A RIGOROUS STUDY OF SOFTWARE PROCESS IMPROVEMENT MODELS IN SOFTWARE INDUSTRY

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ABSTRACT

Now-a-days Software Process Improvement programs are being integrated with the key processes practiced in different software organizations, who really want to improve their processes continuously in order to enhance their quality of the products. Software Process Improvement (SPI) encompasses a set of activities that will lead to a better software process, and as a consequence, higher quality software delivered in a desired time span .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. There exist a set of key processes those are practiced and are being applied by different organizations to improve quality of these products. This paper summarizes important SPI models those comprise of effective set of practices which can enhance the maturity of software organisations.

Keywords: Capability Maturity Model, CMMI, MIL-STD-498, Software Engineering Institute, Software Process Improvement.

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PREFACE

Software Process Improvement programs are becoming an incredible part to every organization. There exist a set of key processes those are practiced and are being applied by different organizations to improve quality of these products. Software Process Improvement (SPI) encompasses a set of activities that will lead to a better software process, and as a consequence, higher quality software delivered in a desired time span. Software Process Improvement is an important activity which instantiates when an organization plans to enhance the capabilities of its ongoing processes. For an organization to produce a high quality product, there is a need to change the processes of the organization. It is through Software Process Improvement Programs which identify and apply changes to current processes so that the new processes can help in producing the high quality product. There are many Software Process improvement Models those exist in software industry. This paper summarizes important SPI models those comprise of effective set of practices which can enhance the maturity of software organisations. A brief summary of each of the software improvement models is given in this paper.

OVERVIEW OF SOFTWARE PROCESS IMPROVEMENT MODELS

1. Capability Maturity Model

In order to have a proper management of the software processes in an organization, the Software Engineering Institute (SEI) had created a Capability Maturity Model (CMM) for developing and maintaining software. It elaborates how to evolve the processes so that the organization maturity is being increased gradually.
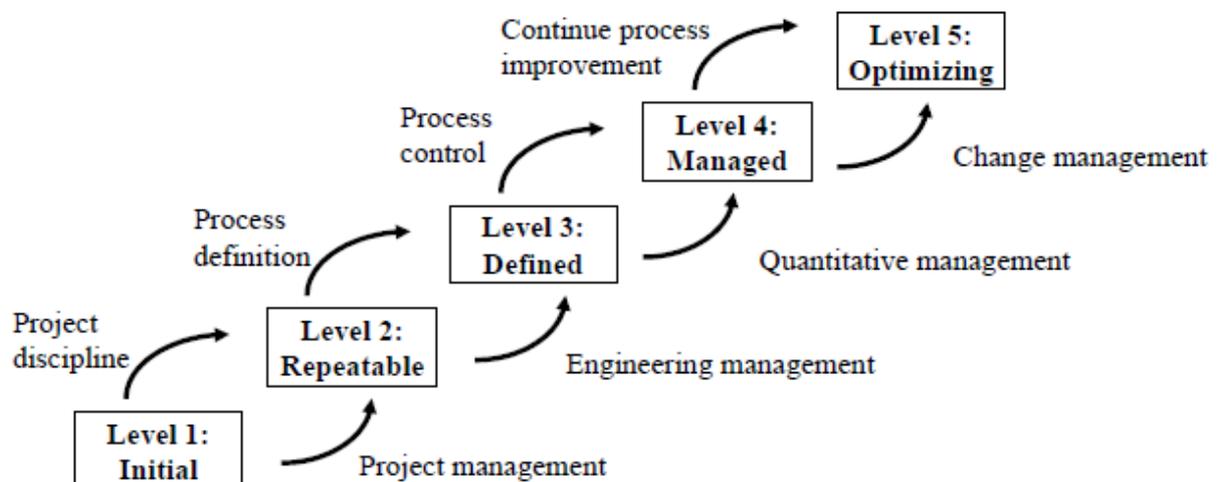

Fig 1: Maturity Level of CMM [19]

The SEI has developed a five-level Capability Maturity Model for software that provides organizations with guidance for measuring software process maturity and establishing process improvement plans. [10] The current processes of an organization are being identified and modified or changed in order to improve the quality of the software. [9] The CMM focuses on the organization's work processes. The Level 1 contains ad hoc processes, the level 2 contains repeatable processes, the level 3 contains defined processes, the level 4 contains managed processes and the level 5 contains optimizing processes.

2. Software Acquisition Capability Maturity Model (SA-CMM)

Acquisition means something that can be acquired or gained. SA-CMM is created so that the organization properly knows what is the goal of the project they had been handling with. [7]It may be sometimes that the project team who is handling the project may not have defined goals. In that case the product that is asked by the customer may not be fulfilled or developed and the quality is also affected. The SA-CMM is developed so that when the maturity levels increases, the capability of the project team will increase gradually as a result prediction of exact goal.

3. People Capability Maturity model (P-CMM)

The P-CMM is developed to provide a framework that continuously develops the human assets of the software or information systems organization. The P-CMM is an organizational change model. It is through P-CMM that an organization is able to identify the capabilities of current workforce practices and also able to evolve the workforce practices with the help of maturity levels of P-CMM. The P-CMM is constructed from workforce practices and process improvement techniques that have proven effective in many organizations. [2] The range of organisational processes that the P-CMM addresses is extensive and covers areas of workforce management. The P-CMM model is divided into five maturity levels .Each level in this model defines a new standard for people management practices. The first level is the initial state. The concept of second level is that a practice cannot be improved if it cannot be repeated. Institutionalizing the processes that work best is the core for the third level. Once the organization can adjust its process with process data it will end at level four. The fifth level is a stage where the organization focuses on continuous process improvement. [12]
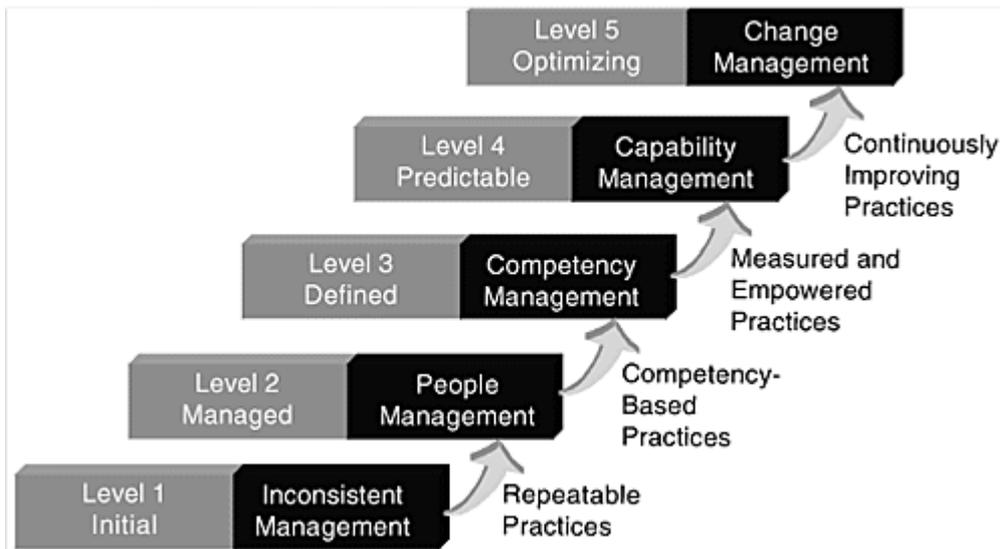
Fig 2: Maturity Level of P-CMM [2]

4. System Engineering – Capability Maturity Model (SE-CMM)

The Systems Engineering - Capability Maturity Model (SE-CMM) was developed by the Enterprise Process Improvement Collaboration (EPIC).To ensure a good system engineering, the essential elements of an organization are being described.[15]The essential elements for the model are being described from the basic technical, management, and support processes for systems engineering.

5. Software Process Improvement Capability dEtermination (SPICE)

SPICE is also known as ISO/IEC 15504.SPICE was developed to provide a framework for software process assessment so that the product can be delivered reliably .The main goal of software process improvement is to provide the software industry with gains in productivity and quality. [1]Capability dEtermination reduces the risk associated with large projects and at the same time helps purchasers to get better value for money. [16]
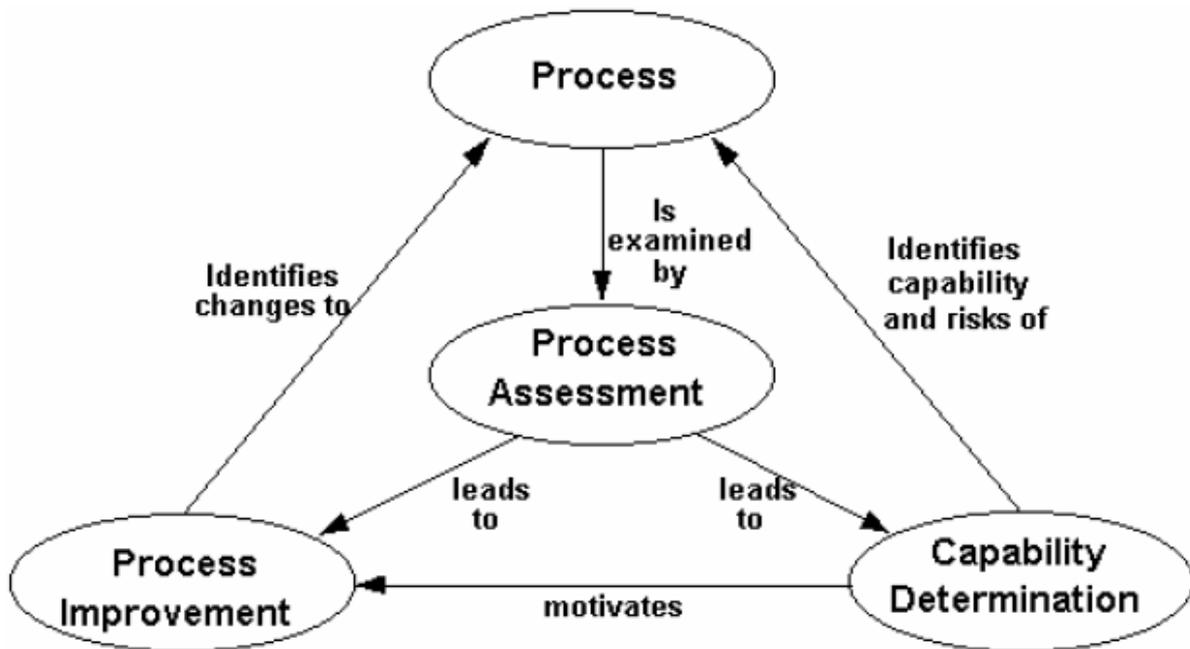
Fig 3: SPICE [16]

6. Bootstrap

BOOTSTRAP is a software process improvement and assessment model. It is basically developed for European industries. Its main goal is to speed up the use of software engineering technology in European software industry. [14] Software processes and product of different types can use BOOTSTRAP.A set of internationally accepted methodologies and software process types are being selected that result in BOOTSTRAP. It helps to identify the strength and weakness of the processes and support in software improvement planning so that organizational goals are being achieved and the quality of the products increases. 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. [20]

7. Trillium

Trillium has been developed by a consortium of telecommunications companies headed by Bell Canada. Trillium was developed with an objective that the organization who wants to implement software improvement programs can start and conducts software process improvement on an existing process. [4] The model is mainly concerned with the system and product development support activities, and a significant number of related marketing activities. The Trillium model contains eight capability areas and each capability area contains several "roadmaps" with practices at multiple process improvement levels. The

Trillium model is quite similar to the CMM. The key process areas of the CMM have been condensed into fewer capability areas that are elaborated and expanded into various roadmaps. [17]
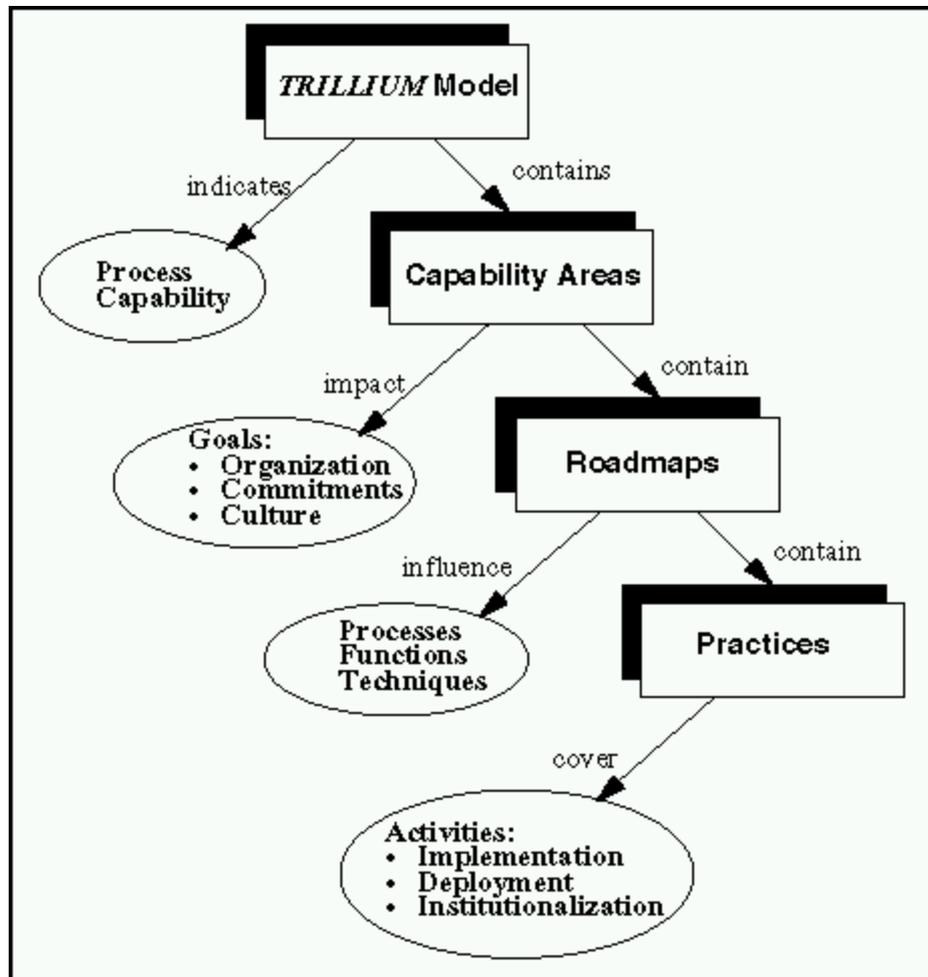

Fig 4: Architecture of the Trillium Model [18]

8. Capability Maturity Model Integration (CMMI)

CMMI is a process improvement model that provides a set of best practices that addresses productivity, performance, costs and stakeholder satisfaction. It is a model that consists of best practices for system and software development and maintenance and is used as a framework for appraising the process maturity of the organization.[8] CMMI has features like Integration of software engineering and system engineering, treating each process very minutely and focusing on continuous improvement.

Maturity Levels	Key Process Areas
Level 5-Optimizing	Organizational Innovation and Deployment Causal Analysis and Resolution
Level 4-Quantitatively Managed	Organizational Process Performance Quantitative Project Management
Level 3-Defined	Requirements Development Technical Solution Product Integration Verification Validation Organizational Process Focus Organizational Process Definition Organizational Training Integrated Project Management Integrated Supplier Management Risk Management Decision Analysis and Resolution
Level 2-Managed	Requirements Management Project Planning Project Monitoring and Control Supplier Agreement Management Measurement and Analysis Process and Product Quality Assurance Configuration Management
Level 1-Performed	

Fig 5: CMMI [13]

9. MIL-STD -498

MIL-STD-498 stands for Military-Standard-498.It was a United States military standard. It was released in Nov, 1994. The main objective is to establish uniform requirements for software development and documentation. MIL-STD-498A was released after MIL-STD-498.Then MIL-STD-498B was developed which was never released. From MIL-STD-498B, two new models were developed and released. They are ANSI/EIA 632 and IEEE 1220. [11]

10. Personal Software Process (PSP): The personal software process (PSP) is developed to provide the software engineers a way to improve the quality, predictability, and productivity of their work. It is designed to address the improvement needs of individual engineers and small software organizations. Various standard software engineering methods are being used by PSP, its principal objective is to show engineers how a defined and measured process can help them to improve their personal performance. The PSP provides software engineers with a defined sequence of upward-compatible personal processes that they can use to guide their individual development.[22]

11. Team Software Process (TSP): The TSP is designed such that the team as a whole is convinced to increase the effectiveness of the method they will use to increased the quality the product they will make. The TSP process is defined in a series of process scripts in a way so that it will describe all aspects of project planning and product development. TSP concentrates on the people aspect of the software triangle. It emphasizes the fact that "Together Everyone Achieves More". The principal benefit of TSP is that it shows engineers that working in a team, how to produce quality products for planned costs and on aggressive schedule by managing their work and owning their own processes and plans [21].

12. Six-Sigma: Six-Sigma is represented as "6σ".Its main objective is elimination of defects, waste, or quality control problems. The name Six-Sigma refers to the capability of the process to deliver units within the set limits. The technical concept of Six Sigma is to measure current performance and to determine how many sigmas exist that can be measured from the current average until customer dissatisfaction occur. When customer dissatisfaction occurs, a defect results. [5] If the internal operations are not well structured, a company will find it difficult to create value and be highly competitive. Six Sigma began as a focus on improving internal operations. [3] The methodology is targeted on the processes within an organization.. The organizational infrastructure of Six-Sigma consists of different levels of experts. They are Champions, Master Black Belts, Black Belts, Green Belts and Team Members. [4]

CONCLUSION

This paper rigorously finds some good SPI models that dominates software industry. Software Process Improvement models are now a days becoming part of software process improvement initiatives carried out in software industry. Market competition and the zeal to conquer the particular software domain make organization to experiment with different traditional, agile software development processes, tools and techniques. Researchers'

working on SPI finds software process improvement models ever evolving, ever growing and always changing field due to software process dynamics.

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