

Experimental Study of Software Quality Issue for SAP

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Abstract - Enterprise Resource Planning (ERP) System provides the real time integrated information and data to all the units of enterprise through a single application. The previous studies reveal that around 60% to 70% of the ERP implementation worldwide ends up in a failure or meet their end prematurely. The delay due to the software development methodology adopted to customize the ERP software. These issues are well defined by Capability Maturity Model Integration (CMMI), it was decided to carry out gap analysis and the map the process areas of CMMI. The organization under study had already gone for an ERP implementation and failed in go live situation. The research studies focused on exposing the software quality issues and analyze the challenges during the ERP implementation and to propose effective framework and recommendations to manage their complexity.

Key Words: Enterprise Resource Planning (ERP), Capability Maturity Model Integration (CMMI), Dynamic symbolic execution (DSE), Genetic Algorithm (GA).

I. INTRODUCTION

In today's highly competitive globalized economy, the enterprises are continuously striving to anticipate customer expectation in terms of quality, time and cost of services. The accelerated pace of change is influencing the enterprises to reinvent, resize and reorganize the business processes [2],[3]. Traditionally, organizations developed computer application only for specific functional area such as general ledger, purchase, inventory and planning. Data was redundant and consolidations of functional areas were not possible. The decision makers of the organization did not have the access to the information that could have helped them in taking timely decision and management control was difficult. Thus, response to change in the constantly changing business environment is challenging.

The integrated software solution must provide a multilingual capability by taking the sales order or the purchase order from the different languages [1]. Order

placed must be printed and returned to customer in their native languages on a single host platform [4]. Multicurrency functionality has the capability of receiving invoices from various currencies and also facilitates the splitting of payment into other currency and vice versa. The system must provide the multi- mode manufacturing strategies, such as single manufacturing strategies and mixed strategies [9]. The total solution must support multiple manufacturing strategies to all department of an organization.

For this reason, today's organizations are hardhearted for implementing the total business solution that supports various business processes and also integrate its value chain with its suppliers and customers. The information across all functional and locations in the organization enables for making informed business decisions. The Enterprise Resource Planning (ERP) can be recommended as an effective tool which supports in decision making for a progressing organization.

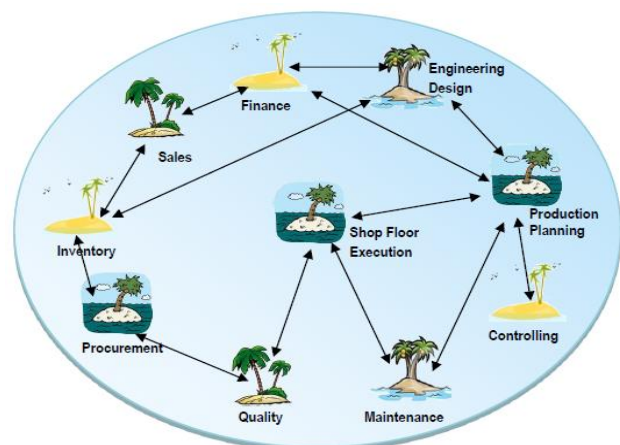


Fig. 1.1: Integrated Enterprise Resource Planning (ERP) system

ERP is essentially an integrated software system consisting of multi-module applications and a common database. Such software systems must help in coordinate business activities and facilitate the flow of information across an enterprise[6].

1.2 Evolution of ERP Systems

ERP has extended from simple Material Requirement Planning to composite integration of enterprise-wide back end processes, the Figure 2 shows the development of ERP System over the years. In the 1960's inventory management and control systems were used by the organizations to maintain an optimum level of stock in the warehouse. Inventory management activities included identifying inventory shortage, providing replenishment techniques, monitoring inventory usage, reconciling the inventory balance and reporting stock status.

1.3 Functional Modules of ERP

A typical ERP package contains multiple functional modules. The main functional module of ERP systems are Sales and Distribution Module, Material Management [1][2] Modules, Finance Modules, Human Resource Modules, Production Planning Modules, Plant Maintenance Modules, Quality Management Modules, Customer Service Modules etc. The number of modules varies from package to package.

1.4 The Market of ERP System

The market shares of ERP software have very large potential market by small medium and large scale enterprises. The share of global and the Indian market ERP software is presented in the following discussion.

Classification of Enterprise According to Size	2008-2013(CAGR* %)
Small Business (< 1000 Employees)	5
Medium-Size Business (1000-4999 Employees)	5.5
Large Business (5000+ Employee)	2.6
Total size	4.2

Table No1.1: Market segmentation of ERP System

1.5 Enterprise Resource Planning Implementation Strategies

Primarily the ERP Implementation phase targeted to integrate all aspect of information flow across the organization. A company must study various available ERP packages before venturing into implementation of right ERP software [10]. The system covers all the major functions of an organization across various business processes. The justification for implementing ERP system should include not only economic but also strategic benefits. Economic and strategic justification for implementing ERP system prior to the installation helps in identifying all potential benefit, it further becomes a yardstick for performance evaluation.

The Managers must conduct a feasibility study of the current situation to assess the organization's needs. In this study identify the availability of hardware, software, databases, and computer expertise within the company to implement ERP. Establish the objectives for the implementation and the goal setting for the improvement. Finally determine the break-even points and Return On Investment (ROI).

1.6 Role of ERP Vendor, Consultant, Customer

The ERP vendors, consultants and the customers all have a significant role to play in a successful ERP Implementation. An ERP vendor is a software firm that design, develop and implement ERP packages. Consultants are the people who specialized in the developing effective techniques and methodologies for ensuring a successful ERP implementation. Customers are the people who will use the ERP system to do their work in the company. The ERP vendors, consultants and the end user bare considered being the three major players in an ERP implementation.

Problem Statement

This study is carried out in a small and medium scale industry (SME) which is into agricultural and biotech product manufacturing and research in Bangalore, India. The organization under study had already gone for an ERP implementation and failed in go live situation. Company was planning for re implementation and elimination of root causes for the failure of the earlier implementation. The research studies focused on exposing the software quality issues and analyze the challenges during the ERP implementation and to propose effective framework and recommendations to manage their complexity.

In the past many ERP implementation studies were focused individually on the vendors, the third party consultants or the customers and very less work was carried on the integrated approaches. This research study focuses on the methodologies involved in building the quality into ERP implementation life cycle by considering integrated approach.

II. RELATED WORK

Literature on ERP Implementation issues in different parts of the world and from the various sector of economy, the benefits Capability Maturity Model Integration implementation and the different approaches adopted to map Capability Maturity Model Integration are studied in details. Finally the six sigma methodologies adopted by various companies to increase the customer satisfaction level have been studied.

2.1 Impact of the Quality of ERP Implementations on Business Value

To compares the financial performance trend of successful and less successful ERP implementers over three years following the implementation.[2] The findings indicate no significant difference in the change in ROA and ROI of the two groups of adopters. Successful ERP adopters however have statistically significant higher efficiency benefits in terms of Asset Turnover and Capital Turnover than the less successful ERP adopters in the first two years after implementation.

Advantages

- Higher efficiency.
- The ERP implementation effort and its success are investigated.
- Important to start with a successful implementation of the package.

Disadvantages

- The implementation process is intensive and takes a long time.
- The model specification does not have a strong theoretical grounding.
- There are also some data matching problems with firms that operate internationally

2.2 Enterprise Resource Planning (ERP): A Review of the Literature

The ERP is an industry-driven concepts and systems, and is universally accepted by the industry as a practical solution to achieve integrated enterprise information systems. It will be useful to researchers who are interested in understanding what kinds of questions have been addressed in the area of ERP. The article intends to serve three goals [7][3]. First, it will be useful to researchers who are interested in understanding what kinds of questions have been addressed in the area of ERP. Second, the article will be a useful resource for searching for research topics. Third, it will serve as a comprehensive bibliography of the articles published during the period.

Advantages

- Quick process time.
- ERP control data and facilitates the necessary contacts to acquire the same information.
- Low operating cost and improving customer service.

Disadvantages

- It is difficult to provide detail review of all the articles.
- ERP is not free from its own limitations.
- ERP is a very expensive and time consuming investment.

2.3 Literature review on the Application of Six Sigma Methodology for Quality Improvement.

This paper aims to present a quality and business improvement framework based on Six Sigma/design, measure, analyze, improve, and control (DMAIC); design for Six Sigma (DFSS)[5]; and Lean principles. A quality/process improvement effort that utilizes Six Sigma and DMAIC, DFSS, and Lean can form two of the three basic building blocks of a company-wide quality management system. More widespread education about DMAIC and the associated problem-solving tools is needed.

III. NEW PROPOSED UDD MODEL

3.1 Context of the Research Study

The success and failure factors for ERP implementation in Small and medium scale enterprises is studied extensively and other implementation issues like the quality issues are not explored much and there is a vast scope for study in this area [2]. Quality is a competitive tool that can result in considerable advantage to organizations that effectively employ its basic principles. A business that can delight customers by improving and controlling quality has the potential to dominate its competitors. Developing an effective quality strategy is a factor in long-term business success.

Methodology

The aim is to expose and analyze the key areas of the implementation process and procedure for various kinds of problems and other than human factors which contributes to the end result of an unsuccessful implementation. The AHP provides a method to assign numerical values to subjective judgments on the relative importance of each element and then to synthesize the judgments to determine which elements have the highest priority. AHP is a method that advocates the comparison of two requirements at one moment. Customer satisfaction is one of the most primary reasons for an industry looking at establishing six sigma standards [6]. Using the above concepts of DMAIC technique and rating scale measures of customer satisfaction.

3.2. Accelerated SAP Methodology

The company implemented SAP ERP software, Implementation procedure of SAP R/3 ERP Software that is Accelerated SAP (ASAP) Methodology is as follows:

- [1] [5] The Accelerated SAP (ASAP) Methodology is an approach developed by SAP to help customers implement the SAP software as quickly and efficiently as possible. ASAP toolset comprises of SAP Solution Composer, SAP Road Maps and SAP Solution Manager which can be used for successful planning and implementation
- SAP Solution composer is used to map the customer's

business requirements to SAP solutions. SAP Road Maps offers a pre defined set of road maps for various implementations, which can be used readily for any specific project. SAP Solution Manager can be used for efficient solution design, documentation, and configuration and testing purposes.

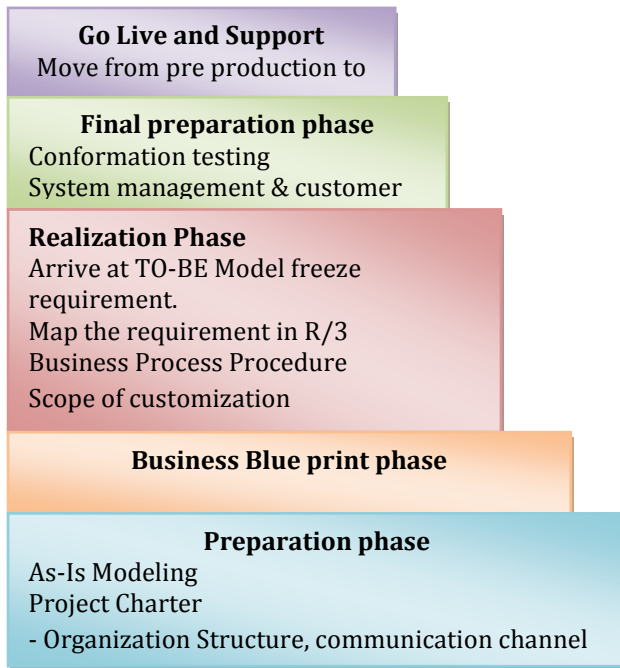


Fig. 3.1: Implementation procedure of SAP R/3 ERP Software

3.3. The data collection and Analysis of quality issues.

In data collection it was made use of primary and secondary data relevant to the study. Initially we considered the secondary data, collected from the company log book [9]. The logbook consisting of software quality issues rose during the implementation phase as well as go in live situations for details The arrangement of data was made to identify the significant module having major problems. The solution for these problems are identified by the technique called Defect Causal Analysis also called Root Cause Analysis (RCA).

Faults/defects

The goal of this step is to identify the class of important parts. The faults are categorized by severity and kind. The defects are categorized based on the occurrence of the issues in the modules, the number of errors and the corresponding modules

Modules	Number of faults
SD	53
FI-CO	35

MM	25
HR	10
PP	4
BASIS	4
Total	131

Table 3.1: Issues observed in Modules

3.4 New Generation Delivery Methodology Model (NGDM model)

The third party consultant developing software by New Generation Delivery Methodology (NGDM) [5], the standardization methodology adopted by the ERP third party consultant is New Generation Delivery Methodology Model. The Challenges of NGDM approach developed by the third party consultants are as follows

1. Weak Project estimation techniques, no proper process to improve our estimation Models.
2. Poor Software engineering practices on many projects, more people driven than process driven
3. Project Implementation history at company shows that the most of the projects have either cost or time over run or both.

3.5. Six Sigma Methodology: Enhancing customer satisfaction

The customer is the principal judge of quality. Perception of value and satisfaction are influenced by many factors throughout the customer's overall experiences. To achieve this task efforts are needed beyond merely meeting the specifications. They must reduce the defects and errors that truly delight the customer and responding rapidly to the changing consumer and market demands.

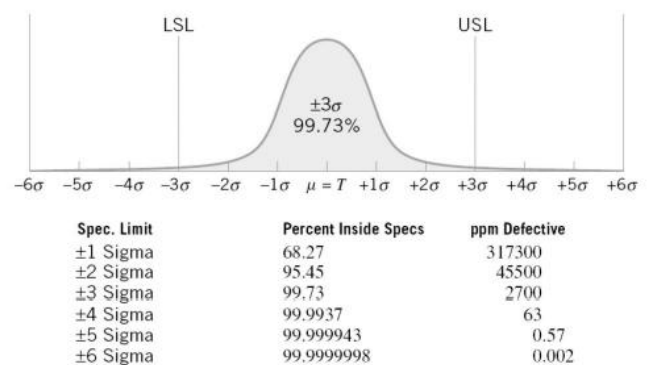


Fig 3.2: Normal distribution

IV. SYSTEM IMPLEMENTATION

4.1. Defect Causal Analysis

The endeavor is to expose and analyze the key areas of the implementation process and procedure for various kinds of problems and other human factors which contributes to the end result of an unsuccessful implementation.

Hence a Defect Causal Analysis was carried out which highlighted the root causes which had a major contribution in the problems that both the client as well as the vendor faced during the course of the ERP implementation procedure. Defects are analyzed to determine the cause of an error. The major root causes were classified into four sub-headings namely, the ERP Package itself, its application, the top management and finally the data collection. The main effect was the challenge faced in the implementation of the ERP system.

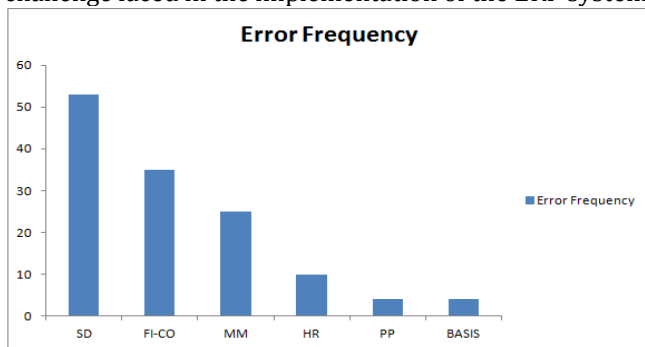


Fig. 4.1: Pareto chart- Implementation issues in each module

Grounded Theory: Factors identified.

Grounded Theory "A theory is inductively derived from the study of the phenomenon it represents. That is, it is discovered, developed, and provisionally verified through systematic data collection, analysis, and theory stand in reciprocal relationship with each other. One does not begin with a theory, and then prove it.

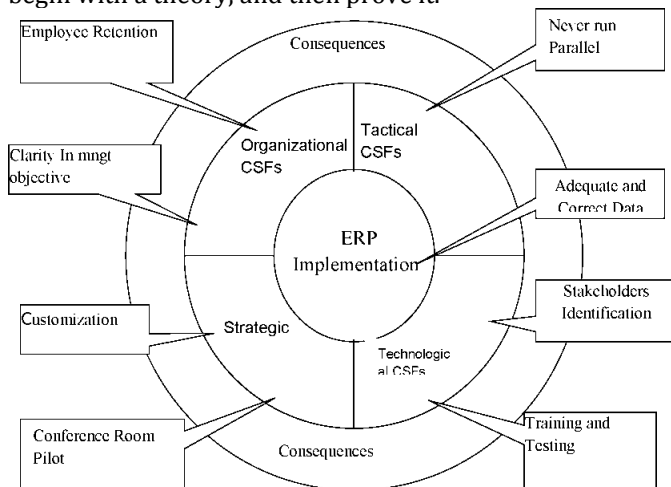


Fig. 4.2: Factors affecting ERP implementation

4.2 Force Field Analysis: Explored restraining forces.

From the force field analysis it was found that the role of consultants and the customer dominates, 38.7% and around 30% respectively. This major restraining force was further considered for analysis to improve ERP implementation successfully.

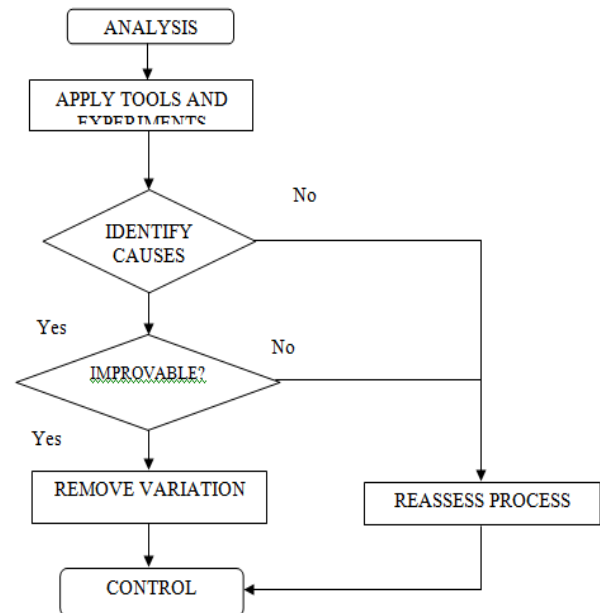


Fig. 4.3 Analysis Phase

The list of generalized questions which were picked up from the above session were looked through and analyzed so as to come to a conclusion to a set of 15 questions which would provide with the important problems that the customers are facing and experiencing while using the software. After the above process is carried out we carry out a pilot study in sales department from which we can assure that the answers we obtain that the questionnaire is satisfactory

4.3 Gap with respect to CMMI.

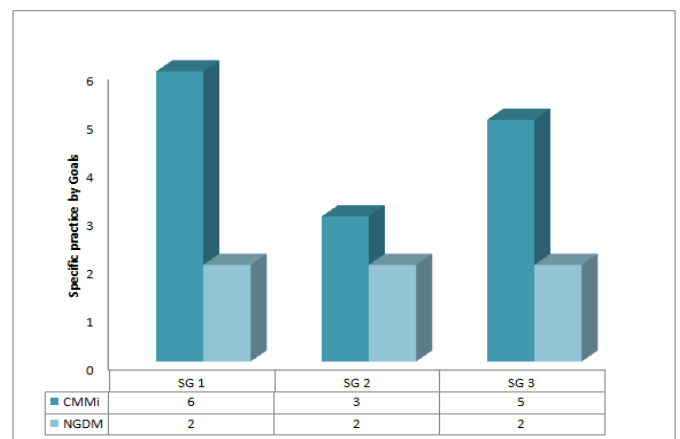


Fig. 4.4: Integrated Project Management

Major problem areas observed by Pareto Chart are Sales and Distribution Module contributing 41% and the Financial Accounting and controlling module contributes 27% summing together becomes 68% of the total problems facing in ERP transaction.

V. EVALUATION RESULT:

Measure phase is to examine the current state of the process; it precisely pinpoints the area causing problems to use it as a basis of the problem-solving. Fault or defect of the project, unit and opportunity must be clearly and precisely defined and all possible and potential causes for such problems must be identified in this step. Subsequently such problems are analyzed statistically, direction of the project and precise standard of the projects subjected to the analysis must be determined.

There are mainly two jobs in measure phase. The first one is to assist define phase for Improvement in the project selection. Before the improvement project is defined, several Characteristics or processes shall be measured. Most of Six Sigma companies apply the mental model (i.e. Y is a function of X). Y is selected from variation results through Six Sigma measurement system, while X factors which influence Y need to be identified for each Ys. The relationship is demonstrated.

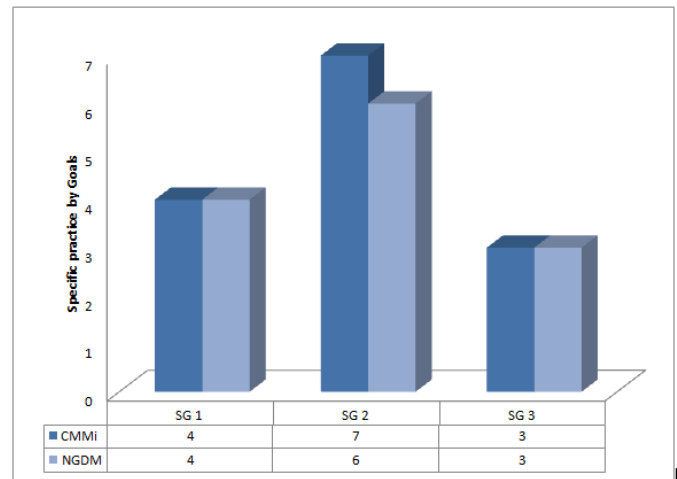


Fig. 5.2: Project planning

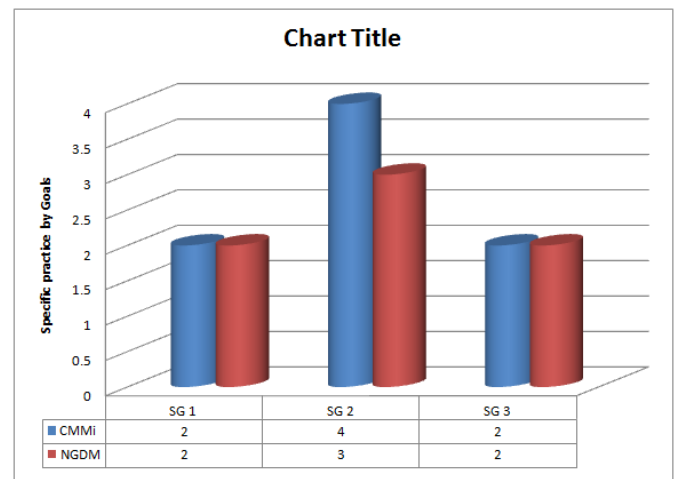


Fig 5.3: Validation

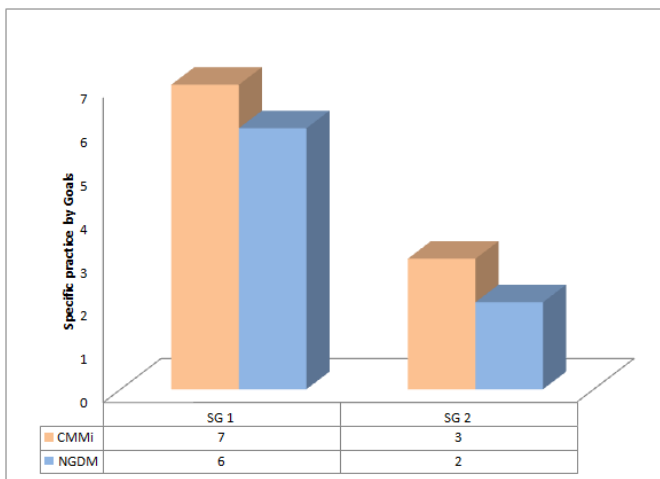


Fig. 5.1: Project Monitoring and control

The number of defects and number of non-defects or accepted questions are calculated by going through the questionnaires, using the formula defects per million is calculated. Defects per million is calculated as it is required and is also an important parameter in the sigma level technique of solving problems. Defects per million is calculated using the formula which has many factors and depends from situation to situation.

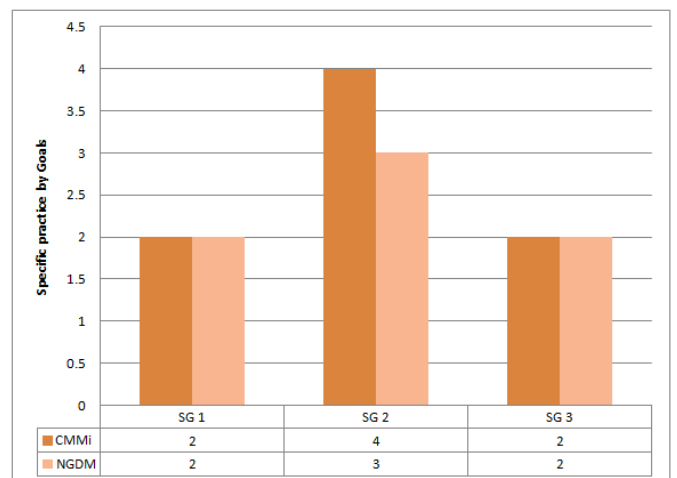


Fig 5.4: Verification

Simulation Result:

The conclusion of this calculation gives us the following data:

- Expert Rating Customer Satisfaction Index = 2.96
- Equal Weight age Customer Satisfaction Index = 2.98
- Random Weight age Customer Satisfaction Index = 2.98

Note: Ideal Customer Satisfaction Index for each case is taken to be = 5. We can note that the as a whole, the customer satisfaction index is nearly 60% of the ideal. This tells us that 60% of the customers are satisfied with the usage of the software. Also, in the measure stage, we had calculated the sigma level for the software which is equal to 3.14. This too tells us that out of the entire Customer, about 60% of the users are satisfied with the usage of the software.

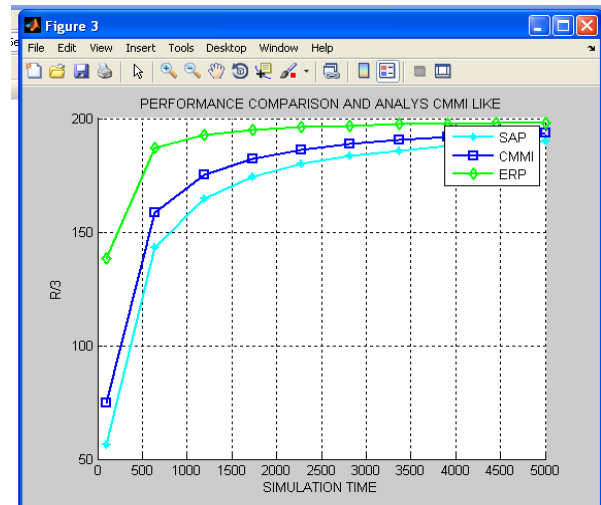


Fig : 5.7 Software Quality Issues of ERP CMMI and SAP

CONCLUSION

The quality issues throughout the life cycle of the ERP implementation were investigated. Detailed implementation procedure of Accelerated SAP (ASAP) Methodology was studied. The quality issues during the implementation as well as post implementation were observed and found that the functional module of Sales and Distribution and Financial control module encountered major problems. The performance issues of the ERP software are explored and corrective action was taken based on identified root causes. The factors affecting ERP implementation have been studied by applying Grounded Theory approach, eight main factors affecting the implementation processes they are inadequate and incorrect data to the consultant, over customization, conference room pilot, stake holder’s identification, training and testing, clarity in objectives of management, running the parallel system and employee attrition. Through the analytical hierarchical process modeling and the force field analysis, it was found the major restraining forces are the role of consultant and the participation of the customer. This was considered for further analysis.

The ‘third party consultant’ customizing the ERP software by New Generation Delivery Methodology(NGDM), implementation history at company shows that the most of the project are either cost or time over run. The consultant was adapted a methodology known as spiral software development life cycle model comprising of three prototypes followed by final solution. The issues of software quality focused on process improvement are well defined by Capability Maturity Model Integration (CMMI).NGDM approach was mapped with CMMI, the gaps in the process areas of NGDM are identified and the major gaps found in the risk management, project planning, integrated project management decision analysis and resolution process areas.

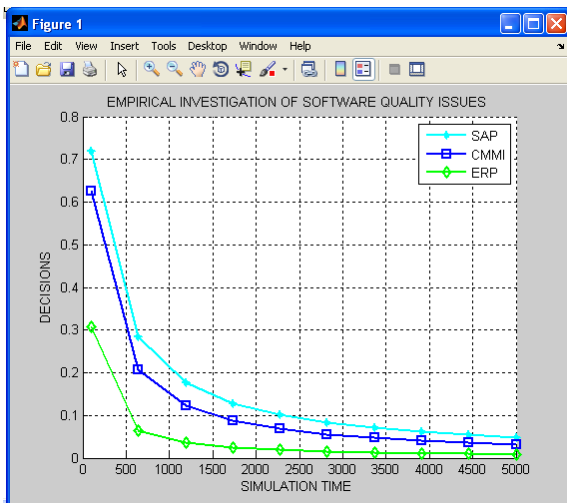


Fig : 5.5 Investigation of ERP CMMI and SAP

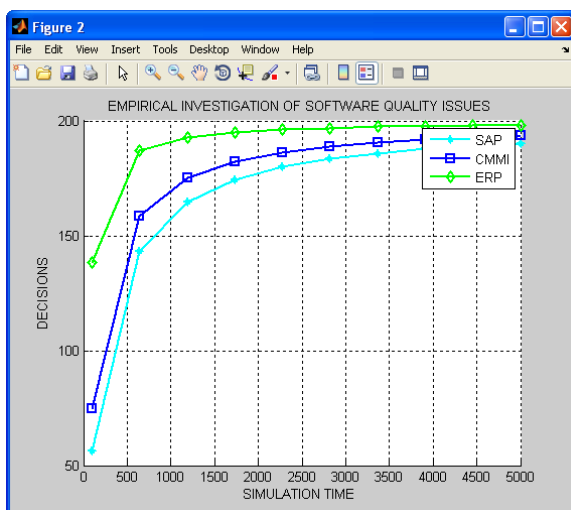


Fig: 5.6 Comparative of performance

The final part of the study was focused on enhancing the customer satisfaction. The detailed DMAIC (Define, Measure, Analyze, Improve and Control) of Six-sigma methodology was applied. Define the categories for the assessment criteria with the help of Affinity diagram. Measured the customers satisfaction index by expert rating weight age and by random weight age method, it was found that about 60% of the customers are satisfied with the existing software capabilities. Analyzed the frequently occurring problems, rectified and deployed in right direction. Avoid the errors during the process by fool proofing. Then the process sigma has improved from the 3.23 to 3.55 sigma. Finally we conclude that for the effective ERP implementation the integrated frame work provides insight issues occurrences by considering the life cycle of the ERP systems implementation.

Scope of Future Research

- The focus of this study is on the Enterprise Resource planning sector in general. However there do exists lot of operational and work culture differences amongst the broad categories of enterprise, So, a comparative study on the quality issues and other related implementation issues amongst these categories can be initiated.
- The sample size can be enhanced to get the outcome of the research to as much reality as possible.

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