Are customers and producers sensitive to green product development?

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Abstract—To address the issue of environmentally friendly design, this paper encompasses various aspects of ecodesign from producer’s and customer’s point of view. Two surveys were conducted. The purpose of the first survey was to investigate the awareness and intention of the Slovenian customers to purchase green products, their perceptions and attitudes towards green products. The second survey was directed to organizations to examine their attitudes toward green products and environmental issues. The study revealed that the green products have substantial awareness among Slovenian customers. The results showed that the vast majority identified the importance of environmental protection in product development as very important. For the customers the most important quality characteristics of the product are: quality, usability and practicality followed by environmental ones. Survey results indicate that environmental concern plays a fundamental role in organizations, too. According to the results, concern for the environment is the most important criteria that encourage organizations to introduce environmental management system (EMS) standard. The introducing of EMS standards has been found to be consistent with the developed procedure for ecodesign.

Keywords—ecodesign, green customer, producer, sustainability, environmentally friendly product

I. INTRODUCTION

Moving towards sustainable development has become a major concern in most of the developed countries, resulting in stricter regulations concerning the impact of the products during their manufacturing, use and end of life, including the obligation to define reverse logistics strategies and systems [26]-[31]-[39]. Generally, the goal of reducing environmental pressure by consumption can be reached via three routes: greening production and products, shifting demand to low-impact consumption categories, and lowering material demands [30]-[76]-[77]-[78]. While sustainable consumption targets consumers, sustainable production is related to companies and organizations that make products or offer services [80].

As Cooper [13] indicates, sustainable consumption involves rethinking how products are conceived and how needs are met. In other words, it requires that we not only address efficiency (i.e. ‘getting the same goods and services out of less’), but also sufficiency, (i.e. ‘getting the same welfare out of fewer goods and services’) [10]. Accordingly, traditional product-centred approaches alone are not capable of providing sufficient change. Highly creative, informed and sensitive design interventions are necessary for the development of alternative solutions that are ecologically responsible, socially relevant, aesthetically pleasing, economically viable, technologically appropriate, and individually satisfying [44]. As stated by Amacher et al. [1], customer preference to purchase from ‘‘green’’ organizations is well established and often revealed through increased willingness to pay for products viewed as ‘‘clean,’’ i.e., produced with environmentally friendly production or abatement technologies such as recycling and use of less polluting inputs. However, an individual concerned about the environment does not necessarily behave in a green way in general, or in their purchasing [59]. This is known as the value-action gap.

From the corporate point of view, the environmental protection is a vital management function, it is perceived as being instrumental in the development of a positive corporate image and an important element to the success of a business enterprise [19]. Environmentally conscious design (eco-design) is particularly important in manufacturing industry, and many design methods and tools have been developed to support ecodesign [38]. Although there are several different ways to define ecodesign [32], ecodesign may be defined as an activity that identifies the environmental aspects of a product and integrates them into the product design process in the early stage of the product development process [56]. Therefore, ecodesign approach is mainly focused on the environmental aspects of a product. It has been noted that a product must meet the basic requirements of a market. These requirements include the following: (1) meeting the required needs in terms of function, performance, durability, safety, etc.; (2) complying with all standards and regulations; and (3) corresponding to the targeted market segments, such as identifying current and emerging customer expectations [56]. If a product does not meet these basic requirements, then the product will fail in the marketplace even if it causes less stress on the environment [39].

It is clear that organizations have to deal with complex issues, which are related to different aspects of product development. From designers’ point of view, the
development of more environmentally-friendly products brings them to take into consideration environmental aspects in concurrence with traditional technical and economical aspects since the beginning of design activities [21]. The requisites an industrial product has to be in compliance with, have become more numerous and stricter than in the past, involving also social aspects, i.e. the impact that industrial products have on the society in general, considering for example their performances from the safety and the environmental point of view [20].

The design steps, then, become critical as a mean of optimising the lifecycle performance, increasing the profitability, enhancing the delivery quality, responding to the regulatory drivers, satisfying customers, stakeholders and third parties, up to facing the manufacturers’ responsibility for the whole supply chain [49].

This paper aims, therefore, at providing insights into product design considering environmental aspects as well as customers’ point of view with regard to the environmentally friendly products. The purpose is to investigate the customer’s and producer’s point of view in relation to environmentally friendly products.

II. RELATED LITERATURE

A. The context of ecodesign and sustainability

Since environmental impacts are intimately connected to flows of materials and energy, and the most important flows, at least for manufacturing companies, are closely linked to products [4] it seems very important to consider environmental aspects during the product development [54].

In recent years, there has been an increasing emphasis on the concept of ‘win-win’ environmental strategies, whereby environmental product benefits go hand-in-hand with technical and economic cost-effectiveness [63]. This is intuitively appealing, since products whose production and use entail less energy, less material input and less waste and pollution should be cost-effective for both consumer and producer. In practice, however, developing a product which excels in environmental terms while remaining economically and technically competitive, is a significant challenge [63].

During the last decade a substantial amount of research has been addressed to ecodesign (environmentally conscious design), which refers to actions taken in product development aimed at minimising a product’s environmental impact during its whole life cycle (ISO/TR 14062:2002), without compromising other essential product criteria such as performance and cost [33]. It should be remembered that ecodesign only adds environmental considerations to product design, it stops short of full sustainable design [37]. Such an approach would incorporate more innovative practices, employ ecological principles, and encompass social and ethical aspects [75]. Byggeth et al. [9] suggested a method for sustainable product development (MSPD) with the aim of integrating social and ecological aspects of sustainability with a strategic business perspective in product development. They propose a modular system where questions concerning sustainability aspects are organised into a system of sustainability product assessment modules. The main reason of proposed modular product is to facilitate the use of the MSPD and give the user the possibility to decide which sustainability aspect should be used and when. A method for sustainable product development should be integrated with the product development process (PDP) to be successful in a company [8]-[22]. It is suggested that the early part of the product innovation process is a critical intervention point for the transformation of society toward sustainability [55].

According to Stevels [73], ecodesign seeks to understand the life cycle of the product and its impact on the environment at each of its life-cycle stages and to make better decisions during product design so that environmental attributes of the product are kept at desired level. The reason for incorporating ecodesign depends on the strategy for each company. Some companies are defensive, proactive or cost driven in their reactions to external development related to environment (i.e., social pressures, additional legislation or taxes) [67]. Eco-efficiency can lead to cost reduction, strengthen the market position of existing products, extended products to new markets, advert criticism by external stakeholders, and increase the possibility of company's surviving in the long run [14]. Rose [67] suggested that the ecodesign give companies opportunities such as: satisfying customer, strengthening corporate competitiveness, and complying legislation.

B. The link between quality characteristics, customers and environmental protection

The term product can be defined as a set of tangible and intangible attributes that provides customer benefits through form and function [23]. Successful new product development requires in-depth understanding of the customers, their situation, their needs and their wants [36]-[40]. To maintain customer satisfaction and thereby long-run profitability, it is clear that companies should provide products of high quality [72].

Green product attributes may be environmentally sound production processes, responsible product uses, or product elimination, which customers compare with those possessed by competing conventional products [48]-[58]. However, the literature does not yet offer an objective definition of what makes a product “environmentally friendly”. Fuller [23] defines sustainable products as a form and function alternatives that possess positive ecological attributes that are nothing more than enhanced waste management factors (eco-attributes) that have purposely been embedded through decisions concerning how products are made/manufactured, what they are made of, how they function, how long they last, how they are distributed, how they are used, and how they are disposed of at the end of useful service life.

In the current business environment, organizations strive towards exceeding the customer's expectations. As a match between product features and customer expectations and needs, quality of design is a market, or externally oriented aspect of quality [48]. According to Widrick et al. [81], quality of design is determined by three factors: a deep understanding of customer requirements, translation of these requirements into a product and continuous improvement of the design process. Such an improvement is based on close cooperation
among marketing, research and development, and engineering [48]. Quality, therefore, can be defined as satisfying or exceeding customer requirements and expectations and hence, to some extent, it is the customer who ultimately judges the quality of a product [72]. In this paper any feature or characteristic of a product that is needed to satisfy customer needs is considered as a quality characteristic.

In recent decades, the term quality has expanded beyond the classical interpretation of “satisfying customer expectations related to the supplied product” to include not only the delivery of excellence to a variety of stakeholders, but also the environmental, safety, financial, and even social aspects of organizational performance [7].

For environmentally orientated products to succeed, they will need to be effective in terms of their marketplace performance. The most advanced environmental technologies will not contribute to the pursuit of sustainability unless they can wrestle market share away from conventional products and change the market’s agenda for product development and marketing [62]. In fact, companies are required to decrease environmental impacts caused by their products/services while they compete in their markets [33]-[69]. To do so, designers/developers play a crucial role; the environmental impacts are determined mainly by design. With respect to customer demands, Dalhammar [16] emphasizes the increasing importance of market drivers, although this may not be entirely independent of environmental legislation which places controls on the use of particular substances or components [25]. However, it is important to listen to customer requirements to obtain market needs and make them reflect on the product design [33].

Park and Tahara [56] suggest that environmental aspects have to be considered together with other product requirements, such as function, performance, economics, and consumer satisfaction in order for eco-products to be successful. By doing this, it is possible to develop a product that possesses a higher product value and less environmental impact – in other words, a product that has a higher eco-efficiency value. Eco-efficiency, which is defined as the ratio of the value of a product to its environmental influence [80], can be used as an analytical tool in ecodesign because eco-efficiency can help create value for a product and the company as a whole by explicitly promoting change towards sustainable growth [74].

Several authors [45]-[20]-[21]-[38] proposed integrated use of the ecodesign tools in relation to quality tools as an effective approach to support effective integration of environmental aspects into product design.

The link between quality management and environmental responsibility is also partially covered by corporate social responsibility (CSR) literature, mainly due to exploring the relationship and potential synergies between quality management and CSR [11]-[24]-[29]-[46]-[66].

III. RESEARCH RESULTS

A. Research methodology
First survey questionnaire was designed, exploring issues relating to customers’ attitudes towards green products and to environmental issues concerning the producers in the Slovenia.

For the concurrent research study, data were obtained using a second survey among Slovenian producers. The sample covered a range of industries including automobiles, chemicals, plastics, IT, food and drink, paper, packaging, and some other industries and services.

The purpose of this survey was to examine producers’ point of view on the integration of environmental issues in their business and into new product development process.

B. The results of the customer survey

Responses to the question on what the customers would give emphasis in product development are presented in Fig. 1. The results on the open question show that customers are aware of the importance of consideration of environmental aspects during the product design.

![Fig. 1 Focus on product development from the customer’s point of view](image)

Quality, usability and practicality seem to be the most important factors from the customer’s point of view. All the other answers indicate a positive attitude of respondents to the environment as they include only characteristics that are related to environmental protection.

The following question (Fig. 2) also reveals a positive attitude towards environment, since the vast majority identified the importance of environmental protection in product development as very important.
Fig. 2 The importance of integrating of environmental protection in product development

Furthermore, the respondents ranked the five given criteria by importance in the following order: the possibility of recycling, energy consumption in use, the environmental impact at the end use of product, the use of environmentally friendly materials and environmentally friendly manufacturing process.

The criteria that most affect the purchase of a product are shown in Fig. 3. Results indicate that customer’s need is the most important criteria, following the product quality, price and environmental friendliness as the fourth criterion. The results presented in Fig 3 are consistent with the results in Fig. 1, where the quality and usability were also ranked ahead of factors which are related to environmental protection.

Based on the result, it has been shown that 72% of respondents would choose the product that is more eco-friendly (Fig. 4).

Further results are encouraging as well, since 54 percent of respondents expressed a positive purchase intention to buy a environmentally friendly product in spite of a higher price, while only 10% said that they would not buy more expensive product regardless the environmentally friendliness of a product (Fig. 5).

Fig. 3 Purchase-decision criteria

C. The results of the producer survey

The results related to the surveyed organizations will be presented in the following section.

The survey covers small (7%), medium-sized (23%) and large (70%) organizations and it provides evidence on producers’ activities towards environmental issues.

From the results in the Fig. 6 it can be seen that ISO 14001 prevails among the EMS standards (52%), following EMAS by 3%.
Among the reasons to introduce the ecodesign concept into product development process the concern for the environment seems to be the most important criterion (25%), following by better image (18%), competitive advantage (16%) and other expressed reasons (Fig. 8).

The results presented in the Fig. 9 show the benefits of the ecodesign from the producer’s point of view. Based on the results the areas where organizations see benefits follow as: waste minimization (25%), emissions (20%), energy (17%), production (15%), image (12%), sale (7%), other (2%) and nowhere (2%).

According to the research results, quality, usability and practicality are the highest ranking product characteristics from the customer’s point of view as far as product development is concerned. All the other answers indicate a positive attitude of respondents to the environmental protection as they include only characteristics that are related to environmental protection. These findings are consistent with the work of Park and Tahara [56], who indicate that a product must meet the basic requirements of a market and therefore meet customer’s needs. While producers want to meet customer’s needs and expectations, they also want to make higher quality products with minimum production cost. Therefore, for the producers, product value can be defined as product quality versus cost. The improvement of product value
can be accomplished by the improvement of product quality, the reduction of production cost, or the accomplishment of these two aspects simultaneously [56].

It is also indicated that environmental concern is reflected in the attitude of customers to product development as well. 86 percent of respondents identified the importance of environmental protection in product development as very important (score 5 out of 5). Furthermore, the results showed that 72 percent of customers would choose the product which is more environmentally friendly. However, it should be considered that customers who prefer the benefits of environmentally friendly products may not necessarily have motivation to purchase them [18]. Author suggests that for these customers any brand will do, hence there is no environmental information search involved when it comes to choosing their brands and green product labelling may not be meaningful to them. These customers would perhaps trade off product attributes such as quality, warranty and performance in their product alternatives evaluation and selection process [19].

The results also show that customers in generally would prefer eco-products in spite of higher prices. More than a half of survey respondents (54%) expressed the willingness to pay more for a product in comparison with product that is considered as less eco-friendly. Mintel [51] found that despite pro-environmental attitudes, intention to recycle, concern about pollution and willingness to pay more for environmentally-friendly products, few customers translated these attitudes into regular green buying behavior. Gupta and Ogden [27] reveal that several characteristics of the individual – trust, in-group identity, expectation of others’ cooperation and perceived efficiency – were significant in differentiating between “non-green” and “green” buyers.

Among the criteria that influence the purchase decision, customer’s need is the most important one, following the product quality, price and environmental friendliness as the fourth criterion. This is also consistent with the findings of Peattie [58], who indicates that if a product does not meet the basic requirements, then the product will fail in the marketplace even if it causes less stress on the environment. Kärnä et al. [35] indicate that satisfying the needs of customers in a profitable way is the core of marketing ideology and in turn is a core of the market economy. Environmental or “green” marketing has been seen as a tool towards sustainable development and satisfaction of different stakeholders [35].

The results show that 55% of organizations have already introduced one of the environmental management system (EMS) standards (according to the results, ISO 14001 prevails among organizations by 52%). The results can be interpreted as a good starting point for effective integration of ecodesign activities as well as can be seen as an important contribution related to CSR. This is consistent with previous works [6]-[34]-[79] indicating that a certified environmental management system (ISO 14001), leads to an increase in environmental planning activities (design for environment - DFE). Some other studies indicate a week connection between environmental management systems and ecodesign [2]-[65].

In essence, environmental management sets out to answer the question of how companies can increase their environmental effectiveness and efficiency [17]. It focuses primarily on how the environmental problems caused by business can be overcome, taking into consideration various environmental management systems (ISO14000, EMAS etc.). Still, recent environmental management concepts have attempted to broaden the term “environment” in the context of “human living conditions” [70], thus placing society in the realm of the environment, at least indirectly. In corporate environmental management, however, the impact of business on stakeholders and society is largely perceived, and discussed, as the indirect impact of organizations on humans through their influence on the ecological environment [17]. Thus, corporate social responsibility (CSR) requires that corporate activities should be made more environmentally friendly [56].

In the present study, we found that among the factors that encourage organizations to introduce an EMS standard, concern for the environment, competitive advantage, legislation and customers’ attitude are the prevailing factors. Pouliot [61] highlights the importance of a market perspective and therefore indicates that some organizations see the certification according to ISO 14001, as a mean of competitive differentiation, which could be done by creating an environmentally friendly image. The usefulness of EMS as a tool to manage environmental issues in companies is a question of interest to many different parties [53]. As stated by authors, one of the most interested groups conceivably is the companies themselves, who invest large amount of resources into the implementation and operation of EMS. As a natural follow up they increased environmental work, but also the general value of the standardized EMS as recognized on the relevant markets. Companies are also interested in environmental management done in other business establishments. One of the reasons is to benchmark with competitors on the market [60]. Another growing trend is to demand ISO 14001 certificate from suppliers.

According to the results, 60% of respondents have developed a procedure for environmentally friendly product design (ecodesign), which is the same proportion of those who already have experience with the introduction of the environmental management standards. Reading through ISO 14001 it is clear that product development is not emphasized and that most product-related requirements leave substantial room for interpretation [3]. This suggests that we cannot conclude to which extent “normal” EMS includes environmental aspects, and thus affect the impact that a product has on environment.

The results indicate that concern for the environment is the most important criterion with regard to introducing the ecodesign concept into product development process, following by better image and competitive advantage. As stated by the Moore and Manring [52], organizations of all size are increasingly being confronted by multiple external stakeholders to demonstrate a commitment to corporate social and environmental responsibility (CSR/CER). Social and environmental responsibility is a dimension that needs to be
clearly communicated to both customers and the general public [71]. Results from our research indicate that waste minimization, emissions, energy and production are the key areas where organizations see the benefits of environmentally friendly design. As stated in literature [5]-[68] the eco-design is concerned with the development of products which are more durable, energy efficient, avoid the use of toxic materials and which can be easily disassembled for recycling. It is clear that eco-design provides opportunities to minimize waste and improve the efficiency of resource use through modifications to product size, serviceable life, recyclability and in use characteristics [43]-[79]. According to the Rao and Holt [64], greening of production leads to savings in raw materials, water and energy usage and thus leads to competitiveness and economic performance.

In evaluating the environmental impacts of a product, some might want to identify the key environmental life cycle stage of a product, while others might want to identify the key environmental component or material of a product. Therefore, companies have to determine which level of key environmental issues will be identified [56].

V. CONCLUSIONS

This paper has focused on environmentally friendly products from customer and producer perspective. In order to understand the gap between customers and producers, we conducted a survey among potential customers and producers. Study results are valuable to both practitioners and theoreticians in their effort to better understand the customers and producers with regard to the environmental protection.

The findings from this research are encouraging to companies. Results showed that potential customers support the movement towards environmentally friendly products. In spite of expressed intention, customer’s needs are still the most influential factor on the purchase decision. It seems very important for the customers, that environmental protection is integrated during the design phase. According to the results, the recycling is the most important environmental criteria.

From the producer’s point of view, concern for the environment, competitive advantage, legislation and customers are the prevailing factors, particularly with regard to the decision for environmental management system (EMS) standard introducing (55% of organizations have already introduced one of the EMS standards).

At the earliest stages of the product lifecycle (product planning), organizations need to efficiently identify customer’s needs and expectations. With regard to environmentally friendliness, organizations should consider, particularly: the focus should not be only on environmentally friendliness, but rather on the quality and usability of the product, green products should be comparable in price, brand, usability and performance to “traditional” products, organization should seek to meet and represent green approaches by improving quality characteristics with respect to durability, usability, innovations, … of products, organization should support the green purchase decision by providing benefits on the field of environmental protection (human health, climate changes, bio nutrition, …).

It is important to bring together the concepts of production and consumption; interaction of organization to market should be considered and there is a substantial potential for improvements, organizations should consider the corporate social responsibility (CSR) as a possible route to gain enhanced reputation and competitive advantage at organizational level as well.

Therefore, green products should look and be perceived as “traditional” products; products should not significantly change customer’s user habits; products should be comparable in price, while be more cost effective during product life-cycle and provide a sense of contribution to environmental protection.

To move towards improving the environmental performance of products, we recommend the use of ISO/TR 14062:2002 from the ISO 14000 family of standards as a guideline for integration eco-design in a product development process and thus enable organizations to identify and integrate environmental aspects into product quality characteristics.

To obtain more substantial changes, we cannot rely solely on making the existing production system more efficient as they use less resources, water and energy, generate less waste and pollution, but need to follow the sustainability principles, and thus include economic, environmental and social aspects.

REFERENCES


