy logic and Artificial Neural Network.

Cost estimation is not only required during the software planning or development but the technologies are also required during the software migration. The research [7] focused on the software migration and the cost estimation utilizing the COCOMO II and Enterprise Architecture Modeling. The framework of the Meta model has been developed in the research study for the calculation of the Software Migration Project. The framework is built on the COCOMO II estimation model and Enterprise Architecture Modeling techniques. The proposed framework in the research has better estimation as compared to the other estimation techniques. According to the results, it has been estimated that the proposed framework has increased the estimation accuracy to ten percentages. The proposed solution has been conducted with the help of real time case study. The results concluded that proposed Meta model [7] is useful, especially after company specifically calibrates with expert estimates.

The [1] presented the research which has being conducted an in-depth analysis for the Empirical Software Effort Estimation Models. These Effort Estimation Models has been utilized in number of different software and application development. The model utilized in this research includes COCOMO estimation model, SEER-SEM estimation Model, SLIM estimation model, REVIC estimation Model, COSTMODL estimation Model. The models have been conducted in the simulation environment and from the results it has been concluded that each model is benefit according to the software requirement and specification and however well the requirement has been calculated. According to the Basha and Ponnuranga “There no cost estimation model which fit best for all situations and environment”. The size-related measurement can’t be performed in the proposed solution.

There are number of different suggestions which have been provided to identify different models for the cost estimation of the ERP however, a large group of the SME suggest that the COCOMO-II should be utilized for the cost estimation of the ERP solution. Improvement are also suggested to automation and integrated new organic in the calculation model of the COCOMO-II.

3. Comparison of Existing Cost Estimation Models

There are number of cost estimation model which can be utilized for the Enterprise Resource Planning Projects Implementation. Most of these cost estimation model has different features and benefits. The selection of the model various from different business requirements, project size, structure and project planning.

Table 1: Comparison of Existing Cost Estimation models [6,11,12,21]

	Existing Model	Software Industry	ERP Implementation	Modified by Software Cost Estimator	Strength	Weakness
1	Analysis Effort method	Yes	No	No	Estimate the Length of the Job required to completed the individual task Utilized the Previous Experience during calculation, Accurate estimate	Can't be Utilized for the ERP cost Estimation Single tasked
2	COCOMO	Yes	Yes	Yes	Accurate for Small projects, Estimate cost as a function of program size.	Can't be directly utilized for ERP solution, Less Drivers as compared to COCOMO™ II
3	COCOMO™ II	Yes	Yes	Yes	productivity measurement, Easy to Use, Results Accurate, Easy to Use.	Can't be directly utilized for ERP solution
4	COSYSMO		No	No	Can be integrated with quite number of Programming languages.	Can't be Utilized for the ERP cost Estimation
5	Evidence-based Scheduling	Yes	No	No	Sequential Calculations, Can be integrated with Agile Approach	Results not Accurate Can't be Utilized for the ERP cost Estimation
6	Function Point Analysis	Yes	Yes	Yes	Support ISO Standards, Can be utilized with ERP	Function Points were highly correlated to lines of code (LOC)

In summary this chapter of literature review has been presented on the related research conducted in the domain of the Cost Estimation Models utilized in the Enterprise Resource Planning Projects Implementation. The chapter has provided different aspects of the researches. There are number of intelligence models and tools which have been developed in the past for the estimation of the project.

4. Conceptual Model

The conceptual model for the Cost Estimation Models in Enterprise Resource Planning Projects Implementation

has been presented in this section. The proposed model is the extension of the Cocomo-II or in simple the Cocomo-II and its drivers can be consider as the base for the formulation of the conceptual mode. There are few Cocomo-II drivers which have been added so that the standard can be developed. The base model of [19] has been modified and new cost driver has been added.

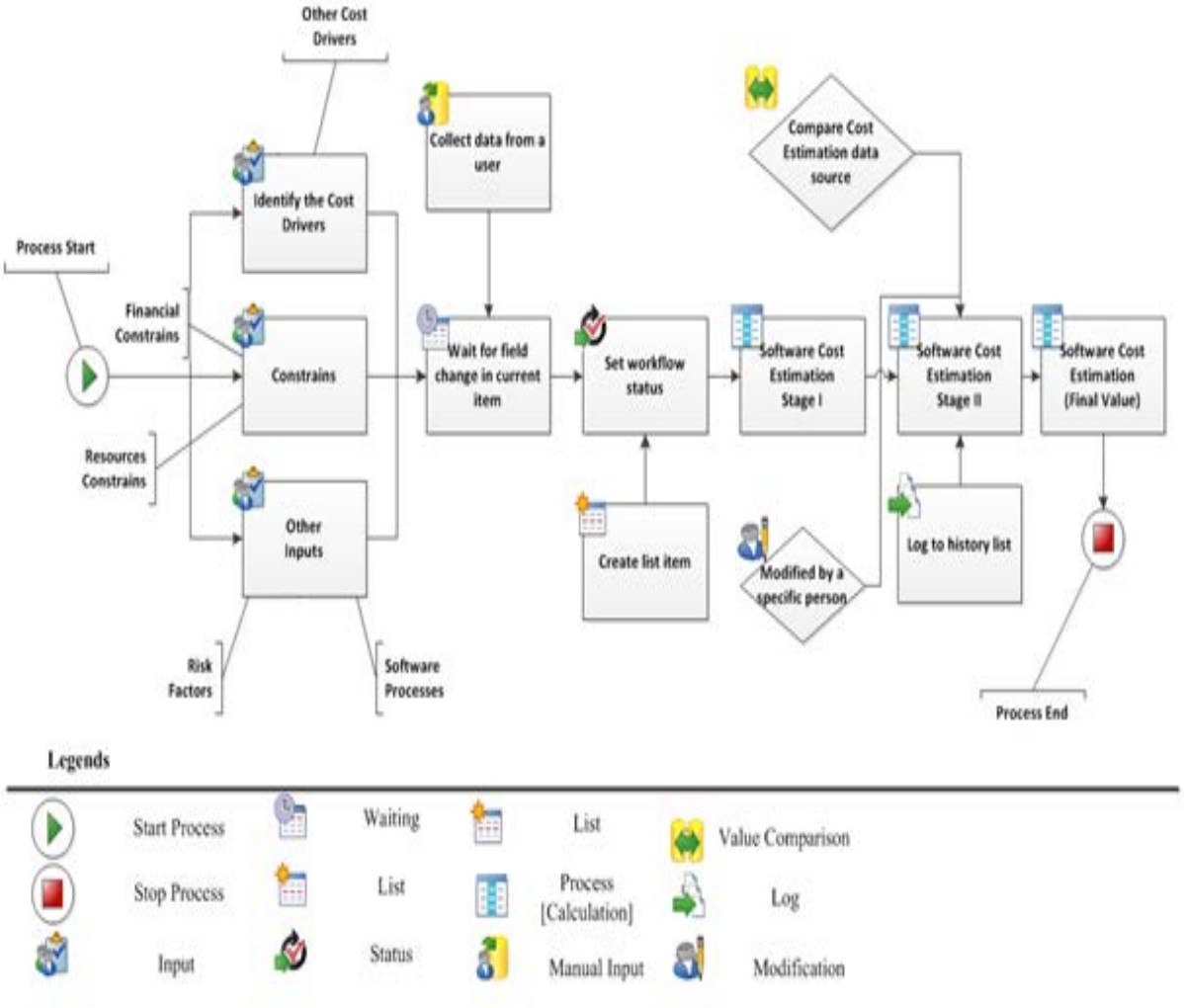

Figure 1: Conceptual Model

5. Methodology

In the first phase, the research problem has been identified. The main emphasis of the problem was to identify the Cost Estimation Models which fit best for the Enterprise Resource Planning. In the phase two, the comparison of in-depth analysis of the existing model are presented.

In the third phase, the data collection techniques have been identified. The quantitative and qualitative data technique has been utilized in the research study. The questionnaire has been developed to analyze different perspectives of the cost estimation utilized in the software industry of Pakistan Once the data is collected, the analysis was performed in the fourth phase and based on that analysis the interpretation of the research report has been developed to identify the Cost Estimation Models which can be best utilized for the Enterprise

Resource Planning Projects implementation. Once all the data analysis and the other phases are completed. The recommend model for the Cost Estimation Models in Enterprise Resource Planning Projects Implementation has been suggested from the evidence collected from the Quantitative and Qualitative data finding.

It has been analyzed that there are more than 1500 software development companies operating and executing different sort of project in Pakistan.

Raosoft application has been utilized to identify and analyses the Sample Size which can be utilized for the research. The sample size of 27 has been identified for this research.

6. Results And Discussion

Selection of the right cost estimation model can lead in the overall success of the software project within the context of the cost, budget estimation and planning. The data is collected by the help of the questionnaire from the software and application companies working in Pakistan.

In this chapter, the details discussion and verification has been performed on the data which has been extracted from the questionnaire conducted in the software and application development companies working in the Pakistan region. The data analysis has been conducted to evaluate the best cost estimation model.

7. Results

Following are the results extracted from SPSS. Results are presented in graphical and tabular form:

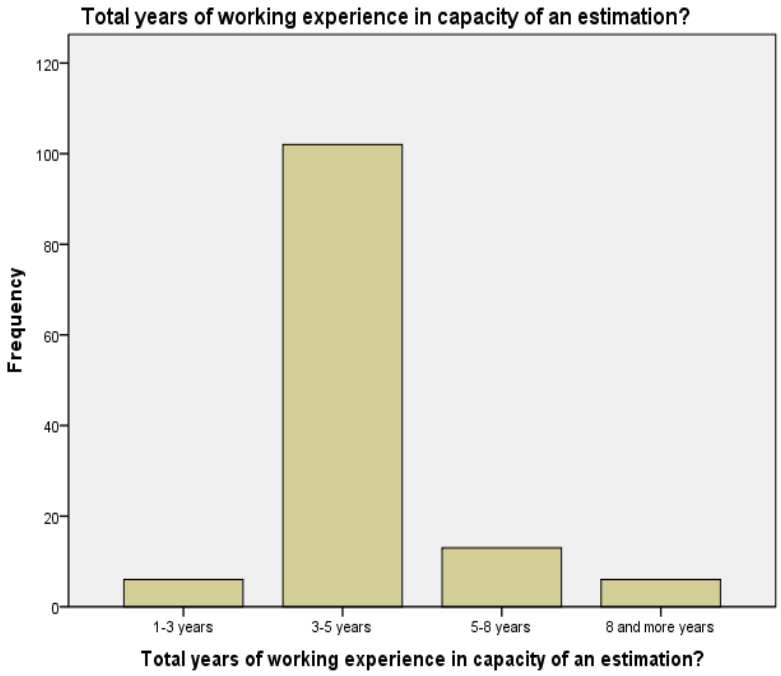

Figure 2: Demographic Results

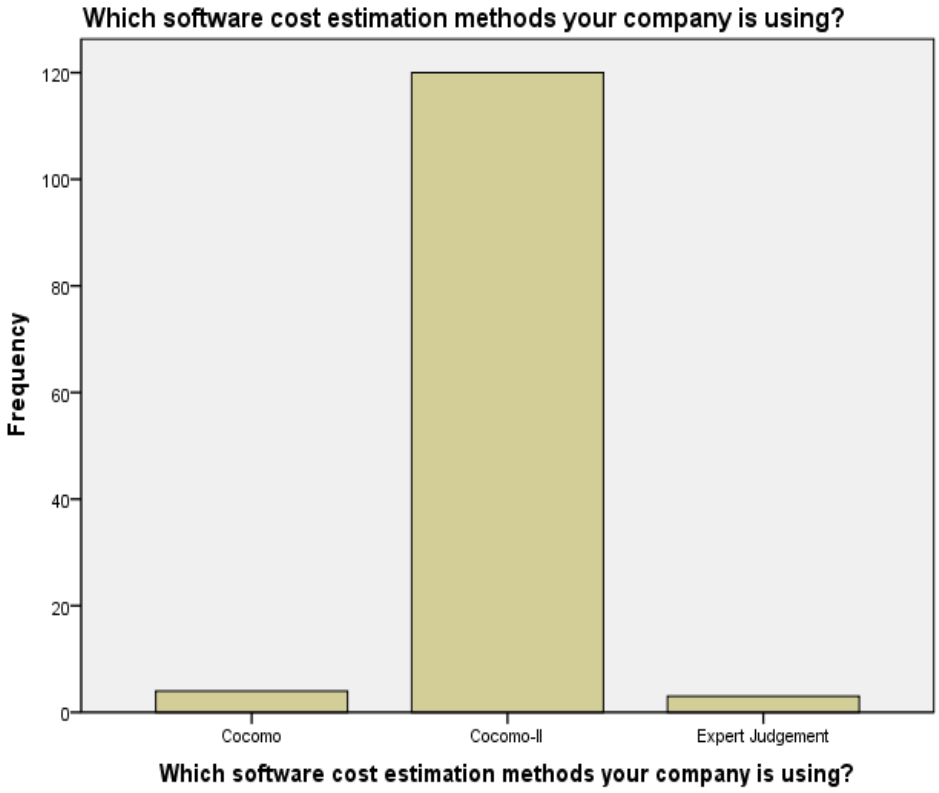

Figure 3: cost estimation models used by companies

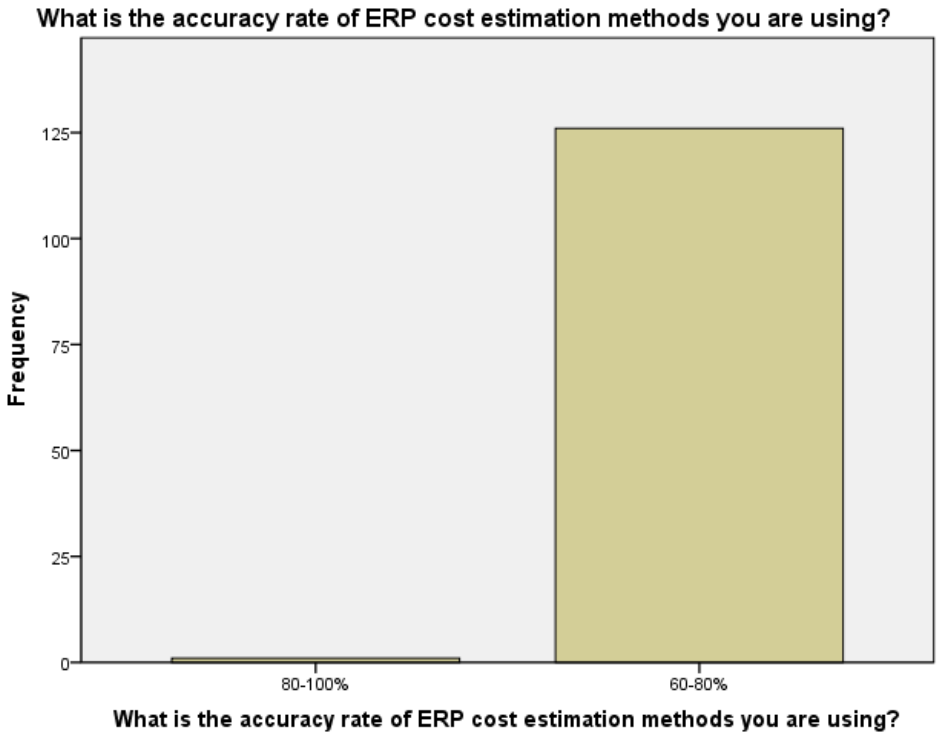

Figure 4: ERP cost estimation method

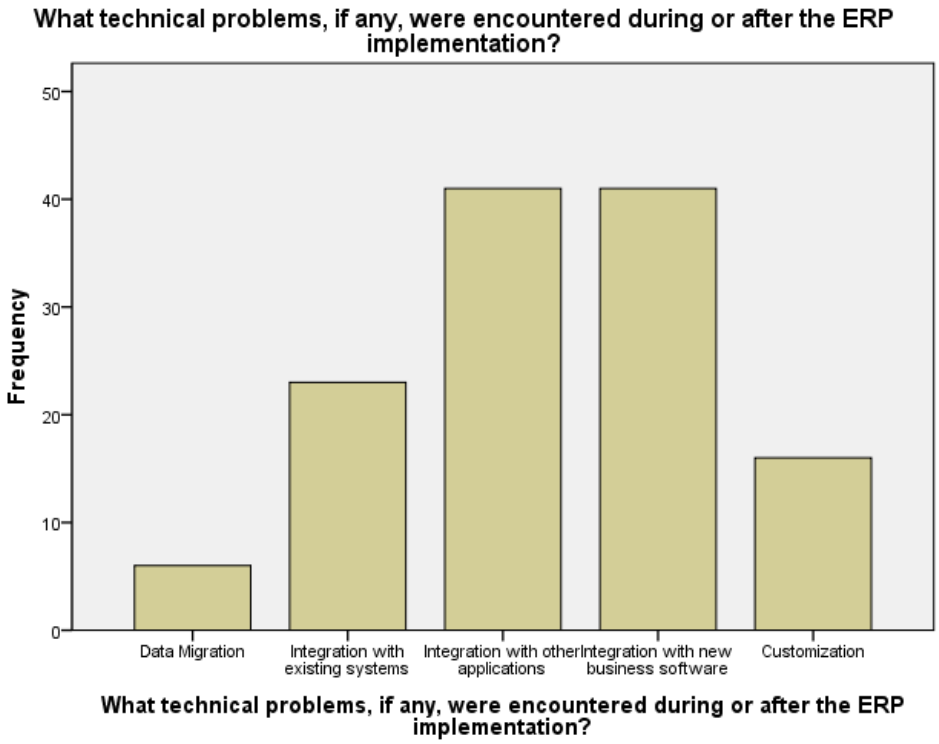

Figure 5: Technical Problems in ERP implementation

Table 2: Years of working experience

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1-3 years	6	4.7	4.7	4.7
	3-5 years	102	80.3	80.3	85.0
	5-8 years	13	10.2	10.2	95.3
	8 and more years	6	4.7	4.7	100
	Total	127	100	100	

Table 3: Cost Estimation Models used by companies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Cocomo	4	3.1	3.1	3.1
	Cocomo-II	120	94.5	94.5	97.6
	Expert Judgment	3	2.4	2.4	100
	Total	127	100	100	

Table 4: ERP cost estimation method

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	80-100%	1	.8	.8	.8
	60-80%	126	99.2	99.2	100
	Total	127	100	100	

Table 5: Technical Problems in ERP implementation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Data Migration	6	4.7	4.7	4.7
	Integration with existing systems	23	18.1	18.1	22.8
	Integration with other applications	41	32.3	32.3	55.1
	Integration with new business software	41	32.3	32.3	87.4
	Customization	16	12.6	12.6	100
	Total	127	100	100	

8. Discussion on Results

1. Most of the people involved in the cost estimation have the experience of around 3 - 5 Years. The Team Lead and Manager are mostly involved in the cost estimation. However, I has been analyzed during the survey that most of the software and application development companies don't have the risk manager involved so most of the estimation may go wrong,

2. Private software and application development companies are most active in performing the cost estimation,

3. Software and application development companies emphasis on the utilization of the cost estimation model. However, there are eight main cost estimation models which has been presented on the questionnaire. Most of the software and application development companies emphasis on the Cocomo and Cocomo-II,

9. Conclusion & Recommendations

The aim of the study was to conduct a research on identification and validation of best ERP implementation cost estimation model in the context of Pakistan. The study has been conducted by using qualitative and quantitative approaches. Comparison of several cost estimation models was done in the section of literature review.

Moreover, a survey has been conducted in the ERP implementation companies operating in Pakistan with the help of an adapted questionnaire in order to validate the best selected COCOMO – II model. Data was collected through adapted questionnaire and results were analyzed by statistical means in SPSS 20. Findings validated the COCOMO – II model as the best fits for ERP cost estimation in the context of Pakistan. Findings further indicated that this model can be utilized by the companies who are in the process of ERP implementation. Findings would be beneficial for the future studies and contributes in the knowledge of scientific community. Moreover, results of this study can be helpful for other companies in Pakistan who are involved in ERP implementation process and looking for best model to estimate cost of ERP implementation.

This study has recommended that further models need to best tested and validated regarding ERP cost estimation in the context of Pakistan. Lastly, it is suggested that COCOMO – II model can be used by the ERP implementation companies in order to best analyze their cost estimation while implementing ERP in the organizations

10. Limitations of The Study

The major limitation of the study is small sample size. Due to limited resources and time constraint it was not possible for the researcher to incorporate large sample size. Therefore, study consider this factors as a limitation. Future researches can consider this limitation and emphasize on increase in sample size.

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