
Identification of critical points for the implementation of a PDP reference model in SMEs

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Abstract. Numerous practices and principles are available to improve the company's Product Development Process (PDP), including multifunctional teams, integrated development process, integration of market evaluation to product development, and product life cycle analysis. Indeed, the importance of PDP systematization and organization is widely recognized, and the existing reference models offer a representation of the PDP. However, most companies fail to incorporate these practices into their routine to improve their PDP, since the implementation of a reference model or the PDP transformation process are influenced by the company's organizational structure. This paper identifies and discusses several critical aspects of the PDP transformation process of SMEs, based on an analysis of the implementation of a reference model in a Brazilian SME. The analysis of this experience enabled us to pinpoint various difficulties attending the transformation of the PDP, which we then compared with the literature on the transformation process. This comparison led to the identification of critical points for the SMEs structure and organization for PDP improvement. These observations are expected to support the design of PDP transformation models, thus helping SMEs to enhance their competitiveness.

Keywords. Small and medium enterprises; Product Development Process improvement; Transformation model

1 Introduction

The product development process (PDP) management knowledge gradually evolved accompanying the management theory evolution. The product view was amplified and the process involves several knowledge areas participation. To this purpose, the PDP become composed by multifunctional teams and concurrent activities. Nevertheless, several companies although have an initial stage PDP, without standardization and with a sequential development process.

The other aspects highlighted by the new approaches are the initial stages of the PDP, the very well defined information flow, and the customer focused philosophy. A PDP reference model comprises activities, tasks and tools related to

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the product development steps execution. Those models are developed to indicate the PDP best practices. Those best practices comprise the principles indicated by the reference philosophies, tools and approaches, as the Concurrent Engineering, the Product Based Business, and the Integrated Product Development. There are many authors describing several models. The most known are Hollins and Pugh[1], Pahl and Beitz[2], Roozenburg and Eekels[3], Copper[4], Crawford and Benedetto[5], Dickson[6], and Kotler[7]. They summarize the answer to a PDP's improvement need in order to reduce the development time and costs. The high competitiveness made that the development process steps incorporate the strategic items, focusing on the customer needs [8].

The PDP literature is largely disseminated, and offers different models. The difficulties are on the reference model implementation on the companies practice, especially on the small and medium enterprises (SME).

The most common way to classify companies is the company's size. Nevertheless, the SME do not have homogenous culture and practices. The specificity of the management of SME tends to disappear with the modern practices as net business, risk capital use, and global market. In this context, those companies tend to have the similar management as the great corporations [9]. In this paper we suppose that the initial approach on low maturity level companies is the sequential development. On this context, the reference models are presented as an important guide providing benchmarking to PDP structuring.

Hunter [10] emphasizes that the organizational structure is related with the company's innovation posture. As the author says, the organizational structure design is defined by contextual and structural elements. The **contextual elements** include the strategy, environment, technology, business size/ life cycle and the culture. The **structural elements** include reporting relationship, decision making processes, communication processes, coordination of work, forms of complexity and distinguishing characteristics.

This paper objectives the identification of the critical points for the PDP reference model implementation on the SME. Those points are identified from the characterization of a medium sized company.

2 Method

The Hunter's [10] elements are related to the company's behavior on its ambient. This paper characterizes those elements in a low to moderate maturity level company's reality. From this evaluation, some aspects to understand the low to moderate maturity level company's culture were identified.

The evaluation of the Hunter's elements was conducted based on the management areas. The relationship between the Hunter's elements and the management areas is presented in the Figure 1. The closed cell represents the management areas contemplated by the Hunter's elements.

			Strategic planning	Information management	Quality management	Financial Management	Human resource management	Product management	Process management	Technologic management
Organizational structure design elements (HUNTER, 2002)	Contextual elements	Management area								
		Strategy								
		Environment								
		Technology								
		Business size/ life cycle								
		Culture								
	Structural elements	Reporting relationship								
		Decision making process								
		Communication process								
		Work coordination process								
		Forms of complexity								
		Distinguishing characteristics.								

Figure 2: Management areas and Hunter's (2002) structural and contextual elements

The critical points identified on the management areas are related to the contextual and structural elements and will assist the diagnostic step on the reference model implementation. The management areas to be evaluated are Strategic Planning, Information Management, Quality Management, Financial Management, Human Resource Management, Product Management, Process Management and Technologic Management.

3 Literature Review

The small to medium sized and low to moderate maturity level companies' related literature was investigated. The literature suggests that all companies need some level of flexibility, depending on their environment, despite their size [9]. Some new tendencies for modern management views that define the high maturity level companies were identified. The new approaches highlighted the organizational structures that present flexibility, empowerment of employees, power decentralization, communication systematization as advantageous to innovative capacity in an instable environmental context [10; 14; 15; 16; 17].

The change management related literature understands that the techniques, tools and conceptually (technologically and scientifically) correct systems must be resultant from the company's learning to bring a proper innovative culture. This innovative culture must be capable to conduct the company to generate itself knowledge to continuous improvement.

The literatures related to the change management [18; 19; 20], the situational method construction [13], and the action research [21; 22] converge to a central idea. Those literatures emphasize the individual person's role on the company's and social group's context as critical for an effective change implementation.

It is expected that the company becomes more innovative after the PDP improvement by reference model implementation. The innovativeness is constructed by learning favorable structure, that propitiates actively capture of data from the environment, transforming more efficiently them into information, using them to generate knowledge [23]. This system is important both for the new structured PDP, as for the transformation (and continuous improvement) process - the reference model implementation. This system will propitiate the organizational memory vehicle to help on an innovative product generation.

The company's structure consideration is important for the evaluation tool selection on a process improvement [13]. This description correlates with the situational method construction. The process improvement project must start considering the company's maturity level and structure to select the most adequate evaluation tool.

Several tools for maturity levels are available in the literature. One adapted for the theme product development is useful for the reference model implementation. A possibility is to adapt the Sturkenboom et al. tool [15], directed to SME.

4 Case study

The selected company is median-sized, by the traditional employee's number based classification. It is located on the south of Brazil and has a familiar origin. Its products had been developed a long time ago, on the company's activities beginning. It has a Product Development Department, but new products are not launched for a several years. The developed products are inspired on market available products.

The company belongs to the pharmaceutical sector. Locally, this sector is characterized as low maturity level on the production process, as the product development process. The local sector's companies have a quality view focused on control. The company has an intention to improve, searching to use some management practices, as strategic planning and use of metrics.

The company's used representation of its functionality is the organogram. This kind of representation shows the hierarchic organizational structure. The existing metrics did not help the management system improvement. In fact, the company did not have an effective performance measurement system.

The strategic planning was not effectively deployed to the tactic level. The company did not present investment planning or financial evaluation. This observation is applied to the equipment and technology substitution politics and to the product development projects. It was observed that the company did not have the habit to planning, evaluate and control projects.

In this company, the pharmaceutical product development was understood as different from the other segments. This idea is the same emphasized by Sharp [11]. This author related that the existent posture is that the product development project quality does not necessary affect the quality perception on the pharmaceutical sector. The pharmaceutical area, as observed on this company, did not consider other product dimensions than the generic dimension (the technical characteristics).

The training system had essentially technical emphasis. The managers appeared to understand the knowledge as coming just from the professional formation. They did not comply with the need on the more structured training on management practices and tools, for example.

The company exists for more than 50 years. It had difficulties to invest on new technologies. For this reason, the company had old technologies on its production processes. The raw materials are imported in its majority, as the country has low number of companies that produce them.

4.1 Discussion

The company's management is oriented by functional departments represented by an organogram. This view, as Mintzberg [12] emphasized, does not allow the competitive advantages visualization. It is recommended that each company have different ways to represent its organizational structure. Those different representations show the company's objectives, the people and department interactions, the company's products and the involved information.

The low to moderate maturity level company presented a low use of the management practices and tools. Considering this, it is important that the pre-implementation assessment (as process and company evaluation) system to be simpler than the used for the high maturity level companies [13]. As the results indicated, the training focus was technical. In this situation, it will be difficult to use complicated assessment systems.

A required feature to reference model implementation to the PDP improvement is to allow the creation of a more amplified vision of the company. On this view, the implementation process must emphasize the front end (pre-development) steps. The main objective must be to convert the definition of what the product means to the company and to the market view. The product must not be just the combination of its components or its technology. The product concept must be more abstract and broad. The product must be considered as the conjoint involving the services, the information, the knowledge, more than technology and components.

On this new and mature view of PDP, the product presentation form, the involved services, the final customer perception and the divulgation and distribution forms are discussed on the product development process. On this more mature view of PDP, the central aspect is the manner that the information flow management will be conducted.

From those descriptions, it is possible to identify some considerations on the management areas for the PDP reference model implementation in low to moderate maturity level companies.

Strategic Planning: It is necessary to deploy the strategic objectives to the tactic level, with the all department managers.

Information management: The efficient information flow is important to the new structured PDP be able to create innovative products. The great number of information must be flown on the company to innovation. Information technologies that would help the PDP should be initially based on the improvement of the already available management systems. If the company decided to incorporate new systems, they must be created just after the process definition.

Quality management: To create an innovative culture that lead to innovative products, the quality concept must be changed. The company and its departments must not more emphasize on quality as resultant of control system. The company must think about quality as the customer satisfaction. For customer satisfaction, other dimensions of product, broader than technical components, must be considered. The metrics must spotlight this view and be used in the related services, as distribution and customer attendance.

Financial management: The company must incorporate in its routine the financial and economic evaluation of the project. This evaluation must incorporate other factors than product component costs. A demand evaluation system must be gradually developed based on the information already available in the company.

Human resource management: To develop innovative products, the involved people must be creative. To be creative, a person must have other training than technical one. It is necessary an innovative and continuous improvement culture to identify the innovative opportunities. For this reason, it is necessary motivated employees and teamwork. Several departments must interact and must have as common objective the customer necessity achievement.

Product management: The product concept must become broader. This concept must incorporate the market definitions. It is recommended the launched products evaluation. The existence of a marketing department is recommended.

Process management: The production planning and control practices implementation is important for launched product performance evaluation. Some technologies might be needed.

Technologic management: In some environments or markets, it will be very important the technologic vigilance as an important part of the PDP. The available tools must be valorized on the PDP improvement.

Project management: the practice of project management is a good tool for PDP conduction. The planning and evaluation practice incorporation on the company's routine will help company's maturing. This practice allows saving money by identifying and stop investments on not rentable projects, for example.

Another important element is related to the reference model selection. The several reference models available on the literature are directed to specific sectors. It is suggested, for this reason, that the selection of the reference model should be conducted considering the type of developed product and the similarities of the model to the company's environmental elements.

5 Critical points identification

The management areas analysis enabled the stabilishment of some successful reference model implementation critical points.

The selection of the the reference model implementation tools and practices is one of the first step elements of the PDP improvement project. For this reason, this work discussed the company's structure evaluation elements. The process mapping is the fundamental step for the process improvement. The process mapping allows the process steps, material and information flow identification.

The literature allied to the case study management areas observation propitiated the critical points identification to the reference model implementation. Those points supply the PDP improvement project needs with methods, tools, or techniques. They are the implementation process requisites. The project management is a well structured practice that allows the planning, conduction and control of the PDP improvement project.

The following critical points for PDP improvement are summarized from the previous discussion: (1) conversion of the sequential PDP to an integrated PDP, with concurrent activities; (2) implementation of an information capture systematic; (3) change management theory contemplation; (4) maturing in context of the project management knowledge.

To define a method for a PDP improvement, those critical points must be converted to method principles. Those principles define the deployed directives that guide the implementation process. They are: (1) mapping of existing PDP, identifying the existence of a process view, the needed interactions between departments, the existing problems, and the existing management mechanisms; (2) Existing information capturing system mapping, and incorporation of company's reality customized tools; (3) change resistance avoiding statements establishing to propitiate a existing culture and philosophies based on learning to allow continuous improvement; (4) analysis of and project management concepts implementation.

6 Conclusions

The present work identified some principles to guide the reference model implementation. A method created for reference model implementation using those principles would be useful to conduct the low to moderate maturity level company to improve its PDP allowing more competitiveness.

This paper based on the organizational structure defining elements proposed by Hunter [10] identified by theoretical review. These elements were associated to the PDP interrelated management areas. The SME improvement aspects for each management area were detailed. Based on those improvement aspects, the critical requisites were identified. Those requisites were denominated the PDP implementation critical points. The paper presents the PDP improvement guiding principles that allow the critical points implementation.

For more details see Gusberti [24].

References

- [1] HOLLINS, B.; PUGH, S. Successful product design. [S1]: Butterworth&Co, 1990.
- [2] PAHL, G.; BEITZ, W. Engineering Design: a systematic approach. London: Springer, 1996.
- [3] ROOZENBURG, N. F. M.; EEEKELS, J. Product design fundamentals and methods. [S.1.]: John Wiley and Sons, 1996.
- [4] COPPER, R. G. New products: the factors that drive success. International Marketing Review, v. 11, n. 1, p. 60-76, 1994.

- [5] CRAWFORD, C. M.; BENEDETTO, C. A. New products management. 6 ed. Chicago: McGraw-Hill, 2000.
- [6] DICKSON, P. Marketing management. Fort Worth: Dryden Press, 1994.
- [7] KOTLER, P. Administração de marketing: análise, planejamento, implementação e controle. 5 ed. São Paulo: Atlas, 1997.
- [8] CUNHA, G. D. Uma Análise da Evolução dos Procedimentos de Execução do Desenvolvimento de Produtos. Rev. Produto&Produção, Porto Alegre, v. 7, n. 1. 2004.
- [9] TORRÈS, O.; JULIEN, P. A. Specificity and Denaturing of Small Business. International Small Business Journal, London, v. 23, no. 4, 2005, 355-377.
- [10] HUNTER, J. Improving organizational performance through the use of effective elements of organizational structure. International Journal of Health Care Quality Assurance incorporating Leadership in Health Services. V. 15, N. 3 (2002). P. xii-xxi
- [11] SHARP, J. Quality in the Manufacture of Medicines and other Healthcare Products. Londres: Pharmaceutical Press, 2000.
- [12] MINTZBERG, H; VAN DER HEYDEN, L. Organigraphs: Drawing How Companies Really Work. Harvard Business Review Septeniber.-October 1999. p. 87-94.
- [13] BENAVENT, F. B.; ROS, S. C.; MORENO-LUZON, M. A model of quality management self-assessment: an exploratory research. International Journal of Quality & Reliability Management. Vol. 22, No. 5, 2005, p. 432-451.
- [14] GARVIN, D. A. Gerenciando a qualidade: a visão estratégica e competitiva. Rio de Janeiro: Qualitymark, 1992.
- [15] STURKENBOOM, J.; VAN DER WIELE, T.; BROWN, A. An action-oriented approach to quality management self-assessment in small and medium-sized enterprises. Total Quality Management, Abingdon, v. 12, N. 2, 2001, 231-246.
- [16] LIEBERMAN, B. A. Gambling with success: software risk management. Available at: <<http://www.therationaleedge.com>> accessed on: january 2005.
- [17] FLANNERY, T. P.; HOFRICHTER, D.; PLATTEN, P. E. Pessoas, desempenho e salários: As mudanças na forma de remuneração nas empresas. São Paulo: Editora Futura, 1997.
- [18] ARMSTRONG, J. S. Strategies for Implementing Change: an Experiential Approach. Group & Organization Studies, Thousand Oaks, V. 7, No. 4, p. 457-475, 1982.
- [19] RENTES, A. F. TransMeth – Proposta de uma Metodologia para Condução de Processos de Transformação de Empresas. São Paulo: USP: 2000. Tese de Livre Docência, Escola de Engenharia de São Carlos, Universidade de São Paulo, 2000.
- [20] WOOD Jr., T. (coordenador). Mudança Organizacional: Liderança; Teoria do Caos; Recursos Humanos; Logística Integrada; Inovações Gerenciais; Cultura Organizacional; Arquitetura Organizacional. 3ed, São Paulo: Editora Atlas, 2002.
- [21] THIOLENT, M. Metodologia da pesquisa-ação. 13ª ed. São Paulo: Cortez, 2004.108p.
- [22] DE HOLANDA, V. B.; RICCIO, E. L. A Utilização da Pesquisa Ação para Perceber e Implementar Sistemas de Informações Empresariais. Available at: <www.tecsi.fea.usp.br>. Accessed on: 08/03/05.
- [23] BLUMMENTRITT, T. Does small and mature have to mean dull? Defying the ho-hum at SMEs. The Journal of Business Strategy; ABI/INFORM Global, v. 25, No. 1, 2004, p. 27 – 33.
- [24] GUSBERTI, T. D. Modelo de intervenção para processo de desenvolvimento de produto farmacêutico para pequenas e médias empresas. Porto Alegre: UFRGS: 2006. Dissertação (Mestrado em Engenharia de Produção), Escola de Engenharia, Universidade Federal do Rio Grande do Sul, 2006