Available online at www.sciencedirect.com

ScienceDirect

Procedia CIRP 48 (2016) 96 – 101

www.elsevier.com/locate/procedia

23rd CIRP Conference on Life Cycle Engineering

Why the upgradability is a present-day opportunity for designing sustainable systems?

Pialot O.[a,*], Millet D.[b]

[a]QUARTZ, Supmeca Toulon, 83000 Toulon, France
[b]COSMER, SeaTech-UTLN, 83000 Toulon, France

* Corresponding author. Tel.: +033-483-166-612; *E-mail address:* Olivier.pialot@supmeca.fr

Abstract

The accelerating rhythm of products renewal causes accelerated exploitation of materials and energy. To remedy this, this paper considers upgradability from the point of view of functionality: the goal is to design an upgrade scenario taking into account a multi-criteria assessment: environmental impact-cost-attractiveness for the consumers. An experiment based on the UpMoS tool and data from the past of electronic device simulates different design hypotheses. With a non-systematic integration of known developments and upgrading design tips like recycling, improving "by plug" and oversizing to delay replacing, the results show that upgradability is a present-day opportunity to develop sustainable systems. Environmental gains are in the order of 5%. Others promising design levers to obtain much more positive results are presented in discussion.

© 2016 The Authors. Published by Elsevier B.V This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).
Peer-review under responsibility of the scientific committee of the 23rd CIRP Conference on Life Cycle Engineering

Keywords: upgradability; upgrade scenario; sustainable systems; PSS; attractiveness

1. Context

Our society is increasingly concerned by environmental dimension. The accelerating rhythm of products renewal causes accelerated exploitation of materials and energy. Today, with an annual consumption of raw materials of approximately 60 billion tons [1], the world population consumes about 50% more natural resources than 30 years ago [2]. In OECD countries, the domestic waste stream has increased by 40% in volume between 1980 and 1997 [3]. These current patterns of consumption and mass production are no longer compatible with sustainable development. It is necessary to imagine new paradigms of production and consumption, such as the "post mass production" [4].

To remedy this, we claim to consider another mode of production / consumption based on upgrade, functional enrichment brought to the product overtime: the Dynamics of Continuous Upgrades Integrated in Sustainable Products, that is to say, a product with a lifetime projected on the medium/long-term through optimal modularity. With these products, technical, visual or functional improvements could be quite easily integrated to adapt the system to changes; in particular the consumer needs changes. Upgradability is promising to add value for customer and producer, and represents new "green" opportunities. With upgradability, it would be possible [5] [6] [7]:

- To have, at any time, the most efficient technologies in term of energy consumption,
- To extend the lifetime of product taking into account not only reliability of parts but also the obsolescence,
- To build eco-learning strategy for user modifying product in function of its behaviour,
- To optimize the end-of-life treatment of material because replaced modules induce more frequent and better controlled use of remanufacturing and/or recycling channels
- to increase the generation of services "linked to the product" which represent an opportunity for industrial

2212-8271 © 2016 The Authors. Published by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).
Peer-review under responsibility of the scientific committee of the 23rd CIRP Conference on Life Cycle Engineering
doi:10.1016/j.procir.2016.03.246

companies who want to switch to offers with more services: services based on sensors upgrades in the spirit of "connected objects", services related to a better consumer understanding due to a closer relationship company-consumer, service related to the upgrades integration itself. PSS is recognized as a way to have a lower environmental impact than traditional business models [8].

In this paper, we focus on the opportunity given by upgradability to extend the lifetime of product. Considering the progressive integration of functional enrichment brought to the product, that we name "Upgrade", the product replacement is delayed. Materials consumed by over-frequent purchases of new conventional product is avoided. Tomorrow, if you consider a price of materials two times more expensive, it's easy to understand the interest to switch towards upgradable systems. Today, with the constraints of the current markets, this interest of upgradable systems is not proved. We think it is already a "green" opportunity because today the value of a product is not optimized overtime. In fact, in our previous works, we show that more of 50% of products are disposed whereas they still work [5] on electronic devices like vacuum cleaners and expresso machines. In this paper, we want to confirm the potential for upgrading.

After presenting upgradability as opportunity for eco-design (section 1), we describe hypotheses to design upgradable systems through upgrade scenario, eco-design method for upgradecycling and specific tool (section 2). An experiment of upgradable system based on the tool and real past evolutions of vacuum cleaner is proposed in section 3. The results which show the potential of product upgradability are presented in section 4, and are discussed in section 5.

2. Issues

2.1. Towards the design of upgrade scenario

In the literature, the lifetime of product depends on the management of the two key reasons why users discard products [9]: (a) Physical Life Time (PLT) [lifetime related to reliability] "the time until a product breaks down" and (b) Value LifeTime (VLT) [lifetime related to the obsolescence] "*the time until a product is disposed when its performance, functionality or appearance cannot satisfy customer's needs any more, although the product itself might work well.*" [9]. The concept of "*Utility Value*" which reflects the "whole time" when the product has value [10] is similar: it depends both on "*physical causes*" (related to reliability and wear) and "*value causes*" (related to the obsolescence). Faced with reliability problem or wear (Physical Lifetime), there is maintenance. Faced with obsolescence phenomenon (Value Lifetime), there are upgrades. The integration of functional enrichments brought to the product overtime increase the attractiveness of a system for the customer and extend the value lifetime.

From an operational point of view, a modular structure is considered to facilitate the integration of these upgrades over time. This integration of upgrades can be made by a distributor/retailer, by a technician at home, by user (in "plug-and-play" way), with remanufacturing operations, etc. Then the reliability problems could be managed with the upgraded modules (when upgraded modules and no reliable modules are the same) or with a specific maintenance agreement.

In the literature, the upgradability is discussed by several authors, especially on technical / technological aspects. In fact, they are interested in the technological roadmap and the evolution of modules in order to optimize the modular structure [11] [12] [13]. For this purpose, Umeda distinguishes the functional upgrades and the parametric upgrades: functional upgrading, which adds or removes functions such as adding the two-sided copying function to a photocopier, and parametric upgrading, which changes the performance of a product such as increasing copying speed. [11].

Our positioning is to consider the upgradability from the point of view of functionality, which is evolving over time. This evolving functional definition of the product through replaced modules brings new questions related to that we named Upgrade scenario: "How much cycles?"; "How long?"; "What kind of upgrades?" etc. We seek to precise the characterization of "upgrades scenarios" which are upgrades sequences programmed over time and that enrich the functionality of the system.

Industrial company can't do whatever upgrades whenever. Extending the lifetime of product dilutes the environmental impact of the manufacturing stage over time. However, the integration of new modules / elements during the lifetime of the product increases material consumption. A structuration of upgradability is required.

From workshops with two industrial companies B2B and B2C and environmental points of view, the absence of upgrade cycles was judged to be risky because there is no visibility on the upgrades brought to the product over time. Not having cycles means that consumers would choose the upgrades they wanted, and when to integrate them. Two extreme cases come to mind:

- Clients who always want their product to be the latest model; they know all the latest evolutions and are always doing upgrades. This situation has a very negative knock on effect for the environment.
- Clients who do not do what they say, or procrastinate about integrating the latest product upgrades. Upgradable products thus become just like conventional products increasingly unattractive with no lengthening of their lifetime.

We propose a planning of upgrades with regular cycles because we want to satisfy the trio "attractiveness for customer, environmental gains and economic benefits" and avoid risks of "too many" upgrades or "too few". Programmed cycles of upgrades ensure that the product maintains its attractiveness overtime and has an extended lifetime. Regular Cycles make the upgradability easy to understand and follow for customer, and easy to manage for company, which can anticipate the flows of used modules to be processed for example. To be sure of the environmental optimization, we imagine a green scorecard which engages both the manufacturer and user towards a common green objective.

Download English Version:

https://daneshyari.com/en/article/1698653

Download Persian Version:

https://daneshyari.com/article/1698653

Daneshyari.com