

Application of user Centered Design for Customer Requirement in Design Process for Automotive Manufacturing Organizations

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Abstract: Recent developments in the automotive industry have witnessed a shift in paradigm from technological centered design to more user-centered designs. Consumer demands vary, but most consumers require that the products they purchase meet their needs in order to gain maximum value for their money. Accordingly, this research project adopted user centered design approach which identifies customer needs right from design stage before embarking on the real design. It has five broad stages. The five stages in designing user-centered products were proposed in this paper. They are; identification of the scope, analysis, design, evaluation, and delivery. By following these steps, the research described a method of designing products that meet user requirement.

Keywords: Customer needs, Design process, User – Centered Design

I. Introduction

The paper focuses on the customer requirement and needs using user centred design for product design in automotive manufacturing organization. For a long time now, the automotive industry has concentrated on technology and innovation in the development of high-tech products that met the competition requirement of this highly competitive industry. However, technological competition has not yielded much in terms of product differentiations because technology has inherent characteristics of being dynamic and uniform. The lack of restrictions regarding the use of technology meant for the automotive products from different companies remained significantly similar. Accordingly, there is need to change the status quo and develop products that are not only differentiable but also meet the demands of consumers, the adoption of customer-oriented design in automotive manufacturing, customer-based approaches to the design and manufacture of automotive products focus on the sales and marketing aspects of automobile products [1].

Furthermore, consumer needs and preferences are increasingly gaining attention in the business world. With an ever-increasing basket of products to choose from, consumers have grown increasingly cautious about the products they purchase. More importantly, they demand maximum satisfaction from every purchase they make in the increasingly competitive markets. For luxury products such as cars, meeting customer requirements is a critical factor that has led engineers to design products that are not only technologically relevant but also meet the demands of the end user.

Several customer-oriented approaches exist. Examples of this include emphasize on customer feedback regarding the products, pre-order customer customization of the vehicle and the dependence of more customer experienced sales agents. According to [2], this involves a combination the traditional technology push approach and the complementary design pull approach with more emphasize on the customers perception of the product. Other techniques of customer-centred design include design-driven innovation, user centred design and emotional design [1].

The design of a new vehicle, from the initial perceived customer need through to its finalization for manufacturing, continues to represent a major investment for automotive manufacturers. With research and development costs reaching up to \$6 billion U.S. [3] and ultimately determining 70% to 90% of total project costs [2], the design process poses a significant financial risk. Similarly, manufacturers typically require between 3.5-5 years of time to bring a complete vehicle to market [4]. This represents a significant investment of company time, in the form of both employee working hours and the lost opportunities of alternative projects, with success ultimately dependent on the design and development of a product that sells [5].

This research study looks at previous studies about the broad topic of meeting user requirement through product design. First, the researcher examines the concept of user-centered design, its definition and implication in automotive product development as well as the origin of the concept. Then, focused on the theoretical frameworks

II. User-Centred Design

User centred design refers to the techniques applied by developers and designers to ensure that final products meet the needs of its intended users [6]. It focuses on the final product users throughout the planning, design and development stages of a product (User Experience Professionals Association, 2014). Ideally, firms often have a limited understanding of what their customers' want, limited to what the observations that are drawn from interaction with potential clients [7]. UCD in the context of business innovation that offers a chance to establish relationships and better understanding with the potential customers, providing a longer-term understanding of customer needs and requirements for driving companies' competitive advantage [7].

2.1UCD in the Automotive Industry

User-centred design originated from the software development Industry in the early 1980,s [8]. However, from the automotive point of view, the concept of user-centred design in the development of automotive products is new. In practice, four major firms in the automotive industry recently adopted UCD within their design process, although the degree to which the technique has been implemented varies. General Motors sought to build deeper understanding of drivers interacted with their in-car entertainment systems, with the aim of tailoring the systems to the demands of the users [9].

Likewise, BMW experimented with the social aspect of vehicle-user interaction, attempting to better understand the potential for social media to influence the use and experience of their vehicles by prospective customers [10]. Nissan's trailing of UCD has only extended as far as contracting out research into current and anticipated usage behaviour of certain customer markets, culminating in the compilation of personas given to the in-house design team [11]. Finally, the fourth automotive manufacturer to implement UCD or UCD tools is Ford which has reached the closest to complete integration within the vehicle design process.

In an attempt to design Ford Fiesta design palatable in all their major markets, Ford centralized the design process around the customer through the use of Personas and storytelling [12]. Through the compilation and assessment of demographic research into the targeted Fiesta customers, Ford developed a handful of Personas, complete with psychological profiles. These characters were used to "get everyone on the same page", in order to ensure the designers were not just designing for themselves but rather for the customer and end-user [12]. However, in spite of the strong sales success of this UCD Ford Fiesta [12], the implementation of the UCD approach appears to have been given solely into the hands of the designers in the Ford design studio.

In addition, such projects are predominantly design-centric, divorcing themselves from the reality of the multi-disciplinary nature of automotive vehicle development, where designers and engineers are solely responsible for vehicle manufacture. Although this may not always be the case, such articles highlight the current absence of the engineer from the design process, at least from the perspective of automotive design. This suggests that there is significant potential for further success if customer needs and requirements were to be placed at the forefront of the engineering design process.

Furthermore, the adoption of personas by engineers in addition to designers at firms such as Ford represents a first potential step towards a customer centred approach to vehicular design and development. This problem represents a key issue for the 50, 4.0 User Centred Design successful implementation in automotive manufacturing companies, and thus for their potential competitive edge in the global automotive industry.

The global automotive industry has evolved to become a pinnacle of technology driven innovation, where companies are competing to produce marketable products that are not only high-tech but also appealing to customers. Increasing competition has made automotive firms to focus on the need to develop customer-based approach to automotive manufacturing. According to [13], customer centred approach to automotive production allow companies to differentiate themselves from similar technology optimistic crowd. Focusing on customer requirement which appears to be centred on sales and marketing strategy meant for improving market share.

In recent times, challenging economic and market conditions has forced majority of automotive companies to question the status quo and come up with new methods of vehicle design that meets the requirements of end users. According to [14], customer needs have become even more important than the greatest technology integrated into their vehicles. This has led to the realization by some automotive manufactures that increasing future competitiveness and sales, that could be determined by the ability to meet customer needs and not just incorporating advanced technologies in the products.

Knobel et al. [10] investigated and promoted the importance of vehicles creating positive experiences and fulfilling the psychological needs of users. They argued that technological product design should focus primarily on the experience of the product providers and the user, rather than on its form and functionality. Similarly, [9] explored the ways in which users interacted with their vehicles, specifically their infotainment systems, in order to refine future designs to provide improved customer experiences. They opined that companies in the automotive industry must focus on understanding the context in which customer's need, in order to better understand and envision future products that are more likely to meet the needs of these contexts.

2.2 Disadvantages of User Centred Design

The degree to which UCD is implemented within any given business or project has been raised as a potential cause for concern. Whilst not strictly a concern regarding UCD itself, if UCD is only informally applied to parts of projects [7], this does raise the issue of the potential benefit of UCD to businesses if it is not properly implemented. [3], argue that lack of proper implementation is ultimately due to a lack of understanding of the benefits of UCD and how to apply the approach. They suggest that the proper implementation of UCD ultimately requires the presence of knowledgeable UCD users who are capable of showing the benefits of UCD within product design process in order to gain overarching support. Furthermore, this implementation needs to gain the support of management in order to bring together operational and strategic decisions for a holistic approach to the process [15].

Despite the reservations and concerns about UCD raised in by different researchers, the general consensus appears to be quite positive towards its use and successful implementation. One particular tool frequently used within UCD has seen recent success in addressing these issues, especially in the automotive manufacturing industry [16], and forms a key part of the foundations of the research upon which this research is built.

III. Theoretical Framework

The focus of this research is mainly on the requirements of the customers by application of UCD in the design process. [15], examined how a design technique, which includes experiments with individuals, could incorporate customer experiences and conceptual ideas for future product development. More precisely, they opined that the involvement of personnel within research and design teams made it possible to provide graphical representation of customers and their needs hence making it possible to come up with ideas and unification of multidisciplinary groups of employees behind this idea. The ability of personnel to facilitate role-playing by employees from various disciplinary origins that helped to overcome individual employee perspectives and understand the context of the problem from a user perspective.

Additionally, studies conducted by [17], examined the use of personnel as design tools to enable engineers to have in mind the objectives they attempt to achieve when faced with technical projects with numerous requirements. They argued that this presented an opportunity for the overall design to focus on what the customer's need, as opposed to the tools that might be used. Similarly, [14] argue that the most important influence of personnel is their capabilities to focus product design teams on the actual goals of the target customers. Moreover, they opined that personas enable design to concentrate design

Efforts on meeting customer needs and requirements, rather than basing design efforts on team ideas. This is critical in addressing problems associated with self-reference while also helping to minimize potentially undesirable design elements.

IV. Methodology

The present study will adopt the user centered design method proposed by the international standard ISO 13407: The human centered design processes. This standard offers an effective approach to implementing user requirements within a product development life cycle (International Organization of Standards 2010). The process has five critical steps and the frame work is represented below.

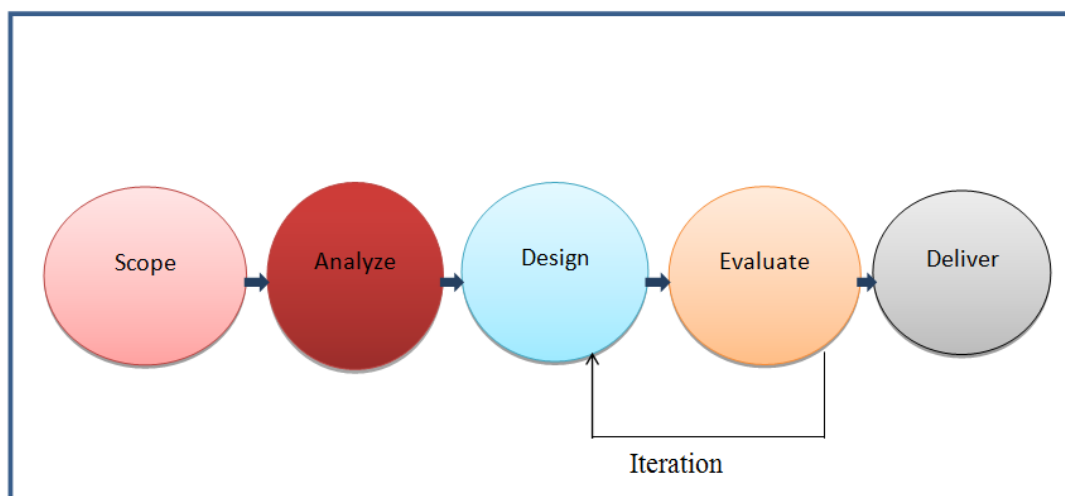


Figure 1.1: User requirement design framework.

Below are the five steps discussed in details;

4.1 Scope

During this phase, all parties in the design process including engineers, management, marketing and sales persons were brought together to discuss and come up with consensus regarding the reference point of the knowledge based product. According to [18], the common point of understanding is used to allow effective communication between stakeholders during different stages of the development process. Ideally, communication was effected by uniform expectations of the project outcome developed during the scoping stage. In other words, the scoping phase enabled the setting of overarching goals and constraints for the project. The goals were established as a group with the aim of achieving desired functionality, while also meeting the target business outcome. In this sense, functionality is defined as the degree to which the system needs to be designed i. e whether the product is to be a visual redesign or needs to be developed from the group up.

4.2 Analyze

After establishing a common ground of what the final product should achieve, a more detailed analysis of the end user follows as the next and equally critical stage [19]. The analysis stage was used to further centralize stakeholder discussion concerning the needs of the actual user. According to [18], this phase is important because it enables the team to avoid unnecessary arguments over design based purely on individuals or disciplinary opinion. The analysis phase followed the completion of field studies in marketing and designers in order to learn more about the needs of the target users.

After completing field studies, a detailed, customer requirement data was converted into a more detailed understandable form. User experience Professional Association (2014) argues that the conversion must be done after developing personas that identifies actual customers and their demands. Ideally, creation of personas enables development team to visualize the target customers together with their needs, user scenario, and the user cases. User scenario represents a typical interaction of the target customers and is often achieved by way of story about the interaction with real customers.

4.3 Design

The main objective in this phase of designing products that meet user requirement was to transform the goals, constraints and requirements from the scope and analysis phase into product. According to [18], this stage predominantly involves designers and engineers and is made up of two separate phase: concept design and detailed design. Designers are often in charge of concept design; the aim is to establish the initial layout of the product and the desired method of interaction with the users. The personas and scenarios developed in the analysis stage from the basis of the conceptual design. In addition, they are applicable in answering the question how the product meets the functional and non-functional requirements of the customer.

This phase requires the specification of all individual components in the product. These components are designed individually meet the required needs of the customer whilst fitting into the overall product concept previously developed by the designers. As the detailed design is finalized, a high-fidelity prototype i.e. a model of the proposed finished product is produced (Web Accessibility Initiative, 2008). This prototype is evaluated via usability testing with potential customers and discussion with project stakeholders, and the detailed design and evaluation process is iterated until a suitable detailed design is developed that meets customer and project requirements.

4.4 Evaluation

The evaluation process occurs parallel to the design process. The prototype is evaluated via usability testing with potential customers and discussion with project stakeholders, and the detailed design and evaluation process is iterated until a suitable detailed design is developed that meets customer. This process ensures that the prototype established during the design stage meets the objectives outlined earlier.

4.5 Deliver

Representing the end of the UCD process, the finalized detailed design is subsequently passed onto the product delivery team for implementation [18]. The design team works closely with the delivery team, ensuring that adequate instructions are provided to allow for the appropriate reproduction of the detailed design as a finished product. This concludes the UCD process, ideally culminating in a product that meets the functional and emotional needs of the customer, and the business and technical requirements specified by the project stakeholders [6].

V. Discussion Of Findings

Despite numerous benefits associated with UCD in product design processes, some researchers argue that the approach has certain weaknesses particularly touching on three critical aspects: Increased focus in user demands can result in unnecessary complex and less functional design [20], possibility of self-reference and bias of the designer on the customer specifications that are developed through UCD [20], and the actual implication regarding implementation of UCD within businesses.

While addressing the three weaknesses identified above, [18] suggested that UCD has developed to become a standard approach when considering many new product designs. He suggested that the primary focus of UCD on the user could lead to the production of products that are less functional. This is because of the possibility that the designers could disregard the importance of the actual activity to be completed by the product when focusing heavily on the customer during the design process. However, whilst this certainly has the potential to occur, it can be argued that when UCD is part of a multidisciplinary approach to product development, it must take into consideration a range of other requirements (such as technical, functional and business)(User Experience Professionals Association, 2014). This is because designers and user-centred design do not work in isolation but are important components of a larger organization looking to develop a new product [18].

A second criticism of the UCD approach points to potential issues with those using UCD methodology rather than with UCD itself. That is, the issue of designers unconsciously imparting personal bias and self-referencing on the overall design under the guise of user-centrism [20].

Whilst certainly a valid concern, that UCD products are not actually user centred but rather designer-centred due to designing for what they feel the users would want rather than the reality, this would only be a problem if UCD methodology were not being adhered to. The Analyze stage of UCD specifically aims to interact with real users and gather real-life data rather than assumed customer behaviour [18]. In light of this, UCD could only fall prey to self-reference and bias if those implementing it were not strictly following the rules and steps.

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