
Sustainable Packaging Design Model

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Abstract. For many consumer products the packaging is as important as the product itself. This means that one does not exist without the other. The product development process, in this in case, is only complete when the packaging is also developed. This work aims to consider an integrated Sustainable Packaging Design Model(SPkDM) .Therefore, in view of the imperious necessity and concurrence of PDP (Product Development Process) and PkDP (Packaging Development Process) and its interdependence and the resulted solutions, a model that also integrates the environmental aspects was established upon their initial phases. The strategies of eco-design and tools must be incorporated in each phase of the development process, as well as the assessment of the impacts, before going to the next phase.. They also provide the designers with data that will enable them to refine the packaging and the product. The model will instrument the packaging designers of the companies, guaranteeing that the process has a better ecological efficiency. The regular use of the model will bring as benefits time, cost and environmental impact reductions of the packaging.

Keywords. Concurrent engineering, Product Development, Packaging development, Ecodesign, SPkDM.

1 Introduction

The packaging development process is an activity becoming more important every day in the economic context. It has its coverage and direct relation with practically all the productive sectors. The packaging industry has a structural role in the capitalist society. Through packaging millions of people in the whole world have access to all types of consumer products. For the consumer, the packaging represents the symbol of the modern world, the consumerism, the practicality, the

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convenience, the comfort, the facility to conserve food and the desire of ownership [1].

Being also a product, packaging generates environmental impacts throughout its life cycle. Packaging developing has become a great challenging task and of enormous responsibility for the companies and the professionals involved. The reality has shown that most of the companies have their product development process totally independent from the PkP. As a result, they face losses in competitiveness, costs increases, and longer lead time. In addition, it also brings an unfavorable environmental performance for both the product and the packaging.

Currently, the companies have focused their concerns in the environmental performance of the products. Thus, both product and packaging development have become of great importance, since their environmental performance is determined mainly during the PDP. The PDP is the key to develop environmental friendly products. Ecodesign is a proposal that incorporates environmental aspects in the traditional product development process, also known as Design for Environment (DfE) [5]. It incorporates a systematic examination, during the PDP, of the aspects related to the environment protection and to the health of the human being. This systematic examination is performed throughout all the phases of the life cycle process of the product. It allows that the development team includes the environmental considerations since the initial phases and during the development, taking also into account the traditional aspects as function, production costs, aesthetic, ergonomics, etc. However “Charter and Tischner” [5] also consider the sustainability in the product development. The development of sustainable products for them is more than just ecodesign, since there is also a concern in balancing economic, social and environmental aspects in the PDP.

The objective of this article is to propose a Sustainable Packaging Design Model (SPkDM), integrating Product Development Process (PDP) and Packaging Development Process (PkDP) as well as the environmental aspects since the initial phases of the process.

2 Packaging

The packaging throughout its history has represented an important tool for the trade development and the growth of the cities. It guarantees that the product reaches the final consumer in safe conditions and quality. It can be defined as an industrial and marketing technique to contain, to protect, to identify and to facilitate sales and distribution of consumption, industrial and agriculture products [15]. “Saghir” [17] defines packaging as a coordinated system of preparation of goods for safety, efficiency and effective handling, transportation, distribution, storage, retail, consumption and recovery, reuses or disposal combined with the maximum value to the consumer, sales and consequent profit.

2.4 Product and Packaging Development Process

2.4.1 Product Development Process (PDP)

PDP involves a flow of activities and information. According to “Rozenfeld *et al*” [16] it allows to understand the critical relations between areas of the company, PDP, market, suppliers, technological information and institutions of product regulations. Thus, PDP has its relation with internal and external processes of the company.

There is a vast literature in terms of product development process models like Back [2], Ulrich&Eppinger, [19], Pahl [11], Rozenfeld *et al* [16]. However these models do not consider packaging, and when there is a reference, it is very limited. In the case of “Rozenfeld *et al*” [16], they only make reference to it at the detailed phase of the project.

Another important aspect to be considered is that these models do not incorporate environmental issues since the initial phases of the design, but just as end of pipe solutions.

2.4.2 Packaging Development Process

The existing models for the packaging development process available in the current literature are limited and scarce and do not include environmental issues since the initial phases of the design.

It was also noted that the existing processes are related to more specific areas for example, food product development like Fuller [7]; Brody and Lord, [4]. There are not much authors with publication in the area of packaging development process which can be cited like Griffin [8]; Paine [12]; Romano [13]; DeMaria [6]; and ten Klooster [18].

Bramklev [3] model's however integrates product and packaging but environmental issues are not considered, therefore this model is not complete for the demands of eco efficient products.

3. Sustainable Packaging Design Model

A Sustainable Packaging Design (SPkD) model was developed, having in mind the relevant necessity and simultaneity of Product Development Process (PDP) and Packaging Development Process (PkDP). It also includes environmental aspects since the initial phases. It is based upon “Rozenfeld *et al*” [16] an updated and generic model. It is integrated with the product and the ecodesign strategies and tools are incorporated in each phase of the development process. The mentioned model is shown on Figure 1.

The interdependency of each one, the product and the packaging processes, will be represented by arrows. Each phase of the model will be described in a generic form. It performs the macro phases of Pre-Development, Development and Post-Development. It includes the various phases of the Packaging Strategic Planning (macro phase of pre-development), Packaging Planning, Concept Design, Detail Design, Proving Functionality, Packaging Launch and Packaging Review (macro phase of post-development).

3.1 Pre-Development – Product and Packaging Strategic Planning Integration

The macro-phase of Pre-Development integrates the Product and Packaging Strategic Planning. It involves the company's planning and business goals related to products and packaging. Almost all the company's sections contribute with these activities, but especially areas involved with Product, Packaging and Environment.

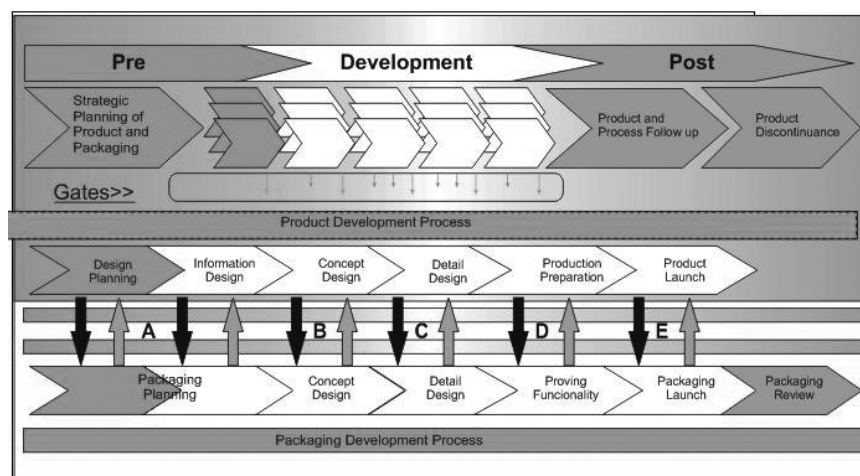


Figure 1 - Sustainable Packaging Development Process (SPkDP)

Note – Process Integration – Black arrows = product and Bordeaux arrows = packaging

Projects to be developed are then prioritized based upon technological, market, product's and packaging's environmental trends information, besides the establishment of environmental and strategic goals. For this, the company utilizes Market Research Information, Competitive Intelligence, Product and Packaging Life Cycle Assessment (LCA) of the competitors and similar products and finally, also, Environmental Impact Information of different materials and processes.

3.2 Packaging Planning

Packaging Planning integrates the macro-phase of Pre-development (Design Planning) – **Stage 1** and the macro phase of Product Development (Informational Design) – **Stage 2**.

3.2.1 Stage 1 – Product and Packaging Planning Integration

This part of the packaging planning phase integrates the Product and Packaging design planning. At the end of all the activities of this phase, the Project Plan is generated and it will be common for the two areas product and packaging.

The design team is composed of people from cross-functional areas. The members of the team, considered core members, are representatives of Product, production, Quality, Supply Chain (SC), Logistics, Packaging, Environmental Management areas, etc. There will be two teams, working in parallel – product and packaging. These two will interact when necessary, as established on the project timeline. For an environmental friendly packaging development the packaging team will have to have a strong interaction with Logistics, Supply Chain and Environmental areas. In addition, there will be exchange of information and participation of external members like packaging and raw material and packaging equipment suppliers.

In this part of the phase the project scope is also worked out in detail. It's a common guideline document for both PD and PkD. Furthermore, Stage 1 of this phase includes situational analysis, task description, establishment of responsibilities and timeline preparation. Also cost indicators, necessary resources, critical success factors and establishment of performance indicators and financial feasibility of the project cannot be ignored.

3.2.2. Stage 2 – Integration of Informational Product Design and Packaging Planning

Stage 2 of this phase has as its purpose, upon collection of information arising from different sources, to establish target-specifications of the product-packaging system. It is necessary the collection of technical and economical information and also information related to components, to the materials and to the partners and suppliers capabilities. These capabilities relate to financial, technical, quality issues, besides environmental performance. Benchmarking analysis is carried out using technical and environmental information's of a base line product-packaging, showing weakness and opportunity for improvement. Important environmental data sources are: LCA, purchase records, monitory reports, quality assurance, reports, records, publicity records *etc.*[9].

This stage also searches information, describing where the product-packaging system goes through and identifying clients and their necessities. The client requirements are obtained through the client's necessities, classifying, arranging and grouping according to the phases of the corresponding life cycle.

Furthermore this phase also includes the planning and the formulation of the product/ packaging requirements and the environmental requirements for both, taking always into consideration the timeline of the design and available budget. In the SPkD integrated model the QFD (Quality Function Development) methodology, for example, will be used as an integrated form for establishment of the target-specifications of the product-packaging system, in this case helping a better understanding of what the product-packaging system needs in order to fulfil the necessities of the consumer and also to beat the competition [14].

3.3 Conceptual Product Design Integration with Conceptual Packaging Design

In this phase the design team looks for, creates and presents solutions for the product-packaging system guided by the target-specifications of the project with environmental focus, considering environmental issues during the life cycle. By

looking for solutions, the team will have to give attention to marketing and logistics requirements and adopt DfE and DFX (Design for X) where X may be any of a number of design attributes to get efficiency, improvement of materials and energy, careful soil use and cleaner production. Packaging alternatives or generated concepts must be analyzed and combined with product alternatives and concepts, evaluating them together in order to generate the concepts of the product-packaging system.

The concept that best fits the target-specification, consumer expectations, costs, technical and environmental criteria, will have to be chosen.

3.4 Detailed Product Design Integration with Detailed Packaging Design

In this phase various decisions are made like materials to be used, shapes and colours. These all cause substantial influence to the flow cycle of materials and production processes which are used. Concepts are developed to comply with the product-packaging design specification and to detail the product-packaging system, before production or introduction for use. In this phase most of the activities run simultaneously for both product and packaging. It is essential to use DfX (Design for X) considerations, including DfE (design for Environmental) ecodesign tools like strategies, matrixes, catalogues, checklists as well as LCA.

It is also very important that the Design team works close together in order to specify thoroughly the product- packaging system, sharing information and characteristics or properties of both systems in order to assure the design success.

In order to determine the primary packaging several tests are necessary. In a sequence, all levels of packaging are detailed.

3.5 Integration of the Preparation of the Product and Packaging Functionality Tests

The purpose of this phase is to assure that the company is able to produce the volume established in the project scope, complying with the client's requirements during the life cycle of the product-packaging system.

The evaluation and assay of a pilot lot of the product-packaging system will improve the detailing of the project, indicating necessary adjustments of the process conditions, and sometimes even change of suppliers. LCA revision can also be performed in this phase.

3.6 Integration between the Product Launching Phase and the Packaging Launching

The launching phase covers the activities of the logistics chain in delivering the product to the market, involving the sales and distribution processes, customer's service, technical assistance and marketing campaign. It encompasses the planning, production and packing of the product and delivery to the sales point. In order for the product launching date to perform as planned in the project time line the various activities related to the manufacturing of the product, packing and distribution will have to be properly coordinated to assure that the product reaches

the sales point during the advertise period and sales promotions. This phase also includes the presentation of the information regarding the characteristics and benefits of the product and its packaging, stimulating customers to look for and to buy the product. The sales catalogue must mention information and benefits of the environmental packaging. It will help to attenuate the environmental impacts during the use and disposal phases of the product and packaging. Environmental information and communication (Environmental Labelling) can be propagated in different forms: at the sales point, on the packaging label, on the Web, on the company's customer service and on other media channels.

The company can also supply collectors for the disposal of the packaging after its use at the sales point, stimulating its recycling.

3.7 Packaging Review and its Development Process and Integration with the Phases of Follow-up and Discontinuing Products

This phase is part of the macro-phase of post-development which integrates two phases of the product project – Follow-up and Discontinuing Product.

3.7.1 Packaging Review and its Development Process and Integration with Product and Process Follow-up Phase

It is extremely important that the company reviews the packaging and its development process six months after launching it [6]. This review must encompass consumer's satisfaction, product functionality, manufacturing records, packaging, waste indicators, worker's health records, energy and water consumption, and environmental impacts.

3.7.2 Packaging Review and its Development Process and Integration with the Product Discontinuing Phase

The discontinuing of an item of the company's Product Portfolio takes place when it shows no more benefits or even importance. The final packaging use or its disposal, having a different life cycle in relation to the product, starts with the use of the product. In this case the packaging is disposed and then sent for the recycling process or to the land fields or to collecting points. It may also be returned to the manufacturer.

In reality, the correct destination of the disposed packaging depends on local authorities and laws applicable in every country, besides the people's education and awareness. This creates then an adequate structure of shared responsibilities of all interested parties. These lead to a gradual expansion of the production and consumption of products and packaging with less environmental impact.

Conclusion

The SPkD model presented complies with the current demand of competitiveness and eco-efficiency, besides fulfilling an important gap in the literature for product developments.

This model will contribute with a greater integration of knowledge within the companies as well as with the partnership commitment among different companies.

It will instrument designers and packaging developers with a complete SPkDM, including the environmental variables in all the phases, assuring a more consistent and sustainable environmental efficiency. By integrating PDP and PkDP and also including the environmental variable, since the beginning of the project there will definitely be quality gain and cost reduction, besides shorter development lead time and great benefits as a consequence of the reduction of the environmental impacts.

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