WWJMRD 2017; 3(8): 235-239
www.wwjmrd.com
International Journal
Peer Reviewed Journal
Refereed Journal
Indexed Journal
UGC Approved Journal
Impact Factor MJIF: 4.25
e-ISSN: 2454-6615

Dr. Ugochukwu Kamalu
Electronics/Computer Engineering Department, University of Port Harcourt, Port Harcourt, Rivers State, Nigeria

Chimdi Ogbonnaya Chukwu
Electronics/Computer Engineering Department, University of Port Harcourt, Port Harcourt, Rivers State, Nigeria

Correspondence:
Dr. Ugochukwu Kamalu
Electronics/Computer Engineering Department, University of Port Harcourt, Port Harcourt, Rivers State, Nigeria

Ergonomics and Aesthetic Elements of Design

Ugochukwu Kamalu, Chimdi Ogbonnaya Chukwu

Abstract
Design in the present day and trends, is not left to the discretion of pure engineering which delivers results based on functionality but in most times omit the human factor to the design…this is where ergonomics and esthetics come in. Various aspects to product design was looked at, while taking a swing at the general approach to product design from the designing done in the drawing room to the point of market entry. Ergonomics and Aesthetics, as a concept, were x-rayed while keeping then close to their impact and importance in product designs. It was established that customers tend to patronize product designs, chiefly, based on their exterior features such as looks, colour, shape, etc. and not necessarily because of how functional the product is.

Keywords: Aesthetics, Ergonomics, Design

Introduction
When talking about engineering, what comes to mind first id the word, 'design'. Lots of effort, in any engineering project, would have been put in from the point of idea conception to materialization. As a problem solver, the Engineer must make sure that his solution or product – be it a tangible or intangible product – has to be able to meet the need of his client or target market. But no matter how good an engineering product is, it is not going to sell itself. According to (Dan Högberg, 2005), Value can be seen as arising from practical benefits (functionality, usability) as well as from emotional benefits, and a customer is likely to perceive a product as a whole; a package of benefits. Product development that focuses only, or mainly, on a few distinct value-generating issues, e.g. technical functionality, cost, manufacturability or aesthetics, leads to a risk of sub-optimizing the product. This calls for a holistic approach, where utilitarian and emotional benefits are merged in the design process.

Design and Its Aspects
Designs of engineering efforts can be said to be systems that are created by human input and never was before or are could be said to be meliorations over existing inventions, processes or systems. Inventions, or designs, do not just make its way from oblivion. Technologies and skillsets have to be bundled together to solve problems of the target user. Sometimes a design is the comes about by attempts to make improvements on already existing solution. The actions in the design process occurs over a period of time and requires a step-by-step methodology.
Engineers, primarily, are referred to as problem solvers. What distinguishes design from other types of problem solving is the nature of both the problem and the solution. Design problems have more than one correct solution, this makes them to be open ended in nature. The open ended nature of a design problem is there because the system has defined attributes. Design problems are usually more vaguely outlined than analysis problems. Let us say that one was asked to determine the possible distance of a crash-landed plan from the last known radar or GPS position, last known velocity (or possible consistent reduction in velocity) and altitude at the time of transmission. This is an analysis problem because it has only one answer. But on the other hand, solving design problems is often an iterative process: As the solution to a design problem evolves, you find yourself continually refining the design. While implementing the solution to a design problem, you may discover that the solution you've developed is of high risk, costly, or will not work. You then "head back to

the drawing board" and modify the solution until it meets your requirements. Design activity is therefore cyclic or iterative in nature, whereas analysis problem solving is primarily sequential.

The solution to a design problem does not suddenly out of nowhere. A good solution requires a methodology or process. There are probably as many processes of design as there are engineers. Therefore, this lesson does not present a rigid "cookbook" approach to design but presents a general application-based of the five-step problem-solving methodology associated with the design process. The process described here is general, and could be adapted to particular problems one is trying to solve

Product Design Process

Products designed, lots of the time, is not used by the designer. There are usually end-users who may not be technically inclined and should be able to see, like, acquire and use these products. That is why concepts of aesthetics, ergonomics and very importantly – marketing – must be incorporated in the overall product design process. The engineering design process involves a series of steps that lead to the development of a new product or system. Initial ideas rarely solve a problem. Instead, different ideas will be tried, mistakes are made and learnt from there, and then try again.

The following are the steps that can be taken in pursuing a design which are elaborated in (Fig. 1) of the design process:

1. Identify the Problem
2. Identify Criteria and Constraints
3. Brainstorm Possible Solutions
4. Generate Ideas
5. Explore Possibilities
6. Select an Approach
7. Build a Model or Prototype
8. Refine the Design.

Step 1: Identify the Problem – The problem that needs a solution must be stated. This will help the designer have a clear idea of the path to take.

Step 2: Identify Criteria and Constraints - State the design requirements (criteria) and limits on the design because of the factor of available resources and the environment (constraints).

Step 3: Discuss ways to solve the problem, sketch ideas, and use labels and arrows to identify parts and how they might move. Drawings should be quick and brief.

Step 4: Generate Ideas - Develop multiple ideas thoroughly. Create new drawings that are orthographic projections (several views displaying the top, front and one side) and isometric drawings (three-dimensional depiction). Parts and measurements should be labeled clearly.

Step 5: Explore Possibilities - The developed ideas should be shared and discussed among the team members. Pros and cons of each design idea must be identified.

Step 6: Select an Approach– Identify the design that best appears to solve the problem with your teammates. Write a statement that describes why the design was chosen, including reference to the criteria and constraints in Step 2.

Step 7: Build a Model or Prototype - Construct a full-size or scale model based on the drawings for the design.

Step 8: Refine the Design - Examine and evaluate the model (prototype) based on the criteria and constraints, then identify any problems and proposed solutions.

Marketing enables the designed product to reach the consciousness of the end-user. Figure 1 is a diagram that shows a typical flow of a product design from inception to consumption

Aesthetics in Design

Aesthetics could be said to be a branch of philosophy dealing with beauty and taste (Wordweb, 2017). (Rolf, 1995) said that engineering involvement with aesthetics is vital for the creation of innovative and successful products in today's fast changing world. While as defined by the Merriam-Webster's dictionary, aesthetics is "a branch of philosophy dealing with the nature of beauty, art, and taste and also with the creation and appreciation of beauty." (Merriam-Webster dictionary, 2004). Cambridge's online dictionary defines aesthetic as "relating to the enjoyment or study of beauty" (Cambridge dictionary, 2004). So, it is not farfetched to connote think up the word, beauty whenever 'aesthetics' come to mind.

There are some principles such as Unity, Balance, Variety, and Proportion that have been developed in the field of Fine Art under the name of "principle of design" or "principle of organization". Principles of design (in Fine Art) are the result of some long-term empirical experiment and intuition, and they have been found effective in different places and times of humankind [Feldman, 1971]. Aesthetic principles are known and usable in the field of computer interface design, and some studies such as (Bauerly and Liu, 2003) and Ngo et al. [2003] have been done in this area. However, there are very few attempts that have been concerned with the critical analysis of aesthetics in engineering design [Pye, 1995], and among them the studies such as Jordan [1998], Yanagisawa and Fukuda [2003], and Yoshimura and Yanagi [2001] can be referred. However, they have not addressed the integration issue; see also the comment made by Lin and Zhang [2006].

Ergonomics

As a scientific discipline that devotes itself to the study of human-machine-environment systems, human factors and ergonomics has long established its goals of enhancing the safety, comfort, productivity, and ease-of-use of products and systems (Wickens, Gordon, Liu, 1998) and has made great strides toward achieving these goals.

As defined by (Seyyed Khandani, 2005), Ergonomics is the human factor in engineering. It is the study of how people interact with machines. Most products have to work with people in some manner. People occupy a space in or around the design, and they may provide a source of power or control or act as a sensor for the design. For example, people sense if an automobile air-conditioning system is maintaining a comfortable temperature inside the car. These factors form the basis for human factors, or ergonomics, of a design.

Companies put considerable effort into marketing, developing and producing products. Designs which have ergonomics considerations in their hind mind offers safe, comfortable and efficient products by factoring human

aspects. Ergonomically designed products prevent fatigue and discomfort (Nayak, 2015).

In order to stay competitive there is a need to do this as well, or better, than other present or coming players in the same field. One important task for companies is to successfully identify what creates value for their present and prospective customers, and to translate this information into attractive differentiated products. Value can be seen as arising from practical benefits (functionality, usability) as well as from emotional benefits, and a customer is likely to perceive a product as a whole; a package of benefits. Product development that focuses only, or mainly, on a few distinct value-generating issues, e.g. technical functionality, cost, manufacturability or aesthetics, leads to a risk of sub-optimizing the product. This calls for a holistic approach, where utilitarian and emotional benefits are merged in the design process. Nearly all products interact with humans in some way. In many cases the main interaction happens during the product's user phase, but if not, most products still interact with humans during production or service. The human might interact as a power source, as a sensor or as a decider. It might also be as representing a volume with certain properties, e.g. when sitting in a car or entering a door. All these kinds of human-product interactions (or man-machine interactions) are treated in the area of ergonomics (or human factors, see definitions later in the thesis). It is important to include ergonomics considerations throughout the design process, and ideally from the very start. The area of ergonomics positively influences the value of the product by improving human-product interaction. Since good ergonomics practice takes human diversity into account when contributing to product development, enhanced ergonomics consideration in product design can also lead to increased human-product interaction quality for more people.

Ergonomic and Aesthetic Considerations in Some Designs

Products and solutions that serves the purpose of its creation will be seen to have aspects and ergonomics touched or outright covered in the process of its coming to be. Ergonomics and Aesthetics can be appreciated and its benefits gotten when looking at the following examples of engineering solutions:

Game Console Controller Design

The video game industry raked in above $30bn at the end of 2016 (ESA, 2016). Many of the consumers of video games or entertainment consoles interact both with the software and with other people across various platforms – mainly PCs and game consoles. They interact using various hardware across the platform e.g. Keyboard, Mouse, Controller.

During the design stages of game controllers, engineers have to take into consideration ergonomic and aesthetic in the for better game player experience. Game controllers which are hand-held.

Ergonomics in Video Game Controller Design

There are two dimensions to controller quality which engineers usually consider when game controllers are designed: Naturalness and Comfort.

- Naturalness: The degree to which the control scheme makes the player feel like the digital experience mimics its real-life counterpart. Based on The principle of *embodied cognition*, player's own thoughts and interpretations of a video game experience will be influenced by his or her own body's position and movement (Wilson M, 2002). If a controller allows a player to move his or her hands and body in a more realistic way, that will lead to a stronger interpretation of the game approximating a real-life experience.
- Comfort: This is the degree to which a controller has a practical shape and button layout. Controllers are often used for hours at a time, and therefore maximum ergonomic sensibility will lead to greater enjoyment and less fatigue. Several factors affect a controller's overall ergonomic quality, such as the naturalness of its shape, its weight, and the ability to reach as many functions of the controller as possible without changing grip.

Earlier video game controllers were made for a specific purpose. Certain criterions where established to establish the ergonomic compliance of four game controllers – PlayStation 4, Xbox 360, Xbox, and SEGA Genesis (Fig. 3-6) respectively):

Conclusion

(Dittmar, H, 2003 and Hekket, P, 2006) established that consumer or user response to a designed product can be classified into categories such as 'aesthetic', 'semantic', 'symbolic', etc. Aesthetic response is about the perception of (UN) attractiveness in products. Semantic response relates to the interpretation of a product's function, the mode of using the product, etc. Symbolic response is about the associations between the product-characteristics and owner- or user-identity. Consumer response to a designed product is often stimulated by visual information as the vision system provides data at higher speed and rates as compared to other senses (Ulrich, 2011). However, consumer responses can be triggered by other senses, namely, taste, smell, touch, and hearing.

Consumer response to designed products has a profound effect on how products are interpreted, approached and used (Crilly, N et al, 2009). Based on such response, evoked by product-characteristics, consumers make judgments on the elegance, functionality and social significance of products (Mono, R., 1997). (Coates, 2002) said that the design of products is crucial in determining consumer response and market success. In a styling or aesthetic design process, designers play an important role in formulating intended consumer response. They generate and evaluate concepts to effectively communicate the intended response. The aesthetic design process has a major influence on the consumer response and product success (Crilly, 2009).

Tables and Figures

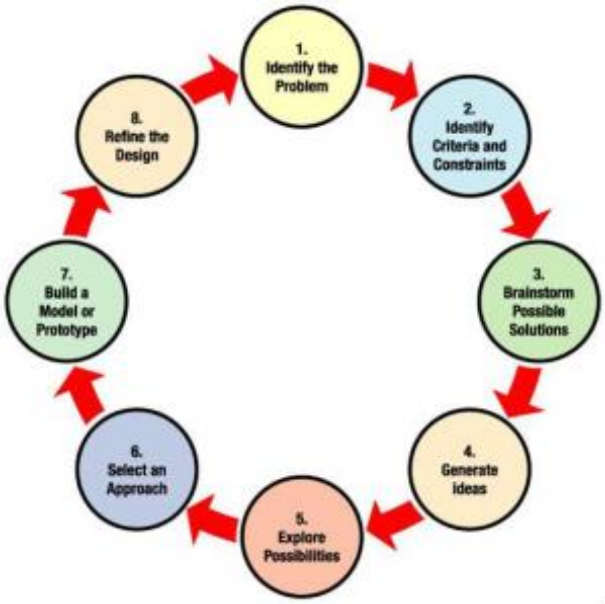

Fig 1: The Design Process Cycle. (NASA, 2008)

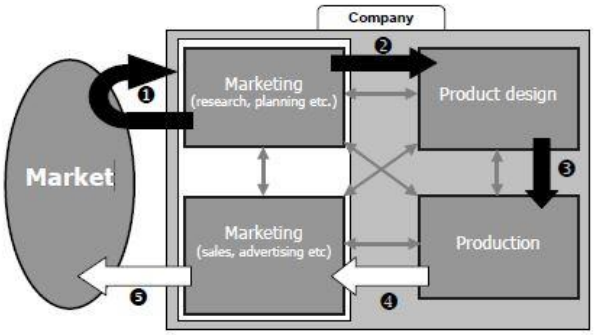

Fig. 2: Design-till-market flow Diagram of a typical Company (Dan, 2005)

Fig. 3: The Sony PlayStation Controller (http://cdn.overclock.net/8/8b/8b08d5fc_control.jpeg)

Fig. 4: Xbox 360 Controller (www.amazon.co.uk)

Fig. 5: Xbox Controller (https://en.wikipedia.org/wiki/Xbox_(console)#/media/File:Xbox-Duke-Controller.jpg)

Fig. 6: SEGA Genesis Controller (http://videogamecritic.com/images/systems/gencontroller.jpg)

Conclusions

Therefore, in the design of a product or solution, it is always pertinent to remember that most of the designs made, in engineering and whatsoever discipline, is going to be mostly used or consumed by people other than themselves who created the solution. When 'aesthetics' and 'ergonomics' are factored in, it is will go a long way in

passively persuading people to patronize a designed product, mainly because humans have the inclination towards using products of design that suit their taste and inherent nature.

References

1. Dan Högberg (2005). "Ergonomics Integration and User Diversity in Product Design".
2. Wickens, C., Gordon, S., and Liu, Y. (1998). An Introduction to Human Factors, https://dspace.lboro.ac.uk/2134/7772
3. Yili Liu, Ph.D. (2003) "Engineering Aesthetics and Aesthetic Ergonomics: Theoretical Foundations and a Dual-Process Research Methodology "ERGONOMICS, 2003, VOL. 46, NOS 13/14, 1273 – 1292 Engineering. New York: Addison-Wesley-Longman.
4. Dittmar, H.: The Social Psychology of Material Possessions: To Have Is to Be. Harvester Wheatsheaf, NewYork (1992)
5. Hekkert, P.: Design aesthetics: principles of pleasure in design. Psychol. Sci. 48(2), 157 (2006)
6. Mono, R.: Design for Product Understanding Liber. Stockholm, Sweden (1997)
7. Ulrich, K.T.: Design: Creation of Artifacts in Society, Karl T. Ulrich (2011)
8. Crilly, N., Moultrie, J., Clarkson, and P.J.: Shaping things: intended consumer response and the other determinants of product form. Des. Stud. 30(3), 224–254 (2009)
9. Coates, D., Watches Tell More Than Time: Product Design, Information, and the Quest for Elegance. McGraw-Hill, NewYork (2002)
10. Rolf A. F.: The Role of Aesthetics in Engineering. JSME Journal (1995)
11. Feldman, E. B., 1971, *Varieties of Visual Experience: Art as Image and Idea*, 2nd Edition,Prentice-Hall Inc., New York.
12. Bauerly, M. and Liu, Y., 2003, "Computational modeling and experimental investigation of effects of compositional elements on interface and design aesthetics," *Proceeding ofthe 8th annual international conference on industrial engineering* – Theory, applicationand practice, Las Vegas, Nevada, USA, November 10-12, 2003.
13. Pye, D., 1995, *the Nature and Aesthetics of Design*, the Herbert Press, UK. Jordan, P.W., 1998, "Human factors for pleasure in product use," *Applied Ergonomics*, Vol. 29, No.1, pp.25-33.
14. Ngo, D. C. L., Teo, L. S., and Byrne, J. G., 2003, "Modeling Interface Aesthetics," *Information Sciences*, Vol. 152, pp. 25-46.
15. Yoshimura, M. and Yanagi, H., 2001, "Strategies for implementing aesthetic factors in product designs," International Journal of Production Research, Vol. 39, No. 5, pp. 1031–1049.
16. Yanagisawa, H. and Fukuda, S., 2003, "Interactive reduct evalouation computation for aesthetics design," *Proceedings of DETC'03 ASME 2003 Design Engineering Technical Conferences and Computers and Information in Engineering Conference*, Chicago, Illinois.
17. Wilson, M., 2002, "Six views of Embodied Cognition", *Psychonomic Bulletin and Review",* Vol. 9, No. 4, pp. 625-636