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Title

SURVEY ON SOFTWARE PROCESS IMPROVEMENT AND IMPROVEMENT MODELS

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Abstract:

Software Process Improvement is common thinking in today's era for any organizations' overall benefit. It starts when organization starts thinking about the change in working environment so that performance and profit can be increased. The organizations need better process improvement regularly. An improved or mature software process results into better quality product. Hence, an organization can aim to have more profit and high quality products. A plenty of process improvement models exists. Aim of this paper is to explore such models and their working towards process improvement.

Keywords: Software process improvement, Improvement steps, Improvement models.

Introduction:

The principle objective of a mature software process is to produce quality products to meet customers' needs. Software Process Improvement is the name given to the identification of the current state of the practice of information systems development within an organization and then improving it. Software Process Improvement is an important activity which starts when an organization plans to enhance the capabilities of its ongoing processes. One major characteristic of process improvement is to emphasize the continuous improvement of products as well as of organizational processes in terms of performance, stability, compatibility. [1, 19]

Process definition:

Software process is a set of activities that begin with the identification of a need and concludes with the retirement of a product that satisfies the need or more completely as a set of activities, methods, practices, and transformations that people use to develop and maintain software and its associated products (e.g., project plans, design documents, code, test cases, user manuals) [2].

Software Process Improvement:

Software process improvement is a deliberate, planned methodology following standardized documentation practices to capture on paper (and in practice) the activities, methods, practices, and transformations that people use to develop and maintain software and the associated products. As each activity, method, practice and transformation is documented, each is analyzed against the standard of value added to the organization. [23]

Survey on Improvement & Improvement Models:

The various basic steps to improve software development process and some standard improvement models are surveyed and explained as below.

Basic Steps for Process Improvement:

The opportunity for improvement to either operating or management processes can often be vast, but must be focused. It is imperative that the number of process improvement activities undertaken by an organization is matched by the organization's ability to fund the activity and implement the changes without harmful disruption to day-to-day delivery of its products and services.

The six basic steps for Process Improvement are:

- Process selection
- Process understanding
- Process performance
- Process review
- Process change
- Capturing the change

The aim of ***Process Selection*** is to select a small and achievable number of processes, most directly influencing the achievement of the organization's goals and objectives, upon which to undertake process improvement activity. It can consume from a few hours to weeks, be either proactive, e.g. management initiative, or reactive, e.g., customer complaint, and involve one or more people. The outcomes of the Process Selection step should be an agreed (i.e. enough) number of processes to be reviewed, management approval to dedicate resource to the work and agreed objectives for the work.

Next stage is ***Process Understanding*** (covering the scope of the process i.e. where it starts and ends, what is included and excluded). In addition, the key sub-processes and accountabilities of the process to the organization must be understood. These can be achieved by completing the elements of a process - title, purpose, scope, inputs, outputs, controls and resources, and using tools such as process mapping and decomposition. The conclusion of this step are a high level process map, sub-process maps, a list of key accountabilities and lists of the major inputs, outputs, controls and resources acting upon the processes and sub-processes.

Process Performance involves recording and detailing the historical performance of the process, obtaining perceptual views of both current and historical performance from customers and suppliers, defining the agreed required performance of the future improved

process, and agreeing how it will be measured, monitored and reviewed. Data must be gathered and analyzed. This can be accomplished via several means, including observation, counting, workshops, interviews, and questionnaires. The outcomes of ***Process Performance*** is an understanding of the key metric data, the underlying capability of the process and customers, suppliers and staff requirements for the future improved Process.

Process Review, the data and information that has been collected and analyzed is reviewed and recommendations made for the improved process. Several tools, such as *Cause and Effect, Pareto and Force Field Analysis* can be used in this step. The outcomes of Process Review include the identification of either continuous improvement activity or a process re-design project, plus the identification of any tactical "quick wins". The business benefits and timescales for realizing these must also be identified, together with process improvement resource allocation, performance metrics and a monitoring and reporting mechanism.

Process Change translates the prioritized process improvement mandates into an integrated programmed of continuous improvement or process re-designs activity. Detailed project plans with milestones, objectives, performance measures and targets, benefits, roles and deliverables must be developed, as well as a plan to manage the change and train all necessary personnel in the new process. Once the previous five steps have been implemented it is essential that the improvements that have been achieved are sustained.

In the final ***Capturing the Change*** step, the process improvements are integrated into the business management system, ensuring the change is reviewed, managed and built upon. Procedures should be written for the improved process, the changes, improvements and benefits communicated to all stakeholders, any training conducted, and the process and procedures regularly audited. [3, 4]

Standard Improvement Models:

The explosion of technological development has led organizations to adopt new technologies at an increasing rate. The various models that are related to software process maturity are briefly described.

(a) IDEAL model: The IDEAL model provides an effective approach to adopt improved software engineering processes, methods, and tools. IDEAL provides a usable, understandable approach to continuous improvement by outlining the steps necessary to establish a successful improvement program. The goals of the IDEAL Model are to continuously improve the ability to implement change. The model consists of five phases. Initiating, Diagnosing, Establishing, Acting and Learning**.** Every phase has its own functionality. [5, 6]

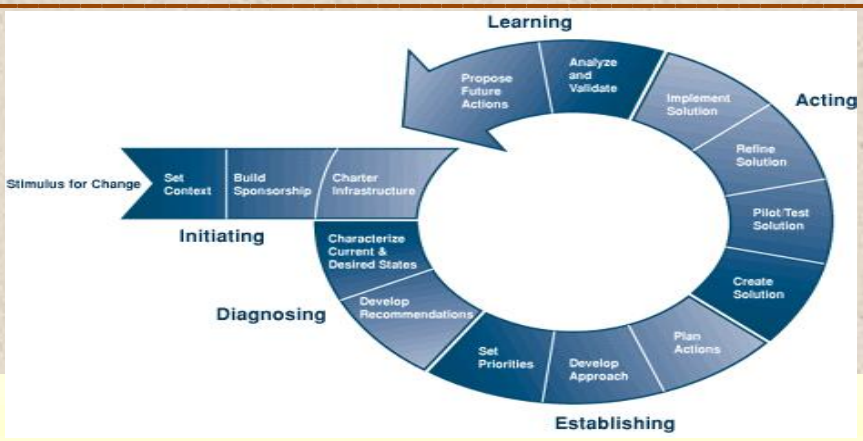

Figure1. IDEAL Model [5]

(b) CMM: CMM is developed by software engineering institute (SEI) in 1987. CMM helps organizations to select improvement strategies based on current process maturity status and to identify critical issues in quality and process improvement. CMM consists of five maturity levels: Initial, Repeatable, Defined, Manage, and Optimizing. Each level has been divided into certain key process areas. For a company to achieve a certain maturity level it must fulfill all the key process areas of the desired maturity level. [9, 10, 21]

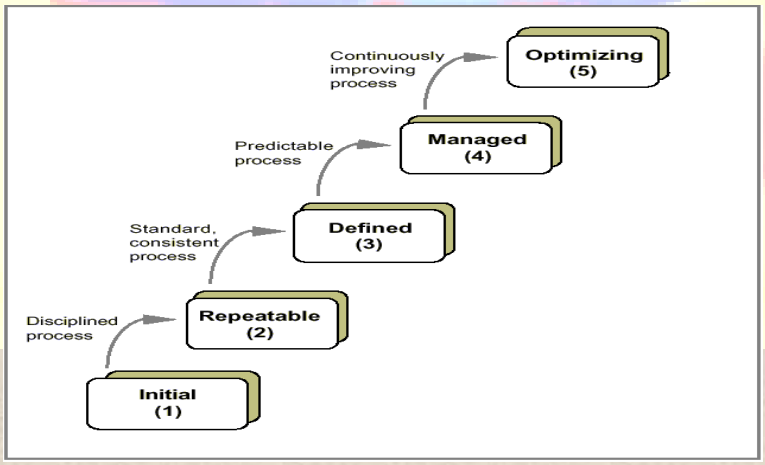

Figure2. CMM Model [11]

(c) International Organization for Standardization (ISO): ISO is a standard of quality management system. This organization gives some standard to the company. ISO is applicable for both software and hardware product. ISO certification is necessary to improve the organization. Standards ensure desirable characteristics of products and services such as quality. Customer can know the profile of the company associated with the ISO standard. Once an organization is certified with ISO, the ISO team audits this organization next every six months. The ISO 9000 series consists of three standards: *1.ISO 9000:2000, Quality management systems, Fundamentals and vocabulary 2. ISO 9001:2000 Quality management systems – Requirements 3.ISO 9004:2000 Quality management systems - Guidelines for performance improvements* [14].

(d) Six Sigma: Six sigma strategies were developed by Motorola in the early 1990s [15]. Six Sigma is based on statistical approach which does the improvement by historical data and by calculation of mathematical formulas. Six Sigma is an effective and systematic quality improvement approach to enhance the organization's performance based on the adoption of various statistical analytic techniques. The goal of the six sigma is to detect the defect and reduce the defect. Six Sigma has six sigmas (i.e. stages) and reduces the defect step by step. Six Sigma is usually related to the magic number of 3.4 defects per million opportunities. [16]

(e) Total Quality Management (TQM): TQM is a management philosophy, a paradigm, a continuous improvement approach for doing business through a new management model. Total Quality Management is an interlocking arrangement of procedures and practices that ensure that all employees in every department are adequately trained and directed to continuously implement aligned improvements in quality, service, and total cost such that customer expectations are met or exceeded. TQM looks for a continuous improvement. TQM is made by the combination of three alphabetical letters. These letters are the following:

Total- involving the entire organization, supply chain, or product life cycle.

Quality- the literal definition of quality

Management- the system of managing with steps like plan, organization, control etc. The four basic concepts which we discuss in TQM are Total Customer Satisfaction, Teamwork, Employee Empowerment, and Continuous Improvement. [17, 18, 20]

(f) SPICE Model: SPICE stands for Software Process Improvement and Capability determination. Process improvement has the objective of changing or optimizing processes for greater effectiveness to achieve gains in product quality and productivity. Capability determination however is concerned with assessing an organization or project in order to determine risks to the successful outcome of a contract, development or service delivery. The capability levels defined within SPICE are:

Incomplete Process **(**The process is not implemented, or fails to achieve its defined process outcomes), ***Performed Process*** **(**The implemented process achieves is defined process outcomes), ***Managed Process*** **(**The previously defined performed process now delivers work products that fulfill expressed quality requirements within defined timescales and resource needs), ***Established Process*** **(**The previously defined managed process are performs using a defined process that is based upon good software engineering principles and is capable of achieving its defined process outcomes), ***Predictable Process*** **(**The previously defined established process now performs consistently within defined limits to achieve its defined process outcomes), ***Optimizing Process*** **(**The previously defined predictable process now dynamically changes and adapts to effectively meet current future business goals). [7, 8]

(g) BOOTSTRAP Methodology: BOOTSTRAP methodology can be applied to small and medium size software companies or software departments within a large organization. A new release (Release 3.0) of the BOOTSTRAP methodology has been developed to assure conformance with the emerging ISO standard for software process assessment and improvement [12].

The BOOTSTRAP methodology has the following objectives:-

- To provide support for the evaluation of process capability against a set of recognized software engineering best practices.

- To include internationally recognized software engineering standards as sources for identification of best practices.
- To identify, in the assessed organization, process strengths and weaknesses.
- To support improvement planning with suitable and reliable results.
- To support the achievement of the organization's goals by planning improvement actions [13].

The BOOTSTRAP process model defines processes and capability levels. Process Capability is measured based on the following capability levels:

Level 0: Incomplete Process

Level 1: Performed Process

Level 2: Managed Process

Level 3: Established Process

Level 4: Predictable Process

Level 5: Optimizing Process

Conclusion:

The work in this paper describes the common ways to improve the software development process and some existing standard improvement models also. These models provide the steps of software process improvement by using their specified steps. The paper is based on survey of existing improvement methods and models so that to get understand the concepts of improvement and its procedures.

Future Work:

A new model in the future can be implemented which can provide better results than these existing models for process improvement. A model which can reduce risks and provide more

quality in terms of user satisfaction, time, cost, etc. Implementation of new improvement model is based on depth of the survey of these existing improvement models.

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