

28 May 2004

DFE - Product Design and Optimization

The activities in this strategy are typically undertaken during the planning phase of the design process. An in-depth understanding of the product's position in the market with respect to environmental concerns and a thorough knowledge of user needs are required to make this strategy a success.

The strategy aims to:

- Optimize the product's function.
- Extend functional life span, i.e. the time during which a product functions well.

Balancing the technical and aesthetic life-span requirements for a product can reduce the energy and materials dedicated to these requirements.

- Design a product with a shorter life span if newer and energy-conserving alternatives are developed.
- A company will offer a product with a longer life span if it is confident that the product appeals to the customers and the higher cost of the product is offset by the long life and better quality of the product.

For example, new high-performance, sealed-glazing window units offer superior energy efficiency and more comfortable indoor living. Therefore, it becomes a priority for the company to offer a system with a longer life span.

Material and space can be saved when several functions or products are integrated into a single product by taking advantage of common components such as power supplies, keypads, structural chassis and displays.

The Pros and Cons of this strategy are:

Pros

- Opens up new markets.
- Provides customers with attractive product alternatives.

Cons

- Product increases in complexity.
- Adds design challenges with regard to volume/size, ease of assembly and ease of use

Manufacturers like Hewlett Packard are now combining common components like a printer, fax machine, scanner and copier into a single multi-purpose machine.

Analyzing a product's functions may cause designers to discover that some components are not really necessary. For example, secondary functions such as the quality or status claimed by a product can often be achieved in an improved and less polluting manner.

Several important questions must be answered before the design phase, such as:



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- What are the product's primary functions for users?
- What are its secondary functions?
- Are the functions utilitarian or aesthetic in nature?

In this respect, the strategy is similar to value engineering, a branch of industrial engineering that provides a systematic method for studying a product in order to meet its optimum cost.

Enter the data into a matrix for analysis, which is a technique used by value engineers. In the table:

- Primary and secondary functions are listed by priority in columns.
- Individual parts are listed by row.
- Part cost is positioned where function and parts meet in the matrix.

This matrix allows designers and engineers to establish the value of each function and identify the minimal cost required to produce a part in order to satisfy the function.

This strategy is not new, but it is emphasized here because of its importance. Designing a product to perform its task in a reliable, consistent manner ensures that it will have a long life span. Reliability and durability are aspects of a product's design that are interrelated.

To achieve reliability, a complete study of the product's reliability must be performed and ways to improve the fatigue and wear of the product must be sought. Durability refers to the ability of the product to withstand the expected demands in the end-users' environments. Designing for durability implies that both technical and aesthetic aspects of the product be taken into consideration.

Product designers and developers can use special methods such as Failure Mode and Effect Analysis to improve the reliability and durability of the products they produce.

Ensuring that a product will be cleaned, maintained and repaired on time increases its usability and life span.

Maintenance by users and manufacturers can ensure that the product lives its full life without any major repairs. Deciding who will maintain at what stage is a crucial factor. The user may undertake regular maintenance of the working parts and complex problems may be taken to the manufacturer.

Suggestions for strategies for facilitating repair and maintenance:

- Indicate clearly on the product how it should be opened for cleaning or repair (for example, where to apply leverage with a screwdriver to open snap connections).
- Indicate on the product which parts must be cleaned or maintained in a specific way (for example, by color-coded lubricating points).
- Indicate on the product any parts or subassemblies that must be inspected often because of rapid wear.

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- Make the location of wear on the product detectable so that repair or replacement can take place on time.
- Place the parts that wear relatively quickly close to one another and within easy reach so that replacements can be easily fitted.
- Make the most vulnerable components easy to dismantle for repair or replacement.
- If a product has a modular structure, then it becomes easier for maintenance personnel to dissect it. Also, a modular structure makes it possible to reengineer a product from a technical or appealing point of view, enabling the product to satisfy the ever-changing needs of the end-user.

A modular product may undergo several upgrades in components over its life span, reducing the need for purchase of new products. The product must be designed so that it enables:

- Future upgrades at a reasonable cost
- Renewal of technically or aesthetically outdated elements, e.g. making furniture with replaceable covers that can be removed and cleaned.
- Facilitation of repair and maintenance by grouping high-wear components together into sub-assemblies.

The challenge for many companies and designers is to create products that users will find attractive to purchase, use and maintain, while keeping down the cost of design, production, maintenance and recovery.

The objective of this strategy is to avoid creating a design that will cause the user to replace the product as soon as it becomes unfashionable. Most products need maintenance and repair to remain attractive and functional. Users are only willing to spend time on such activities if they care about a product. The user must form an affinity to the product, which can be done by:

- Creating a design that more than meets the stated and unstated requirements of the user for a long time.
- Designing surface finishes that improve gracefully with age.
- Ensuring that maintenance and repair will be simple and less time consuming.
- Ensuring that maintenance can be conducted safely with minimal tools.