

# The Many lives of PET: a Strategical Approach for Environmental Questions

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## Abstract

This paper considers the strategies of product differentiation, in which the companies attempt to develop innovations that will have a lesser impact on the environment during its cycle of life. It is argued that with the integration of the cycling notion it is possible to elaborate a strategy that makes it possible to reduce costs, to prepare (themselves for new obligations that will, nevertheless, have marketing and institutional advantages. The companies who find in the ecology an innovation factor are repositioning themselves in relation to the environmental issues. This approach can be materialized through the practice of ecodesign, what presupposes the existence of a productive chain that is progressing, where the companies associate themselves with, in order to develop new products that will have a lesser impact on the environment and to restore new approaches of innovations. We present the strategies of an Italian multinational, a great producer of PET resin (polyethylene terephthalate), for the launching in Brazil of a fiber elaborated from the recycling of PET bottles, fulfilling, thus, the first cycle of the product and starting the second cycle, that is as noble as the first one. The research is our case study, where we used secondary data-collecting, analysis of documents and semi-structured interviews. The results point to the conclusion that that the environment requirements stimulates the creativity and can be the origin of bigger evolutions: new functionalities, new materials, new technologies and new uses for the products. Therefore, as they try to integrate the environment to their strategy to develop new products, the company in question developed a "win-win" approach, as this strategy is a winner for the company as well as for the environment.

## Keywords:

New Product Development, environment, innovation, life cycle of product

## 1 INTRODUCTION

The interaction between companies, society and the environment modifies the management and performance assumptions. It is then that arises the problem of how to innovate and, at the same time, preserve the natural resources in order not to damage society [1, 2]. The biggest understanding of the role of technology in the productive organization and its effects on our society and our environment has generated questions on the standards organizations entrepreneurial and the consequences of their operations.

In this sense, generating innovations and evolving technologically became conditioned by other factors besides the ones that determine the profits that come from economically more efficient processes and new managerial perspectives begin to emerge as essential to the maintenance of the productive process. In this context, the policy of sustainable product development demands an integration between economic, social and ecologic matters. To achieve so, there is the necessity to transform the paradigm based upon the indiscriminating use of resources as the sources of competitive advantages with another that utilizes the adequate form of resources in order to avoid its extinction, replacing it by other that will not cause harm to the environment.

The companies that find one innovation factor in ecology reposition themselves in relation to the environment. This approach can be rendered through ecodesign practices, what presupposes a productive chain in evolution, where the companies associate to develop new products with smaller impact for the environment and to establish new approaches of innovations. This has direct implication in the strategic administration of environmental subjects, looking

for the transformation of the investments in sources of competitive advantages.

Considering that fact, this work intent is to identify the conditions that justify the implementation of environmental strategies in the companies' product development and innovations generation. Specifically, to understand the difficulties faced in the productive chain for the development of products starting from recycled raw materials. That investigative initiative wins larger figure in the measure in that the need of more systematic studies is verified on the strategies of product project in a perspective of its environmental impact. The bibliographical reference in that activity field in Brazil is rare and dispersed, although its present significant economical expression and crescents interests business, government and social.

In search of the proposed objectives there will come a brief revision of the literature related to the construction of a strategy of closed flow, with the development of green products, and the necessary green competences for such enterprise; in the second part, will be presented the strategy of an Italian multinational company, large producer of the PET resin (polyethylene terephthalate), for the release in Brazil of a fiber elaborated from the recycled plastic bottles, accomplishing, like this, the first cycle of the product and leading off one second, as noble as the first one. The results point that the environmental demand stimulates the creativity and shows that it can be in the origin of wider evolutions: new functionalities, new materials, new technologies and new uses for the products.

## 2 BUILDING A CLOSED FLOW STRATEGY

Fundamentally, an ecological product does not exist [5]. Each one of the stages of the product's life generates inputs and outputs that will impact the environment. These stages should be analyzed since the product's conception, because each one has the potential to be made ideal to the environment: in the choice of raw materials; of technologies, of the construction process, of the logistics; and, following that, in the context of the use and final valuation of the product [6,7].

This approach allows one vision a lot broader of the product's life, its future, its life's end and how valuable it may be when it's time to possibly reintegrate it in the life cycle of another product. Thus, we can say that ecodesign – or ecoconception – is one approach that continually better itself, since no state is defined or final. Therefore, ecodesign is a project model oriented by ecologic criteria [8]. The perpetual search will be for a closed flow cycle and for the synergy between the agents.

To integrate the idea of cycles in the making of the products mean that, little by little, all manufactured products will acquire a new and essential function: to be valuable. Its value is designated by each phase in which there's the possibility of reutilization of the product or of one of its components, which may occur in the energy recuperation by burning the material or of resources for recycling or composting. Ideally, all the elements of one product should be allowed to circulate indefinitely –or, at least, during a period as long as possible – in the successive utilization cycles.

The closed flow strategy indicates that the company totally controls the life cycle of the product, notably the end of its life. Once it returns, the product is remanufactured and updated to be put in the market again or disassembled so that some of its parts can be used in new products. This way, new industrial structures are created: two factories in the same production site; one that manufactures and another that remanufactures the utilized and returned products.

Such transformations also lead to the reorganization of the role of the companies in the economic cycle. Manufacturing finished products, the company also becomes the producer of secondary raw materials and of services. Obviously, a logistics organization is very important for the closed flow strategies, even if the organization exists only because of the necessity of maintaining a direct relationship with the clients, that, therefore, cannot be geographically too dispersed [10].

The implementation and the success of such 'win-win' approaches, good for the company and for the environment, depend, regardless, of a permanent commitment of the company's CEO board of directors and its employees [11]. Any approach to integrate the environment begins with the knowledge of the flows and its impacts and continues with the execution of the proactive approaches combined under the generic term: ecoefficiency.

### **3 INTEGRATING THE ENVIRONMENTAL CRITERIA TO THE PRODUCT'S DEVELOPMENT**

Integrate environmental criteria in the process of product development requires managerial; technical and operational changes to elaborate a green product project [12]. In managerial terms, two elements are important to transform the ecologic challenge into a competitive dimension:

1. The participation of suppliers in the product's project. According to the experience of innovative companies, the introduction of co-design together with the suppliers allows these companies to anticipate pressures and identify the project's phases options in a more ample way. Surely, the environmental characteristics of the product frequently are extremely influenced by what the raw material is composed of, besides its quality; for example, it is impossible to recycle one product if one material is not compatible with the other [13].
2. The more profound consideration of the complementary products that generate environmental consequences. For example, one manufacturer of washing machines should analyze itself not only just as a machine manufacturer, but he should also think if its product is the part of one process that allows the consumer to have clean clothes.

In the technical point of view, product managers should consider ecodesign techniques as strategic tools to develop new products. [14,15]. Surely, if you consider that green themes can be a significant motivator to the product's differentiation, the introduction and/or a bigger attention to the project's execution considering the recycling or the disassembling project allow that the product manager identifies the best trade-off between the environmental compatibility of its product and its contribution to the companies profits.

Considering operational criteria in the definition of the product's specifications, product managers need to introduce important changes in the project's logistics. Through an ecodesign perspective, such orientations may be combined in four classes [16]:

1. Product's structure: it is necessary to minimize the variety of materials, diminish the number of items that compose the materials; and make the more valuable materials and the dangerous materials easily accessible.
2. Individual components: avoid the materials that are incompatible with the recycling process.
3. Disassembling operations: use elements that can be easily disassembled; diminish the number of connections and diminish the need for destructive disassembling techniques.
4. Logistics: The project's team must consider the possibility of marking the material with a number that indicates its nature and if it can be recycled; supply all the necessary information to make the recycling process easier
5. Plan and control processes: modify the formatting process of the strategy, including it in the budgetary activities.

Special attention should be given to the logistics process. The change of the traditional view of the

product's life cycle to the approach of from 'the cradle to the cradle' requires the introduction of the concept of an integrated reverse logistics. Surely, the viability of the majority of the green products innovations depends very much upon the possibility to effectively manage the reverse flows of the goods [17.18.19]. In this perspective, the ones in charge of the logistics process can evaluate, for example, if the green product that was planned can easily be recuperated to be used in other industry.

Because it is impossible to have a direct control over the entire life's cycle of the product and the multi-dimensional nature of the 'green' competencies, the innovative company has to define cooperative relationships with the external stakeholders and to consider the communication as a basic element to amplify the desired environmental results [20]. The executives should be involved in the introduction of the vertical cooperation along the chain of supplies (suppliers and clients). Specifically, for the suppliers this causes:

1. The frequent exchange of information to evaluate the best environmental proprieties of the supplied materials and to identify how it may affect the total environmental performance of the end product.
2. To supply a significant support to the betterment of the environmental management system of the suppliers that are not as able in this area.

In a more ample perspective, the integration of the ecologic dimension in the strategic formulation process, frequently forces the executives to rethink the general business strategies and, specifically:

1. Modify the strategies based on cost, since the reduction of the environmental performance of the company generally requires the acquisition and /or the internal development of new technologies, thus affecting the economic results incorporates in terms of expenses to new investments.
2. Change strategies based on the differentiation: specifically, the opportunity to obtain a good chunk of the market of the participation in niches of a new market can favor the redefinition of the specifications of the product's project in favor of a more elevated environmental compatibility of the product.
3. Alter up or down the integration policies. The programs which goal is to better the environmental performance of the key-product can make the managers modify upwards their integration choices: considering the programs based on recycling, the project and the product's engineering can make the company realize internally the components that were previously manufactured by their external suppliers. On the contrary, the increasing interest in reducing the quantity of residues sent to be disposed can lead managers to re-examine their integration choices down. In this case, some companies incorporate reverse channels in the supply chain to inside the corporation, in order to facilitate the return of the products in the end of their lives [21,22].

Here will be investigated, in exploratory character, the environmental strategies of a multinational Italian company, large producer of the PET resin (polyethylene terephthalate), for the release in Brazil of a fiber elaborated from the packaging recycling.

#### 4 METHODOLOGICAL STRATEGY

The selected case belongs to Mossi & Ghisolfi (M&G) that began its operation in Brazil in 2002 by acquiring the polyester division of Rhodia, called Rhodia-ster. Considering this, M&G inherited the environmental politics implanted by the Rhodia group since the eighties in Brazil. Now it possesses one industrial unit installed in Brazil entrusted of producing the resin PET, besides the largest recycling PET plant of the country, RECIPET, located in Indaiatuba (SP).

In this study, the question that characterizes the research problem is: how and why an organization includes the environmental variable in the strategic decisions of products? Specifically, to understand which are the difficulties faced in the productive chain for the development of products with recycled materials. This way, the research enrolls in the field of Study of Case proposed by Yin [23]. The data collection (executed between February and April of 2006) was accomplished through a secondary database about the company and the product and from six semi-structured interviews with company employees involved with the project at that time. Other sources of evidences were, in the same way, investigated through collection of specific secondary data, such as: national and international no-government organizations, and national and international industrial and business associations.

#### 5 THE MANY LIVES OF PET

The PET polymer is a polyester, resin developed by the English chemists Winfield and Dickson in 1941. The polyester has obtained a fast growth, initially by substituting cotton as a textile fiber, and later - in the 80's, on the application of films for packing. PET is the name that the market consecrated for the polyester destined to the production of packaging bottles, the more common of them destined to the soft drinks market. So, the PET is a polyester called "bottle grade" in opposition to its similar used in the textile applications, that is usually called "fiber grade". It's important to consider that both "bottle" and "fiber" grades are made from the same raw material base, but receiving slightly different additives in accordance with the intent final use.

However, one of the most important aspects about the use of polyester in the packaging industry was the same of almost all packaging raw materials: the challenge of the recyclability, as improper disposition can mean a real environmental and social problem. Today the PET is one of the most recycled plastic polymers in the world, due to the wide extension of applications, from the textile to the packaging industry itself. Considering the total amount of recycled PET in Brazil, 47% are addressed to textile applications, the main use of the product.

Other relevant applications are packaging for cleaning products, carpets, and water tubes. The recycled PET demand's evolution is increasing the concerns about quality among the recyclers, as they are developing more reliable products for the actual users and the new application.

The director of Recipet, making a balance of the acting of the PET recycling industry shows that, in 2004, the sector advanced 20%, reaching the 170 thousand tons mark of recycled resin, or 48% of the total amount of PET produced. It is "an expressive percentile, especially when considered that 30% of the more than 5 thousand municipal districts don't count with any garbage collection type and only 200 possess system of selective collection", it detaches Alfredo Sette, President of the Brazilian Association of the Industry of PET (ABIPET) [24].

As in the case of all other materials, the PET post-consumption is obtained, in its great majority, through the services of scrap catchers, organized or not in cooperatives, and scrap dealers, that usually, due to the lack of an appropriate politics for the residues, still remove them directly from the garbage deposits.

The project Alya Eco was born in this context, an integral part of the environmental strategy of Rhodia-ster that was inherited and continued by M&G, that is presented in the sequence.

### **5.1 Alya Eco: a strategic approach for environmental subjects**

To integrate environmental criteria in the product development process required that company changes in managerial, technical and operational aspects. By the end of the 90's, Rhodia-ster (on that occasion a subsidiary of the French Group Rhodia, and today part of the Italian corporation Gruppo Mossi & Ghisolfi - M&G) needed to do managerial changes to launch a new brand in its line of textile products.

The company's polyester staple fiber, raw material used to compose threads used in an extensive range of clothing and decoration products, is still using the brand Tergal, of great recognition in Brazil and in the abroad in the 60's and 70's, but that had presented evident aging along the course of time.

A market research developed by the company with the consumers, from institutional (spinning, weavings and clothes manufacturers) to final consumers revealed that the mark didn't present more the vitality of the past and that its rejuvenation was a costly task and of uncertain result. The decision, by the end of 2000, was the one of creating a new brand that would be more appropriate to name a new family of products - that were then still under development - to substitute those in line.

The chosen name was Alya. For launching the brand however it was necessary to select a product to symbolize the technical innovations and the vanguard aspects that the new mark should suggest at the same time. Among the products in advanced apprenticeship of development was a fiber of polyester very thin, for use in spinning machines and focused to the clothing market that had as differential the fact of being 100% done from recycled PET.

For the development of the new product there would be necessary technical alterations on the bottle grade polyester. The textile fibers done partially starting from recycled polyester are not a technical innovation in itself and, even at that time, the product was already plenty known. Since 1979 Wellman, a nylon and polyester producer and recycler from South Carolina, USA, have being doing that. The first fibers manufactured by this rout just used in its composition a small portion of resin from recycled origin, and they were thick fibers, done for stuffing toys and simple upholstered products, or the making of less technical no-wovens. They were products in that there was no need for more demanding performance, being just enough that it has the minimum attributes of physical resistance and volume.

In the course of time, this bottle transformation in fiber has being technologically improved, and the products generated by this technique were more capable to support a more intense list of demands. The reality, however, had not changed: the fiber done starting from recycled material had inferior technical performance to the similar ones done starting from virgin material. The challenge of producing a polyester staple fiber made from 100% of recycled origin raw material was still big and proposed. This difficulty also came from the variability of the recycled material, besides the subject already commented on of the composition slightly different from the polyesters for the textile use and packing one.

The polyester staple fiber production process starting from the traditional raw materials (PTA. purified terephthalic acid; and MEG. monoethylene-glycol) is strictly controlled, in a way to guarantee that the final product is extremely uniform, and that doesn't cause variations in the processing along the production chain. In the case of the bottles recycling, a lot of variation possibilities are added that, alone or in combination, can bring problems for the stability of the final product. Some of the main difficulties:

1. Different PET manufacturers'with several small possible alterations of specification on raw materials, processes or additives.
2. PET manufactured in very different periods of time, with the consequent divergence of additive types, that had grew in number along the years.
3. PET with different viscosities, depending on the demand requested by specific machines or packing type.
4. Bottles manufactured by different equipments in the packaging production, with divergent stretching degrees.
5. Possible mixtures of PET with other materials, as those that composes the label and the closure or cap, for instance, usually done of other types of plastics.

All considered, the technical challenge turned the polyester fiber done 100% from recycled PET a great innovation, and that would allow that the new brand Alya was presented to the market associated in fact with a differentiated and technologically advanced product, besides the ecological appeal that clearly reinforced the market possibilities of the product.

The project of transforming PET bottles in a quite thin fiber involved Recipet, the recycling company of Rhodia-ster, the Research & Development and fabrication teams of the Poços de Caldas plant. One of the Alya Eco's important differential was its thickness: it is finer than the cotton fiber. That was one of the challenges in its development, even for a company as Rhodia-ster, that already had in the portfolio thicker recycled fibers, for carpet manufacturing among other uses.

The technical problems in the fiber production were solved thanks to the expertise of the company in the production and processing of the polyester, market in that it has already acted per decades. And the most complex aspects linked to the recycled raw material were solved thanks to Recipet, exclusively dealing with the PET recycling matters since 1995.

## 5.2 The Alya Eco project: Integrating competencies

Considering the **operational** criteria for specification of the product, significant changes in the project's logic were relevant to the success of the new fiber, there were concerns with the **product's** structure and with the **reverse logistics**. Recipet was created right after Rhodia-Ster was constituted, and the goal was for the company to be present in all phases of PET's productive chain, since the production of its main raw material (PTA), passing by the manufacturing of PET, the containers, until the recycling of the bottles. One of the risks in utilizing recycled materials as a component of another product is in the solidity of the supply chain. In this case, M&G incorporated, to inside the corporation, part of the reverse channel in order to facilitate and guarantee the return of the PET container to the productive cycle.

The task related to the **product's structure** has also required special attention during the phases of development and manufacture of the PET containers. "PET's use of materials that are difficult to separate in labels, glue; caps and sealers, for example, can be prejudicial to the quality of the recycled resin or make the process impractical", explains Recipet's director.

To make the container's sector conscious of the subject, the PET industry, through Abipet, launched a document entitled: "Guidelines for the PET bottles project", with the recommendations about the technical characteristics of the containers and theirs accessories that should be followed by their designers. The idea is to avoid the use of inadequate materials, which would be difficult to separate and would compromise the quality of the recycled resin. The document is being divulged in the specialized media, in workshops and in visits to large companies which manufacture containers.

In the **logistics** phase, Recipet's director points out that the major difficulties are in the lack of an environmental culture of the Brazilian consumer, that mixes recyclable materials with organic garbage in its origin, and in the logistic, because of the inexistence of a selective garbage collection. The challenge is to elevate the quality. The incentive to the cooperatives of garbage collectors is also part of the work of the reverse channel integration. After the collection, triage and packing up, most of it done by independent

collectors and junk dealers, the revalue continues with the separation by colors of the discarded containers. Pre-washed and pre-grinded, they are transformed into flakes and they go through a refining process, that constitutes of them being washed again, dried and passed by decontamination chambers.

In order to produce Alya Eco, these flakes are submitted to a refusion process, filtered, granulated and crystallized inside Recipet. This is the material that goes to Poços de Caldas (MG) factory to be transformed into fiber. Since it was not an innovating product, in the technical perspective, but it brought in itself a differentiated appeal to the consuming market, the company considered necessary a different approach, encompassing the entire productive chain of the textile area, in order to allow all of the links of this chain to acknowledge and absorb the advantages that the new product brought.

Manufactured from recycled PET bottles, Alya Eco, a polyester fiber, was launched in São Paulo Fashion Week (SPFW), in the summer collection of 2001/2002, the idea of stylist Carlos Miele, of M.Officer and confectioned with Santista's indigo, in a mixture of Alya Eco and recycled cotton. This way, it would reach, at the same time, a series of sectors of the textile sector, and it would associate the product with an event that is also recognized as equally innovative. Project Alya Eco's fruit, that united Rhodia-ster, Santista and M.Officer and with the participation of CoopaRoca – name of the craftswomen cooperative of some female residents on the major slum in Rio de Janeiro, called Favela da Rocinha – the collection reached the consumer in the 80 stores of the brand and in other 500 establishments that sell multiple brands, including stores outside the country.

Alya Eco's program received also ABIT Award (ABIT is the Brazilian Association of the Textile Industry) in 2001, in the Innovation category. Combining technology and creativity, Alya's line was born willing to innovate in the world of fibers and its applications. Alya Eco is the second cycle of polyester, since it has previously fulfilled its container function. With the advantage that the excellent qualities of polyester allow a recycling process without loss: one ton of PET is equal to one ton of fiber.

Therefore, Rhodia-ster's initial goal of launching a new brand to their family of textile fibers was reached and, in the process, it has become an award winning project that united the productive chain and objectives that were deeply aligned with the responsibility of socio-environmental practices, while still being profitable for the companies involved. "Alya Eco is proof that we can turn recycling into an economic viable process, that involves all the links in the chain" [25].

M&G keeps working in the development of diverse applications for recycled PET, together with several partners. "This will help create a demand for recycled PET", says Recipet's director. This way, as we integrate the environment with an opportunity in our strategy to develop products, the company in question implemented a win-win approach. In synthesis,

we can conclude that the company had a proactive attitude and faced the environmental requisites as opportunities to innovate, improving its processes and its products, being able to obtain a better and more competitive position, reducing costs and/or increasing the value of its products.

## 6 FINAL CONSIDERATIONS

Alya Eco's creation is a result of the company's expertise, that has the domain of the complete cycle of the polyester - from the purified terephthalic acid (PTA) to the recycling. This way Rhodia-ster (now M&G) found in the new product an innovation factor, repositioning their strategies, when associating them to the respect for the environment. The implications for the organization went from operational aspects to strategic considerations. These last ones involve the positioning of the company from markets that have as requirement the environmental concern, to the finding of the emerging opportunities and the development of organizational competences along the productive chain.

That approach supposes a system in perpetual evolution, in that the suppliers associate themselves to develop new products of smaller impact for the environment and to establish new approaches of innovations. For its part, Rhodia-ster/M&G can begin exchanges of secondary raw materials, to cooperate in common with complementary companies for new market offers, to maintain exchanges with involved parts, as the institutions, the investors and the associations. Finally, the company can improve its legibility on the market and anticipating the possible future of the product portfolio.

So, seems clear that the traditional limits of the corporations no longer are applied for the development of new products in an environmental perspective, requiring vision and control on the total product life cycle. With the integration of the circularity notion, the company has shown itself capable of establishing other relationship with the time and, starting from that, to elaborate a strategy that allows to reduce costs in raw material, and to pay less taxes besides preparing for new regulatory obligations. The company that appropriates the closed cycle idea incorporates a true economy of natural resources.

Especially, the importance of the growth on the ecological dimension, as in competitive terms as in the economical ones, implicated in a change of the supply chain concept at the company for a logic "imbedded" in the productive chain concept.

This means that the success of the project Alya Eco depended not only of the executives' capacity in administrating the activities based on the strategy of environmental innovation, but also in their ability to integrate the value chain of the company with the other partners' along the productive chain activities. This way, it altered the logic of antagonism (win-loose) for a cooperation (win-win) perspective in the approach of the relationships by the environmental objectives and the business strategies.

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