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## A case study about the product development process evaluation

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**Abstract.** The significance of business process approach has been increasingly recognized on new product development management (NPD). The challenge is how to build models to support it. This paper presents a model named PDPNet to provide it and describes an application case study in a agriculture machine enterprise. The data collect instruments are participant observations and document analysis. The results contains the description and an evaluation of the maturity level, considering the model proposed. The conclusion presents considerations about the support disposal by the model during the application, the challenges findings, and proposals about future research.

**Keywords.** Product development process, maturity model, transformation model

### 1 Introduction

New product development process (NPD) is vital to competitiveness in all sectors of economy. Among the best management practices is the business process (BP) approach [1], which seeks to integrate activities from different enterprise functions, in order to obtain performance excellence. To apply this approach is fundamental the use a formal NPD process, that means to produce a map describing the new product development process and provides a set of techniques that make this possible [2].

Kalpic and Bernus [3] demonstrated the importance of this approach in a case study specifically at the new product development area and explain how reference models can be helpful in project, management and execution of BP. Since the emergence of the BP approach on NPD, more or less elaborated models have been proposed to help professionals to identify the best available practices [4, 5].

The bibliographical review presented in section 3 analyses some one of most knowledge models and as a result two aspects to be noted. The first is the lack of NPD transformation models. The second one is the need to integrate the three types

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of models, i.e. process, maturity and change management. This implies the conception of distinct models evolving and kept independently, but which could be used together, allowing the diagnosis (by means of maturity assessment), identification of needed practices (with the process model) and prioritization and identification of transformation strategies in the change model (NPD change model).

Since 2002 a network of researchers and professionals interested in PDP have developed a reference model, PDPNet, composed of three independent and integrated parts: a process model, a maturity model and a transformation model. This work, through a case study, constitute an evaluation of the maturity according the model proposed and a description of the change management model application.

The objective of this paper is to present the PDPNet model and the account of an application case at an agriculture machinery enterprise. The study contributes to the development of the model by identifying perceived improvements and assessing its application potential.

## 2 New Product Development Process Management

One of the classical definitions of the product development process is given by Clark & Fujimoto [6] and marked the beginning of the utilization of the BP approach in product development management. Until then effective product development had been seen as the responsibility of engineers, thus disregarding the integration of marketing, planning and product introduction activities in factories.

In the last decade, it has expanded to include activities related to strategic planning and production follow-up and recalls, as proposed initially by Clark & Wheelwright [7]. Several theoretical models have been utilized as reference to design and improve NPD, e.g. Pugh [8], Clark & Wheelwright [7], Cooper [9], Ulrich & Eppinger [10], Ullman [11], Baxter [12] and Clausing [13].

These models focus mainly on describing practices—i.e. activities, phases, methods and tools—acknowledged as effective in product development projects. Nevertheless, these practices are often dependent on each other, i.e. the adoption of one of them depends on the existence of the others. This—aggravated by the broad and multidisciplinary nature of NPD process—makes it difficult to identify which practices, tools and techniques should be prioritized in specific cases where the model is being implemented.

In the late 1990's, there appeared several NPD models with distinct characteristics, focusing on the assessment of evolution levels: the maturity models. Besides indicating practices, a maturity model allows the assessment of the evolution level of companies as regards its adoption. The most famous of these models is the CMMi model by Software Engineering Institute [14]. After studying this model, it is possible to notice that—despite allowing level identification—it approaches practices rather broadly; it does not specify the best way to implement them as some of the more detailed process models do, e.g. the model described by Creveling [15].

### 3 The PDPNet Model

The PDPNet product development process was devised by a network of research groups and professionals in the field of product development management. These researchers got together in a practice community on the Internet and met regularly from 2002 to 2004 [16]. The result of this collective work has been recently published as a book, written in Portuguese, and as a web site [17, 18]. The model comprises three distinct parts: process reference model, maturity model and change management model, as detailed at the figure 1 and the following items.

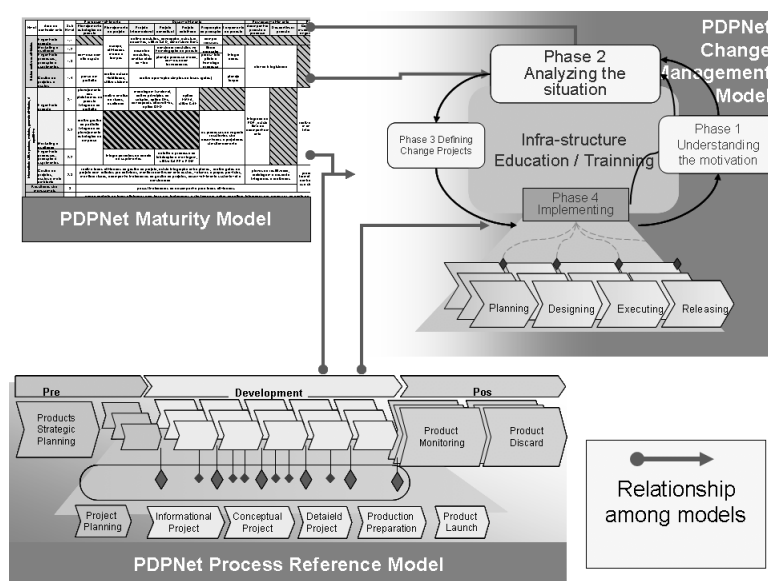


Figure 1. Reference Models

#### 3.1 The PDPNet process reference model

The PDPNet process reference model depicts the best practices for the management of product development processes, presenting and relating phases and activities to several practices and methods available in the field. Its goal is to integrate available practices and to elucidate them in detail irrespective of the company's evolution level.

The reference model is divided into three macro-phases.

**Pre-development macro-phase.** Pre-development is the link between the projects developed by the company and its goals. It includes the company's strategic product planning, which involves the Corporation or Business Unit Strategic Plan deployments on project portfolio, with the evaluation and track of selected projects.

**Development macro-phase.** This macro-phase includes the phases entail the detailing of technical, commercial and production information, involving elements such as technical drawings, prototypes, homologations, records, partnerships with suppliers and production processes.

**Post-development macro-phase.** In this phase one may assess the product performance in the market, its withdrawal and improvement processes that could be implemented.

### 3.2 The PDPNet maturity model

The NPD maturity model is used to support the identification of the evolution level reached by a company at a given moment. It depicts maturity levels and shows which activities should be formalized and implemented at each one of these levels. The description shows, therefore, a hierarchy of priorities in terms of activities so that higher levels can only be achieved if lower levels have already been reached. The model—according the CMMi model—utilizes five possible evolution stages:

**Level 1 – Basic.** When the company systematically carries out a set of practices deemed as essential for the effective management of product development. It is subdivided into five sublevels, each one grouping practices according to areas of knowledge: product engineering, marketing and quality, manufacturing process engineering and projects, costs and environment management.

**Level 2 – Intermediate.** Practices are standardized, thus results are predictable. At the previous level it was sufficient to have them performed, even with variations. This level is also subdivided into four intermediate levels consistent with the knowledge areas

**Level 3 – Measurable.** Besides being standardized, there are indicators that assist in assessing the performance of activities and the quality of results.

**Level 4 – Controlled.** The company works systematically to correct practices whose indicators have deviated from expected values.

**Level 5 – Continuous improvement.** There are institutionalized processes to improve the BP itself. They may take place in the short run or in the long run. The authors propose two models. The first model is the “incremental improvement process”, one of the processes that give support to the NPD reference model. The second one is the NPD transformation process model, which aims at deeper and long-term improvements.

Each maturity level indicates a set of institutionalized practices, as in the CMMi model. In the PDPNet model this is verified by formalized activities.

### 3.3 The PDP change management model

The PDPNet change management model describes how to implement desired changes so that companies may reach the maturity level. It is based on concepts of change management and project management, since broader change actions become projects.

The core of the model is the infrastructure for change. The first step is to define an organizational structure through which the change may occur. Defining responsibilities clearly avoids the common mistake of identifying improvements in

the development process, assigning them to a professional—or to a group—without an effective follow-up process, which could result in inaction in the long run.

The second infrastructure aspect to be tackled is the team's *modus operandi*. Since it is composed of dedicated professionals whose role is critical to routine NPD activities a simple routine is needed. It cannot compromise members' performance in the remaining activities.

Finally, to enable the Committee members to make decisions and prioritize improvement projects more effectively it is necessary to provide them with reliable and adequate information about the product development process. When this infrastructure has been created, the model proposes that the transformation cycles should be initiated. There are four distinct phases: **Phase 1** - Understanding the motivation and necessary changes; **Phase 2** - Analyzing the situation; **Phase 3** - Defining change projects and **Phase 4** - Implementing actions.

## 4 Method

The research methodology employed was a single and holistic case study according to Yin [19]. The BP of the agriculture machinery company (soil preparation and planting) in question constituted its analysis unit, considering both the product development process and the actions taken to improve it. The complete activities involved three steps which have been described at sections 5.1, 5.2 and 5.3.

During the investigation the researchers accompanied the implementation by visiting the company for 18 months on a fortnightly/monthly basis. Data were collected via documents and field observations.

## 5 Analysis and Results

The company under consideration is located in Brazil and has 400 employees. It produces a variety of agriculture machinery, especially for soy bean and corn crops. It exports to several countries, is ISO-9001 certified and is known in the market for its quality products.

The company operated in a classical functional manner. The functions that participated in product development were: product engineering, process engineering, prototypes, ferramentaria, technical assistance and Production and Planning. The functional area of product engineering involves around 15 engineers and designers. The company's functional approach was another problem acknowledged by its top administration. There were several inefficiencies such as faulty manufacture of tools, delays in detailing the process and delivering the product, among others concerning the application of classical management methods. The main inefficiency was the average time of new product development, which was estimated to range from 1.5 to 3 years.

The main phases of the improvement program were described in the sections below.

### 5.1 Diagnosis of new product development process

This phase comprised a critical analysis of the company's problems, whose goal was to assess its maturity level in the management of the new product development process. The diagnosis was carried out by the researchers in the first semester of 2005, during four weeks on a weekly basis.

The analysis was conducted internally by the NPD director with the help of one of the designers from the product design area, using the maturity model assisted by the process reference model. These professionals began by identifying the documents that described the company's NPD process. The most important documents were the Quality Assurance System procedures. The documents and these professionals' experience assisted in carrying out the activities and identifying the level of formalization. The results were discussed with the researchers.

The results showed that the company had a well established set of institutionalized procedures for more conventional and routine development activities, deriving from the Quality System.

However, some relevant gaps were identified according to the maturity model: **Product portfolio**, the company did not have a formal system to manage the portfolio of new products; **Project planning**, it did not seriously take into account aspects such as risks, customers' needs, project strategies; **It did not have phases and gates (phase transitions)**, although there was a procedure to carry out development activities, phases were not formalized; **Flaws in institutionalized procedures**, there were certain flaws in the identification and control process of new product projects; **Functional structure**, the company displayed a classical functional organizational structure.

The company was classified as being in Level 1.1. of the model. The assessment allowed the group to have a shared vision of the main inefficiencies that needed to be tackled.

### 5.2 Structuring the NPD improvement program

The group chose to introduce two fundamental measures: to define formally the project manager's role and to define the improvement team.

A matrix structure was established by creating project manager positions. There were three areas so as to incorporate new markets and types of equipment and a new functional area was also created to address the performance of tests, prototypes and high technology projects.

A team of managers from the product engineering area, the Engineering Committee, was in charge of the program. People of related areas are invited to participate as specific needs arise. Results generated by teams are presented to the Committee, which has the responsibility of validating new standards.

This infrastructure evolved and was consolidated at the end of the work, when it was named as Project Office. It assists in the improvement program as well as in the work carried out by the project Managers. The tasks assisted are: elaboration of standards and procedures related to the NPD process, consolidation of information and product portfolio reports, generation of information on performance and

progress of NPD projects, generation of information about NPD improvement projects, assistance in conducting process improvement processes.

### 5.3 Identifying and carrying out improvement projects

The main goal selected for the first phase was to reach Level 1, i.e. the basic level of the maturity model, thus obtaining a stable development process. Four initial projects were chosen: 1) Introduction of a system to create and manage the project portfolio (medium term); 2) Implementation of system to control resources (medium term); 3) Improvement of document management system (short term); 4) Mapping of NPD process with phases and gates (long term).

The mapping project was put on hold, and the teams' efforts were directed to the other projects. Two projects were finished on time: Aggregated project plan and Solution of specific problems in the document management system.

A third project was partially implemented in this period of time: project to implement a resource control system. This project involved the introduction of information systems capable of integrating resources from diverse functional areas in a single pool, discriminating their allocation in each project. It allowed the introduction of weekly planning of activities performed by people involved in the development of the company's products.

As the previous projects were finished new improvement projects were initiated: Mapping and optimization of the project procedure for supplied parts and Organizational restructuring of areas related to NPD.

The first project is over now and the second one is in its final phase.

This effort resulted in a project prioritization system that contributed a larger quantity of products to the company. The final result was the achievement of the basic maturity level, as initially planned.

## 6 Conclusions

Results from the case study and the analysis of the model indicate that the PDPNet model helped to build a permanent transformation process of the company's NPD business process, which indicated the best practices as well as allowed the establishment of a system—internal to the organization—to keep this ongoing until strategic goals were reached.

The PDPNet model has classifications in process areas and types of basic elements (activities, phases and gates) that were followed in the three models. This aspect was fundamental throughout the implementation, in particular the classification of knowledge areas and phases in the maturity model. They allow the direct identification of activities that are related to gaps in terms of the company's maturity evolution. Then, users may identify which methods, tools and principles can be implemented to improve the activity.

The transformation model, surprisingly, gained more importance than the other models in the case in question and was fundamental to the success of the implementation. When the company's professionals understood the concept of systematic changes deriving from improvement projects the team's focus was

enhanced and the performance of improvement actions advanced. This suggests that transformation models should be studied and be regarded as important as the process and maturity models as to the pursuit of efficacy in NPD management by processes.

In terms of research project, the work emphasizes the importance of continuing to develop the change management model, which played a fundamental role in the implementation under consideration.

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