Software Process Improvement: Supporting the Linking of the Software and the Business Strategies

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Abstract. The market is becoming more and more competitive, a lot of products and services depend of the software product and the software is one of the most important assets, which influence the organizations' businesses. Considering this context, we can observe that the companies must to deal with the software, developing or acquiring, carefully. One of the perspectives that can help to take advantage of the software, supporting effectively the business, is to invest on the organization's software processes. This paper presents an approach to evaluate and improve the processes assets of the software organizations, based on internationally well-known standards and process models. This approach is supported by automated tools from the TABA Workstation and is part of a wider improvement strategy constituted of three layers (organizational layer, process execution layer and external entity layer). Moreover, this paper presents the experience of use and their results.

Keywords: Software Quality, Software Process Improvement, Business Strategy.

1 Introduction

Nowadays, the world's software industry increases because the software became part of many products and activities. According to Nollen [1], the Indian software industry reached about $23.4 billion in sales revenue in the Indian fiscal year 2004-05. The Chinese software industry was $26.5 billion in 2004. And the worldwide software industry size was $1,045 billion in 2004.

Moreover, the software is becoming one of the most important assets to the organizations, because their products depend more and more of the software's services and their characteristics.

Prahalad et al. [2], emphasized that in all businesses, from the consolidated ones to the volatile, the information technology is a critical source of competitive opportunities and risks. They also said that the software products are determining the nature of the experiences that the clients, employees, partners and investors have with the company, their products, services and operations.

Reed [3] highlighted that 40% of the world population will suffer with the consequences, if some globally used systems fail.

In face of a context where the software product is a very important strategical component to the organizations, and knowing that the software process can influence positively the quality of this product, we defined an approach to evaluate and improve the organizations' process assets, integrated to TABA Workstation, where the business objectives and the product quality objectives are strongly considered to the planning and actions of the improvement cycle.

This paper presents this approach and the results of a real experience of use in a software organization of Rio de Janeiro.

Following this introduction, section 2 presents some relevant consideration related to organizational strategic planning. Section 3 presents some knowledge about software process improvement. Section 4 presents the proposed process. Section 5 presents the results of the experience of use and section 6 concludes the paper.

2   Business Strategy

On this competitive market, defining an adequate strategy is fundamental, because, the strategy can be seen as a headlight pointing out the direction of the investments. Without this, the initiatives can do not obtain the expected outcomes.

Moreover, as the software is an essential part of the products and services of the companies, the developer and the consumer should define specially strategies to acquire and develop their software products. Today, the matter "software" and their related actions must be introduced carefully on the strategic planning of any company.

Strategy is the choice of the market segment and clients that the business unities intends to serve, identifying the critical internal processes where the units should reach the excellence to accomplish their value proposition to the clients of the target-segments and selecting the individual and organizational capabilities to achieve the internal, of clients and financial objectives [4].

Wright, Kroll and Parnell [5] said that the strategy should be established with the participation of the high managers to obtain results in harmony with the organization's mission and objectives. At the same manner, Thompson Jr. and Strickland III [6] understand the strategy as the plan defined by the administration to reinforce the position of the organization on the market, promote the clients' satisfaction and achieve the performance objectives.

One of the most used approaches that deal with the strategic management is the Balanced ScoreCard (BSC), which is a methodology to facilitate the organizations to align their management processes and to focus all the organization on the strategy's implementation at long term.

This methodology has four operational perspectives, which are listed bellow. The objectives and measures of the scorecard of each perspective derive from the organization's vision and strategy.

- **Financial Perspective:** indicates if the implementation and execution of the strategy is contributing to improve the company's tangible outcomes. This perspective aims to evaluate the financial and economic outcomes of the business, considering the strategic objectives.

- **Customer Perspective:** indicates how to create values to the organization's clients, how to comply a demand satisfactorily and to identify the reasons which the clients want to obtain the products and services.
- **Internal Process Perspective:** analyzes the organization's internal processes, including the identification of the resources and capabilities that the company needs to raise their level of quality. The organizations should focus on the critical internal operations that permit to satisfy the clients and stockholders needs. According to Kaplan and Norton [17] the organizations should identify and measure their essential competences and the critical technologies necessaries to guarantee their permanence as the leader of the market, from the complete value chain of the internal processes which includes three main processes: Innovation, Operation and Pos-Sale Services.
- **Innovation and Learning Perspective:** ponders the organization's cultural attitudes related to development and retention of talents and the creation and systematization of the knowledge inside the organization [4]. This perspective permits the organization to guarantee its capability of renewing at long term.

However, nowadays, others models similar to BSC have emerged. Maisel [7] defined the Balanced Scorecard model, with the same name of the model created by Kaplan and Norton. This model consists of four perspectives (financial, client, commercial process and human resource) to measure the business. Mc Nair et al. [8] defined an approach called Performance Pyramid, which defined as its basic principle, the focus on the clients, linked with the organization's strategy. Adams and Roberts [9] defined the EP2M – Effective Progress and Performance Measurement, where they highlighted that the implementation of the strategy is not sufficient, but the organization should develop a culture to prepare the company to the changes, that are constants and to permit to make decisions in a rapid way. In 2005, Kim and Mauborgne [10] studying more than 150 strategic movements, created the Blue Ocean Strategy. This strategy tries to guide the organizations to the innovation and to markets not yet explored. The focus of this strategy is not the competition but rather the creation of new markets, aggregating values and reducing costs.

3   Software Process Improvement

The success of an Improvement Program depends of some factors that must be considered adequately. For example: (i) providing sufficient resources [11]; (ii) customizing the Improvement Program to the organization's characteristics [11]; (iii) adjust the improvement objectives to the business strategy objectives [12]; (iv) considering other type of factors besides only technical factors [11]; (v) investing in the human resources qualification [13]; (vi) obtain the engagement of all collaborators [11]; (vii) provide support of knowledge management approaches [11].

In the face of the complexity of some technical, cultural and environmental aspects related to software process improvement, standards and models were created or evolved aiming to guide the organizations to define and improve their processes [14] [15] [16] [17]. Besides, some effective approaches were already defined.

Komi-Sirviö [18] presented the approach Pr2imer, where the actual situation is analyzed, an ideal state and their indicators are defined, pilot projects are performed and according to the results, the improvements are institutionalized.

Birk et al. [19] defined an interesting improvement process approach, which the main characteristic is to be guided to the organization's specific software quality requirements. Birk and Pfhal [20] presented and approach based on system perspective, emphasizing the business objectives, the product objectives and the process objectives.

Caivano [21] defined a continuous process improvement approach using Statistical Process Control. Martins and Da Silva [22] defined the approach SPI – ProPAM, which is supported by the alignment between the processes and the projects management. This alignment is defined as the degree which the projects' plan and goals support and are supported by the processes' practices. Salo and Abrahamsson [23] presented an approach focused on knowledge management, which the objective is to provide, systematically, knowledge and experience mechanisms to help the project teams to define processes more adequate and to improve the engagement of the teams, including the software process group.

4   Process "Evaluation and Improvement of the Process Assets"

This reality, described above, motivated the following research assumption: how would be possible to define and implement on TABA Workstation an strategy able to guide the definition and execution of software process to improve the organizational standard processes using data from the projects.

This approach had to have the following requirements: (i) it must be part of a major strategy (Strategy in Layers to Define, Evaluate and Improve Software Processes); (ii) it must be integrated to the TABA Workstation; (iii) it must be guided by the business objectives; (iv) it must be guided by the product quality objectives; and (v) it must be executed on a real situation. The approach was defined and was called "Evaluation and Improvement of Process Assets". It encompasses four subprocesses: (1) Identifying improvement opportunities; (2) Planning and implementing improvements; (3) Identifying preventive actions; and (4) Concluding the improvement cycle.

Subprocess: Identifying Improvement Opportunities
The purpose of this subprocess is to identify the improvements to be implemented on the process assets aiming to satisfy the organization's vertical and/or horizontal improvement objectives. It encompasses the following activities which are made up of tasks:

1.   **Characterize the improvement cycle:** the purpose of this activity is to characterize the actual improvement cycle of the organization. The process group, the high managers and the consultants (if exist) should to hold a meeting to identify important information to support this characterization.

   a.   **Identify vertical improvements:** objectives related to reach some level on maturity models should be identified.
   b.   **Identify horizontal improvements:** objectives related to the processes' performance or their suitability to the organization's needs should be identified.

c. **Identify business objectives:** the business objectives to support the selection of the organization's critical processes and the prioritization of the improvements should be identified. If the organization has already defined these objectives, it should review them.

d. **Identify product quality objectives:** product quality objectives to support the selection of the organization's critical processes, and the prioritization of the improvements should be identified. If the organization has already defined these objectives, it should review them. Before this definition, the process group should hold a meeting with the organization's collaborators to know their perception about the quality of the products. Besides, the organization could hold a meeting with the clients, a Forum of clients, to know the perceptions of them about its products and services.

e. **Identify and select the organization's critical processes:** the processes considered critical to the organization should be identified. As the problems of these processes are more relevant than others, these processes must be handled on this improvement cycle.

f. **Select projects:** the organization's projects, whose data should be analyzed on the actual improvement cycle to identify problems and improvement needs, are selected.

g. **Plan the process:** the execution of the process "Evaluation and Improvement of the Process Assets" is planned to the actual improvement cycle. On the planning, the activities and respective dates and resources should be defined. If some activity is not relevant to the actual cycle, it can be put out of the plan.

2. **Analyze processes to implement vertical improvements:** the purpose of this activity is to identify what are the improvements to be implemented on the organization's processes aiming to get a new level on maturity models, like: CMMI and MPS.BR.

a. **Identify changes to the processes:** the processes should be analyzed, comparing them with the expected results of the models, to identify the changes to be implemented on the processes. The Gap Analysis technique [24] or the Compliance of Factors technique [25] can be utilized.

3. **Analyze data to implement horizontal improvements:** the purpose of this activity is to analyze data from the processes executed on selected projects, to identify problems that are making difficult achieve the business and product quality objectives. This activity is performed by the process group and consultants, if exist.

a. **Analyze the results of the adequacy evaluations:** the results of the adequacy evaluations, which are always executed at the end of an activity, should be analyzed. The analysis should try to identify pattern of problems related to the training adequacy,

> support tool adequacy, template adequacy, activity's description adequacy and the activity's relevance.
>
> b. **Analyze data from post mortem analysis:** data from the projects' post mortem analysis should be analyzed.
>
> c. **Analyze results of the monitoring processes indicators:** results of the monitoring processes indicators should be analyzed.
>
> d. **Select others data sources to be analyzed:** if necessary, others data sources can be selected, to improve the contextualization of the analysis. The following data source can be selected: (i) processes adherence evaluation; (ii) work products adherence evaluation; (iii) lessons learned; (iv) guidelines; (v) processes changes; (vi) processes changes demands and (vii) results of the official assessment MPS.BR or SCAMPI.
>
> e. **Analyze others data sources:** if others data sources were selected on the anterior task, they should be analyzed.
>
> f. **Evaluate problems:** all the found problems should be evaluated. Optionally, the Matrix to Analyze Problems can be filled out to each process, aiming to confirm or refute the evidences. This matrix is based on the method to support qualitative analysis, called Content Analysis [26]. This technique tries to identify, mainly, the frequency and intensity of some information on the documents.
>
> g. **List the identified problems:** The problems identified during the analysis should be registered.

4. **Identify problems to be held:** the purpose of this activity is to identify the problems to be handled on the actual improvement cycle to achieve the vertical and/or horizontal improvement objectives. The tasks of this activity should be performed by all the process group's participants and if necessary, with the helping of the high managers.

> a. **Present problems:** the collaborators which executed the activities "Analyze processes to implement vertical improvements" and "Analyze data to implement horizontal improvements" should present to the others members of the process group, the results obtained from their work, helping the process group to select the problems to be handled on this actual improvement cycle.
>
> b. **Select problems to be handled:** the meeting's participants should select the problems to be handled, considering, mainly, the business objectives and product quality objectives.

5. **Identify the causes of the problems:** the purpose of this activity is to analyze the problems with the collaborators which performed any processes' activities, to find out the problems' root causes and to identify improvement opportunities to solve the identified problems.

> a. **Analyze problems:** the identified problems are analyzed to identify the root causes. In a meeting, predefined cause and effect diagrams to each problem are presented, supporting the discussion

between the participants and helping them to elaborate final versions of the diagrams. Other approach that can be executed to improve the understanding of the problems is to try to define the relationships between the causes using the Matrix to Discover Relationships or Influence Diagrams.

b. **Suggest improvements:** On the same meeting held to identify the root causes, the process group should capture improvement opportunities, which must come from the final version of the cause and effect diagrams.

6. **Identify improvement opportunities to be implemented:** the purpose of this activity is to present the results of the anterior activity to all members of the process group, supporting them on the selection of the improvement opportunities that must be implemented on the actual improvement cycle. If convenient, the high managers can participate on the execution of this activity.

a. **Analyze and prioritize the improvement opportunities:** the analysis of the improvement opportunities should be performed using, firstly, the approach SWOT Analysis, to deepen the knowledge of the opportunities. Then, the level of prioritization must be defined using the most appropriate approach, considering, especially, the complexity of the improvements and the characteristics of the process group.

b. **Select the improvement opportunities to be implemented:** After the prioritization of the improvement opportunities, the meeting's participants should define the improvements which will be implemented on the actual improvement cycle.

c. **Work out the improvement report:** a member of the process group or the consultant, if exists, should work out a report containing the obtained results from this subprocess.

Subprocess: Planning and Implementing Improvements

The purpose of this subprocess is to plan the implementation of the selected improvement opportunities, and to implement and institutionalize them on the organization. It encompasses the following activities which are made up of tasks:

1. **Change the process assets:** the purpose of this activity is to define and execute an action plan to implement the required modifications on the process assets. If exist high risky improvements to the organization, the action plan must consider the performance of pilot projects to evaluate them, before their institutionalization.

a. **Define the action plan:** the process group should define an action plan to guide the implementation of the improvement opportunities.

b. **Execute the action plan:** the collaborators of the organization should execute the actions defined on the action plan.

c. **Manage the action plan:** the process group should manage the execution of the actions defined on the action plan.

2. **Perform the pilot project:** the purpose of this activity is to perform one or more pilot Project to evaluate the high risky improvement opportunities, before their institutionalization. If they are not risky, the process group can do not execute this activity. All the tasks of this activity are performed by the process group.

    a. **Plan the pilot project:** the pilot projects should be planned, identifying the objectives, the assumptions and the data that must be collected.

    b. **Execute the pilot project:** the planned pilot project should be executed aiming to evaluate the effects derived from the modifications.

    c. **Analyze the results of the pilot projects:** the results obtained from the pilot project execution should be analyzed to decide if the improvement opportunities will be institutionalized. The analysis must verify if the effects are consistent with the assumptions defined on the planning.

3. **Implement the improvement opportunities:** the purpose of this activity is to implement the new process assets and institutionalize the improvements. All the tasks of this activity are performed by the process group.

    a. **Plan the implementation of the improvement opportunities:** the implementation of the improvement opportunities should be planned. When the improvement can not be implemented on the organization, like the creation of a new template, it will be required a new configuration of the TABA Workstation.

    b. **Perform the implementation of the improvement opportunities:** the new process assets are institutionalized on the organization in accordance to the planning and are incorporated on the Organizational Asset Library.

    c. **Training the team on the modified process:** the trainings required to guarantee the adequacy of the modified processes' execution are carried out and the implemented improvements are communicated to the stakeholders. These trainings can be carried out formally, inside the organization, by the members of the process group by the consultants or can be performed more informally, with the support of a mentor. Besides, the implemented improvements should be published on the organization, informing, mainly, the objectives, the origin and the expected outcomes.

Subprocess: Identifying Preventive Actions

The purpose of this subprocess is to analyze historical data of the organization's processes and define preventive actions aiming to eliminate or reduce the probability of the occurrence of imminent problems. This subprocess can be executed whenever the organization considers convenient. It is not dependent of the execution of others subprocesses. It encompasses the following activities which are made up of tasks:

1. **Analyze data focusing in preventive actions:** the purpose of this activity is to analyze organizational historical data to identify possible preventive actions.

   a. **Select processes:** the processes, whose data will be analyzed, should be selected.
   b. **Identify imminent problems:** the relevant imminent problems of the selected processes should be identified. These problems should be identified from the risks which occurred on the organization's projects and from the audit reports. Besides, the results of the monitoring process indicators can be used too.

2. **Establish preventive actions:** the purpose of this activity is to establish preventive action to reduce the chances of the imminent problems to become a real problem.

   a. **Define preventive actions:** imminent problems should be analyzed by the process group to define preventive actions, which must be registered, along with the related problems, on the Matrix of Preventive Actions. The stakeholders can help on the identification of the preventive actions.
   b. **Define preventive actions plan:** a plan including the preventive actions, the respective responsible person, the beginning and final date should be defined by the process group.
   c. **Execute preventive action plan:** the preventive actions should be executed in accordance to the preventive actions plan.
   d. **Manage preventive action plan:** the preventive actions should be managed by the process group.

Subprocess: Concluding the Improvement Cycle

This subprocess has two purposes: the first is to identify, analyze and register the lessons learned during the execution of the processes to permit their reuse. The second aims to collaborate with the consultancy companies (external entities), to support the improvement of their process assets. It encompasses the following activities which are made up of tasks:

1. **Register lessons learned:** the purpose of this activity is to identify the lessons learned during the execution of this approach ("Evaluation and Improvement of the Process Assets"). All the tasks of this activity are performed by the process group.

   a. **Identify lessons learned:** relevant lessons learned during the execution of the approach should be identified.
   b. **Store lessons learned:** the identified lessons learned should be analyzed to choose those that must be stored on the organizational repository.

2. **Communicate results to the consultancy company:** the purpose of this activity is to send the results obtained on the actual improvement cycle and on the official assessments (CMMI, MPS.BR) to the consultancy company to collaborate with its process assets. The improvement report or only a part of it should be sent, including pertinent information.

a.   **Send the report:** if pertinent to the organization, the process group should send, to the consultancy company, the improvement report or just a part of it. The results of the CMMI and MPS.BR assessments are also important to be sent.

5   The Experience of Use

We executed The Process "Evaluation and Improvement of the Process Assets" on the Software Engineering Laboratory (SEL) of COPPE, specifically on the Quality Sector, to evaluate its adequacy. This sector had implemented processes of MPS.BR level E and soon would be assessed in this maturity model.

The Quality Sector team was composed of a doctor professor, a laboratory coordinator, three project manager, one technical coordinator, one quality assurance analyst, one measurement analyst, two responsible for managing the configuration, one responsible to managing the reuse, analysts and programmers. The process group was composed of the laboratory coordinator and three project managers.

The laboratory's activities included three families of projects: (i) projects related to the development of the TABA Workstation; (ii) projects related to the development of CORE-KM, a knowledge management environment and (iii) projects to develop tools related to Master and Ph.D. thesis. All the projects used the software development process and the others processes (Measurement, Configuration Management *etc.*).

Nowadays, the laboratory has implemented the following processes: Project Management, Requirement Management, Quality Assurance, Measurement, Configuration Management, Organizational Process Definition, Reuse Management, Human Resource Management and Evaluation and Improvement of Organizational Process.

When this experience was carried out, there were three concluded projects and five were still in process. The three concluded projects were related to the CORE-KM. They were developed to an external client and one project manager and one analyst participated of it. The quality assurance analyst has audited the products and the adherence of the processes, measures were collected and the activities of the Configuration Management were executed.

As the concluded projects had used the tool AvalPro, one of the tools of TABA Workstation, we had data from the adequacy evaluations and post mortem analysis. We had also the quality assurance reports and the measures collected during the execution of the processes.

The use of the process was restricted to the subprocess 1: Identifying improvement opportunities and subprocess 4: Concluding the improvement cycle. The process group decided do not execute neither the **subprocess 2: Planning and implementing improvements** nor the **subprocess 3: Identifying preventive actions**. The subprocess 2 was not executed because none of the modifications were implemented before the moment of the assessment. And the subprocess 3 was not executed because it was not obligatory.

It is important to highlight that one of the authors of this paper participated on this experience as consultant.

5.1   Execution of the Subprocess 1: Identifying Improvement Opportunities

Activity: Characterize the improvement cycle
Three members of the process group participated in the execution of this activity. A meeting with the process group was held, where the improvement cycle was characterized.

On the meeting, they defined the following horizontal improvement objective: "analyze the results obtained form the execution of the processes, aiming to convert the processes of level E (MPS.BR) more mature and adequate to the reality of the Quality Sector of the SEL, examining, mainly, the processes where the measures present greater deviation from the expected performance.".

On this moment, the group does not defined none vertical improvement objective, because all the processes of level E (MPS.BR) had already been implemented.

The process group defined the following business objectives: (i) increase the confidence of the clients on the quality of the products and on meeting the delivery deadline; (ii) create an experimentation environment to high maturity processes.

Moreover, they defined three product quality objectives: (i) Reliability: the products, when installed on the clients' environment, must have a high level of reliability, with a high time between failures, which must be quantitatively defined to each project in accordance to its characteristics. (ii) Maintainability: the products must be easy to maintain and evolve; (iii) Usability: the products must be easy to use, without any need to carry out training when the software is evolved.

The Project Management and Measurement were defined as critical processes, using as the main criterion the level of relationship between the processes and the business objectives. A third process (Quality Assurance), also related to business objectives, was not considered critical because they did not perceived problems on it. The process Measurement, although considered critical to achieve the second business objective, was excluded from the improvement cycle, because did not exist sufficient data to analyze its adequacy and performance. So, on this improvement cycle, only the Project Management was considered as critical.

Finally, the process group select three concluded projects related to CORE-KM. After the characterization, a member of the group worked out the Process Execution Plan. The next executed activity was "Analyze data to implement horizontal improvements".

Activity: Analyze data to implement horizontal improvements
A member of the process group and the consultant identified tendencies of problems, analyzing data of the selected projects and processes. The analysis included data from the adequacy evaluation, post mortem analysis and process monitoring indicators of the three selected projects. The data were obtained from TABA Workstation, using the tools AvalPro and Metrics. At the end of the activity, the report "Tendencies of problems" was worked out.

Activity: Identify problems to be held
The member of the process group and the consultant, who had analyzed the data, presented the report "Tendencies of problems" to all the participants of the process group. On this meeting, the problems were analyzed again. They also decided to perform a causal analysis on the problem "The timeline estimative precision is far from

the expected", because it was considered important to the organization and it was extremely related to one of the business objective.

They observed that some problems were already being solved. Besides, they decided to handle some problems only on the next improvement cycle. Moreover, they established that two improvement opportunities should be handled on the actual cycle: (i) improve the template used on the activity Data and Communication Management and (ii) begin to use other support tool on the process Configuration Management, replacing the Bugzilla.

Activity: Identify the causes of the problems

This activity was performed in a meeting held with the participants of the three projects. During the meeting, the consultant presented a predefined cause and effect diagram to the problem described on the anterior activity. At the end, were produced: (i) the final version of the cause and effect diagram and (ii) a set of improvement opportunities.

Activity: Identify improvement opportunities to be implemented

This activity was executed in a meeting where the process group analyzing the results obtained on the anterior activities, prioritized and selected the improvement opportunities that should be implemented.

Firstly, a SWOT Analysis was performed in all the improvements, aiming to identify the barriers and the facilitators to the implementation. Then, the group decided that it was not necessary to define the level of prioritization of the improvement opportunities related to TABA Workstation and that they will be inserted automatically on the improvement report. On the same meeting, the group defined the level of prioritization of the others improvements: (i) develop the knowledge about the performance of the processes (quantitative models of process), (ii) improve the template used on the activity Data and Communication Management and (iii) begin to use other support tool on the process Configuration Management, replacing the Bugzilla.

To define the prioritization we used the Matrix to Prioritization (Table 1), where each participant of the meeting evaluated the improvements, considering the criteria of the matrix. When we defined the criteria of the matrix we tried to link the improvements to the business objectives and product quality objectives.

Table 1. Criteria used to prioritize the improvements

Criteria	Description
Seriousness	Seriousness of the problem.
Importance to the organization's business objectives	Importance of the improvement implementation to the organization's business objectives.
Impact on the quality of the software products	Impact of the improvement implementation on the quality of the organization's software products.
Impact on the productivity of the team	Impact of the improvement implementation on the productivity of the teams.
Impact on the satisfaction of the team	Impact of the improvement implementation on the satisfaction of the teams.
Impact on the satisfaction of the clients	Impact of the improvement implementation on the satisfaction of the clients.

After this, when the result of the prioritization was analyzed, we observed that they were very similar. So we used the Delphi technique [27] as a new approach to support the meeting of the consensus.

On this same meeting, the improvement opportunities were analyzed considering others criteria to choose the improvements that must be implemented, considering the short, medium and long term. The following criteria were used: (i) Effort: estimative in Men/Hour to implement the improvement; (ii) Resource Availability: availability of resources (financial, human and technological) to implement the improvement; (iii)Time: time to implement the improvement and (iv) Operational simplicity: simplicity to implement the improvement.

As the result of this activity's execution, was decided the following prioritization: (1) begin to use other support tool on the process Configuration Management, replacing the Bugzilla; (2) develop the knowledge about the performance of the processes (quantitative models of process) and (3) improve the template used on the activity Data and Communication Management. Finally, all the improvement opportunities were selected to be implemented on the actual improvement cycle.

5.2   Execution of the Subprocess 4: Concluding the Improvement Cycle

Some lessons learned were captured and registered during the execution of the approach: (i) The discussions between the members of the process group, occurred when the cycle is being characterized, is very important, because the objectives become more coherent with the organization; (ii) The definition of the critical process helps the data analysis to become more focused; (iii) The orientation of the decision must be always based on the business objectives and the product quality objectives, because the software is one of the most important asset of the companies; (iv) Structured data can speed the analysis up; (v) The predefined cause and effect diagrams helps the participants to remember others possible causes; (vi) The Delphi technique permits the decisions to be in accordance to the organization's needs and to the point of view of the majority of the members; (vii) All the points which were already defined, can be always improved in a new improvement cycle.

At the end, the members of the process group worked out the Improvement Report to be sent to the Consultancy (external entity).

5   Conclusion

Analyzing critically the experience of use in the Quality Sector of the SEL, we could observe, considering the execution of the subprocesses 1and 4, that the process was adequate. In spite of the subprocesses 2 and 3 were not executed, the process seemed feasible and useful, because the main subprocesses were performed.

The process group executed the approach easily. However, on the last activity of the subprocess 1, as the technique used was not adequate, we began to utilize the Delphi technique. Besides, the tools supported adequately the process, for example, the AvalPro. We could also observe that the definition of the business objectives and the product quality objectives were fundamental to the approach, because the it was

executed on behalf of the company. As we could see on the Balanced Scorecard (BSC), the software process has to become a real perspective. So, all the organizations must define and execute their software process to support the achievement of the defined organizational strategy.

After the analysis of the experience we could identify the following limitations of the approach: (i) The qualitative analysis is not well structured; (ii) There is not a tool to support the activities related to the preventive actions and (iv) There are not tasks responsible to evaluate the effectiveness of the implemented improvement opportunities.

Other challenge is to define and implement an approach to software process improvement adequate to companies that invest on innovations and have their strategies focused on the creation of new markets. So, others experiences of use must be carried out. Probably, formal and planned use cases to verify in other context the adequacy of the approach.

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