Case Report

A Customer Methodology for Developing Green Cellular Phone: A Case Study of University Malaysia Pahang Students

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Abstract

Economic and environmental eco-design of mobile phones is considered as promising; however in customer marketplace it's still ineffectual. Inadequate eco-design of green mobile phones determines the lack of consumer voice and participation for product development and design in the marketplace. The main impediment is that, many organizations are asked to formulate and present their designs that support environmental green mobile phone characteristics and features but these organizations are not sufficient enough to recognize their voice in the planning and designing phase of product development. The research proposed in this paper fills the gap between wispy consumer perspective and designer's approach for developing green mobile phones. To research emphasizes on consumer-influenced criteria and features for green mobiles development by reflecting green mobile phone definition and uses quantitative approach as a tool of analysis performed to prove how customer participation can improve the overall green mobile phone design. The research is performed at University Malaysia Pahang where suggestions from different students and staff and other employees were statistically analyzed to prove that customer voice and involvement is really important and major factor for developing green eco-friendly mobile phones.

Introduction

Mobile phone development companies have been forced by the environment legislators to pertain environmental impact of production during their initial phase of mobile phone design [1]. The previous research suggests that process of mobile phone development clearly lacks in developing different approaches and paradigms for enamoring consumer voice in the planning stage of product design and development [2]. Mobile phone manufacturing companies fundamentally consider their own designs and hunch very less to consumer voice, which ponders their product less competitive, corresponds to non-environmental product [3]. The research shows that lack of environmental concern and apprehension in the planning stage of green mobile phone development reflects downward market demand, which is deficient in fulfilling the consumer requirements. Bereketli argued that, environmental product needs to meet the environmental legislation prerequisite in conjunction with the consideration of market demands [4].

The results collected from various studies related to mobile phone development undoubtedly mention that "consumer benefits and regulations play significant role for developing product innovation" [5]. Consumer perspective of eco-environmental value could aid mobile phone development companies to determine standards that influence ones attitude and behavior towards well-being of natural environment. The main purpose of this study is to fill the gap between obscure consumer perspective in developing environmental green mobile phone and architect's approach for springing up green mobile phone eco-design in the planning stage of product development. To influence the characteristics and features of environmental green mobile phone development advance thinking approach is necessary to effectively face on consumer voice, which successively helps engineers and designers to grow up with market driven eco-design idea to reflect consumer environmental value for green mobile phones.

Significance of Voice of Customer in Product Development Process

Voice of consumer (VOC) for environmental green mobile phone is considered as an important factor in the planning and designing stage of product development. The fundamental reason for this is, when product is setup in the market and sold, it reflects the incurring redesigning cost and time of a particular item [4]. Although the technical aspects of product are less reflected in the planning stage of product [6]. In addition, investing the description of environmental green mobile phone in conjunctions with the standards reflects how consumer voice is crucial in contributing towards the development of green mobile phones. The congregated information from customers helps designers to identify what makes environmental green mobile phone innovative and competitive in the market. Standards and description of identifying consumer voice fundamentally describes environmental characteristic of the green mobile phone, which sort out proposed eco-design thoughts of green mobile phone growth. Therefore, the approaches in the process of product development might efficaciously indicate consumer voice [7].

Green Definition

Authors have debated various definitions to reflect a product "eco-friendly" but still lacks in authentic and clear definitions [8]. The main reason indicated by many authors and highlighted in literature clearly points out the deficiency and lack of a commonly accepted definition on devising characteristics and features of green mobile phone development. Dangelcio and Pontrandolfo [9] proposed a definition, which categorizes green mobile phone development into three major categories as:

- Pollution
- Energy
- Material

For developing green environment friendly product its utmost necessary to purchase and use parts and items which is less pollutant than conventional products and possess negligible negative impact on environment [10]. In addition to that, green product must also focus on energy saving methods and techniques where energy should be accustomed from renewable energy resources. The green mobile phone product material must also be reusable and easily recyclable, dissembled, and remanufactured so that overall product should be eco-friendly [9]. Nowadays green IT is being discussed and used everywhere in all industries and businesses as key indicator for developing green environment friendly products and also to create awareness among masses to use eco-friendly products either at homes or in all type of industries and businesses. It helps to increase the utilization of IT resources efficiently and with more power and energy savings. It possesses dominant role in today's global energy crisis and environmental changes effecting global warming issues. It believes on the concept of triple bottom line that includes people, planet and profit [11]. Green IT defines the maximum usage of ICT for practicing environmental sustainability for operations, product, services and resources in any industry [12]. It also describes the study and exercise of designing, manufacturing, and utilizing computer communication system, hardware's, and software's with negligible or minimal impact on environment. The green IT concept assists and helps mobile phone developers to design and develop the product based on customer concerns and to explore the rich information sought from voice of customer to aid further value to the concept of environmental green mobile phone development. Furthermore, it allows designers and makers to recognize the intended eco-design product and come up with the innovative ideas in the initial stage of product development [1].

Green Mobile Phone Criteria

Lin argued that in order to flourish and prosper businesses it's significant to achieve business competitiveness. It's considered as the most important element of business operation and defines market demand. Discriminating the criteria that, customer voice should be perceived as significant during green mobile phone planning and development stage. This helps to determine consumer preference and aid to determine market demand for developing eco-friendly mobile phones [13]. Determining the consumer preference for green mobile phone eco-design boosts up the income level of an organization and continuously decreases the negative impact to the environment [7]. Consumer environmental criteria finds out different environmental expressions of the green mobile phone, which contains eco-friendly product quality, functionality, safeness, energy efficiency, resource efficiency and aesthetics. Information associated with alignment of the customer for various environmental product characteristics is essential for generating and designing environment friendly product [4]. In the planning stage of product development, received data from customer's voice could aid architects, and designers to depict and clarify proposed design idea for green mobile phone development and facilitate to arrange them into technical dimensions [14]. Consumer priorities to purchase eco-friendly product at higher prices has increased since customer perceived throughout environmental effect elicited [15]. This development is fundamentally practiced by increasing consumer awareness of environmental issues such as global warming, product sustainability and climate changes that promote consumer awareness and consent of higher price of environmental product and services [16]. The same concern about customer orientation to pay higher price was argued by various researchers [4,17,18]. Additionally the consumer preference for environment friendly product is influenced by, consumer's environmental concern, the higher the consumer concern; the greater would be priority to pay for green product [19].

Research Design and Methodology

Recognizing consumer's considerations in providing green mobile phone aids organizations to understand consumer priorities for developing eco-friendly products [19]. Based on the random probability sampling technique, aggregately 235 questionnaire were designed and distributed to determine consumer definition for green cellular phone and explore their preferences for several environmental criteria as follows; Quality, Resource Efficiency, Aesthetic appearance, Brand, Innovative features, Safeness, media influence, price and personal recommendations. Pilot study have been attempted to determine appropriateness and feasibility of research instruments. In order to get assist in research, to find out possible written errors, to check respondents understanding of the questions and over all time consumed to fill up questionnaire; sample version of questionnaire has been disseminated to 30 students where half were postgraduate research candidates. Based on the feedback provided by respondents, minor statements have been modified accordingly.

In this study factor analysis were used to extract significant criteria from multiple variables. In addition, with respect of each criterion it was used to explain statistically a group of related variables [20]. Furthermore principle component analysis along with Varimax rotation method was practiced to extract variables with higher loadings; this assisted to reduce significant numbers of selected criteria. Moreover, Bartlett's and KMO tests were practiced to influence sampling adequacy and appropriateness of factor analysis. Additionally, chi-square test was performed to determine whether there was any big difference between variables. Finally, to make sure the reliability of items in the questionnaires Cronbach's alpha test have been performed [8].

Results and Discussion

In this exploratory research, results brought out consumer perspectives for green definition of mobile phones. The questionnaire was designed on following criteria to get customer responses to elucidate eco-friendly product.

- Cell phone that consumes minimal amount of energy and resources
- Cell phone which produces least pollution
- Cell phone that uses renewable source of energy
- Cell phone which is free from toxic radiation and toxic materials

- Cell phone designed from reusable and recycle materials

Collected data revealed that sustainability of green cellular phone should take into circumstances energy saving features, reusability, recyclability and consideration on minimal environmental pollution. Besides that "SPSS" statistical package for social science and as an initial step, the suitability of the data for factor is investigated. The KMO measure of sampling adequacy recorded 0.56, which is greater than the minimal satisfactory level value of 0.5, reflecting sample size is appropriate to analyze 9 variables. Furthermore, Chi square value of Bartlett's Test of Sphericity ($x^2(1) = 21.434$), indicates suitability of the inter-correlation matrix of 9 variables for factor analysis is significant. Finally, to evaluate reliability of questionnaire Cronbach's Alpha were practiced, where it was recorded with the value of 0.76, which confirms questionnaire is reliable; generally lowest acceptable required value of Cronbach's Alpha for evaluating reliability of questionnaire is 0.70.

Principal component analysis have been practiced which is totally grounded on assumption of components are extracted from variables and explain 100% of the variation in the data. The rotation aim's to clarify and simplify the data construct; hence, to understand interpretation clearly we have selected Varimax rotation method which is an orthogonal rotation method that minimize variable which reflects higher loading on factors; therefore, it simplifies the interpretation of the factors. Subsequently, Kaiser's criterion was practiced: eigen values>0.1 and Cattel's scree test was conducted in order to elicit the essential numbers of variables. Number of factor's chosen criteria for this research is that selection is constructed when eigenvalue is leastwise one ($\lambda \geq 1$). Selection for number of factors remained continue to explicate until 80% of the data variance. Hence by reflecting benchmark of eigenvalues of 1 we should evoke 5 factors. However, by considering priori criterion and Cattell's scree test we can admit the leveling off factors as well; therefore we extracted 6 factors as follows (Table 1).

Components	Initial Eigenvalues			Extraction Sums of Squared Loading			Rotation Sums of squared Loading		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	1.752	18.467	18.467	1.752	18.467	18.467	1.4	15.055	15.055
2	1.278	13.603	32.07	1.278	13.603	32.07	1.245	13.844	28.899
3	1.251	13.889	45.959	1.251	13.889	45.959	1.227	13.767	42.666
4	1.164	13.32	59.279	1.164	13.32	59.279	1.134	13.095	55.761
5	0.902	9.587	68.866	0.902	9.587	68.866	1.126	12.338	68.099
6	0.806	7.984	76.85	0.806	7.984	76.85	1.022	11.45	79.549
7	0.678	8.333	85.183						
8	0.604	7.609	92.792						
9	0.566	7.208	100						
Extraction Method: Principle Components Analysis									

Table 1: Total variance explained.

Factor analysis consequences reflect that Safeness, quality, energy efficiency, Resource efficiency, Price and Innovative features are performing significant function in consumer priority choice. The collected results disclosed that environmental features playing a significant character compare to previous era. This explains by the fact that consumer priority and awareness for eco environmental concern are increasing and becomes a key element forcing companies to output product and services by considering environmental concern. Consumer issue regarding environmental concern fundamentally related to Safeness. Thus, total variance of Safeness variable recorded 15.05%. Finding reflects safeness becomes prominent element of buying decision [21] afterwards environmental concern vary buyers buying behavior for consuming eco-friendly product and services [22].

The second highlighted variable of total variance is a quality recorded 13.86%. Conducted survey reflects that quality is a prominent criterion-mobilizing consumer to make eco-friendly decision-making. Lin et al. [23] depicted consumer are not interested to buy low-priced items reasoning poor quality, in addition high quality of the green product is the second priority that consumer concern in selecting green mobile phone [22,24]. In fact today green product in the market reflects low quality products, which are highly the outcomes of poor eco-design [6]. Thus, customer don't believe on false information of the companies regarding greenness of the product and services, they prioritize to buy environmental sound product and services that fulfill their requirements.

Respondent's valuable choice among variables indicated Energy efficiency as a worthy variable recorded 13.75% of the total variability of items. Selected choice of respondents related to the energy efficiency variable can be pointed out that mostly consumer nowadays are replacing their cellular phone because of diminished battery life, lack of energy saving phenomena as well as less efficient charger in mobile phone devices, left continuous replacement of cellular phone with the latest one [2]. As mentioned above consumer prefers energy conservation on their mobile phone, which could provide longer usage of battery life as well as improve effectiveness and energy conservation of their cell phone [7].

Dominantly, organization practicing similar goals for energy conservation, minimizing resource consumption for their product and services offer. Results collected from survey shows resource efficiency recorded approximately 13.1% of the total variance. It has been considered as critical criterion for developing green cellular phone in the perspective of utilization of recyclable and reusable material. It also simpatico with literature, where most of the respondents have favourable views towards recycled or re-useable product this assures respondents awareness and knowledge for eco-friendly products. The finding also coherent with Ramayah and Rahbar [25] it was pointed out positive behavior of Malaysian consumers towards recycled product, which mainly characterized by consumer awareness concern regarding environmental issues. Practice of recycle and reusable material could favorably impact on corporate economy and significantly help organization to achieve cellular phone sustainability.

Total variance of the variable innovative features recorded 12.30% which reflects consumer prioritize cellular phone environmentally sounds attributes as well as emphasis on its programming and innovative features. Thus, in decision making innovative features plays significant role and lack of its results replacement of obsolesce devices to the latest one [2]. To fulfill the requirement of consumers IT companies invest in R&D and consistently updating innovative features in cellular phone that could functions multiple attributions [21]. Besides that, updated functionality is ability to interchange various portable accessories like video camera, MP3, with a single device; additionally advance or updated technology require high energy consumption, excess resource consumption, and results pollution. Therefore, innovative or green solution is required for enhancing power saving features, product upgradability, which could be consequences for longer cellular phone usage and minimize its disposal.

Obtained results of factor analysis for green cellular phone price recorded 11.40% of the total variance. Results reflects that many people are knowledgeable and fully concerned about environment, prefer to consume highly of eco-friendly product. This might be considered as consumer are environmentally aware and concern about environment protection, this could be the outcome of new economic trend and environmental awareness. By considering compatible research finding; "Respondents with high environmental concern have more confidence in product price" [18]. However, higher price of environmental product compare to non-environmental product lack access in the market for majority of the customers. Thus, to enhance the buying market of Green Cellular phone for customers companies need to promote and create good value for money and fulfill consumer requirements and needs for green cellular phone. In results consumer preference to buy green cellular phone (product) at premium price might be trend up with increasing rate.

Conclusion

The aim of this research is to determine green cellular phone development in the user's perspective. For cellular phone, consumer's considered a criterion was practice based on the consumer's selected choice for those criteria that considered significant by consumer in green cellular phone [26]. Discussion of the results yields key perceptivity about understanding different consideration of what green mobile is and which criterion is crucial for sustainability of the green cellular phone. The age exists in the presentation of the approach in identifying consumer voice during initial stage of product development that further require to designer to deepen and enrich the information of concerned consumers [27]. The results benefit designers in understanding consumer requirements that aid designers to interpret consumer's needs effectively. Furthermore, research is suggested to align consumer needs with corporate strategy, which help companies to identify strategic approach for product realization in the marketplace.

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