

## Principle of Triple Bottom Line in the Integrated Development of Sustainable Products

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It is perceptible that sustainability as innovation strategy for product development has become a mandatory requirement for companies to remain competitive in the market. The quick reaction before the increased competition, technological advances and the progressive intensification of the consumer's requests for 'green products' demands from companies and their managers agility, great productivity and a quality standard that is related to the investment in their management processes and in the development process of their products. A sustainable company must generate profits, protect the environment and improve the lives of those whom interact with it. This must occur in a way that its commercial interests, the environment and society intersect. Nowadays, the integrated product development process is being conditioned to new consumption patterns and legal constraints, especially those related to the Triple Bottom Line (TBL) principles, which aim to simultaneously achieve economic prosperity, environmental protection and social responsibility while minimizing the negative impacts and maximizing the positive points of the product throughout its life cycle, through reports such as the Global reporting Initiative (GRI). In the contemporary context of the discussion on sustainability, this article provides a literature review of the principles of TBL and the product development process and seeks to identify how these concepts are interrelated and can lead the companies to the integrated development of sustainable products.

### 1. Introduction

The sustainable development is subject of global interest and has attained significant importance because of the growing concern with the preservation of natural resources and the increasing political and social pressure for the adoption of more sustainable practices. The definition of sustainable development states that the future generations must be taken in consideration since they are entitled to benefit from the same resources as the previous generations, making all humans beings responsible for natural resources as well as for the economy and social equity.

From this idea, arose the term Triple Bottom Line (TBL) articulated by John Elkington in 1998, which suggests that the corporations success should not be measured only by the financial terms, but also by the environmental and social objectives. The TBL is a tool to integrate sustainability into the business agenda, balancing traditional economic targets to the social and environmental concerns creating a new dimension of corporate performance. In response to these aspects of sustainability, requirements of the integrated product development process (IPDP) started to be used and it is one of the activities responsible for providing products to market that meet the needs and expectations of consumers. The IPDP involves all activities of the product process, from planning to the final disposal. React quickly in the face of the increasing competition; technological evolutions and consumer progressive demand are basic conditions to stay competitive. These conditions require, from the companies and their managers, agility, greater productivity and a quality standard that is conditioned to the investment in its management processes and in the new products development process. In this context, it is noted that the processes of integrated product development should be directed to a new perspective oriented to fulfil the principles of TBL and the new demands of the global market. One of these new demands is ecologically, socially and

technologically sustainable designs which became constantly studied requirements in organizations to indicate alternative solutions for new business strategies. Othman et al. (2010) have presented the necessity to adopt sustainable consumption that has been changing the way designers are conceiving new products that meet the expectations of new consumers. In this context, the present article seeks to answer what the application is given to the concept of the Triple Bottom Line in the integrated development of sustainable products. The research aims to conduct a literature review on the principles of TBL and the product development process identifying how these concepts can interact in the process of integrated development of sustainable products.

## **2. Integrated Product Development Process**

The product development is considered a business process increasingly critical for companies, due to the growing markets internationalization, augmented products diversity and the reduction of the products life cycle on the market (Zarandi et al., 2011). It is one of the most important and complex activities for the companies competitiveness being responsible for innovation and product development by identifying needs and expectations of current and future market. It involves, from a holistic point of view, all activities of the product process, from planning and design to the disposal at end of the product useful life, providing competitive advantage for the companies and adding value to the business (Romeiro Filho, 2010).

Initially, the activities in the product development models were performed in sequential series and presented many conformity problems with specifications between the interfaces of the functional departments (Back et al., 2008). To lighten these problems methodologies for integrated product development and multidisciplinary teams were adopted, resulting in the simultaneous approach (Rozenfeld et al., 2006). In this approach, according with Manzini and Vezzoli (2002), it is important that processes are applied, analysing the product on the aspects of technology development, performance, maintenance, reliability, marketing, environmental aspects, among others (Tingström et al., 2006).

Currently, the simultaneous approach is also known as Integrated Product Development (IPD) including the best practices in product development. The objective of the IPD is to improve all aspects of the triangle called "cost-quality-time" and provides an effective design of product, process and manufacturing (Raunier et al., 2007). The IPD can be defined as the elaboration of a set of product specifications starting from the consumer's needs and market opportunities, followed by the process of conceptual and technical development to its submission to manufacturing and marketing. The requirements, restrictions and solutions along the process stages should also be considered simultaneously (Back et al. 2008). To Koufteros et al. (2002) due to this integration, companies can respond quickly to customer specific requirements related to new products, with high quality and innovative, enabling companies to alter the strategy and structure, building inter-functional skills, increasing the flexibility and sharing the knowledge.

## **3. Sustainable Development**

According to the Brundtland Report (WCED, 1987) a series of measures should be taken by countries to promote sustainable development and among them, stand out: limiting population growth; guarantee of basic resources; biodiversity preservation; reduction of energy consumption. This meta-cultural framework of sustainable development emerged in an international context of bringing sustainability in a very unequal world, where the needs of poor countries are placed in a two-way interaction context. To Jepson (2003) referred by Coffman and Umemoto (2009) sustainable development translates sustainability into a more anthropocentric concept, incorporating non-physical mutual attributes, such as equity and poverty reduction. For Imran (2011) a resolution on sustainable development where the ecological well-being is not considered secondary, but equally to human welfare, is the basis upon which the principles of sustainable development need to be reformulated. Pannocchia et al., (2013) have developed and applied a method to diagnose the source of performance degradation in MPC Systems in Italy. Also, the concept of eco development proposed by Sachs and Strong in 1972, resulted in the United Nations Program for Environment (UNEP) officially creating the concept of Sustainable Development (Pereira, 2009). For companies, the sustainable development has become a dominant and essential principle. Orecchini et al. (2012) affirm that since the 1990s, companies began to adopt the sustainability principles in their organizations. The first activities are related to the implementing of the eco-efficient activities and green innovations and subsequently the adoption of social responsibility practices and reporting.

## **4. Triple Bottom Line and Global Reporting Initiative**

In the business world, the term Bottom Line refers to all actions that may increase or decrease net or global profit of a company. Derived from this, the definition Triple Bottom Line (TBL) emerged in the 1990's

and became public knowledge in 1999, with the publication of the book *Cannibals with Forks: The Triple Bottom Line of 21st Century Business* by Elkington, which included, beyond traditional financial measures, the social and environmental dimensions.

The TBL is a tool for support the integration of sustainability objectives in the business agenda, as showed in figure 1, balancing traditional economic targets with social and environmental concerns creating a new dimension of corporate performance. It focuses on the performance of the inter-relationship between the dimensions of profit, people and planet - sometimes also called the Three-E (Economy, Ecology and Equity) - and the relationship with their activities, processes and products. It is an interpretation of sustainable development in a different structural level, where organizations must consider the role of corporate responsibility (Heijungs et al., 2010).

In the current context, for a business to be successful, profitable and generate value for its shareholders, it must have its management process based on these three dimensions. To make it possible, it is necessary not only risks management and monitoring, but also the alignment with stakeholders and innovation in sustainable solutions (Slaper and Hall, 2011).

One approach for communication with the growing popularity is the Global Reporting Initiative (GRI) founded in 1997 that provides indicators for the three dimensions of TBL and it is the result of a joint project between the Coalition for Environmentally Responsible Economies (CERES) and the United Nations Environment Programme (UNEP). The GRI is the most important institution in the context of TBL reports being applied as a tool to promote sustainable development by a wide range of professionals. Its creation allowed the standardization of the sustainability reporting and their evaluation (Isaksson and Steimle, 2009). Also, its structure establishes the principles and performance indicators that organizations can use to measure and report their economic, environmental and social. In this context, Jasch and Lavicka (2006) had worked with automobile cluster and Leszczynska (2012) made an analysis of sustainability towards shareholders.

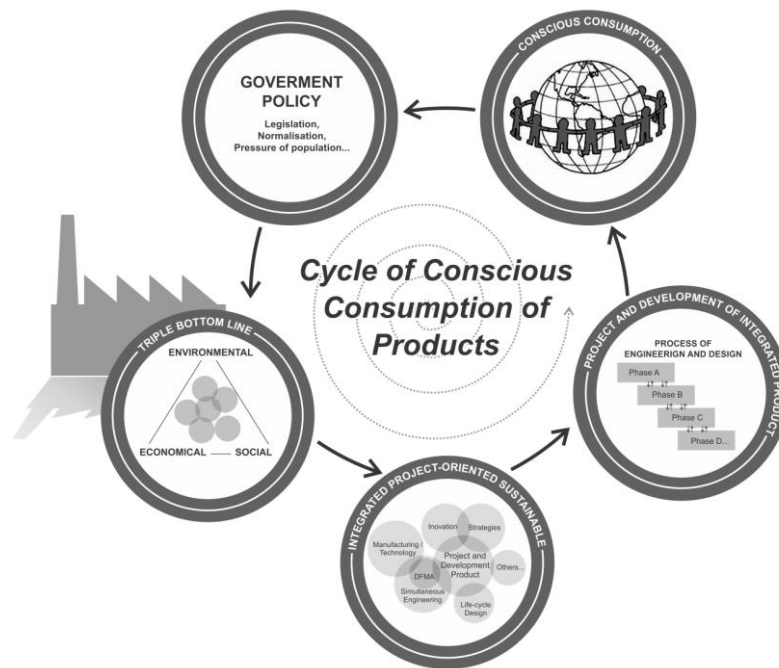


Figure 1: Development Integrated Product Oriented sustainability cycle

## 5. Integrated Development of Sustainable Product

As Holloway et al. (1996) the need to incorporate environmental considerations has been addressed by some factors that can facilitate the different approaches that act on a specific problem, such as: financial, legislative, market pressures and environmental concerns. In 1997, the United Nations Environment Program proposed the concept of sustainable product development that considers the relationship between the production, the environment and the society, redefining the process according to the resources availability, the environment capacity and the distribution of time-related resources (Jofre et al.,

2003). Increasingly, people look for products that are sustainable and it is up to the designer to find solutions that are meaningful and provide new experiences that inspire and create a positive impact on society and on the daily life (Ashby and Johnson, 2011).

Sustainable products can be defined as those that offer environmental, social and economic benefits while protecting public health, welfare and the environment (Lu et al., 2010). They propose solutions to the social demands and needs, minimizing negative impacts and maximizing positive ones in the economic, social and environmental dimensions (Triple Bottom Line) throughout their life cycle (Spangenberg et al., 2010).

Nowadays, most products have a short life cycle due mainly to rapid technological innovation, growing products diversity and variety, increasing customer's requests and global competition (Léon and Farris, 2011). Concomitantly with these facts, new standards and legal restrictions, particularly those related to the preservation of the environment, have been contributing to the emergence of the integrated development of sustainable products (Wu et al., 2010). The focus of integrated development of sustainable products is to keep under control the environmental costs incurred at each stage of the product life cycle and to adopt less harmful measures to the environment after considering the issues of cost, quality and speed (Hui Mien et al., 2005). According to O'Shea (2002) there are evidences that incorporating environmental features into product design does not necessarily result in higher cost, but may lead to lower the costs of development, assembly, packaging, services and transfer up to 50 %.

According with Guimarães (2012) in terms of sustainability in product design, one of the pioneers was Buckminster Fuller who in the 1930s was already pondering about the optimization of materials and energy resources. The author proposed that the technology should improve the human condition and it was necessary a revolution in design in order to make more using less. Another pioneer, Victor Papanek (1971), considered that "in an era of mass production, when everything must be planned and designed, the project has become the most powerful tool which man uses to shape his tools and environments (and, by extension, society and himself). This requires a social and moral responsibility of the designer". For the author, if it is to be environmentally responsible and socially responsive must be revolutionary and radical (going back to the roots) in the true sense. As an instrument of sustainable development the sustainable design must conceive products, processes and services that meet the needs of the society maintaining the balance between economic and environmental interests (Lu et al., 2010). The Design for Sustainability combines the complexity of traditional architectural conception with the complexity of considering a number of environmental issues that are based on ecological principles which attend the needs of society (Pohl et al., 2010). This can only be achieved by understanding the user and their needs within their social and economic context (Melles et al., 2011).

To Manzini and Vezzoli (2011) "propose the design for sustainability means to promote the capacity of the productive system to answer the searching for social welfare using a number of environmental resource drastically below the levels currently practiced ...". can be recognized as a kind of strategic design, i.e., the strategies design applied by companies who have established themselves seriously prospective environmental sustainability should deepen their proposals in the constant assessment of environmental implications in the different acceptable technical, economic and socially solutions and considered during the products and services conceptions, all the constraints that determine throughout its lifecycle - Life Cycle Design." Mattioda et al. (2012) suggest that all the design phases for the product development should be contained in a broader thinking. For the authors, these phases that interact are encompassed by the prospect of TBL thinking that, in this particular case, is called "Integrated Product Design Oriented for Sustainability". The understanding of the sustainability aspects inside new paradigms must present integrated development solutions for sustainable products meeting the Triple Bottom Line concepts. In this context the sustainable development and the reduction of greenhouse gas emissions also are matters of great concern in current scenario (Sha et al., 2013).

The objective of the integrated development of sustainable products is to meet the consumers' need closing the cycles around the product as much as possible, because the predilection for durable, reusable and remanufactured products is already identified as a tendency by some authors (Mulder, 2007). In this context, environmental awareness is considered as a vital concept to the survival of the companies in the global competitive market and product development must be focused not only on meeting the needs of consumers, but also consider all aspects that permeate its production, consumption and disposal (Vinodh and Rathod, 2011). Borchart et al. (2009) identified the company's potential for the application of ecodesign that is needed to build their limits. According to the authors, for companies insert the ecodesign considerations in the development process of their products is necessary to evaluate: i) the internal factors of the company as the motivation of the organization and its managers, innovation, competitiveness; and ii) the external environment such as regulations, customers, market and suppliers, beyond the product itself.

## 6. Conclusion

In spite of the world's demands and the searching of the organizations to attend the development of sustainable products, the companies still need to adopt sustainability in a systematically way into their strategies, where all parties must be considered. The final product should try to meet the concepts related to the Triple Bottom Line and be integrated and optimized at all stages of the product development design, which must be oriented to the sustainability. A sustainable company must generate profits for its shareholders while protecting the environment and improving the lives of those whom it interacts. It should operate in a way that their commercial and environment and social interests intersect. The awareness of these issues and their strategic use certainly supports the efforts of the company to be profitable and is clearly a compulsory requirement for its survival. In this contemporary discussion about sustainability, it is necessary to identify the approaches that should be explored for the interrelationship of the integrated product development process and Triple Bottom Line. As a literature review result, it is observed that the topic still in a discussion phase and does not acknowledge the existence of the TBL concept which is characterized specifically for the integrated development of sustainable product. It is believed that products which can meet these expectations will certainly change the behaviour related to consumption, social equity and conservation of the planet. As further research the author's propose a Conceptual Framework for designing of integrated development of sustainable products focused on the interaction of the agents involved in the initial stages of the development and the definition of a guidelines settings for design-oriented sustainability in the design and detailed design.

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