Available online at www.sciencedirect.com
ScienceDirect
Procedia CIRP 16 (2014) 128 – 133
www.elsevier.com/locate/procedia

Product Services Systems and Value Creation. Proceedings of the 6th CIRP Conference on Industrial Product-Service Systems

"Design for Mobility – A Customer Value Creation Approach"

Tarek AlGeddawy[a,*], Mohamed Abbas[b], Hoda ElMaraghy[b]

[a]*Mechanical and Industrial Engineering, University of Minnesota Duluth, Duluth, MN, 55812,USA*
[b]*Intillegent Manufacturing Systems Center, University of Windsor, Windsor, ON, N9B 1K3*

* Corresponding author. Tel.: +1-218-726-6810; fax: +1-218-726-8596. *E-mail address:geddawy@d.umn.edu*

Abstract

It is a global trend nowadays for manufacturing and service firms to create and increase customer value either during initial design of a product/service or by modifying their existing products/service. When a product already exists, customer value can be increased by adding new qualities/features to a traditional product that would add much needed services while keeping price competitive. Qualities, such as foldability and mobility when product is not in use, are examples of creating and improving customer value. This paper presents a design model that helps designers incorporate foldability, mobility and personalization in a regular product design.

"Keywords: Design for Mobility; Value Creation; Foldability; Ease of Folding; Cladistics"

1. Motivation

Value creation in products is created in many ways. ElMaraghy H. and ElMaraghy W. [1] showed that creating product variants by introducing new qualities and services can enhance customer satisfaction. They also introduced the different strategies used in order to manage variety, starting from product design up to the manufacturing phase.

As an example, the Telecommunication industry has evolved over the past two decades with the introduction of cell phones. [2]. Fig. 1 illustrates how the phone as a product survived by introducing a series of added upgrades, qualities and services. Services like cellular networks and data services accompanied the introduction of qualities like handheld mobility, touch screens and smartphone capabilities in telephones. Landlines used to be the common method of communication; now cell phone users exceed the number of landline users by eight or nine to one [3].

One of the main reasons for this tremendous increase in the number of users is that customers perceived mobility as a main feature of the value proposition of mobile commerce [2]. Furthermore, the innovation of the touch screen as a new quality preserved the phone success trend and increased its value to customers as a micro-computer, calendar, media player, gaming station, etc. [4]. The ultimate advantage of the introduction of handheld mobility to phones was the personalization of phones, while making them indispensable for millions of customers. Decreasing the dimensions of products is a main enabler for better product mobility. In the case of the telephone, the dimensions of the product itself became smaller due to technology advancement in electronics. However, folding the product, when not in use, can also lead to better mobility, introducing personalization as a new service to ordinary large volume immobile products (Fig. 2).In this case, value creation is increased through better qualities (foldability and mobility), better services (personalization), and better price through reduction of transportation, handling as well as storage costs [5][6]. This paper presents a design model that helps designers incorporate foldability, mobility and personalization in common designs.

doi:10.1016/j.procir.2014.01.016

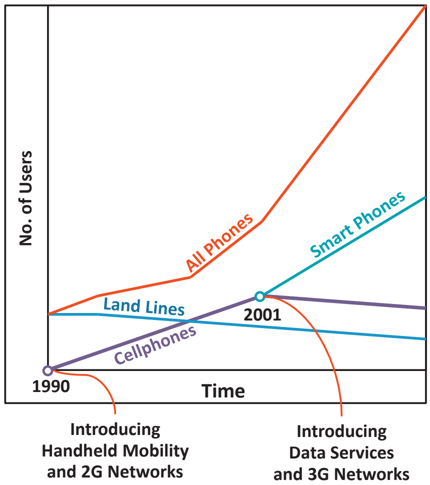

Fig. 1: The Qualities and Services that Sustained the Phones industry

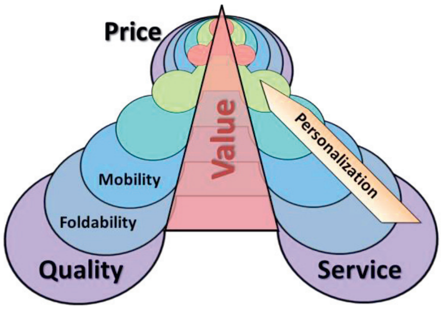

Fig. 2: Introducing Mobility to Create Customer Value

2. Literature Survey

2.1. The Need for Foldability and Mobility

Mobility can be created in various ways. For example, imbedding wheels or rollers within a product is highly evident in many applications. Providing compact products can also enhance portability, such as replacing a bulky desktop with a laptop. Another scheme to enhance mobility within a product is modular design that can be easily assembled and disassembled. Varghese et al. [7] showed that their proposed modular dining table scored higher than other alternatives based on the constraint space conditions. Jackson et al. [8] discussed the concept of factory-in-a-box that consists of standardized production modules which can be easily installed and transported to the desired location. This concept is similar to the Reconfigurable Manufacturing Systems introduced by Koren et al. [9]. Khalilbeigi et al. [10] presented a double sided projected displays that can be folded with the aid of predefined hinges, assisting users in manipulating the size and shape of the display using fold gestures. De Temmerman et al. [11] proposed a concept for mobile shelter which is based on the geometry and kinematic behavior of the foldable plate structure. It introduced a new type of joint for connecting bars, which allowed the system to be deployed as desired, while maintaining the degrees of freedom of a plate system. Konings and Thijs [5] discussed new perspectives in developing foldable containers in order to reduce the transportation, handling and storage costs of empty containers. Also, Shintani et al. [6] discussed the potential to use foldable containers in order to reduce management costs of the container fleet.

2.2. Simple 2D/3D folding

Mollerup [12] suggested 12 concepts for producing collapsible products. The concepts and examples are shown in Figure 3. Some of the concepts are in fact variants of the same idea, such as: 1) working with soft materials for folding, creasing, bellows and rolling, 2) working with modular design for bundling, assembling and nesting, 3) working with an articulated mechanism using hinging, fanning and concertina, while sliding and inflating are genuine ideas. Group (3) working with an articulated mechanism is of a special interest as it serves a wide range of products which require structural rigidity.

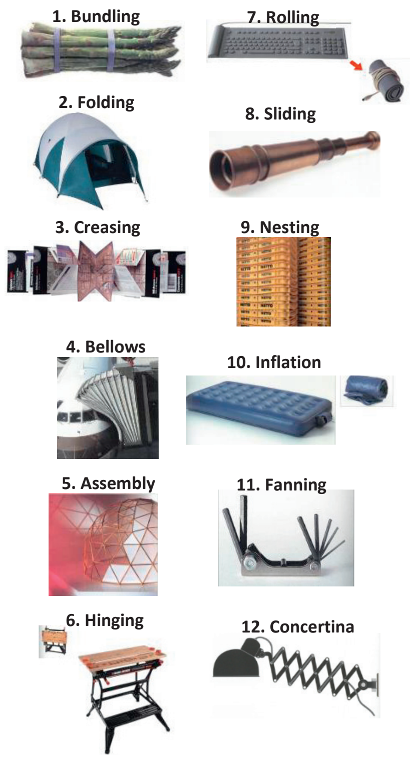

Figure 3: Foldability Concepts in Products (Adopted from [12])

2.3. Complex 3D folding (Origami)

When the needed folding mechanisms becomes complex with multidimensional folding potential, Origami, which represents a mixture of art and science, can be used to develop such mechanisms. Dureisseix [13] illustrated some aspects of origami related to engineering structures and pointed out the recent developments in assembly of repetitive elementary structures such as planar geometrics with tessellations and foldable/deployable structures. Tachi [14] introduced the first practical method to solve the inverse problem of obtaining the