Significance of Research in Green Design of product: An Overview

Abstract

Green design is not on work for waste prevention but also provide solution. This allow the people to produce products with less environmental impact. Electronic waste are now days becoming a biggest issues after plastic in sustainable development. A environmental design process must be considered for pristine the natural resources and reusing the earth's scare resources, where energy and material consumption is optimized ,minimal waste is generated and output waste stream from any process can be used as the raw materials.Lot many specific methods and tools were used to validate designed product and to analyze end product information and its impact on environment.'Design for Environment' (DFE) is an umbrella term describing techniques used to incorporate an environmental component into products and services before they enter the production phase.Design research empowers the designer to create better design for the users centric sustainable market.Evaluative Research Design is essential for the product success. It helps to validate the idea, that much particular product is satisfying the targeted consumers.

Key Words: Green design, zero emissions, sustainable products,*Guerilla testing,* ,Life cycle analysis .

1.Introduction-

Electronic waste are now days becoming a biggest issues after plastic in sustainable development. Since electronics are blooming in 20th century. A environmental design process must be considered for conserving and reusing the earth's scare resources, where energy and material consumption is optimized ,minimal waste is generated and output waste stream from any process can be used as the raw materials.

This is the process of addressing surrounding environmental parameters when devising plans, programs, policies, buildings, or products. These fields include architecture, geography, urban planning, landscape architecture, and interior design.

Design for Environment (DFE) is an another name of a United State's Environmental Protection Agency (EPA) program, created in 1992, which works for the prevention of pollution and the risk of pollution for human being and environment[1]. The program provides information regarding safer chemical formulations for cleaning and other products. EPA has given again a new name to this program " Safer Choice"[2] in 2015.

The other instruments of EPA, by which EPA is working is Waste Management Act,1996, Protection of the Environment Act,2003 and Radiological Protection Act 2014 etc.

The main goal of EPA to protect , improve and restore our environment through regulation, scientific knowledge and working with others.

Modern day businesses all aim to produce goods at a low cost while maintaining quality, staying competitive in the global marketplace, and meeting consumer preferences for more environment friendly products. To help businesses meet these challenges, EPA encourages businesses to incorporate environmental considerations into the design process. The benefits of incorporating Design for Environment include: cost savings, reduced business and environmental risks, expanded business and market opportunities, and to meet environmental regulations[3]. The DFE strategy aims to improve technology and design tactics to expand the scope of products.

When we design for the world , start with the identification of problems, explorative study about the problems, sustainable solution for the problems and then ensure that outcome would direct the challenges positively. Research in designing processes footing for the creation of user centered (UCD) design. It involves not only users requirement but also consider what consumers

Through the proper research , Environmental designer work with the objective of to create highly usable and accessible product. For example if researchers are going to design diamondjewellary , they focuses on current trends of diamond jewellary , critical design, business requirements together with users needs, users feedback loop in product life style.

Designing research is a structural investigation of users behavior, motivation and context . Design research empowers the designer to create better design for the users centric sustainable market.

2.Literature Review-

Product designers are always under challenges of optimizing the multitude of success or failure of the designed product. The choices of raw materials , environmentally friendly disposal are during the synthesis and energy utilization during the production of particular product(Amit Kapur, Thomas E. Graedel, Encyclopedia of Energy, 2004). Researcher very frequently use the LCA and DFE methodology as a tool to find out the impact of designed product on the environment.(Zhang et al., 1999, Boks and Stevels, 2007, Grote et al.,2007) ,

Georgiadis and Vlachos in 2004 , presented a System Dyanamics Simulation (SDS) model to evaluate the long term effect of closed loop supply chain as an alternative of environmental protection policies in concern of take back obligation, proper collection campaign and green image effect.

Life cycle analysis (LCA) is also used to analyse the impact of product on the environment(MehmetAliIlgin, Surendra M. Gupta , Journal of Enviromental Management,2010)

Initial guidelines for a DFE approach were written in 1990 by East Meets West , a New York-based non-governmental organization. It became a global movement targeting design initiatives and incorporating environmental motives to improve product design in order to minimize health and environmental impacts by incorporating it from design stage all the way to the manufacturing process.. By incorporating eco-efficiency into design tactics, DFE takes into consideration the entire life-cycle of the product, while still making products usable but minimizing resource use (D.E.Santos-Reyes, T.Lawlor-Wright,2001). The key focus of DFE is to minimize the environmental-economic cost to consumers while still focusing on the life-cycle framework of the product.

By balancing both customer needs as well as environmental and social impacts DFE aims to "improve the product use experience both for consumers and producers, while minimally impacting the environment".

A number of tools were also used to evaluate the designed product with respect to environmental impact. Green design Advisor (GDA) were proposed by Nicole M.Ardoin 2020, which considers metrics related to raw materials used in product formation, toxicity of product, recyclability of the product.

Lye et al. developed a computer based designed tool (ECoDE) to compare the environmental impact of component of products.

Wilhelm Griga in 2008 developed a new recovery-conscious design method for the quantitative analysis of recoverability of complex product.

3.0 Design for Environment-

'Design for Environment' (DFE) is an umbrella term describing techniques used to incorporate an environmental component into products and services before they enter the production phase (Karl T. Ulrich and Steven D. Eppinger, 2012) .DFE seeks to discover product innovations that will meet cost and performance objectives while reducing pollution and waste throughout the life-cycle. A wide variety of techniques are available, and they fall into two broad categories.

a. Techniques that are used to identify the environmental impact of a product throughout its life cycle such as life-cycle assessment;
b. Techniques that help designers improve the environmental performance of their products.

Analysis tools can be used to identify broad environmental issues, but improvement techniques are needed in order to solve any problems identified.DFE strategies are sufficiently broad to be used at the product planning and problem definition stage of the design process. Concept demonstrators, on the other hand, are a tangible vision of the possible product of the future.

4.0 Methodology-Lot many specific methods and tools were used to validate designed product and to analyze end product information and its impact on environment .(Chetan Mehta & Ben Wang, 2007)

4.1 Zero Emission -

The concept of zero emissions is based on improving technologies and processes to the point of maximum resource productivity and virtually no waste[7-9]. This goal can be approached in a number of ways, including technological innovation, pollution prevention, cleaner production, by-product synergy, or industrial ecology. All of these are ways of eliminating wastes or turning wastes into profitable resources, while preventing harm to environmental and human health. Zero emissions may appear an unrealistic objective, yet it is a proven and profitable goal.

The "***Zero Emission Research Initiative***" (ZERI), developed at the United Nations University in Tokyo, has as its goal 'zero global emissions, zero water waste, zero solid waste, and zero waste in the air'. This can be done by using nature as a model for process and product design, and by increasing resource productivity through industrial 'clustering'.(Gunter Pauli, 1998)

The concept of zero emissions has been developed into a methodology that can be applied to any industry sector. The ZERI methodology, as proposed by United Nations University, is as follows:

- **(i)** **'Total throughput'**-A review of the industry identifies opportunities to minimize inputs and maximize outputs. The aim is to make full use of all the inputs; i.e. total throughput. If this cannot be achieved, the next step of the methodology is applied.
- **(ii)** **Output-input models-**An inventory is created of all 'wastes' - i.e. outputs not consumed in the final product or in its process of manufacture. An active search is then initiated to identify industries which could use these outputs, or modified versions of them, as inputs.
- **(iii)** **Industrial clusters-**The output-input models are used to determine potential candidates for industry 'clustering'. The next step is to identify optimal clusters in terms of size and number of participants.
- **(iv)** **Breakthrough technologies-**In cases where current engineering expertise and process technologies are not able to secure effective and economical coupling of outputs and inputs, research into 'breakthrough technologies' or system designs is initiated.
- **(v)** **Industrial policy-**The identification of suitable industry clusters, and of the breakthroughs required, must be accompanied by appropriate government policies. Where sectors with no previous history of working together are combined, collaborative efforts involving policy makers, industry representatives and academics are needed.

4.2 Research Design Methodology – Different research design methodologies use are as following types-(KassuJilchaSileyew, 2019)

a)Generative Research Design - It is computer aided research design system. This is AI to optimize the designing process. In this designers uses generative design software to iterate the design alternatives and then pick up the best design according to required criteria. This is

widely use in automotive industries to design the auto parts, aerospace industries to design with the objective of improved environmental impact and weight reduction, consumers goods for improved performance and lower cost .(Graedel T.E., Allenby B.R,1995)

b)Evaluative Research Design -It is kind of quantitative research , essential for the product success. It helps to validate the idea, that much particular product is satisfying the targeted consumers. Designers use different types of techniques to for the usability testing. Like-

Guerilla testing- In this designers head over to a public space as tea or coffee shop, mall, restaurants where the centered users hang out, designers ask the random users for their feed back.

Eye- tracking- Designers uses webcams to get the users look on the particular webpage or dashboard for the ease of analysis.

Session replays- Research designers records that how many times users use the particular app or search a particular product on the website.

c)Quantitative Research Design- Designers use systematic and structured approach to get better product. To follow this research they follow following steps-

i) formulate a specific measurable objective questions about the product which has to be answered by consumers.
ii) They identified different types of variable relevant to questions that could be dependent (outcomes or responses) or independent variables (controlled or manipulated factors) .
iii) Based on research question ,they develop hypothesis (type of statements) make predictions about the variables.
iv) Researchers target the particular users for the sampling. Target population must be enough to calculate statistically significant results.
v) Quantitative research design is mainly based on numerical data collection, which could be done by any mean as surveys, experiments, secondary data analysis etc.
vi) Designers go through data analysis ,by descriptive statistics to summarize the data then inferential statistics to draw conclusion.
vii) The designers interprets the outcomes and draw conclusions on the basis of analysis which could be presented in form of Cancers or graphs.

d) **Qualitative Research Design -** In qualitative research design , designers typically involved the collection of data via different ways as interviews, observations on targeted groups and then analysis of documents. The different types of qualitative research design used are-

Phenomenological Research- In this research design ,designers try to understand the targeted users experiences towards particular products. They go through

explorative study in depth interviews or observation to understand their lived experiences.

Ethnographic Research- This research go through study of culture, practices, and social behavioural interaction of specific group or community in their natural home environment for a specific period of time . Generally done by interviews, participant observation and through document analysis.

Narrative Research- This research is based on personal stories and narratives shared by targeted users.Designers then examine the narratives to get insight that how an individuals absorb the meaning and make sense of their experience for the particular product.

Participatory Action Research (PAR)- This is a collaborative type of approach in which designers works together with participants to find out the social issues and problems. This type of research is use to empowers the targeted participants with actionable knowledge by the process of reflection, action and change.

Conclusion-

Overall I can say that design activity is definitely as important as research but used different methods and goals. In cases where current engineering expertise and process technologies are not effectively work "breakthrough technologies' or system designs is initiated to work effectively.

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