A COMPARATIVE ANALYSIS OF VARIOUS SOFTWARE PROCESS IMPROVEMENT MODELS

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Abstract:

It is rightly said that the 'change is inevitable' and when the change has been witnessed in the positive direction it is termed as improvement. It can be either in terms of enhancement to the existing system or adaptability to cater the changing requirements of the users. Software Process Improvement is a process based approach to software development which lay stress on the techniques and tools for the improvement of software development processes. Software Process Improvement (SPI) consists of a set of activities that will lead to a better software process, and as a consequence, high quality software is delivered in a desired time span. Although it is an never ending process and is difficult to find any particular standardized model for all systems but SPI models provide a yardstick to access the existing processes and hence setting a path for designing the new models for development of new systems. The existing paper studies the various process models and explores the possibility of further improvement.

Keywords: ideal model, process models, software quality, standardization, customization.

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Introduction

Change, improvement and innovations are the buzzwords in the today's era of cut throat competition and globalization. Software Process Improvement is the biggest challenge being faced by the computer based organizations. The survival mantra is to foresight the user's requirements and to implement them successfully well before the competitors. The software process should be flexible enough to grasp the new evolving functionalities and the changes such like environmental changes, corporate level changes, and unplanned changes. The overall objective to carry out the improvement is to enhance the quality of the product, its suitability for the users and to enhance its functionalities to cater to the needs of various users having varied requirements. Software process improvement is not implemented at single stage rather it is a continuous and iterative process carried out throughout the life cycle, with the ultimate aim to help the organization in achieving high maturity level. In software development, process models are implemented to manage various concerns associated with cost, time, and quality and changing requirements of client's etc. The particular life cycle model can significantly affect various concerns associated with a software product. If the process is weak, the end product certainly will suffer. Enough effort has been done in this field; still ever changing requirement during the development process for large software development is still not managed by software process models, which results in software projects not meeting their expectation in terms of functionality, cost and delivery schedule.

The concept of Software Process Improvement (SPI) started in the 1990s from the process based approach to software development. Process improvement is a basic goal of the software process which implies that the process used in such a way so that it supports its improvement. This requires evaluating the existing process and understanding the weakness in the process. The main objective of Software Process Improvement is to set the methods in order to improve the development process. SPI denotes activities aiming at improving the software development process and is used for reaching a desired improvement goal. The methods used in the improvement process are the instruments which can act as guiding force to manage improvement activities. So the purpose of improvement is to enhance software development in order to raise the quality of software.

Review of Literature

Software Process Improvement is an important activity which starts when an organization plans to enhance the capabilities of its ongoing processes. There are many Software Process Models those exist in software industry.

The objectives of software process improvement is to set methods in order to improve the development process including project management, anticipating and managing requirements of the user's at various levels, the process of decision making, measuring performance, planning the work, handling the risks and to handle all other activities which may contribute in enhancing the quality of development process. It is an inter-disciplinary activities where the organization should have a pause to evaluate all the projects, i.e both successful and failed projects , to identify the main reasons behind their failed and successful projects and take measures to make improvements wherever needed. The present study evaluates the various SPI models available in the market are:

The Capability Maturity Model developed by the Software Engineering Institute (SEI) at Carneige Mellon University in 1986. Its goal is to improve the applications of an organization's software technologies. The CMM is a methodology used to develop and refine an organization's software development process. The term "maturity" relates to the optimization of processes, from adhoc practices to active optimization of the processes. In CMM models with a staged representation, there are five maturity levels .These maturity levels provides a progressive scale for measuring the maturity of an organization. These levels are as shown below:

1. Initial: The software process is characterized as adhoc, and occasionally even chaotic. Organizations at this level can benefit most by improving project management, quality assurance and change control.

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2. Repeatable: Basic project management processes are established to track cost, schedule, and functionality. The necessary process discipline is in place to repeat earlier successes on projects with similar applications.

3. Defined: The software process for both management and engineering activities is documented, standardized, and integrated into a standard software process for the organization. In this process each step is carefully defined with verifiable entry and exit criteria. Here both the development and management process are formal.

4. Managed: Detailed measures of the software process and product quality are collected. Both the software process and products are quantitatively understood and controlled.

5. Optimizing: Continuous process improvement is enabled by quantitative feedback from the process and from piloting innovative ideas and technologies. Best software engineering and management practices are used throughout the organization.

ISO is one of the standards developed by International Organization for Standardization (ISO). The purpose of this family of standards is to increase customer satisfaction through the deliverance of quality products and services. There are several different documents in ISO family of standards, ISO 9001 is an international standard on quality management system requirements necessary for quality assurance in an organization. ISO 9001 is suitable for all sizes and types of organizations and is well established around the world as an invaluable quality management standard. ISO 9001 certification is not just suitable for large organizations but also small businesses that will benefit from adopting efficient **Quality Management Systems** that will save time and cost, improve efficiency and ultimately improve customer relationships.   ISO 9001 specifies requirements for a quality management system where an organization aims to enhance customer satisfaction through the effective application of the system including processes for continual improvement of the system.

Total Quality Management is a management approach based on quality and participation of organization's people and aiming at long term success. This is achieved through customer satisfaction and benefits all members of an organization.TQM means quality involves everyone and all activities in an organizations. Quality means that meeting customer requirements. Management means that quality must be managed.TQM is an organizational management concept of the voice of the customer and is defined as commitment of all employees to the continuous improvement of work process with the purpose of satisfying internal and external customer. TQM is a method of thinking about missions, organizations and people to make assure that the right things should be done at right time. This thought can change the attitude, behavior and hence result for better.TQM has following principles:

1. Customer satisfaction: TQM is based on customer's satisfaction. An organization depends upon their customers and can understand current and future needs of the customer, meet customer requirements according to their expectations.
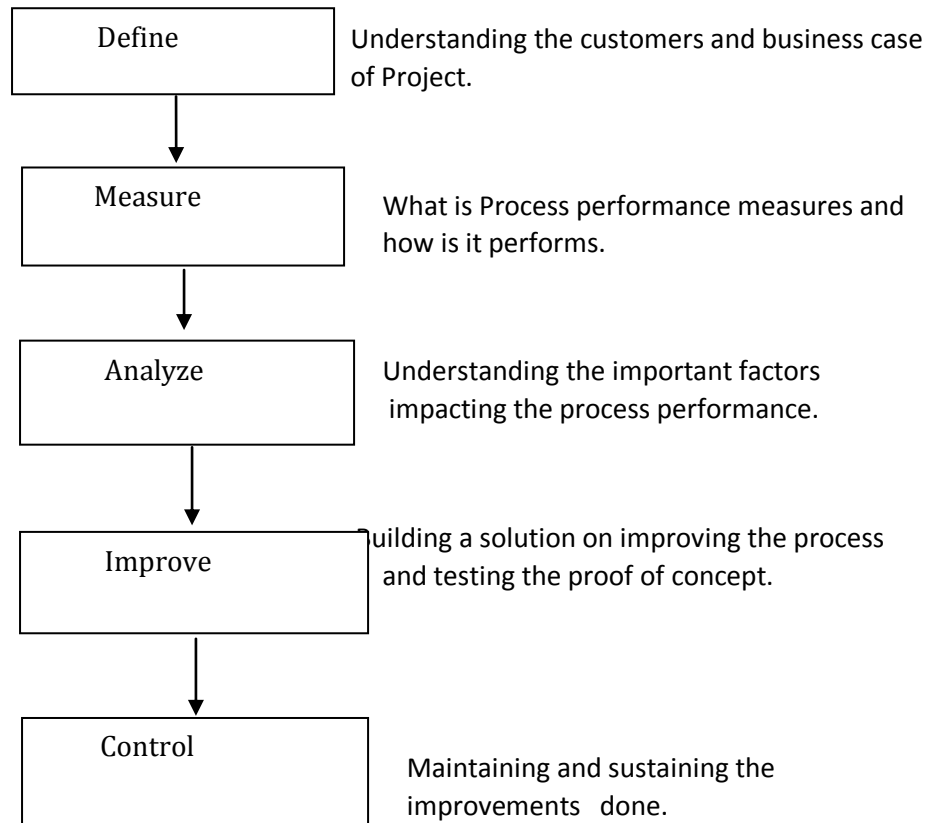**2. Employee involvement:** Employee involvement is very important in achieving high level of quality. Employee must be encouraged and involved to participate in quality management by using different techniques for achieving and sustaining high level of quality.
3. Continuous improvement in quality: Continuous improvement in quality is a permanent objective of an organization an organization must specify the quality attributes of the product and try his best to gain the quality of a product. Quality should be made the responsibility of everyone in an organization.

Six Sigma is a set of techniques and tools for process improvement. It was developed by Motorola in 1986. Six Sigma is a metrics driven approach to continuous improvement that starts with quantitative business goals providing direct value to the customers. Six Sigma seeks to improve the quality output of process by identifying and removing the causes of defects and minimizing variability in

manufacturing processes. Each Six Sigma project carried out within an organization follows a defined sequence of steps and Six Sigma is used as a measurement of product quality. A Six Sigma quality level means that a product is 99.9997 errors free.

Six Sigma projects follow two project methodologies bear the acronyms DMAIC and DMADV. Both of these methodologies are composed of five phases each.

Define	Understanding the customers and business case of Project.
Measure	What is Process performance measures and how is it performs.
Analyze	Understanding the important factors impacting the process performance.
Improve	Building a solution on improving the process and testing the proof of concept.
Control	Maintaining and sustaining the improvements done.

Figure I: Six Sigma Methodology

DMAIC is used for projects aimed at improving an existing business process.	**DMADV** is used for projects aimed at creating new product or process designs.
• ***Define*** the system, their requirements and the project goals specifically. • ***Measure*** key aspects of the current process and collect relevant data and calculate its Process Capability. • ***Analyze*** the data to investigate and determine what the relationships they are. • ***Improve*** the current process based upon data analysis using techniques in order to create new future state process. • ***Control*** the future state process to ensure that any deviations from the target are corrected before they result in defects and continuously monitor the process.	• ***Define*** design goals that are consistent with customer demands and the enterprise strategy. • ***Measure*** and identify characteristics that are **C**ritical **to Q**uality, Measure product capabilities, production process capability, and measure risks. • ***Analyze*** to develop and design alternatives. • ***Design*** an improved alternative which is best suited per analysis in the previous step. • ***Verify*** the design, implement the production process and hand it over to the process owners.

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IDEAL (Initiating, Diagnosing, Establishing, Acting and Learning) model is an organizational improvement model that serves as a roadmap for initiating, planning and implementing improvement actions. The IDEAL model forms an infrastructure to guide organizations in planning and implementing an effective software process improvement program. The IDEAL model is named for the five phases which are initiating, diagnosing, establishing, acting, and learning.

1. Initiating Phase:

This is the initial step in the IDEAL model. The initial improvement is established and responsibilities for the infrastructure are initially defined and initial resources are assigned.

2. Diagnosing Phase:

In Diagnosing Phase the management group must understand the current software process baseline so that it can develop a plan that will achieve the business changes specified in the organization's SPI goals. The baseline activities performed in the diagnosing phase will provide this information into the SPI planning process.

3. Establishing Phase:

The Establishing Phase is where the issues efforts that organization has decided are prioritized and approaches are developed. This is the phase where the management team develop the SPI action plan which was initiated in the diagnosing phase will be completed. This is the step that is repeated as needed.

4. Acting Phase:

The Acting Phase is where the improvement are developed, put into practice and deployed across the organization. The various improvement that working group have developed are completed and their value will be proven to the organization by piloting them.

5. Leveraging Phase:

The aim of this phase is to make the next pass through the IDEAL model more effective.

In the Leveraging phase the information collected in the earlier phases, lessons learned, and metrics on performances, are evaluated to make the next pass through the IDEAL model more effective.

NEED OF STUDY

 The process followed to develop any product is one of the most important factors for the success or failure of the product. The same is true for the development of software. There are various models which can be used for the development of softwares and each one of these are having their own prons and cons. The present study is motivated by the fact that one should be able to find out the model

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which is best suited for his/her requirements. So moving in this direction the present study provides a comparative analysis of various models, which will help the developers to choose the one best suitable for their requirements.

OBJECTIVES OF THE STUDY

1. To study the various software process models available in the industry.
2. To compare the various process models and to evaluate their performance.
3. To draw a conclusion of this comparative study and to give suggestions for further enhancements.

RESEARCH METHODOLOGY

The study reviews the secondary data available through various sources like published research papers, reviews, books and material available on internet.

RESULTS & DISCUSSION

The various process models discussed here have their own prons and cons and applications to the specific application or industries. The major differences between these models can be enumerated as:

CMM VS SIX SIGMA

	CMM	SIX SIGMA
1.	CMM is a process improvement model.	Six Sigma is a process improvement methodology.
2.	Lack of standard metric.	Customer –centric
3	Define basic process infrastructure	Does not include any process model.
4.	CMM is a specific domain approach. Its application depends on the area /industry in which it has been implemented.	Six Sigma is non domain specific methodology.

CMM VS ISO

	CMM	ISO
1.	CMM puts emphasis on software engineering only.	ISO describe both software and system Engineering. It provides standards and guidelines to improve the system in general and a software in particular.
2.	CMM provides guidelines mainly for software development.	ISO work for software and hardware both.
3.	CMM is a way to communicate capabilities.	The ISO is a way to communicate the process.
4.	CMM is a process improvement approach, which have 5 maturity levels	ISO has a wider scope and can be implemented to various applications and processes.

LIMITATIONS

The present study is limited to some of the process models and their comparative analysis on some of the factors only, the factors like user's requirements, his/her vision for the project, which are quiet customer oriented can not be taken into the study. to include such factors, the study must like pshychological, social, behavioual studies into consideration.

SCOPE FOR FURTHER RESEARCH

The present research can be further enhanced to include more process models and the number of factors on which study is based can also be increased, which may include the social, psychological. Behavioral factors into consideration. Apart from that the user's/ organizations' vision about the project and organization is also a major factor which may be included in the study. It will make the study more viberate and customer oriented.

CONCLUSION

The software process model consists of a set of activities undertaken to design, develop and maintain software systems. A variety of software process models have been designed to structure, describe and prescribe the software development process. The software process models play a very important role in software development, so it forms the core of the software product.. The SPIM model does the process improvement in a stepwise way. It covers user requirements software quality assurance, and

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organization point of view. Many of the factors can be found in the organization from the SPIM model like management commitment and teamwork were strengthened.

SPIM model cover the some limitation of existing model (CMM, SIX SIGMA).For example, the main limitation of CMM is key practice describes. "What to do "but does not prescribe "how to do". SPIM model describe the Implementation and prescribe how to do. The SPIM model does not necessary to work for the repeatable task .When the new problem come it will work for that also .SPIM is a flexible model. If there is a change in the process, SPIM covers all the aspect of the changing of process due to cyclic model.

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