A Software Process Improvement Model (SPIM)

Pankaj Kumar, Gajraj Singh and Paritosh Kumar

Ramjas College, University of Delhi (India)
pkumar240183@gmail. com
Ramjas College, University of Delhi (India)
gajraj76@gmail. com
Thapar University Punjab (India)
paritosh200623@gmail. com

Abstract

Software Process Improvement (SPI) is a systematic approach and continuous improvement of software producing organization's ability to produce and deliver quality software within time and budget constraints. In the course of this project, the researcher developed, verified and validated such a model. This paper presents an approach to software process improvement model for improving the process overall. This paper focus on improvement in process as well as organisation. This model is based on experience on project of software companies, which covered assessment, software process improvement, factor which affects software process improvement. The ultimate aim is to develop a model which would be useful in practice for small software development companies. This paper also describes the principle of software process improvement and improvement models.

Keyword software process, software process improvement model

I. INTRODUCTION

SOFTWARE process improvement is an approach for the process improvement. The ultimate aim of the software process improvement is make a better result rather than the normal process. In past decades, a crises came around 1965-1985. At that time growth of project failure increase very fast. The output would not be better as needed. The crises manifested it-self in several ways:
1. Project running over budget
2. Project running over time

3. Software was low quality
4. Software often did not meet requirements
5. Project was unmanageable and code difficult to maintain. A lot of problems have come in to the project which leads to not a better result. For example Lack of management, lack of communication among the member of organisation. Software process improvement is a set of activities by which processes can achieve a high quality in the organization [1]. A lot of models are already existing such as CMM, ISO, IDEAL, and SIX SIGMA extra. CMM (capability maturity model) model is a popular planned methodology for improving the software process, which was developed by software engineering institute (SEI) in 1987. CMM have 5 levels of maturity, 18 key practices, and 5 common features. CMM model later on integrated, named as CMMI (capability maturity model and integration) [10]. Organization reaches the next level of model, if fulfil the 1st level of requirements. TQM is a paradigm for a continuous improvement approach for doing business through a new management model. TQM is made by the combination of three alphabetical letters T, Q, M.

As Total means involving the entire organization, supply chain, or product life cycle and Quality means the literal definition of quality as well as Management means the system of managing with steps like plan, organization, control etc. ISO (International Organization for Standardization) is a standard of quality management system. ISO is applicable for both software and hardware product. Standards ensure desirable characteristics of products and services such as quality. The ISO 9000 series consists of three standards: ISO 9000: 2000, Quality management systems – Fundamentals and vocabulary, ISO 9001: 2000 Quality management systems – Requirements, ISO 9004: 2000 Quality management systems - Guidelines for performance improvements [4].

Six sigma strategy was developed by Motorola in the early 1990s [7]. Six sigma is based on statistical approach having done the improvement by historical data and by calculation of mathematical formulas. Kaoru Ishikawa integrated the 7 statistical tools in the 1960's. These are seven quality control tools. The main purpose is to improve all kind of processes, promoting the interrelation and team work of all people involved. Combination of Six Sigma and these quality control tools is an important key of success in the company for a long time ago [11]. The SPICE model provides a framework for the assessment of software process. This framework can be used by organization involved in the planning, managing, monitoring, controlling, and improving the acquisition, supply, development, operation, evolution, and support of software [8]. SPICE identifies five level of process capability (which are very similar to the levels of process maturity found in SEI' CMMI) [9]. SPICE level are as followed: not performed, performed-informally, planned and tracked, well defined, quantity controlled. 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 [6]. Six Sigma reduced the defect step by step. Six sigma use two approaches for improvement.

DMAIC (Define, Measure, Analysis, Improve, Control) DMADV (Define, Measure, Analysis, design, Control) [5].

TABLE 1 Level of Six Sigma [13]

Sigma Level	Defects per Million	Defects as Percent
One sigma	690, 000.0	69.0000%
Two sigma	308, 000.0	30.8000%
Three sigma	66, 800.0	6.6800%
Four sigma	6, 210.0	0.6210%
Five sigma	230.0	0.0230%
Six sigma	3.4	0.0003%

IDEAL model is developed by software engineering group. IDEAL model is an approach to continuous improvement by some steps which are necessary to establish a successful improvement plan. IDEAL model contain five steps of improvement i. e. Initiating, Diagnosing, Establishing, Acting, Learning.

II. SOFTWARE PROCESS IMPROVEMENT

Process improvement is a change in the process to get a better output rather than original output. A lot of factor play important role in software process. Project should be with in time, under budget and better quality for long term business. Reuse of software process improvement can be utilising for next project. Software process improvement is a set of activities by which organisations can get a maturity in their process and fulfil all goals and get a high quality product. We can define process improvement as

"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" [2].

Software process improvement improves not only quality but also the process of organization. A simple software process improvement life cycle is presenting as follow
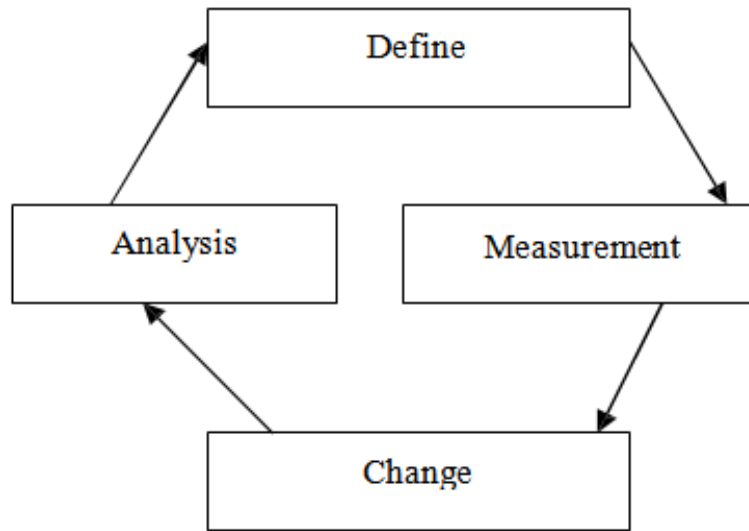
Fig 2: A Software Life Cycle

Software process improvement term is used for improving the organization. There are some activities for this;
1. Identify the current process
2. Identify the current status of the organization
3. Identify the strength and weakness of the organization
4. Analyse where the changes are needed
5. What will be the effect of these changes?
6. Understand these changes that how much they are affected

Some steps for the process improvement are following:
1. Aware for organization culture
2. Consistence should be there
3. Make target and keep in mind
4. Put a option in the process
5. Set up a well communication team member and senior management
6. Treat process improvement like a project
7. Make changes according to the priority
8. Make a profile of the company
9. Introduce a software process engineering group (SEPG) to your organization
10. Have patience
11. Reuse the previous result

A. Why do we need for Software Process Improvement?
Software process improvement makes an immature organization to a mature organization. An immature organization could not generate a good quality product. There are a lot of reasons for failure of good quality software. Like

there is no sense between the work methodologies, no support between the senior management and management. Project is only working and no reuse. No proper documentation of the project makes it un-work for next time. Project is not according to costumer demand. Costumer requirement is other than project can give. Project does not prepare in time and budget. There are a lot of shortcomings in immature organization. But mature organization provides a good quality to costumer with in proper time and budget. There is commitment between the employees. If there is any problem or any problem between management then senior management handle the problem and give a better solution.

B. The comparison between the Immature and Mature organization
Comparisons enumerated with tables as follow [12]

TABLE 2: A Mature Organization

Level	Characteristic	Key problem Areas
Optimising	Improvement feed back into process	Automation
Managed	(quantitive) measured Process	Changing technology problem analysis problem prevention
Defined	(qualitative) process defined & institutionalised	Process measurement process analysis quantitive quality plans
Repeatable	(intuitive) process dependent on individuals	Training technical practices process focus
Initial	(ad hoc/chaotic)	Project management project planning configuration management software quality assurance

TABLE 3: A Immature Organization

Level	Characteristic	Key Problem Areas
Foolish	(negligent) failure to allow successful development process	Software reuse
Stupid	(negligent) failure to allow successful development process	Development environments Repositories
Lunatic	(contemptuous) disregard for good software engineering institutionalised	Automatic programming

III. Software Process Improvement Model (SPIM)
Software process improvement model is an approach or method or both by which it improves process and give better result rather than a normal process. With the software process improvement a better and high quality product could

be found within budget and time.

The researcher proposes a Software process improvement model in this paper. This model is an iterative as well as cyclic model and it consists of eight steps.
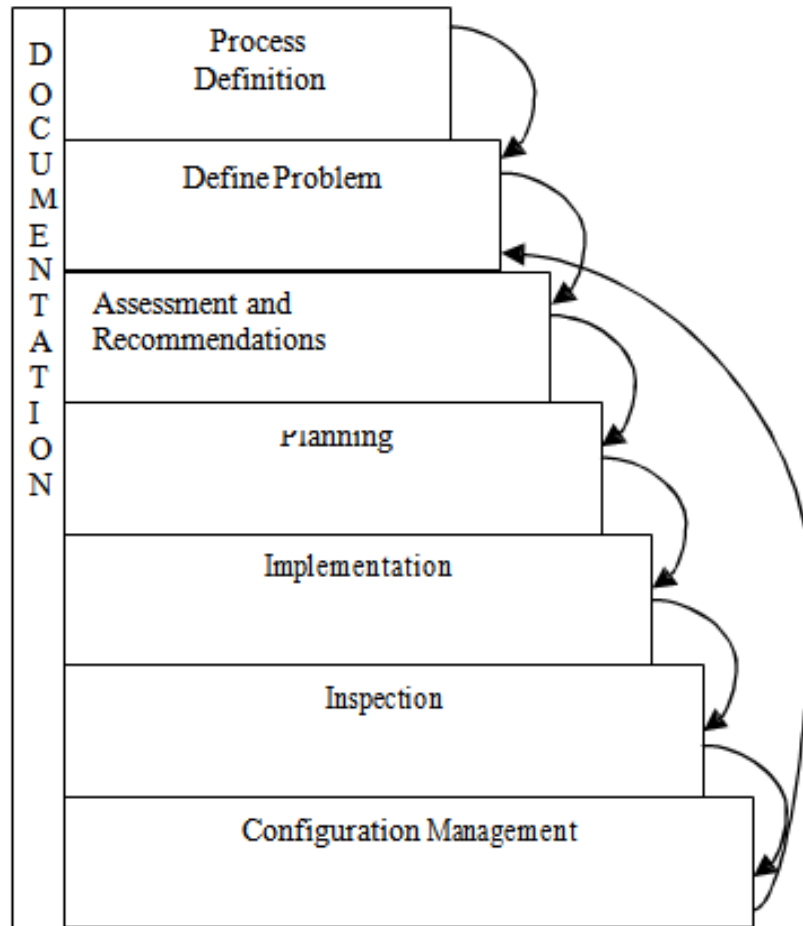

Fig 2: Software process improvement model (SPIM)

A. Problem in project

There are three problems which are mainly to be solved in the software project.
1. Projects are not of good quality
2. Projects do not deliver in time
3. Project goes over budget

B. Process Definition and Problem Define

A doctor gives the medicine when he knows about the patient diseases. Without knowing they cannot do anything. Similarly any process improvement

model can work accurately if one know the exact problems in the process. Therefore the main issue is to make problem clear at first. When problem become clear then a solution can be found.

A lot of reason may be part of unsuccessful project.
1. Lack of management
2. Lack of right communication inside organization
3. Lack of right communication between costumer and organization
4. Technical problem and lack of resources
5. Lack of man power
6. Lack of good training
7. Ego problem
8. Not working in adequate way

Every problem has some causes which can be presented by Decision table.

Table 4 Decision table

CAUSE	1	2	3
Lack of management	Y	Y	Y
Misunderstanding	Y		Y
Not provide good training		Y	
Technologies	Y		
Not well Communication			Y
Inadequate work		Y	
Lack of well communication		Y	Y
Manpower	Y	Y	Y
Ego power		Y	
EFFECT			
Bad quality	Y		
Over budget			Y
Over time		Y	

C. Assessment and Recommendation
Once the problem is defined, one can easily find about area need to improve and then according to problem an assessment team formed with recommendation of higher authorities. Team depends upon the management and size of problem. Team, which is so formed should be made of highly qualified and experience members. If the size of the problem is small, a team of 2-3 researchers are good enough. If the improvement area is large, then team will be formed according to the size of problem. Sometime software improvement is not so much effective because no one can say or give promise that applied technique or method can improve the quality of project and culture of organization. So if area of improvement is small like in small project, then

risk is reduced. But if area of improvement is of higher level then it may be a great risk. A project/organization take time for improvement and have no guarantee for success, but only probability for the success of same. So at this condition it is better to take sponsorship by the third party. But it requires higher authority's permission. They can take decision about timing of sponsorship needed. They have a meeting with senior management about the improvement of process and assessment of team like who should be the member of team for process improvement. This is very important step because team should be consist of highly qualified member and as small as possible with their role defined and known to them. Member of the team must be certified by SEI (software engineering institute) as only then they can take better decision in critical situation.

D. Planning
After formation of assessment team, they start work on the project. They make plan and prepare strategy about how can they improve process by finding changes required. For this first of all entire problems should be clearly defined. Team now make questionnaires for the members coming from different level in organization. Analysis the current situation of the company and then makes a profile for the future of the company. For that, they conduct interview of as much person as possible and make a plan. If there is more than one strategy for any process improvement, then they should choose one which produces the better result. With the approach defined, a detailed implementation plan can be developed by taking consideration of all the factors like, technical and nontechnical. When the team complete the plan, they have a meeting with the senior management and there they give a presentation to the seniors. By doing this they reduce risk level. At this situation assessment team is not responsible for any casualty. If the senior management comfortable with your plan, only then team would be allow to move towards next step of implementation plan. If they don't satisfied with plan, then alternative plan have to make along with the presentation. This plan includes schedule, tasks, milestones, decision points, resources, responsibilities, measurement, tracking mechanisms, risks and mitigation strategies, and any other elements required by the organization.

E. Implementation
When the plan establish according to problem, then create the solution according to plan. First make a paper solution on basis of experience and knowledge as well as skill of the assessment team. Then again gives presentation to the higher authorities. If they give some suggestion for modification in the solution, then modify the plan accordingly and if they are comfortable for solution then start the implementation. They choose a better solution. Before implementing the plan it should be discuss with the senior management and organization. When they are agree on solution, start working on the solution. All the solution does not apply in one step; it is a step by

step process. Makes a baseline after every step and take a pilot test and check the result if the result is positive then next continue the solution. If there are more then one solution. Then one shouldn't take decision by himself in this situation. Again discuss with the higher authorities. Whatever solution seems better, apply the solution. By doing this risk is less because at this situation team is not responsible and if the plan be successful the all the credit goes to the assessment team.

F. Inspection and Configuration Management

An inspection is generally an organized examination or a formal evaluation exercise. It involves the measurements, tests, and gauges applied to certain characteristics in regard to an object or activity. The results are usually compared to specified requirements and standards for determining whether the item or activity is in line with these targets. Inspections are usually non-destructive. It is not guarantee that the work plan and implementation is correct. For inspection a team is formed, in which members are moderator, reader, and inspectors. A formal meeting is conducted. Role of the moderator is to conduct the meeting and ensure the subject of the meeting. Role of the moderator is like a leader of the inspection team. So moderator should be highly qualified and skilful. Moderator tells the team how the inspection starts and leads them. Inspection team takes the interview of assessment team. They make a questionnaire for every member of team.

Review of the work done by all and they analyse the result. What result will come after process improvement? Review all the factors came in the technique. Main motive of the inspection is to find the defect in the module. If there are no defects then team will give the clean chit for the process improvement. If there is any problem in the technique then they tell where the problem is or what problem can be faced. What change should be done in process. They specify where the changes are need. This work is handling by the configuration management. Before a configuration item makes a baseline of the work. A baseline is a software configuration management concept that helps us to control changes without seriously impeding justifiable changes. Once a baseline is established, we pass through a one way door. After that changes inspection team again inspect the process. This process will continue till the defect does not end. And the improvement has done.

G. Documentation

Documentation is an umbrella activity in this model, which is going on side by side throughout process. In each phase documentation is needed. Documentation is needed for the future work so that anybody can reuse it as well as future work can be done. The documents associated with a software project and the system being developed has a number of associated requirements:

They should act as a communication medium between members of the development team.

They should be a system information repository to be used by maintenance engineers.

They should provide information for management to help them plan, budget and schedule the software development process [3].

IV. COMPARISON BETWEEN SPIM AND OTHER MODELS

SPIM model is different from other process improvement models. There are some comparisons between the SPIM and other models as following.

TABLE 5 Comparison between CMM And SPIM

S.No.	CMM	SPIM
1	The main problem with the CMM model is that CMM give the maturity level. That an organization across the level then it's entering the next level. But CMM does not specify the implementation.	In SPIM model implementation is defined and a proper document is prepared for every process.
2	CMM works on software.	SPIM works on software and organization.
3	CMM is a goal. Being used just as stamp of approval	SPIM model is a method.
4	CMM is works only a repeating task.	SPIM model does not work for repeating task only but also whole. If problem is change then this model works due to a cyclic model

TABLE 6 Comparison between Ideal Model And SPIM

S.NO	IDEAL MODEL	MODEL
1	Ideal model is also a continuous model. But it is a full method such that there is no recovery. Means either it is success or fail.	This model is a cyclic model. So if any problem face then it will work until improvement has not completed.

TABLE 7 Comparison between Six Sigma and SPIM

S.NO	SIXSIGMA	SPIM
1	Six Sigma is a statistically-based process improvement methodology that aims to reduce defects to a rate of 3.4 defects per million defect opportunities by identifying and eliminating causes of variation in business processes.	SPIM model is a planned methodology of continuous improvement methodology.
2	SIX SIGMA is iterative methodology reduced the defect one by one.	SPIM model is a cyclic and iterative model that improves the process one by one step. After completion of last step if further improvement are needed the cycle start again.
3	SIX SIGMA methodology works on two approaches DMAIC, DMADV.	SPIM works as a full flash model.
4	Six Sigma focuses on prioritizing and solving specific problems which are selected based on the strategic priorities of the company and the problems which are causing the most defects	SPIM model does not focus on prioritizing and solving problems. SPIM model solve all types of problems.

V. CONCLUSION

The SPIM software process improvement model improves the process in a traditional way. This model is an iterative model. The SPIM model does the process improvement stepwise. It covers user requirements, software quality assurance, and organization point of view. Many of the factors can be found in the organization from the SPIM model like management commitment and teamwork strength. SPIM model also covers the some limitation of existing model (CMM, SIX SIGMA, and IDEAL) . For example, the main limitation of CMM is main practice describes "what to do" but does not prescribe "how to do". SPIM model describe the implementation and prescribe how to do.

SPIM model is a flexible model. If there is a change come in process. It covers all the aspect of the changing of process due to its cyclic nature.

SPIM model reduce the risk as much as possible but with some limitations. It takes so much time in presentation and conduct the meeting. In the further work a lot of work can be precede on the SPIM model like removing the timing problem of the SPIM model.

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