The Trends of Environment Friendly Product Design in Bangladesh

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Abstract

Environmental awareness continues to rise, and customers of all types are realizing the importance of eco-friendly products which are essential to protect our planet. Eco-designer creates designs that are demanded by markets. Green design rules are needed to support the implementation of environmental features in the practical design situation. Green design or Design for Environment (DfE) is a field of product design methodology that includes tools, methods and principles to help designers reduce environmental impact. The main objective of this work is to compile a set of DfE principles that are useful during the design process. Later the trends of environment friendly product and process design in Bangladesh are studied. Today, many industries in Bangladesh are aware of green design and implementing DfE principles. The present situations about the Green Design trends in some of the leading consumer goods manufacturers, Unilever Bangladesh, PRAN-RFL Group and Rahimafrooz were studied. Moreover the Government’s recent initiatives concerning DfE are discussed in this article. This article may help the product designers a lot during eco-friendly design and to compare them with some market leaders. Though the list of compiled DfE principles is based on best practices, further work is needed to expand the list.

Key words: Green Design; Environment; Design Guidelines; DfE.

1. Introduction

Environmental issues are becoming more and more important and Design for Environment (DfE) seems to be the most effective way of dealing with environmental concerns. Design for environment (DfE) is defined as systematic consideration of design performance with respect to environmental, health, and safety objectives over the full product and process life cycle [1, 2]. Only in recent years, people have realized the importance of environmental protection. People are concerned about the context they are living in and the way people make use of resources. An important entrepreneurial challenge is to match products and services not only to the requirements of the market, but also to those of the environment. When products are being planned, the relevant ecological requirements and risks must be determined by considering both the needs of the market and the technologies available. Key requirements at the product planning stage are energy and material efficiency, and the environmentally compatible disposal of individual components. During product design, environmental aspects are taken into account with respect to material preparation, manufacturing, installation, operation, maintenance and dismantling [3]. While environmental considerations have always been part of the design process, environmental awareness continues to become a more pressing imperative.

1.1 Objectives

The main objective of this research is to review the literature related to Design for Environment and hence compile the DfE rules, so that Eco-designers can easily take advantage of getting DfE principles at a glance.
A lot has been written about Design for Environment, but less has been said about how it should be implemented. This paper presents few case studies about how Design for Environment is currently being implemented. That is the next target of this research is to study and observe the present scenario of implementing DfE principles in some leading industries as well as during creating environmental laws in Bangladesh.

1.2 Literature Review

A great number of researches are being going on for compiling the product design guidelines for protecting the environment. A growing number of managers believe that there are tangible advantages to incorporating environmental concerns into product design decisions. The research of Murray [4] is about the issue of industrialization and the environment and the role of product design in the supply of products which do not have a negative environmental impact, in their production, use or disposal.

Some studies are concerned about the trends of using DfE guidelines in different industries. One of these studies demonstrates the application of Eco-Design techniques in the re-design of a fish tank air compressor. This application aims the reduction of components, the minimization of raw materials and the manufacture processes and tends as main focus the minimization of environmental impact in the development of new products. This air compressor was awarded the first prize in the Product Project category in the ECODESIGN Award – FIESP/CIESP 2004 [5]. Lenox, in his Doctoral thesis [6] explores the efforts by four electronics firms to implement Design for Environment (DfE) practices within product development teams.

Many of the articles focus on the selection of raw materials which may be recyclable or collected from sustainable sources. In 2006 Medina discussed the role of eco-design tools in materials selection presenting some results of a six-month case study on Eco-design and Recycling Strategy. The different groups in charge of different automobile sectors worked together in simultaneous engineering at the design, prototyping and assembly line and achieved a recycling rate of 95% and incorporated over 18 Kg of recycled plastic [7]. But it is evident that not only the material but also product architecture significantly influences environmental impact [8].

Some research papers are based on life-cycle assessment of the product and concerned about the end-of-life strategies. Jeganova researched and proposed how to integrate Life Cycle Design in product design and development process at Alfa Laval industry. The study investigated external and internal driving forces and implementation barriers around life cycle design at Alfa Laval [2]. Rose, in his doctoral thesis [9] developed methodologies that aid in formulating the end-of-life strategies across a wide range of products. The analysis of current end-of-life practices identifies improvements to product design that reduce the impact of manufactured goods on the environment. The product end-of-life strategies include reuse, service, remanufacture and recycle. The research compares the strategies these companies have taken in implementing new environmental policies and to discover the most streamlined and cost-effective method for moving towards environmentally friendly product designs. On the other hand, reducing the quantity of waste for disposal and saving natural resources are main drivers for the introduction of the European Directive on waste electrical and electronic equipment [10]. This policy focuses on an extension of the producer responsibility (EPR) to the end-of-life-phase of their products.

In a paper [11], a number of options and environmental issues were illustrated which companies and organizations seeking to incorporate in product design. A brief overview and classification of a number of approaches for reducing the environmental impact has been given in this paper. In 1996 Kaila and Hyvarinen [12] described the way of environmental issues that are being integrated into the product design of the Switching Platforms unit of Nokia Telecommunications. Switching Platforms is implementing Design for Environment by integrating environmental issues into its product design through influencing points found in the product process.

Today, the world’s community is very concerned about shearing of the knowledge on DfE. In 2009 Pitt and Lubben [13] develops a framework for Education for Sustainable Development (ESD) that includes a ‘concentric’ view of Sustainable Development (SD). It is used to evaluate an intervention aimed at including sustainability, particularly the social dimension, in design tasks in the subject Design & Technology (D&T) in England and Wales, and in the Netherlands.

Research of Jeswiet and Hauschild [14] deals with three sections: Green House Gas emissions and environmental impacts, Design for Environment (DfE) and toxic substances to be avoided in design. All three parts must be addressed by the Eco-Designer in any design situation. Second and third sections give the eco-designer rules, which can be applied in many design situations.

Environmental awareness continues to rise among customers of all types. Consumer, SMB, and enterprise are realizing that the IT products they acquire and use on a daily basis need to be designed with a different set of criteria in mind. IT users expect reduced operating costs as well as more predictable disposal costs at the end of the product life cycle. Creative product design is the first step in a product life-cycle (Fig. 1) strategy with the goal of
developing environmentally friendly products for customers of all types [15]. To protect the environment, researches are running not only for sustainability but also for economies of redesign. With the rapid development of electronics and semiconductor technology, the life cycle of personal computers is getting shorter. To solve the problem, a study has been employed on economic benefit analysis of disassembling personal computers to reduce the cost of product upgrading and to help to protect environment and save resources [16]. At Dell, environmental opportunities and challenges are considered at every stage of the product life cycle from design and development, manufacturing and operations, to product use and recovery [17].

![Product Life Cycle](image)

Not only product design but also all sectors of modern technologies are going to be concerned about the environment. For example, Cools tried to express the method of shifting towards environment-friendly modes of transport [18]. Green performance measure is vital for enterprises in making continuous improvements to maintain sustainable competitive advantages. Tseng [19] and others [20] have done a lot of researches for evaluating the performance of green design approaches and initiatives.

Different researchers provide DfE guidelines in different ways. But all of these guidelines can be classified into main six principles which are summarized in table 1. This are compiles from different articles [14, 15, 21].

### Table 1. The Six DfE Principles

<table>
<thead>
<tr>
<th>Principle A</th>
<th>Ensure sustainability of resources</th>
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<tbody>
<tr>
<td>Principle B</td>
<td>Ensure healthy inputs and outputs</td>
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<tr>
<td>Principle C</td>
<td>Ensure minimal use of resources in production and transportation phases</td>
</tr>
<tr>
<td>Principle D</td>
<td>Ensure minimal use of resources during use</td>
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<tr>
<td>Principle E</td>
<td>Ensure appropriate durability of the product and components</td>
</tr>
<tr>
<td>Principle F</td>
<td>Enable disassembly, separation, and purification</td>
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</tbody>
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Principle A aims to address resource depletion by encouraging reuse of resources within the techno-sphere, such as materials and components, and renewability of consumed resources, such as energy. In principle B healthy inputs and outputs are those that do not cause environmental degradation or adversely affect human health. This principle requires elimination of hazardous substances and pollutants as well as the conversion of waste to useful materials for products and ecosystems.

Principle C encourages the designer to think about how product attributes affect the efficiencies of seemingly unrelated processes. Principle D motivates the product’s design to be efficient in its consumption of energy and material and its interactions with the user during the usage stage of its life cycle.

Extending the life of a product avoids extra transportation and processing steps, as well as postponing waste, recycling, and remanufacturing steps. Principle E addresses this aspect by presenting two important strategies: durability for long life, coupled with the ability to update the product to current best practices. Recycling, remanufacturing, reuse, repair, and, upgrading can be facilitated by incorporating these features for disassembly, separation, and purification. Principle F is about these features.
2. Research Methods

When incorporating an environmental viewpoint into the design of materials and structures of a product, the entire context of the design process must be reconsidered in order to integrate environmental aspects into a set of other design aspects. This kind of process is known as “Integrated Life Cycle Design” [22]. The eco-designer creates designs that are demanded by markets. A designer cannot control market forces but must be cognizant of them. To enable the designer to work with market demands, and translate them into product characteristics in an environmentally friendly way, DfE rules are needed to support the implementation of environmental features in the practical design situation.

In this paper different DfE guidelines have been compiled from many articles and internet websites, and summarized into seven basic principles. The last principle is totally a new concept in DfE which has been introduced based on the present scenario and requirement of environment awareness programs. The case study of this research is based on observation of three leading industries in Bangladesh, how they are introducing the DfE principles in their production system. These are, PRAN-RFL Group, which is an agro based consumer goods manufacturer; Rahimafrooz, which is basically a wet battery manufacturer and Unilever Bangladesh, a world’s leading consumer goods manufacturer. Information has been collected from the internet websites and some mid-level management personals of these manufacturers.

3. Results and Discussion

All of the six principles described earlier will become worthless if any customer in the value chain is unaware of environment. As a result the last principle for DfE is introduced in this study. The last principle G tells about the training or education or awareness program. Considering this aspect the manufacturers need to arrange environment awareness programs in order to spread the DfE concepts among all individuals who are directly or indirectly related to the product. The education program should be planned during design phase and performed as soon as the product reaches the customer. Different stages of customers may need different levels of training programs. The customer can be internal or external.

Principle G: Ensure appropriate training program for all stages of individuals in the value chain in order to enhance consciousness about environment.

Bangladesh is one of the least developed countries with a low resource base, a burgeoning population with a very low land-man ratio, often threatened by both natural & anthropogenic stresses. The vast majority of the population lives almost exclusively on the natural resource base. This resource base is under serious threat and environmental planning is essential for the survival with dignity for Bangladesh’s over 160 million people & for sustainability of the echo system.

Like all other nations of the world Bangladesh also acted to the global call for the protection and conservation of natural environment & ecology. Industrial development significantly contributes towards economic growth of a country. It brings along with it a host of environmental problem too. It is increasingly being recognized in Bangladesh as in other part of the world that for development to be meaningful & sustainable over a longer period environmental concern must be integrated into all development. Integrating environment in all development activities and achieving environmentally sound development planning has immerged as the greatest challenge to the dominant development paradigms all over the world and becomes a more formidable challenge countries such as Bangladesh with resource constraints inherent geomorphologic instabilities along with its vulnerability to natural disaster.

The Government of Bangladesh (GOB) is taking necessary initiatives to regulate the industries to follow the DfE principles by creating or modifying the environmental regulations. For example, from 1st January 2002, the use of polythene bags is banned in Dhaka city, with a nationwide ban to follow on the 1st March, 2002 [23]. The government of Bangladesh has banned thousands of two-stroke three-wheelers, sometimes known as baby taxis, from the streets of Dhaka from 1 January, 2003 [24]. Polythene bags pollute the soil and water. On the other hand two-stroke three-wheelers were creating hazardous gasses. Both of them are harmful to environment and violets DfE Principles A & B.

Next the authors describe what the industries in Bangladesh are doing for protecting environment. Rahimafrooz as a Group is highly committed to its social and environmental responsibilities. All its operations are built and managed in a way so that the possibility of any detrimental effect on the environment can be eliminated or minimized. Being the leader in the lead-acid battery industry, RBL is no exception to that commitment. Safe disposal of the used batteries in Bangladesh has been a big concern. Rahimafrooz has lobbied actively in getting a
law formulated and enacted in this regard. Following the DfE principle F RBL has ensured proper facilities and establishments for collecting (buying back) and breaking used batteries safely in an isolated location in Savar. Simultaneously, it has also made huge investments in setting up a smelting plant to recycle the recovered lead from the used batteries. In order to make all these efforts truly meaningful, Rahimafroz has been periodically running awareness building campaigns in the society among the battery users (including the drivers) to educate them about the need for a safe disposal of batteries and also encouraging them to avail the buy-back benefits offered by Rahimafroz for used batteries. This awareness program is obviously a clear reflection of DfE Principle G.

Since Rahimafroz won an Ashden Award in 2006 it has continued to design and install new solar systems at an impressive rate [25]. Rahimafroz has now installed over 200,000 solar home systems (Fig. 2). Rahimafroz has also installed the largest off-grid solar centralized system in Barkal, Rangamati. The 10 kW power system provides lighting for the entire community living in Barkal. This is a direct following of DfE Principle A. Rahimafroz believes in promoting individual environmental responsibility through commitment to 3R (Reduce, Reuse, Recycle), a globally recognized concept and practice to address Environmental Issues. Every year, Rahimafroz celebrates the International Environment Day with “RSF Pobibesh Utshab”. In year 2010, Rural Services Foundation (RSF), a Social Development Initiative of Rahimafroz, organized quiz competition covering 30 upazillas of Bangladesh and gave awards to 450 students. The quiz competition is aimed for candidates of SSC examination and the topics include climate change, renewable energy technology and 3R issues to promote greater environmental responsibility and to encourage the students to increase their knowledge on environment as well as to make them conscious about the climate change [25]. This program is the basic theme of DfE Principle G.

PRAN-RFL Group was born in 1980 and over the years they diversified their activities. Today they are the largest processors of fruits & vegetables in Bangladesh. They encourage farmers and help them to grow quality crops with increased emphasis to source all their key agricultural raw materials sustainably and hence follow DfE principle A. The management is conscious about environment. They have established Effluent Treatment Plant and use recyclable and reusable material for packaging. RFL produces most of their product from recycled materials [26].

2009 saw the launch of a new vision for Unilever, to double the size of the company while reducing overall impact on the environment. They are embarking on a long-term program of work with the suppliers, customers and other partners to realize this goal. From the year 1995 the company has significantly improved the eco-efficiency of its network of factories. In 2008 they developed a set of metrics for four priority environmental impact areas: greenhouse gas emissions, water, waste and sustainable sourcing. Their target is to source 100% raw material sustainable by year 2015. Some remarkable works can be listed as:

a) 15% of palm oil now sourced sustainable via Green-Palm certificates
b) 15% of the tea globally now sourced from Rainforest Alliance Certified farms
c) Reduced environmental impacts of the manufacturing operations by 41% for CO2 from energy, 65% for water use and 73% for total waste
d) Lifebuoy promoted Global Hand-washing Day in 23 countries.

Unilever observes the impacts of a product on environment in every stage of its lifecycle: in sourcing raw materials, packaging, manufacture, distribution, consumer use and disposal [27] (Unilever Bangladesh, 2009).
Sustainability is now central to their business strategy. So it is clear that Unilever follows almost all of the DfE principles.

4. Conclusions

In general, environmental impact comes from excessive consumption of natural resources and emissions of pollutants to air, water, and land. If the DfE principles are followed properly in every stage of product life cycle then environmental impact will definitely become lesser. Then it would become a Green Product. From this study it is evident that just like other countries the leading industries in Bangladesh as well as GOB are very conscious about this fact.

All of the DfE principles may not be followed in a structured way but main principles like Principle A, B & G are strictly maintained during creating Government Regulations and Product Design in the manufacturing industries. It is expected that this trend will continue in following all of the DfE principles. In this article Design for Environment, for reducing environmental impacts, has been discussed, and a list to which a designer can refer has been included. It may help the related personals to make greater number of eco-friendly products. The eco-designer must be cognizant of all DfE principles.

DfE principles are still being discovered. Further work is needed to expand the list as new principles become available. Finally, the list of principles based on best practices but rigorous, quantitative validation of some of these principles is still lacking.

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