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Design for Disassembly Approaches on Product Development

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Abstract— In today's challenging global market & changing fashion trends and rapidly advancing product development technology has led to the shortening of life-spans for many of today's product and organization must innovate to survive business innovation must occur in all dimensions to improve product, process, and organization for competitiveness and business performance. Organization searching a way of constantly re-styled, re-engineered and re-marketed to meet our todays growing market demands for enabling more of the product to be recycled economically. Design for Disassembly is a technique design the product to be disassembled for easier maintenance, enhance serviceability and configurations that allow for cost-effective separation and recovery of reusable components and materials at the end of life product and other related process such as product reuse, remanufacture and recycling . Disassembly process has become an important strategic issue in order to reduce the environmental impact and increase the value of end-of-life products .In this paper discuss an overview of a detailed Design for disassembly approaches on product development process may use as an effective tool for product development and recovery of the increasing flow of disposal products and material. The main objective of this research is to support the current and future development in the field of disassembly and reuse of disposal products and material designer should products are designed to be taken apart, so that they can be used in later generations of products

Index Terms— Basic concept of DFD, Implementing DFD, DFD Approaches on product development, Disassembly Types, Principle of DFD.

1 INTRODUCTION

Design for Disassembly is a technique design the product to be disassembled for easier maintenance, repair, recovery and reuse of component and material reduce the environmental impact and increase the value of end-of-life products and enabled to recent advances technologies and is needed to support current organization needs for faster innovation product development cycles combined with products. The design for disassembly is necessary condition for products to be economically recycled, by improving components and material reuse and remanufacture processes, extending the service life of the products and component and product may be disassembled to enable maintenance, enhance serviceability and to affect end-of-life (EOL) [1]. The current research concern the design for disassembly as applied to product development in this paper discuss an overview of a detailed DFD concept may use as an effective tool for product development to extending the its concept to the product development if properly implementing DFD into a design specification allows the product and its component to be better suitable for reuse, recycling when it has reached its end of life, thus reducing the scale of resource required to create new product. A DFD vastly reduce waste in the manufacturing and recovery processes & allow for greater flexibility during product development, shorter development time scales and reduced development costs at the end of life and with lower cost even prolongs the life of product by allowing for changes. Though the DFD concept had been used in commercial product, heavy steel structure application where adaptable & movable space is preferred.

2 BSIC CONCEPT OF DFD

In today's challenging global market, organization must innovate to survive product, process, and organization to improve changing fashion trends and rapidly development of product and advancing technology has approach that helps organization achieve its business goals of shortening time to market and shelf-life, increasing the quantity of wasted used for many of today's products and improve competitiveness and business performance [2], [3]. In the engineering context, disassembly may be defined as the use of assembly methods and configurations that allow for development of product cost-effective facilitates the separation of components and materials from used product to encourage recovery and reuse. Design for Disassembly a type of green manufacturing is the term used to describe environmentally sound practices of producing products, or producing environmentally sound products. When the product is originally designed to be taken apart, so that they can be used in later generations of products DFD is the first step in designing a product for reuse, remanufacturing, and recycling or disposal of end-of-life products [2].Which are constantly re-engineered, re-styled and re-marketed to meet our growing organization demands for better products [3]

3 IMPLEMENTING DFD

In today's engineering world, people are searching for a way to utilize computing technologies to solve complex problems. The choice to utilize advanced computing technologies often makes the problem more complex than it need be. In fact, the

incorrect use of technology can cause a product to be designed slower than when engineers used drafting boards. The reason for implementing DFD techniques are allows companies to take a product from the end of its life-cycle back to the beginning and unlike other green business program. To optimize a product's end-of-life system, you should consider designing for Disassembly because this type of design can enable to user make product more, serviceability, maintenance and repeatability [4]. Today many effort in the recycling area concentrate on the materials how recyclable thermoplastics can replace thermosets, how to use fewer materials in a product, and "finding new applications for recycled materials. However, in the process of disposing of old products and recycling them, the cost of handling, sorting and disassembly will play an ever more important role. Implementing DFD into a design specification enable to the product and its components to be better suited for re-use or recycling. The work described here directed at the mechanical design of products to develop design for disassembly used when designing new products to make their disassembly for to easier recycling [5]. Disassembly is a strategy that helps reducing environmental impact in the use phase, since, if a product is easy to disassemble, it will be possible to repair it more easily and therefore its service life will be increased [6]

3.1 Benefits of DFD Improving business performance

The DFD may be defined as the use of assembly methods and configurations that allow for development of product cost-effective, facilitates the separation of components and materials from used product and increase reusability, recycle ability and encourage minimize waste, minimize scrap by-products and to achieve end of life [7]. The design for disassembly is necessary condition for products to be economically recycled, by improving components and material reuse and remanufacture processes, extending the service life of the products and components. The maintenance can be simpler and the output of all these improvements mean less raw material and energy waste and better performance in terms of assembly, test, procurement, shipping, delivery, service, time to market, and customer satisfaction and life cycle of evaluation. Benefits from using DFD are Core business product can be recover, metals separation with no contamination, improving best process quality, dismountable non-metallic parts can be re-processed[1] & DFD allows companies to take a product from the end of its life-cycle back to the beginning. In today's challenging global market increase of landfills of products has prompted regulatory and voluntary initiatives for recycling and reusing around the world. For example, directive on Waste Electric and Electronic Equipment (WEEE) in European Union is effective since July 2005. According to this directive, more than 50% of the product must be recycled. Consequently, manufacturers must be more responsible for the End-Of-Life (EOL) of their products (see figure 1) [6]

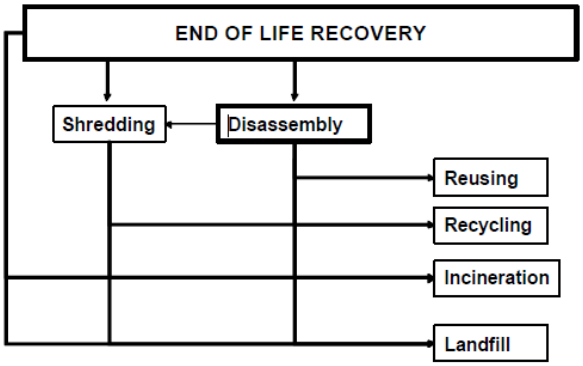

Figure 1: EOL treatment options [6]

At the End of Life products can be disassembled to separate the useful components from the non-useful component. Useful components can be reused, recycled or energy obtained out of them by incineration, etc. Non useful components can be stored in landfills. [6]

4 DFD Apporaches on Product Devlopment

The concept of DFD growing within manufacturing industries as greater attention is devoted to the end-of-life of products. This need is driven by the increasing disposal problems of large amounts of consumer product, and the environmental impacts and loss of materials resources and energy that is embodied in this product [8]. The research presented in this paper concern the design of disassembly process are required for the recovery and reuse the increase flow of disposal product, component & material. The designer should consider the structure of the product and its feasibility for the easy disassembly maintenance, repair, and recovery and reuse of component and material in order to reduce the environmental impact and increase the value of end-of-life (EOL) products for this purpose the designer not needs advanced design tools but also methods for evaluation of product during the conceptual design phase [9] products are designed to be taken apart, so that they can be used in later generations of products. During the conceptual design phase designers try to identify the necessary requirement to realize these specifications [10].

The recovery of materials is intended to maximize economic value and minimize environmental impacts through subsequent reuse, repair, remanufacture and recycling

Examples of vehicles dismantling lines - Car Recycling System (CRS) - can be found in Europe, USA and Japan [12, 13].An analogy of an assembly line plant can be made, however dedicated to disassembly. Vehicles are carried continuously in cradles/ skids and, sequentially, parts of its structure (auto body, transmission, engines, cockpit, etc) are dismantled and separated until only the body structure component remains. (See Figure 2) [1]

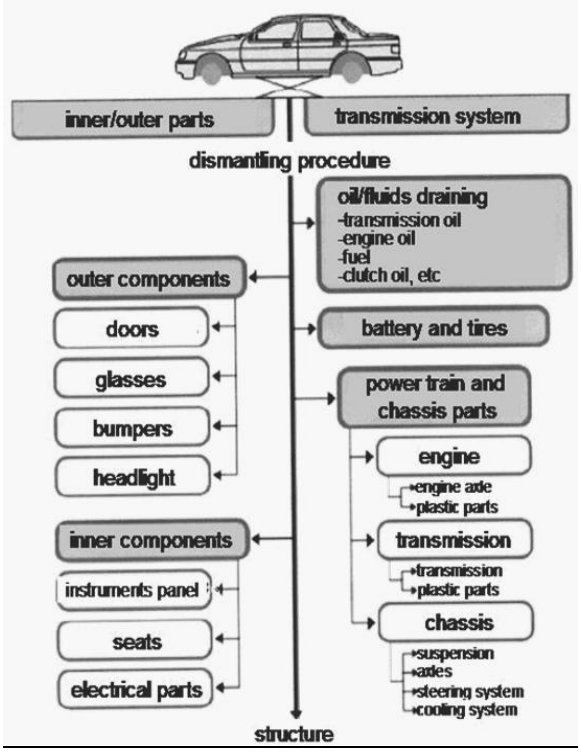

Fig 2 Typical vehicle dismantling line [1]

5 DISASSEMBLY TYPES

1. Reverse Disassembly /Non-Destructive (disassembly).

The aim of disassembly process is to "dismount discarded product into constituent parts by means of various operation where the obtained parts are not broken and damaged." In other words Reverse disassembly is taking each piece apart e.g., take Nut, Bolt out to be reused.

Two types of reverse disassembly, Total- disassembly is not economically feasible in most cases Selective- Selective disassembly is the process of reversing more complex components into subassemblies and individual parts.

2. Destructive (dismantling)

A destructive disassembly process is dismantling which aims to take apart into constituent and destroyed elements by demolishing the discard product element. In other words destructive disassembly is basically pulling parts and cutting them. From this point of view two disassembly techniques can be distinguished Disassembly covers various stage of the product life cycle. During usage, disassembly is applied to repair and maintain product after the products are rejected by the customers, disassembly is applied to recycle the materials in the most efficient way. In this context, it aims to close the life cycle chain and to prolong the useful life of products and materials. Many goods are not repaired due to high costs, because they are not designed for easy disassembly. In other words, the designer and producers have limited their effort to develop product for easy manufacture and assembly. Most of the attention has been devoted to easy assembly since it determines 70 % of the total production costs. Moreover, assembly has a large impact on the costs of maintenance and recycling during the useful life and reuse of products, which is achieved by disassembly. These two processed are segments of the product life cycle and they are mutually related. Generally, they should be considered simultaneously during the early design in order to ensure satisfactory results during all life cycle stages [9].

6 PRINCIPLE OF DFD

When design the product designer must be consider in mind this enable the product and its parts to be easily reuse, remanufacturing or disassembly and reduced environmental impact at end of life product. There are three important factor which must be consider designer [2, 15]

- Material Selection
- Fasteners and Connections
- Product Structure & Component design

1. Material Selection

The selection of materials should in no way compromise the structural requirements of the design the properties of a specific material meet the requirements for the design better than other [3]. For manual separation, large masses of a single material are important. For mechanical separation, reducing the total number of different materials in the assembly is more important and maximizes the recovery, recycling, and remanufacturing throughout the product life cycle [2, 15, 16]

- Select materials that minimize pollution during extraction, processing, deployment, recycling and disposal
- Minimize the different type of material in each part
- Minimize the number of different material in product
- Enabling the disassembly material to be easily recycle whenever possible
- Enabling the disassembly parts for remanufacturing or reuse
- Facilitate identification of material
- Select compatible of material
- Reduced overall material diversity
- Use all material optimally
- Avoid contaminant material

2. Fasteners and Connections

Fasteners play a role of an integral part in the joining of component and subassembly when designing for manual separa-

tion different techniques can be used intended to reduce the amount of time it takes to dismantle the components specifically designer should. [2, 15, 16]

- Reduce number of fasteners and connections used within an assembly
- Select fasteners and connections, enabling easy and quick disassembly
- Reduced the different types of fastener used within an assembly
- Avoiding non removable fasteners
- Use snap fit fasteners where possible
- Use slandered fasteners
- Design to enable use of common hand tools to disassembly
- Avoid incompatible adhesives which degrade recyclability of material
- Use fasteners and connectors instead of hard-wired connection
- Reduce fastener count and diversity

3. Product Structure & Component design

Product Structure & Component design are useful for component which is easy to disassemble for servicing will usually be easy to disassembly for recycling designer should [2, 15, 16]

- Enabling product rapid and economically disassembly
- Reduced the number of assembly operation
- Ensure that the product service life is appropriate
- Design modular product to enable modules to be disassembly for service or reuse
- Reduced the number of parts used in an assembly
- Standardization of component assembly material priority
- Reduced the different types of material in an assembly
- Construct sub-assemblies in planes which do not affect the function of the component
- Reduced fragile parts and leads to enable reuse and re-assembly
- Avoid using laminates which requires separation prior to reuse.

7 Conclusion

In this paper discuss an overview of a detailed Design for disassembly approaches on product development process may use as an effective tool for product development and recovery of the increasing flow of disposal products and material. The main objective of this research is to support the current and future development in the field of disassembly and reuse of disposal products and material and product are designed to be taken apart, so that they can be used in later generations of products. The Design for disassembly techniques are allows companies to take a product from the end of its life-cycle back to the beginning and unlike other green business programs, Design for disassembly has financial benefits as well as reduce manufacturing costs, easy maintenance and repair, increase the value of end-of-life (EOL) product, make components easily separable, DFD involves examining a product's entire life cycle, DFD is important part of a firm's quality strategy & the environmental impact.

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