

Experiences in Training for Software Process Improvement

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Abstract

An important factor for successful software process improvement are people, which need to be motivated and adequately trained to perform the process(es) being improved. And, although, there exist various software process improvement approaches, they, generally, do not provide detailed information on when to train what to which level of detail using which methodology. This paper reports our experiences and lessons learned in designing a tailored training program throughout a software process improvement initiative at the CYCLOPS Group at the Federal University of Santa Catarina/Brazil.

Keywords

Training, Software Process Improvement

1 Introduction

Successful software process improvement requires an effective alignment of people, processes and technology to establish process improvements that meet business goals. An important factor are people, which need to be motivated, committed and have the necessary competency to perform adequately the process(es) being improved. Even, although process performers may be competent to execute the process(es) in place, they may - especially in more immature organizations - lack knowledge on specific process areas, such as, e.g., requirements management. Inadequate knowledge can misdirect SPI efforts and, in practice, various organizations abandon their software process improvement (SPI) initiatives, because inappropriate training led to negative outcomes, or, in many cases, no implementation of proposed solutions [6, 11]. Thus, for SPI initiatives to succeed, organizations must properly align training to meet this need [6]. In practice, especially when considering SPI initiatives in small organizations, SPI training is often provided in an inadequate way, which does not satisfy the specific knowledge needs. For example, in many collaborative SPI initiatives, involving several small organizations at the same time, training is typically provided in blocks with a general training unit on SPI and reference models and then one unit about each process area (e.g., project planning or requirements management). In our experience, such training programs do not achieve their goal. Often the content of such trainings is too theoretical, too broad or too specific and does not provide concrete examples within the context of a specific organization. Especially, when considering that throughout a software process improvement program, there exist diverse training needs for different roles involved, e.g., basic understanding for managers in the beginning, process performers on the organizational standard process, etc., such a block design does not seem to be ideal. And, as it may be the only form

of training provided, typically, more people than necessary may be involved, consuming considerable effort spent in training [8]. Another factor is that such a training may be provided not related to the actual schedule of the SPI program and, thus, the delay in applying the acquired knowledge may contribute negatively on the learning effect and motivation.

Yet, especially small organizations often have to surge into inadequate off-the-shelf training programs, which often fail to teach people effectively on how to do their individual activities. And, although, there exist various software process improvement approaches, they, generally, do not provide any detailed information on when to train what to which level of detail using which methodology. Thus, a challenge lies in the design of appropriate training programs to support SPI initiatives that meet individual's training needs just before the knowledge is needed for work activities and that deliver the required knowledge cost-effectively with minimal schedule upheaval [9].

This paper relates our experiences in designing a tailored training program throughout a software process improvement initiative at the CYCLOPS Group (<http://cyclops.telemedicina.ufsc.br>) at the Federal University of Santa Catarina/Brazil. The CYCLOPS Group is a small R&D group that aims at the development and transfer of innovative methods, techniques and tools in the health care domain, including telemedicine, medical image analysis, 3D imaging, and workflow management in cooperation with several hospitals and medical clinics. Recognizing the need to improve its software process, the CYCLOPS Group started an improvement program in 2006. As part of the program, its software process has been organized and defined in accordance to CMMI-DEV [1], ISO/IEC 15504 [5] and MPS.BR [10] with a special focus on project management and requirements development and management.

2 Overview on the SPI Program

In 2006, we started the SPI initiative at the CYCLOPS Group adopting an enhanced version of ASPE-MS (Approach for Software Process Establishment in Micro and Small Companies) [4], an approach aiming at a cost-efficient and effective improvement of software processes in small companies. As illustrated in Figure 1, the principal phases of the approach are Initiation, Diagnosis, Strategic Analysis, Definition and Deployment, which can be executed in an iterative and incremental way in order to improve step-by-step one or more process(es) within an organization. In addition, the approach also covers the management of the improvement of the software process(es), including planning, monitoring & control and post-mortem.

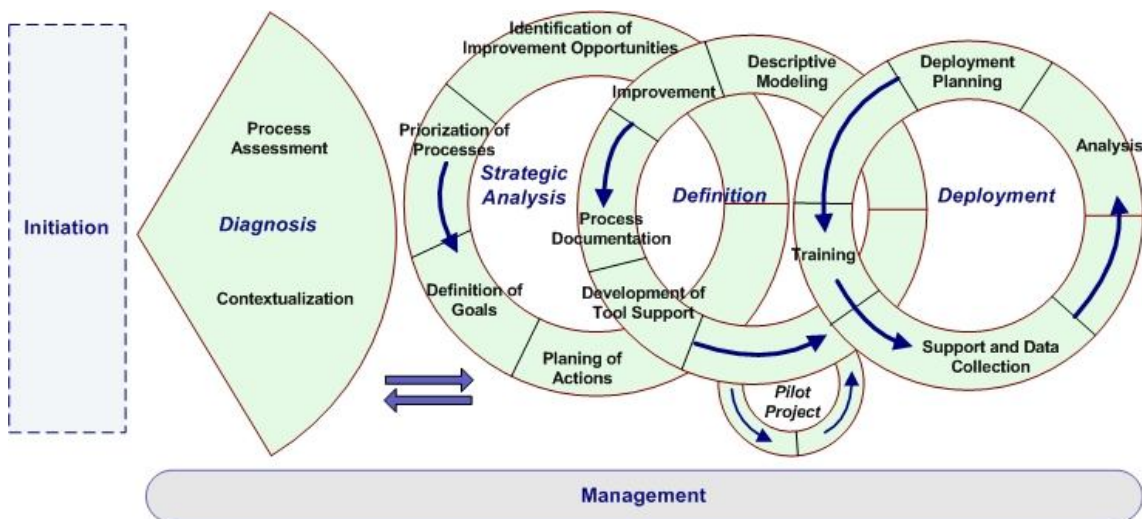


Figure 1. Overview on ASPE-MS approach

During the initiation phase, a high-level planning of the SPI program was done and the required infrastructure was created. This included also the contraction of 2 process engineers (one full-time and one part-time) with competence in SPI as well as external consultants.

During the diagnosis phase, the context was characterized and the group's business and improvement goals were identified. We run a process assessment using MARES [3] in alignment with CMMI-DEV, ISO/IEC 15504 and MPS.BR providing as result the current process capability profile and a target profile. Based on this information, a strategic analysis took place, in which was decided to focus in a first improvement cycle on project management, in a second cycle on requirements development and management and in a third cycle on verification & validation. Based on this, the SPI program plan was refined. We, then, started to define, first, the project management process, covering project initiation, planning, monitoring & control and finalization.

Following the ASPE/MSc approach, the process definition was done by eliciting the actual process in place through process workshops and, then, based on a gap analysis improving the process in alignment with the reference models. The standard process and any related information to the SPI program was documented on the organizational WIKI. As part of the process definition, we also enhanced the open-source tool dotProject in conformity with the group's standard process. Once an initial version of the standard process became available, we introduced the process through pilot projects and periodically revised the process definition with the project managers. When the process definition became more stable, we started to institutionalize the standard process organization-wide. Required resources, information and infrastructure were made available and allocated. During the first weeks, the Software Process Improvement Group (SEPG) closely followed the process deployment and provided support. As part of the institutionalization, we also introduced periodic internal process audits in order to monitor and control the adherence of the defined processes. Feedback on the process deployment is used to revise and, if necessary, to adapt the standard process. In parallel to the institutionalization of the project management process, we started the second improvement cycle focusing on requirements development & management. Here we followed the same steps. Currently, we are continuing to monitor and control the process adherence with respect to the project management and requirements development & management process. Today, more than 70 percent of these processes are characterized at least as largely implemented in the majority of the software projects of the organization in relation to the standard process. So far, we have not yet initiated the third improvement cycle.

3 Training Program

Based on our experiences in performing SPI initiatives in small organizations or cooperative projects as well as other experiences related in literature [2, 7, 8, 11], we designed a comprehensive training program based on the actual needs throughout a SPI initiative. As a consequence, we realized various training sessions throughout the SPI program, with different learning objectives, audience and instructional methodology. Figure 2 illustrates the different training sessions performed.

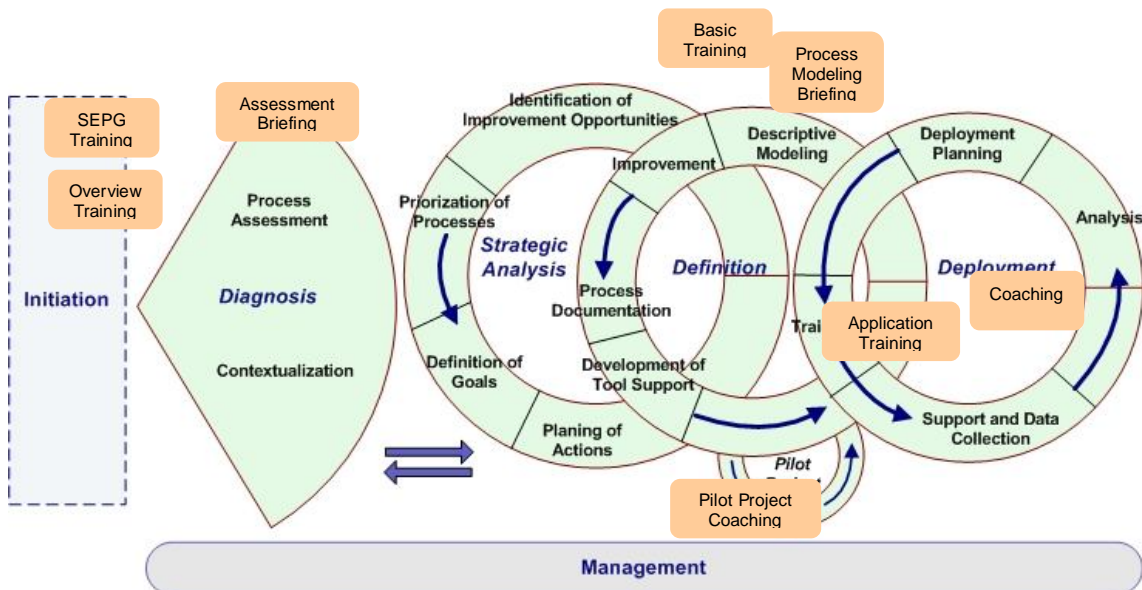


Figure 2. Overview on training program

SEPG Training. As a first step, we completed the training of the SEPG composed of two junior SPI consultants. Both SEPG members had already previous theoretical and practical knowledge on Software Process Improvement, reference models (principally CMMI and ISO/IEC 15504) and the process areas to be improved at the CYCLOPS group. In addition, both members of the SEPG participated in an official introductory course on the Brazilian process improvement model MPS.BR (16 hours). Further advanced topics in SPI were also covered in academic lectures, which both members attended as part of their participation in the Graduate Program on Computer Science at the Federal University of Santa Catarina. In addition, they were constantly assisted by the external consultants throughout the whole improvement program.

Overview Training. In the beginning of the improvement initiative, we also provided a one-hour overview training to all members of the CYCLOPS Group (including software analysts, programmers, managers etc.). The objective of the overview training was to provide a basic understanding on SPI, the improvement approach and reference models to be adopted. The training was also used in order to inform all members of the R&D group about the beginning improvement initiative, explain the steps and their planned involvement. One of the objectives was also to motivate the members and obtain their commitment. Therefore, the head of the group introduced the training and stressed the importance of the improvement program and the active participation of all members. The duration of the training was 1 hour and was held for all members of the organization. The training was provided by an external senior SPI consultant in form of an expositive lecture with discussion.

Assessment briefing. In the beginning of the process assessment, we provided a short assessment briefing in order to provide a basic understanding on the assessment objectives, the assessment process and the reference models to be considered. The objective was also to inform all assessment participants on when and how they would participate in the assessment and which information would be requested. Explaining the assessment objective and assuring the confidentiality of the information to be gathered was also intended to motivate them and obtain their commitment. The assessment briefing was provided in the beginning of the assessment itself and took about 30 minutes. The briefing was presented by an external senior SPI consultant in form of an expositive lecture with dialogue.

Basic training. Once a specific process had been selected for improvement, we carried out a basic training for this specific process. The objective was to provide a basic understanding on concepts, terminology and methods/techniques with respect to the process. The basic trainings were provided shortly before we started the elicitation of the respective process. The knowledge provided in these trainings is considered a pre-requisite for an effective definition of the process providing a common understanding and language to all participants. During the improvement cycles at the CYCLOPS Group, we realized the following basic trainings, so far as shown in Table 1.

Table 1. Overview on realized trainings

	Focus	Duration	Audience
1. Cycle	Project Planning	16 hours	Project manager
	Project Monitoring & Control	16 hours	Project manager
2. Cycle	Requirements Development	32 hours	System Analyst
	Requirements Management	08 hours	System Analyst

All basic trainings were provided by external senior SPI consultants in form of expositive lecture with discussion, including several concrete and practical examples and in-class exercises tailored to the specific context of the CYCLOPS Group.

Process workshop briefing. In the beginning of the process workshops, we provided a short briefing on process modeling presenting especially the graphical notation to be used. We also explained the objectives and expected usage of the process to be modeled in order to motivate the participants and obtain their commitment. The process workshop briefing took about 15 minutes and was presented to all participants of the process workshop, principally, representatives of performers of the respective process. The briefing was presented by an external senior SPI consultant in form of an expositive lecture with dialogue.

Pilot project coaching. In order to enable participants of pilot projects to successfully execute the process, we provided on-the-job coaching involving actively the SEPG within the pilot projects (ranging from 2 – 8 hours weekly). No formal training was provided at this moment of the SPI initiative, as the standard process was still being defined and, as the number of people to be trained was limited to

the personnel of the pilot projects. In addition, the intensive involvement of the SEPG assured a constant feedback and discussion of critical aspects of the standard process and facilitated also its evaluation.

Application training. Once an organizational standard process (e.g., on project management) had been defined and was being institutionalized, we provided an organization-wide training session on the standard process, presenting its objective, its execution step-by-step as well as demonstrating tools to be used during the process execution. The objective of the application training was to inform all process performers about the standard process and enable them to execute the process as defined. The application trainings with a duration of 2 hours each were presented by the SEPG of the CYCLOPS Group. We used various instructional methods, including an expositive lecture with an execution example based on a real case from the CYCLOPS Group. As part of the example, we also demonstrate the tool usage during the process execution. In order to further illustrate the standard process and to emphasize changes, we used two custom produced videos: one showing an exemplar execution of the informal process used before and one showing the newly defined standard process. The videos were set in an actual laboratory of the R&D group, starring members of the CYCLOPS group as actors. In order to assure the participation of basically all members of the CYCLOPS group, we offered identical application trainings at two different times, immediately before we started the organization-wide deployment of the respective process.

Coaching. Throughout the institutionalization of the processes, we are providing training in form of coaching. Coaching takes place periodically together with internal process audits, which have been established in order to monitor & control the deployment of the processes. During these audits, the SEPG assesses the adherence of a project's execution in relation to the organizational standard process. As a result of the assessment, detailed to-do lists on what has to be improved are provided as well as a general evaluation of the degree of adherence. Coaching then takes place by explaining the actions to be taken, assisting the process performer on-the-job in order to guide and to facilitate the process execution and by discussing any problems with regard to the standard process. In the beginning of each process institutionalization, we spent a considerable amount of effort on coaching summing up to approx. 20 person-hours/week by the SEPG. However, after the initial phase, we are continuously reducing this effort to now about 2 person-hours/week. Coaching also takes place on demand, when a process performer has any question or difficulty with respect to the processes being improved.

4 Lessons Learned

Comparing our experiences in designing the training program for software process improvement at the CYCLOPS Group to other experiences in other SPI initiatives, we observed several lessons learned based on evaluations of the training sessions themselves as well as subjectively perceived learning effects:

Training tailored to the specific context. One of the principal strengths of this training program was its tailoring to the specific context of the CYCLOPS Group. We customized all training sessions, using concrete situations and examples of the process execution and work products from the organization, which we elicited in cooperation with process performer. Comparing such a tailoring to more generic of-the-shelf trainings, as, e.g., typically applied in cooperative SPI programs, we perceived a significant difference on the understanding as well as the motivation, as tailored trainings illustrate much more convincingly which problems are to be solved and how. Tailoring training courses to a specific context, of course, requires a larger amount of preparation, yet the achieved benefits seem to justify the higher costs. In addition, the trainings were all provided in a form, which stimulated discussion and the exchange of experience of members, which in itself directly resulted in some improvements, besides the learning and engagement effect with respect to the training.

Only as much and when necessary. Especially compared to trainings typically offered as general training sessions in blocks, we considered the subdivision of the SPI training in several sessions at different moments of the SPI program a substantial strength. By dividing the training into several training sessions we were able to focus on relevant competence required at a particular step of the SPI initiative. As a consequence we were able to provide tailored training for specific audiences keeping

focus on exactly the knowledge, which was important for them. This had various positive outcomes: increased learning effect as exactly the needed knowledge was taught and reduced time spent in training, as the sessions were more focused and only people, which were in fact involved, participated. We also observed that the timely provision of the trainings, which allowed the participants to apply the knowledge immediately, afterwards, further motivated and increased the learning effectiveness.

Training can be fun. As one of the principal strengths of the trainings, the members of the CYCLOPS group cited the videos presented during the application training. We experienced the usage of such custom made videos, showing the standard process in a way the audience can directly relate to and even enjoy, an opportunity to receive the audience's full attention. Especially the fact, that the videos were produced within the CYCLOPS laboratory presenting real life scenes with actual members of the group increased the engagement during the whole training. An additional advantage of such video material is also it's just-in-time availability that accommodates individual schedules and needs as well as the training of new members and its aid to retention due to its ability to be viewed repeatedly, especially when filed with additional training material and process guides. We consider the production of such short videos (both of about 5 minutes duration) rather simple and worth the additional effort. The videos (figure 3) were produced in an inexpensive way by the SEPG in cooperation with a journalism student of the university. As a basis a high-level script was sketched and then filmed without any further preparation. The total effort for the production of the videos was about 40 person-hours.



Figure 3. Training videos

Training in cooperation with SEPG. For the training program at the CYCLOPS Group, we customized general training material based on information provided by process performers. This contact with the organizations' members also helped to create an open atmosphere characterized through mutual respect. The trainings were prepared and provided in cooperation by the external consultants and SEPG, coaching also the SEPG on-the-job in order to enable them to assume this responsibility in future improvement cycles.

Constant coaching during deployment. Based on our experience, one of the most important factors for the successful institutionalization of a standard process are its monitoring & control (e.g., through internal process audits) and constant coaching throughout the organization-wide deployment. We observed that, although, the application training was evaluated as adequate for understanding the process execution, process performers encountered various problems and questions, when actually starting to execute the process or process were simply not executed in alignment with the standard process as identified through audits. In this situation, we started to prepare concrete to-do lists based on the audit results and provided on-the-job coaching in which SEPG members assisted the project performers closely throughout the first process executions, if necessary. With progressed process institutionalization, we are now reducing this coaching effort, but maintaining a minimum in order to keep a communication channel with the process performers to obtain feedback on the process application.

5 Conclusions

Based on the comments and evaluations of the participants of the trainings and the subjectively perceived learning effect in practice, we consider the training program at the CYCLOPS group a success. Another indication is also the fact that various members of the group requested further trainings on subjects related to software process improvement, which shows the motivation and interest in SPI they developed. This one application is, of course, not sufficient to generalize the obtained results, yet, our approach may also serve as an example for training programs in other SPI initiatives. We intend to repeat the proposed training structure in other programs and perform more formal evaluations of the trainings and the achieved learning effects.

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