Proposal of the BPM method for improving NPD processes

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Abstract: Software development process (SDP) systematization in a NPD process, i.e. the definition of a standard process for software and new product development, is acknowledged as a key factor for the competitive development of technological SMEs, since most of the high tech products consist of software as one of their key elements. The standard process ensures repeatability and quality of project development. The process of SDP systematization is a change project that improves the NPD process. The definition of a development project based on a standard process establishes a working model, as well as supporting tools for the SDP. A change project like this must also be incorporated into the broader context of the company's change management, because it may affect different areas of the company. This work proposes a change management method and describes a practical experience in defining and institutionalizing an on-demand NPD process in a small enterprise that is integrated in a collaborative network of high tech SMEs. The focus of this implementation is on software development. The proposed method synthesizes the best practices of the following change management methods: SSM (soft systems methodology); IDEAL (initiating, diagnosing, acting, establishing and learning) Model; DMAIC (define, measure, analyze, and control) of Six Sigma. Two change projects have been carried out and are presented: "Definition of the on-demand NPD process" and "Implementation of the Sale Phase". This paper shows the results of these projects and reports on how the collaborators are dealing with the changes.
Keywords: change management, NPD process, project management.

1. Introduction

In spite of the fact that business process (BP) change has been present in organizations' routine, its effective management is far from being considered as part of the management culture (CAO et al., 2004). This new reality affects technological companies, so they are trying to handle this situation by seeking new management methods. This threatens the strategic survival of companies. BP change management has become a core competence for world class companies and should be evaluated by a strategic and holistic view. Or else, these changes will determine the course of the company, producing negative results, which are difficult to reverse (COUNSELL et al., 2005). A BPM approach is one of the solutions to this evaluation be succeeded and toward to the companies' strategic plans.

The change management methods and process analyzed in COSTA (2006) were considered very generic and none specific. Because of the fact that those methods or processes are very vague, they can be applied in any kind of problem.

This characteristic does not contribute with any template or standards that could integrate the change into a BPM approach. Those methods do not deal with NPD specific problems.

Therefore, a BPM method that integrates change management techniques toward NPD processes will contribute to the progress of management practices.

The objective of this work is to present a new BPM method focusing on NPD. This new method sought to join the best practices of five classical change methods which are complementary to each other.

The next section provides a literature review of BP change management methods. In section three the research method is briefly discussed. After that the BPM method and two applications to improve the NPD process of a software company are presented. Finally, the insights resulting from the action-research and suggestions for further research are discussed.

2. Literature review

2.1. BPM (business process management)

BPM is a structured approach to analyze and continually improve fundamental processes such as manufacturing, marketing, communications and other major elements of a company's operation. BPM focuses on the main aspects in which there is high aggregate value (ZAIRI, 1997).

BPM is regarded as one of the best practice management principles to help companies sustain competitive advantage (HUNG, 2006). It promotes the alignment of business operations to strategy priorities. In addition, BPM can be effective in helping companies to avoid falling prey to management fads by incorporating re-engineering, continuous improvement and benchmarking as improvement tools (LEE & DALE, 1998).

It is clear that BPM is an all-encompassing approach dependent on strategic elements, operational elements, use of modern tools and techniques, people commitment and, more importantly, on the horizontal focus that will best meet and deliver customer requirements in an optimum and satisfactory way. BPM should comprise a systematic problem-solving methodology that takes into account the integration of organizational functions to achieve better results from change projects (ZAIRI, 1997).

2.2. Change management

The term 'change' is related to a transition from one state or situation to another. This transition may involve changes in people's attitudes, behaviors and abilities to improve their performance (MOITRA, 1998). The term change are very known in the context of engineering change management, but here, in this article, this kind of change are not being considered. The transformations of companies and people's behaviors are the main issue of this paper. The search for needed changes is as important as having them implemented efficiently. Reports show that companies have been failing to carry out changes, because they do no not adopt adequate transformation processes or change management methods. Indeed, when companies adopt some methods or processes', they usually skip some of the method stages or activities; this produces negative results (KOTTER, 1995).

Despite the fact that some predisposition to change is inherent to all companies, the effective management of its implementation cannot be considered intrinsic to its organization management (CAO et al., 2004). Complex and long term changes, to be efficiently managed, should be implemented by means of a model that lead managers to reflect on the complexity, uncertainty, flexibility and comprehensiveness of future changes that can cause a high impact on the organization's technological strategy (CAO et al., 2004).

The change management method proposed in this article is a systematization of some change management methods; three of them are detailed below.

2.3. Change management methods

2.3.1. Soft system methodology - SSM

The SSM methodology evaluates the problem domain in a holist way, instead of a reductionism way, recognizing that the parts of one system are interconnected. Therefore a local change affects other areas of the same subsystem. Systemic thinking recognizes that a problem in one domain can affect other domains, so changes can also affect other systems (CHECKLAND, 1981).

SSM differs from other systemic methods because it considers people's perceptions about the reality, their points of view, and how these perceptions affect the design of future situations (BERGVALL & KAREBORN, 2002). This methodology attributes meaning to human activities, and these attributions are significant in terms of one particular point of view.

2.3.2. Ideal model

The activity of improving the software development process (SDP) for all companies that develop software is rather complex, expensive and very challenging (CASEY & RICHARDSON, 2002) The Software Engineering Institute (SEI), at Carnegie Mellon University, developed a model of SDP continuous improvement. This model was named Ideal, and it was published as a guide to improve SDP (MCFEELEY, 1996).

The Ideal model is an organizational improvement model that acts as a roadmap for initiating, planning and implementing improvement actions. Ideal stands for the five phases the model describes: initiating, diagnosing, establishing, acting, and learning. The goals of this model are: a) management of improvement program; and b) establishment of conditions to manage long terms strategies. Ideal was based on total quality management best practices, as well as on SEI´s experiences of projects such as capability maturity model (CMM); software process assessment; software capability evaluation; organization capability development; software process measurement; e software process definition (MCFEELEY, 1996; KAUTS et al., 2000).

2.3.3. DMAIC methodology

Six Sigma is an organized and systematic method for strategic process improvement and new product and service development that relies on statistical and scientific methods

to make dramatic reductions in customer defined defect rates (BRADY & ALLEN, 2006).

Six Sigma approach is a new way to measure the intern process efficiency. It is a systematic and rigorous methodology that uses statistic tools and methods to measure and improve the operation performance of an organization (BRADY & ALLEN, 2006).

Six Sigma is based on DMAIC, a systematic methodology for the analysis of problems and implementation of process improvements. The use of statistic tools and methods are necessary: a) to enable the definition of the problem and the situation; b) to measure this situation; and c) to carry out the improvements; and d) to control the processes that were improved. It creates a cycle of continuous improvement (ROTONDARO, 2002).

3. Research method

This work is part of a broader action-research project that is being carried out in a network of high-technology companies. One of the goals of this project is to promote the improvement of NPD processes of technological SMEs. Two Brazilian companies were selected from this network of high tech SMEs. One company develops web solutions and the other, embedded software.

To enable the achievement of the project goals the researchers modeled a generic process to sell and develop software on demand, which may serve as the basis to model processes of companies pertaining to this collaborative network.

None of these companies had already used a specific BPM method. Indeed, they had not conducted their BP changes as a project. The need of a BPM method aimed at their needs and objectives became explicit.

Planning the development of this change management method was based on the principles of action-research and hypothetical deductive method research. The Figure 1 illustrates this planning, showing a schematic view of the research phases.

In the first phase the following topics were studied: BPM, project management and product development process. The fist phase feedback appointed to BP change management methods that should be evaluated in the second phase. The third phase was aimed to systematize the BPM method. In the last phase the method was tested by mean of your application, which is described in the practical application of this paper.

4. Proposed BPM method

The method was initially developed focusing on software-on-demand development companies. The theoretical study about BPM served as a basis for the deduction of this method, which represents a synthesis of the discussed method. The validation or attempt to refute it
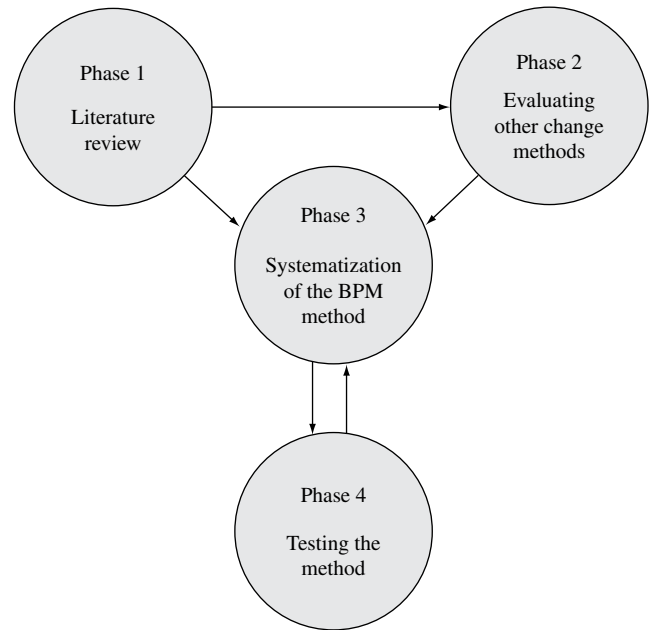

Figure 1. Phases of research project.

was carried out by means of action-research in a technology company (COSTA, 2006).

The method is based on the following methods/processes: SSM - soft system methodology (CHECKLAND, 1981), ideal model (MCFEELEY, 1996), DMAIC (BRADY & ALLEN, 2006), product development process transformation method (ROZENFELD et al., 2006) and transformation methodology - transmeth (RENTES, 2000). It should also be pointed out that the systematization of this method is anchored in PMBOK project management concepts (PMI, 2004). These methods were chosen due to their features: the systemic approach of SSM; the focus on software development process of the Ideal Model; the emphasis on the importance of performance indicators and concrete measurements in DMAIC; the focus on improvement of business processes in Product Development Process Transformation Method; and the strategic outlook of transmeth. Table 1 shows which best practice was select from each method analyzed.

Figure 2 represents the phases of the BPM method proposed.

The BPM method is cyclic, as are most of the change management methods, and comprises the phases of strategy definition, diagnosis and modeling of current situation, definition of change project portfolios and development of projects.

In the first phase of the method, **defining the change,** the need for change is evaluated together with the company's business strategy.

Table 1. Best practices of the proposed method versus best practices of the analyzed methods.

BPM method				Analyzed methods			
Phases	**Best practices**	**PDP T.M.**	**Ideal model**	**SSM**	**DMAIC**	**Trans meth**	**PMBOK**
Defining the change	Understand the need of the change		X			X	
	Analyze the change versus the business strategy					X	
Diagnosis	Analyze the current situation	X				X	
Evaluating the portfolio of change projects	Specify the change projects	X			X		
	Analyze the portfolio of change projects	X					
	Select the change projects	X					
Planning the change	Define the project sponsor	X	X		X	X	X
	State the product scope	X					X
	State the project scope	X					X
	Develop WBS (work breakdown structure)						X
	Develop the project schedule						X
	Evaluate risks	X	X				X
	Develop the necessary infrastructure	X	X			X	X
	Involve and train people	X					X
	Communicate and document the change planning						X
Analyzing the current situation	Diagnose of the current situation (as-is)			X			
	Define CATWOE (client, actor, transformation, weltanschauung, owner and environment)			X			
	Requirements gathering	X	X	X		X	
	Measure the current situation (as-is)				X		
	Communicate and document the change						X
Designing the future situation	Model the future situation (to-be)	X	X	X	X	X	
	Communicate and document the change						X
Implementing the change	Train the involved people	X					X
	Realize the change	X	X	X	X	X	
	Change the culture - weltanschauung			X			
	Communicate and document the change						X
Validating the change	Evaluate the change		X		X	X	
	Correct possible alterations				X		
	Compare the measurements of the current versus future situation				X		
	Communicate and document the change	X	X		X		X

The **diagnosis phase** seeks to understand the problematic situation to be changed. In the following phase, **evaluating the portfolio of change projects,** the proposed change projects are analyzed and their priorities are evaluated. This phase occurs only if several change projects have been considered, otherwise the next phase may be started. Some minor and simple improvements might be done without a definition of a project. Only medium and major projects, which are of higher priority, go to the next phase. Other projects are kept in the portfolio up to the time they become a priority.

Each one of the medium and major change projects triggers the next phase, **planning the change.** In this phase

the product scope, project scope and objectives are defined and refined. In addition, the work breakdown structure (WBS) is developed. Finally the project activities might be defined and a schedule is proposed.

In the **analyzing the current situation** phase a more detailed diagnosis of the situation might be carried out than in the diagnosis phase, depending on the level of detail is needed. The to-be process requirements are developed, and the quantitative e qualitative data of the present situation (as-is) are collected.

Subsequently, the **designing the future situation** phase starts to devise a solution taking into account the initial
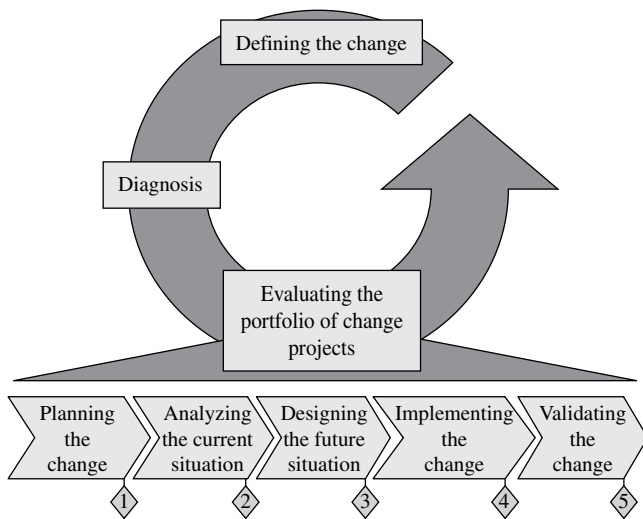
Figure 2. Change management method.

objectives and the project stakeholders' opinions. As a result, possible resistances are minimized.

After the future situation (to-be) has been modeled, each project triggers the **implementing the change** phase. In this phase the people involved are trained, the improvement is implemented and the stakeholders are communicated about the project situation.

The last phase of the method, **validating the change,** should start after a period of institutionalization of the changed process. It verifies whether any of the objectives has drifted away from what was initially planned. Furthermore, it analyzes the initial problem and whether needs have been met. Finally, the end of the change projects is communicated to stakeholders.

It is important to highlight that even though the BPM method may be executed periodically, it can also be triggered by the companies' needs. Furthermore, each BPM project has different project durations and can be stared at different moments.

5. Practical application

Software development companies are increasingly challenged to continually improve the quality of their processes and products. A pool of technology companies in Brazil, organized in a network, saw the need to define a software-on-demand development process as a way to promote the collaborative development of projects of new products, while assuring the quality of the products.

Two of these companies have participated in the first three phases described below.

5.1. Defining the change

To start this phase several meetings with stakeholders were held to elicit what had triggered the change and

its importance. The need for the collaborative network companies to understand each other's NPD processes was considered as a main goal. After these meetings, it was clear that a generic NPD process needed to be modeled so that the companies would have the same generic process as the basis for their own NPD process.

The high level of quality that the market imposes on software development companies was another point that highlighted the importance of the companies seeking the improvement of their NPD processes. This need was also present in the strategic plans of these companies. Then, the next phase was started.

5.2. Diagnosis

In this phase the need to evaluate how these companies had been developing their product was defined. Two companies were selected to be references. The ways both companies developed their software were diagnosed through interviews with key employees and modeling techniques.

The diagnosis revealed that neither company had standards for documents or a systematic view of their activities, as a result each project development created specific standards for all artifacts and activities.

Although it had been expected that the development process of on-demand software would be initiated by the sales team, it was observed that the technical team hardly ever participated in requirements development meetings with the clients. A problematic situation was established at the very beginning of the project because only the sales team gathered the requirements that would later influence the planning of the entire NPD project.

In addition, some qualitative data on the software development process performance were collected:

- high index of extra labor hours due to lack of planning;
- high number of projects delivered with delay;
- high number of projects that go over the budget;
- misunderstandings between sales and technical teams;
- high index of request for changes in the product; and
- failure in the management of artifacts.

5.3. Evaluating the portfolio of change projects

The diagnosis results led to the evaluation of change projects. It became evident that there was the need to elaborate projects that would fulfill partially the main objective of the change, which was the modeling of one generic NPD process and the improvement of the companies' NPD process.

Statements of work (SOW's) of these projects were prepared, which defined the project objectives,

budget, deliverables, main activities, main risks and the implementation duration.

The portfolio of change projects was evaluated through a spreadsheet. The following criteria were used in the analysis:

- project priority: defined by the company's top executives;
- project effort: a) technical difficulty; b) implementation difficulty; c) employee effort needed; and d) risks; and
- project importance: a) business strategy alignment; b) process weakness elimination; c) impact in the company; and d) capacity to meet clients' needs.

Three change projects have been defined: one for the whole network and two for a specific company. The first project consisted of defining a generic NPD process for the network. This project would be used as a reference to define the network members' specific projects. This paper refers to the two projects related to one specific company. They are: the definition of a reference model (standard process) of one company and the institutionalization of a phase of this NPD process. These two projects are described below.

5.4. Definition of a standard NPD process for one company

This project is based on the aforementioned generic NPD process.

5.4.1. Planning the change

The sponsors of this change project were the executives of the collaborative network and the owner of the company. The project goals were:

- to increase the software development efficiency and efficacy;
- to reach CMMi Level 2;
- to standardize documents;
- to improve the software development project control; and
- to increase sales.

The change project team comprised three researchers from de EI2 Group (University of São Paulo), one software engineer, one requirement engineer and the company's owner.

5.4.2. Analyzing the current situation

The current situation (as-is) analysis sought to investigate all the activities linked to the software development process. Therefore, the activities turned to the acquisition of new customers and activities related to the maintenance of the sold products were mapped.

The as-is situation was modeled and checked by selected collaborators by means of structured interviews. The existing templates and artifacts were also analyzed.

5.4.3. Designing the future situation

The definition of the future situation (to-be model) was based on the results of the previous phase and the best practices of CMMi Level 2.

Two posters were created to organize the information about the new NPD process and to facilitate the team's understanding of it. The first poster represented the activity flow and its inputs and outputs. The second showed the relations among the NPD process information pieces. An activity book was made in which every activity was detailed.

A second event at the company was carried out to show the new NPD Process to all collaborators. The presentation covered not only the overview of the NPD process, but also all the details of each new phase. The companies' collaborators made a report containing their criticisms and suggestions about the new NPD Process. This report was analyzed by the change project team and the necessary modifications in the process were performed.

5.4.4. Implementing

The implementation of the new NPD process was planned to be gradual, respecting the company's maturity level. Therefore the first phase to be implemented was the sales phase. This happened because of the company's characteristics. The company sold software on demand, which meant that the requirement phase of a generic NPD process was carried out during the sales process.

5.5. Institutionalization of sales phase of the first company's NPD process

5.5.1. Planning the change

The sponsor of this change project was the owner of the company because this improvement had a major impact on sales. The following goals were defined: sales increase; activities standardization; pricing decision improvement; improvement of communication between sales and technical team; improvement of utilization of CRM (customer relation management) system. The main risk found was the company's collaborators' lack of time. The infra-structure established for the project was a CMS (content management system), in which all the activity descriptions, document templates and resources were made available.

5.5.2. Analyzing the current situation

The team was divided into two groups: one to analyze the sales documents and the other to analyze the activities that should be performed by the technical team. The collected performance data indicated: misunderstandings between sales and technical teams; lack of control of proposal status; great number of proposals sent out with delay; high index

of failure in requirement development; and large quantity of mistakes in foreseeing project duration.

5.5.3. Designing the future situation

The artifacts and activities were refined based on the company's needs and constraints. Firstly, the sales process artifacts were developed as well as all resources such spreadsheets, procedures and reports generated by the CRM.

A short definition for each activity was defined, as were its actors, resources, inputs and outputs and necessary tasks to carry it out. Concurrently a website was developed, in which all the templates, procedures, activity details and phase drawings were posted to be downloaded by the company's collaborators.

5.5.4. Implementing the change

Training related to the new sales phase was divided to match the collaborators' profiles: technical and commercial. During the implementation, the change project team clarified all the collaborators' doubts, and chiefly highlighted the importance of their collaboration by following the new routines.

In an attempt to adapt the change to the company's culture, an event, named "launching the sales phase", was carried out. In this event all the collaborators were able to participate and express their criticism. The beginning of the two other change projects was communicated and the need for the company's collaborators' support was emphasized.

5.5.5. Validating the change

After the institutionalization period, an audit was performed to evaluate whether the collaborators were following the new routine. It checked whether all the generated artifacts were satisfactory. If they were, this would be an indication of good quality of the implementation. Afterwards, the accomplishment of the initial goals was evaluated:

Sales increase: Table 2 shows the monthly evolution in 2006 of the number of proposals approved by customers, sent to customers and number of activities inserted in the CRM system. The average monthly evolution was estimated before and after implementation of this project.

These data indicate that this project had a positive impact on the company' sales figures.

Table 2. Sales monthly evolution in 2006.

Item	Before	After	%
Number of proposals approved by customers	0.8	1.25	56
Number of proposals sent to customers	2.8	4	43
Number of activities inserted in the CRM system	40	135	238

Activity standardization: The standardization of activities decreased the time to prepare a proposal. Before the implementation it used to take ten days on average, afterwards, it fell to two days on average.

Pricing decision improvement: The proposals began to be dimensioned based on financial viability reports, this consequently improved the pricing decisions.

Improving the communication between sales and technical teams: One of the factors that hindered communication was poor of project duration estimates and requirements. Document templates, e.g. requirement document and schedules, were elaborated to eliminate misunderstandings in requirement gathering and planning activities.

6. Conclusion

This work shows that it is important that companies define a generic NPD process to be their reference model. In addition, despite the fact that no generic NPD process address the companies' sales process, results suggest that in some cases, such as the one under consideration, this should be done. The results also show the relevance of integrating sales and NPD processes to improve the development of products on demand.

Another conclusion that can be drawn from this study is the advantage of implementing the NPD process gradually. Most SMEs cannot handle company-wide improvement projects, so these major projects should be divided into smaller projects or phases, as happened in this action-research.

The portfolio management of BPM projects proposed in this method facilitated the implementation by projects. This approach promoted the perception that other improvement projects could be also implemented. This curbed the collaborators' attempts to expand one project to include goals of other projects. As a result, the change project can be performed according to what was initially planned.

On the other hand, the proposed BPM method indicates a good framework to manage the changes in a holistic way. It acted as a guide to promote change, providing the collaborators with a sense of confidence and optimism to the results. One of the reasons for this positive attitude of the collaborators was the fact that they realized the need for change and that they were able to participate in defining the transformation, sure that their opinions were essential to successfully change the company's processes.

It seems that both BPM projects shown have brought benefits to the companies. The changes have been successful and, moreover, they promoted the company's perception of the need for systematically seeking and effecting its improvement. It is hoped that the results of this work will encourage the company to keep on using the proposed

method and thus managing its changes instead of being managed by them.

Evidently, this method has to be implemented in other contexts so that its general applicability may be assessed. At present this is being done by the authors through the application of the method in question at another SME-with differing characteristics-that wishes to change its CRM system.

7. Acknowledgments

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