

11 Upgrade planning for upgradeable product design

Kentaro Watanabe^a, Yoshiki Shimomura^a, Akira Matsuda^a, Shinsuke Kondoh^b and Yasushi Umeda^b

^a *Research into Artifacts, Center for Engineering, the University of Tokyo*

^b *Department of Mechanical Engineering, Tokio Metropolitan University*

Abstract

The current mass production paradigm contributes significantly to environmental degradation. To solve these environmental problems, concepts involving the reuse and remanufacture of products and materials are being proposed. The design of upgradeable products, which could be used for longer than conventional products and encourage people to reuse artefacts, is one of the most promising approaches using these methodologies. In addition, they might provide new business opportunities in the later stages of their product life cycle. Achieving upgradeable design requires a proper plan, which must include information on the upgradeable design, including when a product should be upgraded, with regard to which function, and to what extent. The upgrade plan should also include a solution lineup for upgradeable design that satisfies these conditions. To devise such an upgrade plan, designers need to predict technological trends and user demands. This paper proposes a methodology for upgrade planning based on the prediction of user demand, and on the assumption that technological trends influence user demands. In addition, a methodology is proposed for changing upgrade plans after target products have been distributed, to meet possible fluctuations in technological trends or user demands.

11.1 Introduction

In order to reduce the environmental problems caused by excessive disposal of products in modern society, products with closed-loop life cycles need to be manufactured. Inverse Manufacturing is one of the most promising concepts to achieve such products (Umeda and Tomiyama 2000). Reuse and remanufacturing, the concepts related to Inverse Manufacturing, are effective means to extend the physical life of a product. However, product life means not only physical life but also value life, which is terminated when functions become insufficient. Many manufactured products, such as mobile phones, are abandoned at the end of their value life. This paper presents a method for extending the value life of products by upgrading them (Shimomura et al. 1999). Efficient upgrading of products requires an upgrade plan which includes the specifications of the products in every product generation. To make this upgrade plan realistic and flexible, it is necessary to predict future technological trends and user demands. Technological trends are assumed to generally influence consumer demands, and on the basis of this assumption, an upgrade plan which includes the prediction of technological trends could be effectively adapted to satisfy user demands. The objective of this paper is to propose a general upgrade planning method. In addition, a method is proposed to modify the upgrade plan to adjust to unpredicted events. Most future events in an upgrade plan can be expressed as changes in the product's components. Therefore, a database should be prepared that can manage the required information, such as product categories, performance and cost, for the purposes of managing and maintaining the information about a product's structure and components. This information could be used to devise a plan for the design of upgradeable products that could adjust flexibly to future events.

11.2 Upgrade design methodology

Upgrade design is the design of a product so that its performance can be adjusted to changeable user demands by replacing some of its components. Section 11.2 explains the fundamentals of upgrade design and its influence on the environment.