Sustainable Product Innovation for Customer Experience: A Conceptual Framework

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***Abstract*—Designing a sustainable product for sustained customer experience over the product life cycle is crucial consideration. As customers increasingly become aware of the need to protect the environment, economy and energy (3Es), product innovation should have a holistic perspective over the entire product life cycle. In this paper, we offer a conceptual framework for sustainable product innovation for customer experience (SPICE). First, we explore recent challenges in sustainable product innovation. Second, we develop a framework for sustainable product innovation for holistic customer experience. Third, we derive tools and techniques for enhanced sustainable product innovation. The framework is useful for decision makers concerned with sustainable product innovation for customer experience in a competitive market place.**

Keywords-sustainability; sustainable innovation; product innovation; customer experience

I. INTRODUCTION

Designing a sustainable product is crucial for sustained customer experience and business viability in the modern world. Customers and enterprises are increasingly more conscious of the environment, the economy, and the energy resources (3Es) [1]. Apart from the traditional criteria such as cost and features, customers continue to consider the environmental impact of products they use. In this vein, enterprises have no option except to put in place mechanisms for life-cycle environmental assessment when purchasing raw materials [1] [2].

There is a continually growing public sentiment that, throughout the product life cycle, products should have the lowest possible harm on the 3Es [1]. A typical product life cycle consists of four stages, namely (i) pre-manufacturing, (ii) manufacturing, (iii) use, and finally, (iv) postuse [3]. As such, the customer expects an enhanced customer experience while using the product throughout its life cycle [2] In this view, a holistic customer experience, focusing on entirety of how the customer perceives the product and its characteristics, throughout the product life cycle, is crucial for sustainable product (and process) innovation.

In light of the ever-increasing dynamic demand for enhanced holistic customer experience, there is need for new enhanced perspectives on sustainable production innovation. However, for sustainable product innovation endeavors, it is important to understand the voice of the customer over the life cycle of the product. As such, enterprises should make a spirited effort to understand the customer voice in order to provide the relevant innovation. However,

considering that the customer voice comes in various forms, accurate capturing of the voice is a challenge. Questions arising from this discussion include the following:

(1) How may enterprises best understand customer expectations?

(2) Can a holistic perspective towards customer experience help in product innovation?

(3) What are the possible tools to capture customer needs over the product life cycle?

The purpose of this study is to suggest a conceptual guide to sustainable product innovation with a focus on sustained customer experience. The objectives are as follows:

(1) To explore the current trends and challenges in product innovation;

(2) To propose a new framework for enhanced customer experience; and,

(3) To provide tools and techniques for sustainable product innovation.

The rest of the paper is structured thus: The next section presents the trends and challenges in product innovation. Section III proposes a new holistic perspective on product innovation. Techniques and tools for the perspective are outline in Section IV. Some application areas are presented in Section V. Section VI concludes the paper.

II. PRODUCT INNOVATION: TRENDS AND CHALLENGES

Product innovation has attracted considerable attention in the research and development community. There major challenging goals of sustainable innovation and design can be observed from the literature, that is: (i) to minimize the use of non-renewable resources, (ii) to ensure sustainable design that reflects customer value and aesthetics, and (iii) to ensure sustainable design with cultural and social, acceptable by the society.

Recent trends and developments have shown that the philosophy of sustainable design is applicable throughout the life cycle of products, including product design, product manufacture, marketing, distribution, use, recycle, reuse, remanufacture, and disposal [3] [4] [5] [8] [9]. We consider that, for a thriving innovation, customer needs have to be captured at a number of points along the product life cycle. The challenge is that customer needs which come in various forms such as, (i) spoken customer need; (ii) observable customer needs, possibly through consumer behavior, (iii) unspoken customer needs, and, (iv) unknown future customer need. The worst challenge is to identify the tools for capturing the unknown and unspoken customer needs.

In view of the above, we summarize product innovation challenges as follows:

- It is difficult to capture the relevant product information over the life cycle of a product;
- Accurate capture of the voice of the customer is not easy as some customer needs may not be observable or expressible;
- Deriving the relevant design innovation features from customer voice is non-trivial; and,
- It is difficult to visualize the long term gains of enhanced customer experience.

It is needful to view product innovation in the context of sustainability and enhanced customer experience. The next section presents this perspective.

III. THE SPICE PERSPECTIVE

To “spice up” customer experience, four dimensions should be considered from a holistic perspective. These dimensions are as follows;

(1) customer value: this refers to the value the customer and other stakeholders receive;

(2) environment: this points to the need for eco-friendly products over the product life cycle;

(3) energy: this refers to the focus on efficient energy resource usage; and,

(4) economy: this pertains to the need for sustaining economic growth.

Fig. 1 shows our view of the holistic perspective of customer experience, deriving from the four dimensions enumerated above.

In the real world, customer experience pertains to the entirety of customer interactions with a company and its products throughout the product life cycle and its impact on the environment, the economy, and energy usage. In this respect, understanding the customer experience is an integral part of design innovation and improvement. The overall customer experience reflects how the customer feels about the company and its offerings. However, obtaining the full picture of the customer experience may be challenging, yet important for sustainable innovation. We present a framework for sustainable product innovation.

Fig. 1 The SPICE perspective

IV. SPICE FRAMEWORK

The SPICE framework is a continuous innovation loop that consists of five steps identified by the acronym IDEAS, as outline below:

I - Investigate the needs and perspectives of stakeholders;

D - Define innovation requirements;

E - Evaluate options;

A - Apply the innovation; and,

S - Sustain and manage innovation

Fig. 2 presents the IDEAS framework for sustainable product innovation.

Fig. 2 The SPICE framework (IDEAS)

A. Investigate Needs

Mechanisms should be put in place to capture the market behavior or consumer behavior on a regular basis. Customer needs, perceptions, and feedback should be gathered from the view point of customer value, economy, energy and the environment. To determine the customer experience, surveys, feedback forms and other data gathering techniques can be used. Thus, the needs of the customer should be regularly investigated throughout the product life cycle, so that the necessary product requirements are accurately derived.

B. Define Requirements

With a regular investigation of customer needs, product requirements are continuously updated and developed into product design features that meet the economic, environmental, and energy usage obligations, while satisfying customer expectations. On a regular basis, design features and the ensuing process technologies are reviewed and improved from a holistic perspective.

C. Evaluate Options

Alternative solutions to design innovations are normally developed. These options have to be evaluated based on multiple criteria decision approaches that consider the 3Es and the customer value, howbeit, over the entire life cycle of the product. Economic, environmental, and energy considerations should be done [9] [10] [11].

D. Apply Innovation

The selected product innovation strategies are implemented, from a holistic view point, considering the product life cycle and its impact of 3Es [8] [9]. This also calls for the consideration of the processes by which the product is made.

E. Sustain

The recommended innovation strategies are supposed to be sustainable through sustainable design throughout the life cycle of products. Innovation management techniques should be put in place to maintain the innovation strategies in place, up until the need investigation activities necessitate design innovation changes.

V. SPICE TECHNIQUES AND TOOLS

We outline some selected tools and techniques that can be applied within the SPICE perspective.

A. Predictive Consumer Intelligence

Predictive consumer intelligence is a modern tool for investigating and understanding the voice of customers. This helps the designer to anticipate the behavior of individual customers. This will enable the designer to take the most appropriate innovation action, so as to provide sustainable recommendations for customer retention.

B. Culture-Based Design

Culture-based design is a qualitative method for researching customer needs based on studying the culture or anthropology of the user. The method is very useful for extracting unknown customer needs. It involves spending time observing customers and their environment to better understand their lifestyle or culture to understand their needs. It provides a deeper understanding of the customer leading to fundamental insights for better product design features and product positioning.

C. Shadowing

Shadowing is a structured observation of a customer's experience of a product throughout its life cycle. This entails watching an individual over a course of time or many people doing something to find patterns. By this tool, the designer can learn what customers would never speak out. Therefore, the tool can be very inspirational for product innovations.

D. Design for Reduced Resouce Usage

This refers to minimizing the usage of resources, e.g., energy resources. Therefore, green design concepts, incorporating the desires of the stakeholders, are essential. These concepts should also be extended to the process technologies used to produce the product. These concepts apply especially during the first three stages of the proposed SPICE framework [3].

E. Design for Reuse

Design for reuse of the product, or its components, is a sustainability initiative much appreciated by stakeholders. This helps to reduce the amount of raw virgin materials demanded, and the amount of material wasted into the environment. These design concepts should apply throughout the product life cycle, from design conception to reuse or remanufacture [4] [5].

F. Design for Recyclability

Design for recyclability means incorporating features into a product so that the components of the product can be transformed into useful materials, without which the components could be regarded as waste [5]. These innovation concepts can also be applied throughout the life cycle of the product, across the supply chain [6] [7].

G. Desing for Recovery

Design for product for recovery seeks to ensure that the product or its components can easily be collected at the end of its use for postuse activities. Innovation concepts can be gathered from stakeholders during the investigation stage of the SPICE framework. For instance, design for ease of disassembly is crucial at the end of life cycle of a product [3] [8].

H. Redesign

To make the product (and the process) more sustainable, redesign is essential, following the input from the concepts gathered from stakeholders throughout the SPICE stages, especially in the first stage (Investigate Needs) s the act of redesigning products to simplify [8] [9].

I. Design for Re-manufacturability

Design for re-manufacturability ensures that reprocessing of already used products or components is highly possible [6]. In other words, the product components can be restored to like-new condition, with similar characteristics and function to that of the original product [9].

VI. CONCLUSIONS AND FURTHER RESEARCH

Innovative product design for a sustainable product over the product life cycle is essential, howbeit, it has several challenges. Customers are increasingly becoming aware of the need to protect the environment, economy and energy (3Es). The paper presented a conceptual framework for sustainable product innovation, with the aim of providing a customer experience over the product life cycle. Recent challenges in sustainable product innovation were presented, and the SPICE framework proposed. Some tools and techniques for enhanced sustainable product innovation were presented. It is hoped that the suggested framework is useful for decision makers concerned with sustainable product innovation in the competitive market place.

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BIOGRAPHY

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