

# MANAGEMENT SYSTEM FOR PRODUCT DEVELOPMENT PROCESS FOR SMALL AND MEDIUM ENTERPRISES WHICH PRODUCES DRUGS

Leticia Milena Arcusin<sup>1</sup> & Germán Horacio Rossetti<sup>2</sup>

<sup>1,2</sup>Departamento de Ingeniería Industrial. Universidad Nacional del Litoral (UNL),  
Santiago del Estero 2829, Santa Fe, Argentina

## ABSTRACT

Management of the Product Development Process (PDP) involves performing a set of activities, in which should intervene the majority of functional areas of the organization. Each of them is carried out taking into account the product to develop, business strategy and the philosophical conception of the company.

The PDP management is performed by reference models involving tools, concepts and practices. Its structure is advantageous for all companies, as it improves the understanding of customer needs in the early stages of development, reduces duplication of work in the stages of development and helps control the cost, quality and schedule project. However, this task is not easy for Small and Medium Enterprises (SMEs), mainly due to: (i) lack of knowledge about the product engineering practices, (ii) the lack of skilled and knowledge and / or appropriate management techniques for planning, monitoring and control of projects, (iii) organizational difficulties of each company that operates in unstable environments, with social and cultural difficulties and (iv) other external features that harm the internal performance of the companies.

In this paper a System for Management of the Product Development Process for Small and Medium Enterprises Producing Drugs is developed, taking into account the reference model of Rozenfeld [1] and the characteristic parameters of the companies. The proposed management system is developed in order to improve procedures in the development of products, taking into account the culture of business, so as to adjust, adapt and be accepted by the community productive. Furthermore, the system is developed in terms of competitive environment, strategies and capabilities of enterprises, presenting concepts, tools and information flow applied in the various activities for understanding and translating customer requirements, improving product specifications of its production process and monitoring.

**Keywords:** *Management, Drugs Development, SMEs.*

## 1. INTRODUCTION

The new products development is an essential activity for survival and competitiveness of enterprises. Products must be managed in order to quickly enter the market, better meet customer needs, are easier to manufacture, are attractive in the market and ensure a profit for the company.

To that effect, it must be considered the objectives that each company wants to achieve in the future and how it plans to achieve them. That is, it is impossible to conceive the Product Development Process isolated from the Strategic Business Plan of each company.

Management of Product Development Process (PDP) involves performing a set of activities, in which must intervene the majority of functional areas of the organization. Basically all theories of product development process involve the following steps: (i) design and development of the idea; (ii) evaluation and selection of the idea of the product; (iii) development and engineering of the product and process; (iv) evaluation and design testing; (v) production of the product; (vi) launching and monitoring and (vii) product withdrawal from the market and/or innovation. Each of these stages is carried out taking into account the product development, business strategy and philosophical conception of the company [2].

Different authors trained in the field of marketing and strategic planning [3] include Management of the Product Development Process as part of their area of expertise. Conversely, authors related to the development of products claim that strategic planning is included in the development of new products [4]. Beyond that, the important thing is that there is integration between these activities. The idea of strategic management states that the companies' activities must be aligned with strategic planning, forming key indicators for monitoring PDP Management [5].

Management of the Product Development Process is carried out through reference models involving tools, concepts and better practices [1]. Structuring the management of the PDP is advantageous for all businesses, because it improves understanding of customer needs in the early stages of development, reduces duplication of work in the stages of development and helps control costs, quality and schedule [6]. However, this task is not easy for Small and Medium Enterprises (SMEs), mainly due to: (i) lack of knowledge about product engineering practices; (ii) lack of skilled staff and lack of knowledge and/or management of appropriate techniques of planning, monitoring and

control of project; (iii) organizational difficulties of each company which develops in unstable environments, with social and cultural difficulties and (iv) other external features that damage the internal performance of companies. In this paper a System for Management of the Product Development Process for Small and Medium Enterprises Producing Drugs is developed, taking into account the reference model of Rozenfeld [1] and the characteristic parameters of the companies. The proposed management system is developed in order to improve procedures in the development of products, taking into account the culture of business, so as to adjust, adapt and be accepted by the community productive. Furthermore, the system is developed in terms of competitive environment, strategies and capabilities of enterprises, presenting concepts, tools and information flow applied in the various activities for understanding and translating customer requirements, improving product specifications of its production process and monitoring.

A Management System is a cyclical process that must be executed until it becomes a routine for companies with the aim that the continuous improvement policies are incorporated into the Management of Product Development Process.

## 2. THEORETICAL FRAMEWORK

In the evolutionary process of the forms of the Management of the Product Development Process, it is shown that, initially, the product is mainly focused on a generic dimension (technical components of the product). This view is taken into account on the methodologies described by Hollins and Pugh [6], Pahl and Beitz [7], and Eeckels Roozenburg [8], from the area of engineering. The later visions of methodologies, such as those developed by Cooper [9] Crawford [9] and Benedetto [9], Dickson [9] and Kotler [9], come from the marketing area, initiating the incorporation of aspects of market as a concept of product development process [9].

Today, there are different proposals for systemization of activities in PDP models on the literature, depending on the area of knowledge from which come authors who address this issue. However, as highlighted Eekels and Roozenburg, in many cases the differences between these proposals are more terminological than conceptual [8].

Models with an engineering vision give greater importance to the construction stages of the product, and therefore, are directed mainly technical aspects. On the other hand, the models with a marketing vision, highlight, first, the relevance of the pre-development stage, in which should be considered the market characteristics and strategies of the company, and, second, the importance of the post-development stage, consisting of the monitoring, control and removal product from the market where it had been launched.

The model proposed by Rozenfeld et al. [1] seeks to integrate these views, as well as organize the good practices developed in academia and in business. For this reason, this model is called "Unified Model of PDP", bringing together different academic perspectives on a single theoretical model.

The Unified Model of PDP has three distinct parts: (i) PDP reference model; (ii) PDP maturity level and (iii) intervention or transformation project. Includes three macro-phases called: pre-development, development and post-development. Each of these phases is split into stages, activities and tasks. Although this model presents the stages sequentially, in the sublevels of activities and tasks could appear simultaneity. This depends on the type of activity to be performed and the resources available. The model also includes at the end of each stage, a specific activity for review and approval to advance to the next stage [1].

The unified model of the PDP developed by Rozenfeld et al is systematic and structured. It was originated from the union of methodologies, case studies, models, experiences and best practices developed and identified by the author and his team of researchers. The great contribution of this model is to see the PDP management in a holistic way, encompassing all phases. It integrates views of previous models, considering the PDP as a whole, unifying the vision between marketing and engineering. The main difference with other models of managing product development is that it takes into account the full life cycle of the product, and is for this reason that includes the macro-stage of post-development. That is, the PDP management does not end with the launch of the product on the market, it is necessary to monitor and control the performance, and consider a possible withdrawal from the market. Figure 1 shows graphically the unified model of PDP proposed by Rozenfeld.

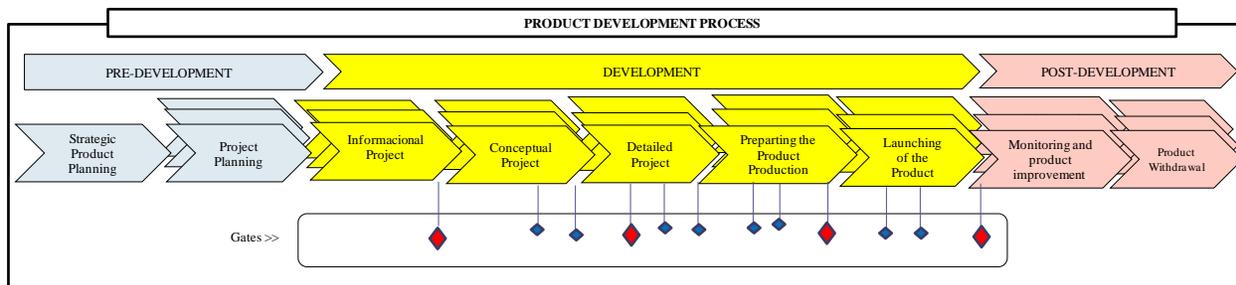


Figure 1. An Overview of the Rozenfeld Model

Rozenfeld systematizes and unified product development process through the presented reference model, which consists of three macro-phases:

1. Pre-Development: This phase ensures the best decision on the portfolio of products and projects, as well as a clear definition of them.
2. Development: in this particular phase the development is made, considering the information required performing the same concept and functionality, available technology, product architecture, production process and marketing launch.
3. Post-Development: focuses on the monitoring and control of product performance in the market, and also includes the strategic plan of withdrawal.

In recent years, there have been studies reported in the literature about PDP models for drugs producing companies located in Brazil. De Paula [10] proposed an integrated management product development model, recognizing that each product development is a project in itself, with the collaboration of various sectors in parallel. Therefore, the management of such processes should be performed using the project management theory. Thus, the product development process must be monitored and controlled through a series of indicators.

According to De Paula [10], in the pre-development opportunities are identified and defined objectives. In the development phase, in contrast, the processes and products are operated and analyzed, and the marketing plan is implemented. Furthermore, as has happened over the course of the history of PDP, the author makes a distinction between those stages usually related to technical development and those that are related to marketing.

### 3. CURRENT STATUS OF PRODUCING DRUGS SMEs

To carry out the analysis of the current situation of small and medium producers of drugs, located in Argentina, respect to the management of the PDP, has selected a representative set, taking into account the capacity and productive diversity, organization and market presence.

Through interviews and questionnaires to different actors from different companies, as well as through on-site observation, it has succeeded in detecting certain parameters or behaviors common to all companies. Here are the main features observed.

The companies under study produce drugs, whether for human or veterinary use. In turn, these may be in the form of suspension, tablets, capsules, creams, injections, syrups and drops, that is, solids, semi-solids and liquids.

Planning for product development is covered within each company's strategic planning, establishing general rules for product innovation through the description of the relative position they have in the market and the selection of products the company want to innovate.

The strategy that the SMEs producing drugs adopt is a combination of traditional and defensive strategy. On one hand, constantly monitor the environment, waiting to discover new products with high growth potential. Then develop a differentiated product, which they market to a relatively low price.

This strategy allows competitors to innovate first, with the philosophy that any significant innovation can be copied, and possibly improved, before there has been a significant loss of sales and customers before they have developed a strong loyalty to the product of competition.

Moreover, these companies operate in established markets, where there is little or no demand for product changes.

The organizational structure is the result of the division of labor among members of the organization and / or establishment of coordination mechanisms established to integrate the commercial and productive work. The structure should be adapted to the competitive strategy, because each organizational design generates certain behaviors and outcomes.

The company size has a direct influence on its type of organization. The SMEs interviewed are run by general managers and staff has experience in market research, financial analysis, marketing, human resources management, among other areas.

In small and medium businesses, entrepreneurs need to make decisions regarding the areas of marketing, finance, advertising and other, without the advice and guidance of those who have big business, a fact that puts them at a distinct disadvantage against major competitors.

On the other hand, following the organizational structure, SMEs interviewed work with product designs that require specialized knowledge, and traditionally correspond to "functional" organizations, as shown in Figure 2.

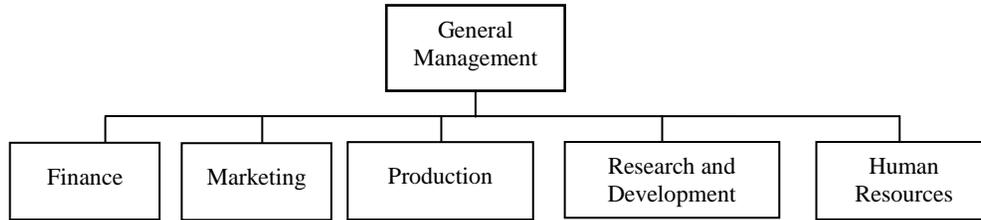


Figure 2. Organizational structure of SMEs (functional type)

In the functional approach, the people assigned to the development process of new products remain physically in their functional areas under the control of the corresponding functional manager.

In this type of structure does not create a proper team, there is no project manager or staff to act as liaison between the various functions, so there is a general lack of coordination and communication between the different activities necessary for the development process. The functions participants have to coordinate ideas through detailed specifications, which have been agreed at the beginning, and later through occasional meetings to smooth matters affecting several specialties. Responsibility for the project changes sequentially over time from one function to the next, according to an agreement on who will control each activity, which results in a process that sometimes becomes inadequate. The biggest advantage of this structure is the specialization of the activities it promotes.

It is interesting to note that SMEs producing drugs have multifunctional teams for the product development. However, what we see in them, is holding meetings in which project management, usually represented by the company's chief financial officer and the head of R&D, distributes tasks and leads exchange information among team members. In the remaining time, each area is responsible for a part of the development along the routine activities of production, while the project manager oversees compliance schedule of product development.

SMEs producing drugs do not have a structured mechanism for the development of products and, therefore, the responsibility for development rests mainly on the figure or the management responsible for the area of R & D. Moreover, they have a small number of people involved with product development, and as a result some sectors of the company should take more responsibility than others.

The sectors of R&D of these SMEs engaged in different activities because their caregivers participate actively in making decisions on the type of product to be developed, assuming the duties of drug development and the organization of the registration and tracking evolution of the Product Development Process.

In these companies, the project is under the leadership and responsibility of the owner of R&D, along with financial management, or disseminated by the project team. It is evident that perform a range of activities in order to develop products; these activities have a greater or lesser degree of formalization, but do not become an integral process formalized.

Below is presented in Figure 3 the PDP phases of SME producing drugs with in reference with Rozenfeld Model.

PDP MODEL Rozenfeld	Strategic Product Planning	Project Planning	Informacional Project	Conceptual Project	Detailed Project	Preparing the Product Production	Product Launching	Monitoring and product improvement	Product Withdrawal
SMEs PRODUCING DRUGS	-	Market Research and Product Development				Production	Product Launching	Product Monitoring	-
MACRO-PHASES	PRE-DEVELOPMENT		DEVELOPMENT				POST-DEVELOPMENT		

Figure 3. Comparison between the phases of Rozenfeld's Model and of the SMEs which produce drugs

It is noted that producing drugs SME activities not perform the initial phase of pre-development. The absence of strategic planning implies that there are set clear objectives and innovation strategies that define the conditions under which the organization operates, such as: strengths and weaknesses of management, technological dimension definition and of the market, objectives for the short and long term for the design of products, methods of evaluating the progress of the PDP, etc.

Basically, the development of new drugs by these companies is part of the manufacture of generics. This is so because, on the one hand, their mission is the satisfaction of primary care, and on the other, as happens in all SMEs, they do not have the necessary tools to develop an innovative product. Moreover, quite often detected, which is not made the generation of new products, but the improvement of existing either formulas or characteristics of the drug.

It is evident that the companies under study conducted the activities of the phase "Project Planning", but informally, without a specific management and without adequate control. They perform SWOT analysis, allowing them to identify potential risks and create actions to reduce their impact.

The decision-making processes, although they are highly centralized in the managers of all companies surveyed, have considerable information flow to perform. Small structures of these organizations are an advantage, because there are fewer interdepartmental barriers. This facilitates consultation and exchange of views to make decisions with good management of information from all areas. There were no clear decision formalized instances but these appear along the entire process.

Potential developments to be made by the companies are evaluated by the manager or by the field of sales and / or marketing and in a few cases the market assessment is done through internal meetings with a group of collaborators. The evaluated data generally focus on manufacturing costs and user needs. Development time, while not mentioned as a factor to be taken into account when making decisions, is considered implicitly as well as the feasibility of manufacturing, technology and equipment needed.

Moreover, the companies under study conducted just some of the activities of the phase "Informational Project ". Mainly focus on the identification of customer requirements and, as they usually tend to be subjective, seeking to identify the technical requirements of the product. They conduct market research to data collection related to four key variables: (i) competitive market, (ii) consumer market, (iii) Analysis of Price and (iv) marketing analysis. This analysis allows, among other things, to detect the existence of an unmet need in the market, or the ability to provide better service to offer products on the market. On the other hand, it can determine the amount of the new product that the company would be willing to buy at certain prices.

With respect to product development, it is not possible to classify the activities carried out by the companies under the phase "Conceptual Project ", "Detailed Project" and "Preparing for Production and Product".

Referring to the phase "Launching Product" companies make almost all the activities involved in this phase. First they plan launching product, emphasizing how it will sell and what will be the road to go before reaching the final consumer. Each of the companies under study adopts different strategies to launch the product to the market, but generally focus on customer service, recognizing the vital importance of achieving its satisfaction.

Finally, these companies make product tracking, evaluating customer satisfaction and product performance in the market. The companies analyzed removed the product from the market, but without a retirement plan formally constituted.

#### 4. PROPOSAL

The authors of this paper have developed a Management System of the Product Development Process for Small and Medium producers of drugs, with reference on the Rozenfeld Model [1] and the characteristic parameters of the companies described in section 3. Therefore, the PDP Management System for Small and Medium Enterprises which produce Drugs proposed has macro phases, phases and activities. The macro phases are called: (i) Pre-Development, (ii) Development and (iii) Post-Development. The structure of each of these macro phases is different to that proposed by Rozenfeld. The Pre-Development macro phase still has two phases: (i) Strategic Planning Product and (ii) Project Planning. The macro phase Development consists of three phases: (i) Product development and Product preparation, (ii) Planning and preparation of production and (iii) Launching the product to market. Finally, the post-development macro phase has a single phase which aims to assist and improve the product and withdrawn from the market.

Figure 4 shows the PDP management system proposed, the PDP model that is intended for small and medium producers of drugs taken, in order to systematize the process and thus achieve better results.



Figure 4. Management System of the Product Development Process Proposed

The first stage of the macro phase Pre-Development is the Strategic Planning of Products, which aims to get a plan containing the product portfolio of the company, from the Strategic Planning Business Unit. In practice this means a

list that describes the product line of the company and the projects to be developed in order to help achieve the strategic objectives of the business. That is, it seeks to develop the Strategic Business Plan. The main actors of this phase are board members and CEOs.

Notice that in the phase Strategic Planning of Products, in the activity 1.4 "Define Objectives and Strategies for Product Development", should study and consider all existing laws, both provincial and national level on the design, development, marketing and conservation of the product to develop, whereas in this case it is a pharmaceutical. Furthermore, according to the business plan of the company, also should look at the quality standards according to the target market (internal or external).

Project planning is the last phase of the Pre-Development macro phase. In this phase the macro planning of the projects in the new portfolio is made. Planning begins when a specific project is formally accepted. The end result is the Project Plan Product that once demonstrated its viability, will be used as a guide for macro phase Product Development. This document brings together information relevant to the project, such as: project objectives, product objectives, description of activities and their durations, deadlines, budget, definition of responsible personnel, resources needed for their implementation, specification of criteria for evaluating quality, risk analysis and performance indicators selected for the project and the product, among others. Given the direct relationship with the following macro phase, the development of this plan should consider the purpose and characteristics of each of the three phases of product development: (i) development and preparation of product, (ii) planning and production preparation and (iii) launching product.

Project Management is an area of knowledge that studies the tools and best practices for the management of all types of projects. Planning is one of the main stages of a project management and, therefore, the activities of this phase are strongly related to this area of knowledge.

The person who coordinates all project planning, and run all activities of this phase should be the same as exercising the role of project manager, the person who is also in the coordination of the team during the development macro phase.

The importance of Pre-Development lies in the systematic planning of the projects, as this allows a correct prediction and analysis of the objectives and risks, preventing problems that could occur when developing the product.

The data obtained at the end of the planning phase of the product help define the objectives, describing the product to be obtained and restrictions around the project, in addition to activities and resources. Detailed information allows an analysis of economic and technical feasibility of the project. With all this, the development team can begin the next phase. Table 1 shows in detail the activities that make up the macro phases of the pre-development phase.

*Table 1. Phases and Activities of the Pre-Development Macro Phase*

Macro Phase	Phase	Activities
PRE-DEVELOPMENT	1. Strategic Product Planning	1.1 Analyze internal and external environment
		1.2 Define or revise the mission and vision
		1.3 Define objectives and strategies
		1.4 Define Objectives and Product
		1.5 Development Strategies
		1.6 Develop the Strategic Business Plan
		1.7 Approve Strategic Business Plan
	2. Project Planning	2.1 Define project stakeholders
		2.2 Define objectives of the Product
		2.3 Define project objectives
		2.4 Detail the project objective
		2.5 Define activities and sequences
		2.6 Prepare the schedule
	2.7 Evaluate risks	
	2.8 Prepare project organization	
	2.9 Analyze the economic viability of the project	
	2.10 Define performance indicators	
	2.11 Define communication plan	
	2.12 Plan and prepare procurement	
	2.13 Prepare the Project Plan	

Upon completion of the Pre-Development macro phase, begin with the macro phase Development. The first stage is to carry out the development phase and product preparation. The objective of this phase is to get the product specifications-objectives, from the documentation generated during the planning phase of the project and further

information obtained from other sources. Therefore, on the identification of the customer requirements, which are often too subjective as well as being described in the form of needs, should describe the technical characteristics through, possible to be measured, or translated into specifications -product objectives. Then define the actors involved in the product and the project (individuals or organizations), at each stage of the product life cycle. These specification, guide the generation of solutions and build the foundation which will be mounted on the evaluation criteria and decision-making used in the later stages of the development process. Finally, are carried out the last activities of this phase, related to the economic viability and the record of decisions made and lessons learned.

In the next phase, called Planning and Preparation of Production, the project team activities are relate to the search, creation, representation and selection of solutions for the production of the product. Thus develops the production process are defined suppliers and distributors, planning the manufacturing process (process plan) and assembly. The process of creating solutions should be based on the needs, requirements and design specifications of the product. This phase includes the production of a pilot batch, the definition of production processes and the maintenance plan of the product. In this phase, the production process is validated. Table 2 describes in detail the activities that make up the macro phase Development.

*Table 2. Phases and Activities of the Development Macro Phase*

Macro Phase	Phases	Activities
DEVELOPMENT	3. Development and Product Preparation	3.1 Detail the product life cycle and define their clients 3.2 Identify customer requirements in relation with product 3.3 Define product requirements 3.4 Define specifications of the Product 3.5 Product Development 3.6 Monitor the economic and financial viability of the product 3.7 Evaluate and approve phase 3.8 Document decisions and record lessons learned
	4. Planning and Preparing for Production	4.1 Develop the production process 4.2 Define suppliers and distributors 4.3 Plan the manufacturing process / Define the process plan 4.4 Schedule manufacturing and assembly process 4.5 Upgrade economic feasibility study 4.6 Evaluate and Approve phase 4.7 Document decisions and record lessons learned
	5. Launching Product to the Market	5.1 Plan launching 5.2 Develop the sales process 5.3 Develop the distribution process 5.4 Develop customer process 5.5 Develop technical assistance process 5.6 Promote launching marketing 5.7 Product Launch 5.8 Managing the Launch 5.9 Update plan for the end of product life 5.10 Monitor the economic and financial viability 5.11 Evaluate and Approve phase 5.12 Document decisions and record lessons learned

Then the phase launching product to market is held, in which the main objective is to place the product on the market, meeting the requirements of customers and fulfilling the final specifications of the product design and manufacturing process, created at the stage of planning and production preparation. During the previous phases, we developed several plans and specifications which are now implemented, such as specification of machines, equipment, plant design, marketing plan, product launch plan, requirements of production processes, technical assistance, customer care, etc. It covers the design of sales and distribution process, customer service, technical support and marketing campaigns.

Once the product was launched, the company aims to achieve objectives related to profitability and market share. This period can be long and the company must have well established the minimum target expected product performance released until the end of their life cycle. In the post-development macro phase the company begins to benefit from expected returns, therefore, the management of the activities of this macro phase is a key factor that problems can be solved within the appropriate timescale.

Phase accompany and improve the product, and withdraw it of the market consists of a set of activities that involve the entire product life cycle. Its main objective is to ensure the monitoring of product performance in the market, identifying needs and opportunities for improvement and ensuring that retirement causes the least possible impact on consumers, businesses and the environment. This phase performs a post-project audit, evaluating the customer satisfaction and product performance monitors, both technical and economic, including production, technical assistance and environmental aspects.

The production is disabled when the product does not present more advantages from the economic point of view (turnover, profit contribution, company growth, etc.) or from the standpoint of strategic (competitive advantages, market share, brand image, etc.). Signs that the product life is coming to an end are: (i) lower sales, (ii) reduction of profit margins, (iii) loss of market share and / or a combination of these factors. These data should be compared to what was planned in the Project Plan.

A well formulated plan to end the life of the product and to implement it helps customers and consumers opt for the new generation of the company's products and / or substitute products, enabling relocation of resources to more profitable opportunities. Table 3 shows the activities that make up the post-development macro phase.

*Table 3. Phases and activities of the Post –Development Macro Phase*

Macro Phase	Phases	Activities
POST-DEVELOPMENT	6. Monitoring and product improvement. Product withdrawal	6.1 Evaluate customer satisfaction 6.2 Monitor product performance (technical, economic, productive and services) 6.3 Conduct post-project audit 6.4 Evaluate the product lifecycle 6.5 Register lessons learned

## 5. OVERALL CONCLUSIONS

First, the PDP model developed by Rozenfeld et al. [1] was studied, highlighting that its integrated vision is the main advantage. However, this model must be adapted to the company in terms of organization, size, culture and products they manufacture. Then, a survey of the situation of the product development process in small and medium producers of drugs, located in Argentina was carried out, through surveys, interviews and observation in situ. This survey has thrown that most companies have failed to systematize Management Product Development Process (PDP), mainly due to the following factors: (i) lack of vision of the PDP as a process, (ii) lack of knowledge about the product engineering practices, (iii) organizational difficulties of each company that operates in unstable environments, social and cultural difficulties, and (iv) individual efforts of each project leader to perform the sequence of activities considered more appropriate, according to their own experience, to carry out the PDP.

Finally, Management System Product Development Process for Small and Medium producers of drugs was developed, considering the referencia Model of Rozenfeld [1] and the characteristic parameters of the companies. Furthermore, it has been considered that: (i) a Management System is a cyclical process that must be executed until it becomes a routine for companies, so that continuous improvement policies are incorporated into Management of the Product Development Process and (ii) the sector made by companies producing drugs face ongoing challenges regarding Management PDP to continue existing in the market, which is increasingly competitive and fast-paced.

The Management System of Product Development Process for Small and Medium Enterprises which produce drugs was carried out with the aim of improving the procedures performed for the Management of Product Development process, taking into account the corporate culture, so as to adjust, adapt and be accepted by the community productive. Furthermore, the system is developed in terms of the competitive environment, strategies and capabilities of companies, presenting concepts, tools and information flow applied in the diverse activities for understanding and translating customer requirements by improving product specifications, its production process and monitoring and control of product on the market.

## 6. ACKNOWLEDGEMENTS

The authors wish to acknowledge the financial contribution provided by the Universidad Nacional del Litoral, through the Research Project CAI + D 2009 Type II PI 58-284, as well as the directors of the companies under study to provide the necessary data to carry out this work.

## 7. REFERENCES

- [1] H. Rozenfeld, F. A. Forcellini, D. C. Amaral, J. C. Toledo,; S. L. Da Silva, D. H. Alliprandini, y R. K. Scalice, “Gestão de Desenvolvimento de Produtos: Uma Referência para a Melhoria do Processo”. San Pablo. Editora Saraiva (2006).
- [2] K.T. Ulrich and S.D. Eppinger, “Product Design and Development”. New York. 3º Ed. McGraw-Hill (2006).
- [3] M. Santesmases Mestre, F. Sánchez de Dusso, G. Kosiak de Gesualdo. “Marketing: conceptos y estrategias”. Madrid. 2ª Ed. Pirámide (2004).
- [4] R. Holman. El futuro del desarrollo de productos. *Revista Gestión*, vol. 9, Nº 2 (2004).
- [5] M. Jarvis. Concurrent Engineering. *MCB University Press*, vol. 48, Nº 3 (1999).
- [6] S. Pugh and B. Hollins. “Successful Product Design: What to Do and When”. Oxford. Butterworth-Heinemann (1990).
- [7] G. Pahl and W. Beitz. “Engineering Design. A Systematic Approach”. Berlin. Springer (1995).
- [8] N. Roozemburg y J. Eekels. “Product Design. Fundamentals and methods”. New York. John Wiley & Sons (1995).
- [9] M. E. Echeveste. Uma abordagem para estruturação e controle do processo de desenvolvimento de produtos. Porto Alegre: UFRGS. *Tese (Doutorado em Engenharia de Produção)*, Escola de Engenharia, Universidade Federal do Rio Grande do Sul (2003).
- [10] I. De Paula, Proposta de um modelo de referência para o processo de desenvolvimento de produtos farmacêuticos. Porto Alegre: UFRGS. *Tese (Doutorado em Engenharia de Produção)*, Escola de Engenharia, Universidade Federal do Rio Grande do Sul (2004).