

New Product Development Project Management Practices Improvement in a Textile Company

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Abstract

In today's fierce globalized marketplace, the ability to innovate is one of the prerequisites for excellence to ensure the competitiveness of any organization. The need to respond efficiently and in an integrated manner to the emerging challenges of the daily routines and the need to maintain market leading position encourages the implementation of methodologies that support new product development, making the process of developing new products an important differential. The primary goal of this research was to analyse new product development processes, in order to modify the conventional guidelines and ensure the speed and quality of new products and project management processes in an industrial sewing thread company. This research focused on developing an embryonic solution for the implementation of project management methodologies for the development of new products. As a major contribution, this work presents a reference model that helps the company to plan its product development processes, establish systematic stages for the development process, streamline all the processes involved and thus, increase its chances of success for new products in the market. For that, a new product development project was defined, where adaptations of methods and tools were made according to the latent needs of the organization.

Keywords: Project Management, Reference Model, SME, Product Development Process.

Introduction

In a significantly uncertain, complex and globalized economy where adaptation and change are success factors, organizations must continually look for new ways to compete. In this context, greater flexibility and innovation, combined with better management and optimization of resources, is paramount. This is crucial in the textile industry, where the market is highly volatile and dynamic, as orders have a low profit margin and are heavily dependent on fashion trends and colour seasonality, thus leading to strong variation in sales throughout the year. Therefore, there is a need to create a sustainable competitive advantage, anchored on meeting customer needs. Companies need to adapt to these changes and have a strong ability to innovate and influence market developments to, consequently, introduce and leverage new product development in the market before competition, reinforcing their competitive advantage and always focusing on quality and unremitting demand, not only for excellence, but also for high productivity, flexibility, shorter time-to-market, controlled costs and good value for money (Becker & Gerhart, 1996).

In this context, management techniques, tools and approaches applicable to new product development projects emerged in the design and development phase and later during the production phase, where efforts are needed to reduce costs in design and development, seeking constant cost reduction (Cooper & Kleinschmidt, 1995).

Project management has proven to be crucial to the success of companies' innovation projects, being the guiding thread for precisely defining short- and long-term goals, enabling change, designing strategies and thus increase the success rate of projects in organizations through better positioning in the market in which they operate. However, developing a new product on time and within budget is a difficult process because project management is an area that should be considered throughout the process of developing a new product (Costa, Fernandes, & Tereso, 2018). Moreover, introducing new products into a Small and Medium Enterprise (SME) leads to the need to clearly, efficiently and systematically define all the processes underlying their creation, development and marketing. The introduction of new products sometimes has distinct development and production characteristics from existing products, so it is necessary to redefine all stages, since the new project increases until it is produced and delivered to the end consumer.

The main objectives of this research focused on the improvement of project management practices and tools in the development and production of a new product, and the proposal of a reference model that assists the process of introducing new products in the market in a textile company.

The following section of this paper presents the relevant literature background, referring to the importance of project management in SMEs, reference models and product development processes in general, and in textile industry SMEs in particular. The third section explains the methodology adopted to conduct the research. The fourth section presents an analysis of the current situation, and the next section presents the proposals for improvement, including a new integrated project management process and the proposed model for the new product development process. Finally, in the last section, the conclusions of the study are drawn.

Background

Project Management in SMEs

In order to adapt to today's changing environment and resource constraints, SMEs are forced to implement changes to current business processes as they face difficulties in successfully developing new products. It is in this context that projects emerge as plans that guide the changes that escape the daily and routine activities of the company. The search for strategic optimization through project management for better results and higher profit margins demonstrates that SMEs are beginning to understand the importance of project management (Silva & Matamoros, 2010). However, it can also generate major losses if the methodology is not correctly planned, defined, introduced and implemented (Pinto & Kharbanda, 1996).

Reference Models and the Product Development Process

According to Rozenfeld et al. (2006), consumers are increasingly demanding, informed and with greater choice. The demand for higher quality products, lower costs and development lead-time forces companies to focus on various new product development strategies (Krause *et al.*, 1993). Therefore, it can be defined, as crucial elements for the company's growth and/or survival, the importance given to market conditions, the discovery of new technologies to be incorporated to make a superior product, and the involvement of top management of the company in the product development process.

The product development process (PDP) is described by several authors as a set of organizational activities, in various phases, that process market information in order to design a product and/or a service of value to the customer (Clark & Fujimoto, 1991). The PDP should be created based on the organization's competences, knowledge and resources, and consider the recognition of market

opportunities and product characteristics valued and desired by consumers. Furthermore, PDP can organize and discipline the various stages of a product development process, structure it to improve market understanding in the early stages of product development, reduce engineering rework, facilitate cost, quality and time control during development, allowing everyone involved to have a common vision. However, to structure the PDP it is necessary to use reference models that establish systematized steps / phases for the process development, in order to standardize the activity and information flows, minimizing uncertainties and increasing the probability of product success in the market. Therefore, in order to ensure their prosperity, organizations are constantly looking for ways to revitalize, restructure and redefine their NPD practices and processes to obtain better results. Many researchers have tried to develop a model that captures the relevant stages of the NPD process as a way to reduce the levels of uncertainty and risk during the process and to better plan and control the tasks performed from the moment the opportunity is identified until it becomes a commercially available product (Cooper, 2001; Crawford, 2006; Pahl & Beitz, 1988; Rozenfeld et al., 2006; Ulrich & Eppinger, 2007). Nevertheless, it differs from industry to industry and from company to company and should therefore be tailored to the specific context of each company, considering its needs and resources.

Reference models support standardization of NPD processes and aim to institutionalize best practices related to PDP management (Cooper, 2001; Rosenthal, 1992; Rozenfeld et al., 2006), contributing to the maturation of companies. For this reason, the contribution of PDP as a source of competitive advantage for companies is being increasingly emphasized, as it presents a solution for implementing innovation strategies, and above all, offers future business opportunities for the organization (Pons, 2008). It is then estimated that 85% of the life cycle costs of a product reflect the design phase, i.e., are determined by what is defined in the project (basic product and process technologies, materials, specifications, etc.) (Rozenfeld et al., 2006). It is also estimated that reductions of more than 50% in product launch time are achieved when design problems are identified and resolved in advance, reducing the number of subsequent changes, production and response times to consumer needs and, consequently, generating greater competitiveness in the market (Rozenfeld et al., 2006).

Product development process in textile industry SMEs

In order to face the competitive and innovative market, the management systems of SMEs tend to be increasingly similar to the management model of large companies (Gusberty & Echeveste, 2007). When comparing the innovation process and the PDP of SMEs with that of large organizations, the lack of structure and informality of the processes is notorious. In this sense, the survival and sustainability of SMEs can be determined by strategic and competitive advantages, so the use of a clearly structured and standardized PDP can be a crucial factor in this process (De Toni & Nassimbeni, 2003; Gusberty & Echeveste, 2007). In addition, the success and failure of SMEs can be associated with being closely related to the experience, knowledge and skills of the owners and employees of the organization (Silva & Matamoros, 2010).

However, the complexity of this process increases when it is referred to SMEs in the textile sector, as it is an extremely dynamic process. Due to the characteristics by which the fashion market is characterized, the process of developing new products needs to be agile, effective and efficient, so given the intense and volatile environment, the ability of an SME to design quality products, in a wide range and faster than its competitors, is the crucial point to conquer the market (Wheelwright & Clark, 1992). The development of new textile products is a rewarding process because this activity is necessary to maintain the company's profitability, obtain more attractive margins and its reference position (Senanayake & Little, 2001). Therefore, PDP management in the textile industries is strategic to increase the chances of success of the developed products.

Methodology

Considering the project objectives, the most appropriate research methodology is the Action Research methodology, since the established objectives were based on the analysis of the problem under study. This study aimed to develop a conceptual reference model and relate the orientation to a new market by monitoring the development of a new product. In order to do so, it was intended to investigate the development phenomenon of a new product, and to understand it completely, not controlling the underlying variables, but observing all the variables and their interaction relations (Dooley, 2002). Therefore, this type of study has a positive impact on organizational performance. For this, a collaborative approach was adopted, since this project involves the participation of employees from various departments of the company who, directly or indirectly, are part of the work team. In this sense, a qualitative research was outlined, in which the nature of the research and data collected are essentially descriptive and inductive.

The relevant literature was collected and analysed in order to understand in depth the importance of reference models in the development of new products in SMEs (Back, Ogliari, Dias, & Silva, 2008; Cooper, 2001; Rozenfeld et al., 2006), and the project management integrated process described in the sixth edition of PMI's PMBOK Guide (PMI, 2017). Then, to gather the data needed to conduct this research, in this particular type of business context, gather feedback from all stakeholders, and understand the maturity of the project, unstructured meetings and interviews with the heads of the related departments and the project leader were held. In addition, by analysing of existing documentation provided by the company, it was possible to identify problems, to later identify the necessary improvements.

Analysis of the Current Situation

The purpose of this section is to present the diagnosis made while monitoring this project by answering the questions of how the new product development process is carried out within the company and how important to the company is the NPD process, considering the characterization of the business environment. From the answers obtained and document analysis, a description and critical analysis of the current situation was established (Table 1). Moreover, for a better characterization, a set of categories were defined based on the study of Jordan (2004).

Table 1: Summary of key difficulties encountered in the integrated project management process and project development of the new product

Category	Difficulties and Critical Points
Project management	<ul style="list-style-type: none">• Unclear detail of the work to be done and its planning on a timescale;• Absence of a schedule;• Disorganization in the sequencing of activities;• Difficulties in determining the duration of each activity;• Little overview of projects;• Unclear roles and responsibilities;• Difficulties in understanding the state of each activity;• Lack of project management support documents;• Lack of an auxiliary tool to support project monitoring;

Category	Difficulties and Critical Points
	<ul style="list-style-type: none"> • Absence of a project manager.
Market orientation	<ul style="list-style-type: none"> • Lack of a distinctly defined policy of consumer and market research. This causes delays, because as the project goes on, new information is being discovered that requires changes in product development, so this information could already have been obtained in further market research, bringing more stability to the project and a fewer deviations.
Product planning and conception	<ul style="list-style-type: none"> • Relatively little time devoted to process planning as a whole; • Lack of stakeholder documentation; • Deficiencies in market valuation mechanisms; • Little documentation regarding the integral processes of new product development.
NPD management and organization	<ul style="list-style-type: none"> • Lack of qualified human resources in the area; • Absence of a team dedicated only to the elaboration and implementation of NPD; • Lack of a shared platform to support process development and foster communication between the various phases; • Little know-how in the area; • Lack of a clear and objective definition of the responsibilities of each department involved in NPD; • Lack of investment policies, both in NPD new aid tools and in developing talent for creation; • Lack of detailed definition of the activities to be developed; • Lack of formalization of decision points; • No deviation records in the project.
Referential methodology	<ul style="list-style-type: none"> • Weak formalization of NPD; • Lack of a clearly defined, established and formalized product development methodology.
Management process	<ul style="list-style-type: none"> • Very focused on employee experience; • Resistance to change; • Lack of a quality control system formalized and systematized in the stages of new product development.
Decision structure process	<ul style="list-style-type: none"> • Decision very focused on experience; • Undefined of entry criteria for the next phase; • Undefined deliverables needed for the later phase.
Information management and documentation	<ul style="list-style-type: none"> • Inefficient method of reviewing information; • Failures in the technical documentation of the project; • Decentralized integration between departments from strong departmentalization; • Undefined of established information flows; • Non-systematization of the documentation process; • Each department has its own files and manages them according to its own methodologies, so the knowledge of the technical parts of the product is only in the domain of each department rather than the entire company.

Category	Difficulties and Critical Points
Internal communication mechanisms	<ul style="list-style-type: none"> • There are no formal communication platforms accessible to all departments; • Modifications made in relation to the product are not previously contemplated without formal communication, generating doubts in subsequent processes.
Inter-functional integration	<ul style="list-style-type: none"> • Lack of a responsibility matrix that distributes the tasks and responsibilities of those involved in the development process. Hence, the difficulty in understanding the responsibilities in the project.
NPD techniques and tools	<ul style="list-style-type: none"> • Lack of tools applied to the development of NPD activities; • Disorganized information management, causing many to be missed and recorded.
PDP control	<ul style="list-style-type: none"> • Absence of schedule as a basis of control; • Lack of assessment and verification points during NPD steps; • Failure to record product design practices; • Absence of formal documentation of necessary changes registration and justification.

Regarding the NPD process, based on the comparison of the PDP reference models of Paula and Mello (2012), a comparison was made with the guidelines of the NPD process used by the company under study (see Table 2).

Table 2: Comparison of theoretical PDP models with those of the company under analysis
Adapted from Paula and Mello (2012)

Macro-phase	Item	Product Development Process Steps	Wheelwright e Clark (1992)	Rosenthal (1992)	Cooper (2001)	Pahl et al. (2005)	Rozenfeld et al. (2006)	Back et al. (2008)	Organization under study
Pre-development	1	Identification of business opportunities (idea generation)		X	X	X	X		X
	2	Prioritization of the best business idea		X	X	X	X		X
	3	Market analysis (strategic formulation)	X		X	X	X	X	
	4	Feasibility study (physical, economic, financial)		X	X	X	X	X	X
	5	Product design	X	X	X	X	X	X	X
	6	Project evaluation points (stage-gate)		X	X		X	X	
	7	Project team definition	X			X	X	X	X
	8	Project planning	X	X	X	X	X	X	
	9	Definition of project entries	X	X	X	X	X	X	
	10	Process design		X			X	X	

Macro-phase	Item	Product Development Process Steps	Wheelwright e Clark (1992)	Rosenthal (1992)	Cooper (2001)	Pahl et al. (2005)	Rozenfeld et al. (2006)	Back et al. (2008)	Organization under study
Development	11	Definition of product specifications and components	X	X	X	X	X	X	X
	12	Definition of project outputs	X	X	X	X	X	X	
	13	Definition of production methods		X		X	X	X	X
	14	Tool definition					X	X	
	15	Project verification	X	X			X	X	
	16	Project tests (Project validation)	X	X	X	X	X	X	
	17	Prototype	X	X	X		X	X	X
	18	Pilot production / Operation	X	X	X	X	X	X	
	19	Development of training programs		X			X	X	
	20	Development of advertising campaigns			X		X		X
	21	Market launch			X		X	X	X
Post-development	22	After sales monitoring			X		X	X	X
	23	Project review	X		X		X	X	
	24	Discontinue product					X		

According to the established diagnosis, the company is in an embryonic phase regarding its maturity in project management. However, despite the NPD process being carried out has serious shortcomings, the development and integration of a more structured methodology could undoubtedly be a valuable tool for the development of the project in question, bringing financial, time, communication and quality benefits.

Proposals for improvement

Based on the critical points described in Table 1, some proposals for improvement in relation to the opportunities presented by the company are presented in Table 3. The opportunities presented were divided into 5 different categories and, additionally, in the factors that contributed to their incorporation within the organization and, subsequently, allow a more objective analysis.

Table 3: NPD process proposals for improvement

Area (Critical Points of Diagnosis)		Proposal
Market orientation	Market research	• Create market understanding mechanisms based on market research (interviews, focus groups, questionnaires, experimental techniques, on-site observations, among others).

Area (Critical Points of Diagnosis)		Proposal
Organization management and NPD structuring	Integrated product development	<ul style="list-style-type: none"> • Establish a reference model for the integration of NPD activities adapted to the company's characteristics; • Description of the phases; • Definition of the location of gates in the generic referential model; • Describe the main decisions (gates); • Create mid-term evaluation guidelines for new product development.
Employee management	Define cross-functional teams	<ul style="list-style-type: none"> • Establish a project team organization policy.
	Responsibility matrix	<ul style="list-style-type: none"> • Establish a responsibility matrix for NPD.
Project management	Organization of activities	<ul style="list-style-type: none"> • Clearly structure the activities of NPD; • Introduce project management methodologies; • Develop templates that allow better project management; • Organization of activities by department and by development phase; • Introduction of project management tools and techniques (WBS, list of milestones and constraints, ...); • Establish project management practices as an internal standard.
	Evaluation	<ul style="list-style-type: none"> • Definition of revision points of the NPD development and evaluation process; • NPD phase control (gates); • Establish project progress indicators; • Record the experiences and lessons learned.
	Documentation	<ul style="list-style-type: none"> • Documentation of macro development activities. • Formalization of documents that record NPD decisions; • Formalization of gates validation documents.
Knowledge management	Information management	<ul style="list-style-type: none"> • Identify all information that should be available before and during NPD; • Create an integrated, departmental support information base; • Create a dossier per project, with documentation of all phases, development times and costs, among other information.
	Training and awareness of employees	<ul style="list-style-type: none"> • Establish specific training for project leaders; • Establish training programs for improvements in NPD; • Foster a learning culture; • Develop awareness of the value of project management among all employees; • Establish a career path in project management for all who play project management roles in the company.

Integrated project management process

The integrated project management process will be used as support for future new product development projects as they follow a similar structure. However, it will have to be adapted considering the type of project, the processes and the various problems that may arise during its development.

The integrated project management process consists of project management processes - initiation, initial planning, execution (includes monitoring and controlling) and closing - shown in orange below, in parallel to the product development processes, shown in grey (see Fig. 1).

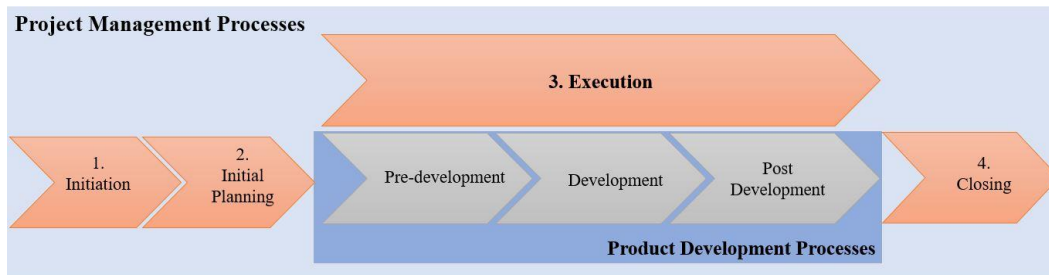


Fig. 1: Integrated project management process

Processes related to product development already existed informally in the company. The processes of the development phase are well defined by the company, but the remaining phases do not have a general structure of processes or activities, so it is up to the executors of those phases to develop the processes or activities that they believe are appropriate. Therefore, this integrated project management process introduces and details all the phases involved for a better and effective integration of project management processes with the existing new product development processes.

Regarding the process of integrating project management with product development, it is possible to understand the interconnection between the PM process and the NPD process as it can occur at various times in the model (see Fig. 2).

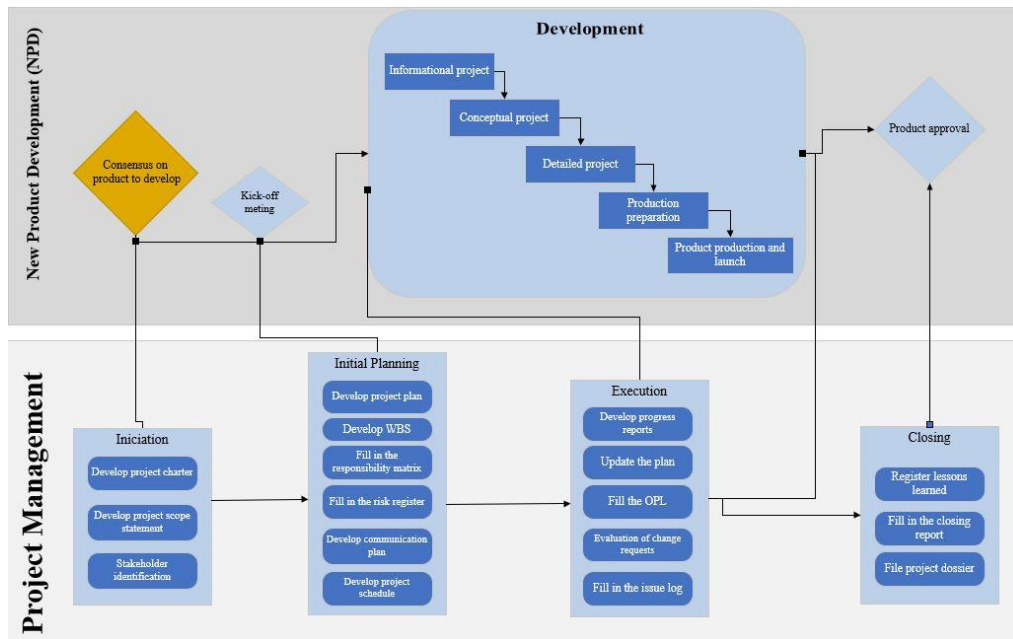


Fig. 2: Project management integration with the NPD process

Proposed model for new product development process

This section presents the proposed reference model for the process of developing new products in the company under analysis. Its representation becomes a procedure manual for the development of new products and serves as a repository of best practices, becoming a reference for other projects of the company.

The proposed integration model can be characterized as a specific prescriptive reference model, as it has a set of generic guidelines, allowing it to be adapted to any new product that the company decides to develop. Given the prescriptive nature of the model, it focuses essentially on the description of the work to be done and how it should be done, providing useful foundations for planning the development of a new product, which is considered as a project.

The subdivision of the phases of the proposed model into the respective macro-phases, illustrated in Fig. 3, represents the generic activities of each phase of project development.

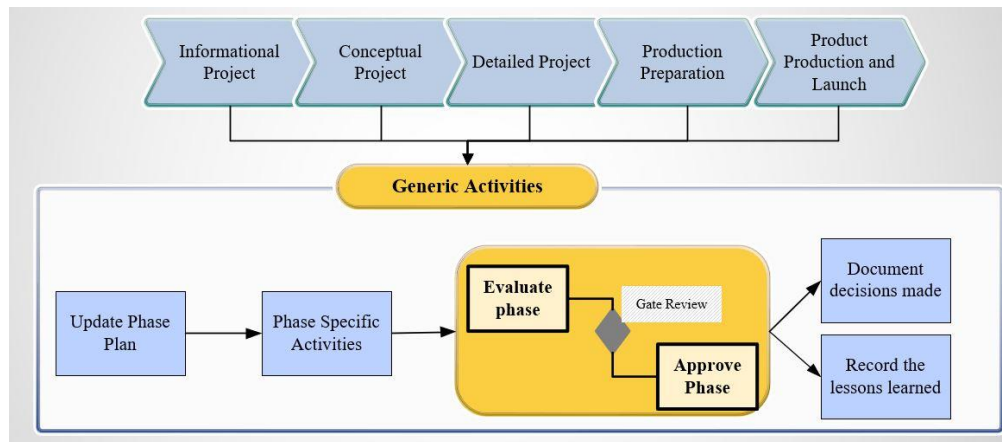


Fig. 3: Transition from one phase to the next one

Each macro-phase is described through phases, activities, tasks, inputs, outputs, methods and tools and supporting documents. Activities and tasks represent “what” needs to be done and “how to” do it, with methods and tools. Inputs and outputs are physical resources or supporting information or information generated to perform tasks and activities. To represent the reference model, it was broken down in detail according to Fig. 4.

Phase	Name of the phase			
	Task Name	Inputs	Outputs	Methods / Tools
	Activity			
	Task			
	Task			
Phase	Task Name			

Fig. 4: Detailed representation of each phase of the reference model

Based on the structure defined in Fig. 4, and to illustrate the knowledge involved in this structure, the model was divided according to the product development phases - pre-development, development and post-development. With reference to the model proposed by Rozenfeld et al. (2006), the proposed reference model is decomposed into 3 macro-phases:

(1) Pre-development: The pre-development phase encompasses company and product strategy and planning issues. This phase begins with the identification and recognition of a latent market opportunity, extending to the formal approval of the project that has been selected. This phase establishes and records the general characteristics of the product to be produced, i.e. characteristics capable of translating an identified product opportunity into a finished product. This macro-phase ends with the approval of the development project.

(2) Development: This phase answers questions about the organization of product development and project management, with the purpose of transforming the identified opportunity (idea/concept), in the previous phase, into a physical product that will later be released to the market. For this, there is a need to translate opportunities (market needs), through activities and tasks, into products that meet the expectations set by the company and, consequently, that of consumers. It is during this macro-phase that product itself is defined and the entire production and development process occurs. Within this macro-phase, 5 phases must be considered:

1. The phase titled “Informational Project” focuses on the generation and definition of product and process design technical specifications. This requires the understanding of who the consumers are, their needs, and what the requirements and constraints of the project are for producing a new product. In conclusion these specifications lay the foundation for the next stages of development.
2. The phase entitled “Conceptual Project” is intended to design the product and its process and to define the overall function of the product, based on its target specifications. In short, the expected outcomes of this phase are technology analysis to address product function, initial bill of materials considering the product architecture and function, product design and, finally, the production macro-process.
3. The “Detailed Project” phase is for defining systems, subsystems, and product components. This phase is also intended to define the final process layout, the production process structure and the economic viability assessment of the project. Furthermore, all these activities included in this phase aim to predict the functional behaviour of the production process in product design through functional testing, task sequencing and process and product optimization. In addition, the activities of designing the packaging process and product marketing planning also play an important role in this process.
4. The phase entitled “Production Preparation” is primarily concerned with production management aspects and customer requirements throughout the product life cycle. This phase assesses the overall viability of the project, in terms of product, production process, and consumer acceptance. The main activities performed in this phase are: preparation; review of the production process; approval of purchased resources; product testing (alpha and beta), in order to verify its quality and performance; pilot production, to test the production process and determine in more detail production costs and fees; pre-market testing, to check consumer reactions, measure launch plan effectiveness, determine market share and expected return; a detailed review of the financial analysis, to verify the economic viability of the project based on new and more accurate cost and return data.
5. The “Product Production and Launch” phase essentially consists on the release of the product to the market, the final approval on the production process, and finally starting to produce the new product on a large scale.

(3) Post-development: This macro-phase comprises the evaluation of the development process, the monitoring of the release of the product in the market and comparison between the obtained and planned pre-development metrics.

Conclusions

Currently, there is still the perception that project management only applies to large companies. This is because a frequently encountered barrier is the absence of models or benchmarks dedicated to SMEs. However, small companies naturally have a higher risk aversion and together with the lack of structure of project management and NPD methodologies can make companies in the sector unable to advance in terms of innovation and differentiation of their products.

The formalization of these processes resulting from its modelling (description of the phases, activities, tasks, responsible and necessary and/or generated information), promotes a univocal vision, which will serve as a common reference for better communication between all process actors. Through its graphic representation, the structure used contributes for the activities and

tasks to be presented in an organized manner and referenced to the knowledge domains to which they belong, making clear the flow of information (inputs, outputs and supporting documents) and the tools to be employed. In particular, the objective of the model was to introduce and organize best practices and to increment the process with the main methods identified in literature.

The main contributions of the study involved the standardization of the project steps and, therefore, to meet with quality the diverse project needs of the company, supporting the current and future projects of the company. However, one of the main limitations of the study deals with the lack of research on the proposed theme. More studies are necessary to understand the real impact of introducing project management practices and tools in the development and production of a new product in SME, and in proposing a reference model to assist the process of introducing new products into the market.

Future research work can propose an adaptation and/or redefinition of the proposed model based on the improvement points previously identified, so that the model can be tailored to the organization.

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