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DESIGN FOR OBSOLESCENCE AND ECODESIGN – A DICHOTOMY OR AN INNOVATION OPPORTUNITY?

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Abstract:
Designing products to wear out, or become obsolete for other reasons, over pre-determined timeframes has been, and continues to be, common business practice. Fulfilling obsolescence criteria and creating eco-friendly products at the same time is an area that has received scant research attention, but is one that could open up a whole series of new possibilities and design methodologies. This is investigated by the means of consumer and industry research and a product case study (a lawnmower) and conclusions are drawn from the findings of this study.

Key words: *Design, Ecodesign, Obsolescence, Innovation, Lawnmower*

1.INTRODUCTION

In the Fast Moving Consumer Goods (FMCG) marketplace it is commonplace for products to be designed to last pre-determined lifespans, thereby encouraging rapid and continued sales turnovers and preventing saturated markets occurring. Equally there are continued and developing pressures on engineering designers and manufacturers to not only comply with current and forthcoming EU environmental legislation, but also to satisfy the demands of increasingly environmentally conscious and aware consumers, who can be more selective in their product purchasing choices, based on their environmental beliefs and perceptions, as well as actual product cost and specification.

In the context of the research that has been conducted it is necessary to clearly define what is meant by the term "Design for Obsolescence" (DFO). Designing for obsolescence can take a variety of forms from that undertaken by the fashion industry where products are designed to have very short lifespans (but not from a "wearing out" perspective) to that of the mobile phone industry where superseding technologies will make products obsolete in pre-determined times (but again the products will not necessarily "wear out") primarily as described by (Smith, 2001) to that of the consumer products industry where products are specifically designed to wear out in known pre-determined times (although there may also be elements of superseding technologies forcing consumer product renewals/changes to assist with the obsolescence process). The overriding aim of DFO should be to ensure that a consumer will re-purchase their replacement product from the same manufacturer once the original product is obsolete.

Research has been undertaken within the area of appropriate product life in relation to customer expectations and is shown to be consistent with current practices undertaken by FMCG manufacturing industries

2. ACCEPTABLE PRODUCT LIFETIME RESEARCH

One of the key factors that needed to be determined as part of the primary research for this investigation was the consumers perception of when products had achieved a satisfactory usage lifespan, such that they were deemed by the consumer to be both satisfactory in their overall performance and, more importantly, worthy of being replaced by a similar product ideally from the same manufacturer.

Following questionnaire analysis of consumers concerning their remembered purchase times for products that they owned, and their considered levels of satisfaction with product performance as a result, the following diagram was developed to summarise the findings from the research:

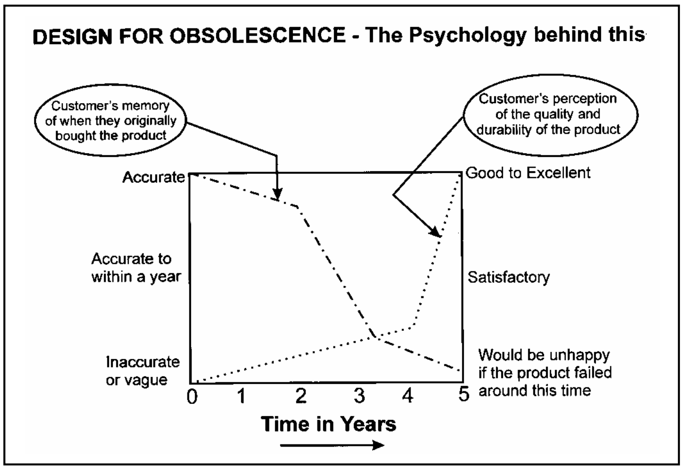

Figure 1. Diagrammatic representation of the findings from the primary consumer research on product lifespan acceptability

Before reviewing the findings from this research there are a number of issues that need to be qualified. Firstly the research was based around generic household products (predominantly "white goods", although garden products and audio/visual products were also considered). The levels of satisfaction specified on the right hand axis are obviously qualitative and are very much dependant on not only the nature, but also the original purchase cost of the product. The criteria of "Good to Excellent" specified represent the situation where respondents would consider repurchase/replacement of the product acceptable, and would at least be neutral in their preferred choice of manufacturer for the replacement, if not having a positive bias towards the same manufacturer as the original product.

2.1 Review of Findings

There was strong evidence to suggest that as typical household products reached a lifespan of four to five years that customers considered this to have been satisfactory and that they were not averse to replacing the product after this time had elapsed (assuming satisfactory product performance throughout this time). Obviously this can, in the main, be attributed to the fact that beyond three years product lifespan the consumers memory of when they purchased the product originally was becoming vague anyway.

It is interesting to note that the perceived indications of satisfactory and then good/excellent product performance only really started to occur at, and beyond, four-year lifespans (indicated by the sharp change in gradient of the data line at this point). The original purchase date memories show a much more gradual decline and it is felt that this is probably attributable to the varying ages of the respondents, and their individual mental/memory dexterity as a result.

The indications from this basic research are that a designed lifespan of five years for household products is not an unreasonable target for manufacturing industries to be aiming at.

3. THE INDUSTRY STANDPOINT

Following on from this consumer research it was decided to undertake expert interviews with design engineering personnel based within the household products manufacturing area. Three in-depth interviews were conducted with one "white goods" manufacturer, one lawnmower manufacturer and a garden aquatics products manufacturer. The manufacturers in each case do not wish to be identified within this research for reasons of both confidentiality, and the possibility of negative public connotations being made about their products in the marketplace as a result of this information being in the public domain..

3.1 Industry Findings on Design for Obsolescence

The following factors were deemed to be important from a design perspective as regards designing products to wear out, and/or become unusable over a pre-defined lifespan:

Good recognition of average usage patterns for the product during its lifespan, enabling fairly accurate engineering design criteria to be implemented to limit the lifespan. For example, if a product is going to be used on average for one hour per week, over a thirty-week season, for five years, then appropriate components should be designed to wear out or fail (non-catastrophically) after 150 hours use. Electric motor brushes, for example, can be designed to survive 150 hours usage before their length and associated contact spring pressure (in the case of a series wound motor) becomes such that the motor can no longer conduct satisfactory current, and therefore doesn't function anymore. In combination with this design strategy it has to be ensured that replacement motor brushes are unavailable, and that access to the motor brushes to effect a repair would render the motor completely useless.

Use of appropriate decorative/corrosion inhibiting finishes where required. If a product is deemed to be redundant after five years then it follows that corrosion protection and decorative finishes need no longer be effective. There are significant tie-ins with value engineering in this respect, whereby the following criteria are applied. If a corrodible component is completely hidden, and five years corrosion would not impair its required function (or the product function overall) then it can be left untreated as regards finish. Normally a light oiled finish may be given to provide minimal protection during component delivery and storage prior to final product assembly though. For those components hidden during normal use of the product (e.g. underneath the product) then minimal protection, e.g. blackodised/oiled finishes may be all that is necessary (again dependant upon the nature and function of the corrodible component). For visible components then obviously more attention is required as regards appropriate decorative/corrosion inhibiting finishes.

Dynamic components and bearings need careful consideration. Wherever possible, and particularly under low load/low speed applications the exclusion of bearings is considered, e.g. plastic wheels on metal axles, where significant amounts of bore wear in the wheel over time can be tolerated without undue perception from the customer. Bush type bearings are used wherever possible, not only from a value engineering aspect to achieve obsolescence, but also because it is easier from an engineering design viewpoint to make accurate predictions for bearing life, based upon initial clearance sizes and shaft/bearing materials. The dependency on actual fit/interference conditions that would affect the life of ball/roller bearings does not need consideration in this respect. Where rolling element bearings are required, because of load/speed conditions, then bearing lubrication/protection needs to be considered. If the bearing can survive and function, and possibly ultimately fail non-catastrophically within the desired timespan without sealing/shielding to protect it, then this should be the case. In the case of garden products there was actually product test evidence to suggest that the presence of chlorophyll from grass/plants within an unshielded rolling element bearing actually served to enhance bearing life by providing a degree of lubrication during product use!

Fasteners were also another key area identified, not so much in terms of design for obsolescence primarily, but as a value engineering design consideration to complement the objectives for DFO. Single use fasteners that would be destroyed if a consumer tried to gain access to a worn/failed component would therefore discourage consumers from trying to repair products at the very least. Care needed to be taken in the design to try to ensure that the housing and localised environment for the single use fasteners precluded the use of a replacement multi-use fastener, e.g. a rivet fastening should not be easily replaceable by a screw and nut, or indeed another rivet, if the original rivet is forcibly removed.

3.2 Review of Industry Findings on DFO

To a large extent the above selection of design criteria for DFO do appear to have quite strong connections to the rules and principles for value-engineered design. This is particularly evident in the hierachical design approach that is taken in the application of DFO principles, i.e. evaluating the most minimalistic, and usually most cost effective approach to design problems to see if they fulfil the objectives for phased wear and/or non-catastrophic failure during the product lifespan. The main difference appears to be that whereas value engineered design looks to achieve the most from product function for a cost effective product design, DFO looks to achieve function and potentially non-catastrophic failure following a known (and hopefully minimal or non-perceivable) performance deterioration in the product/component during it's lifespan.

Effective DFO does appear to require good understanding of the product function and performance criteria, as well as good knowledge and appreciation of consumer tolerance levels in terms of designed, known and anticipated deteriorations in function and performance (and also potentially appearance/aesthetics). There is a very fine balance between effective DFO and potentially disastrous DFO (causing severe impact on product/brand credibility in the marketplace) if obsolescence occurs too early in the lifespan, or does occur catastrophically. This was evident as feedback from all of the interviews. Practitioners of DFO have to expect and make allowance for the consumer who is going to use the product under more extreme or heavier conditions than average, and again it is seen as being a very fine balance between satisfying the majority of customers without over-engineering the product, and therefore exceeding the DFO objectives in a significant number of cases. Decisions have to be taken on the proportion or percentile of consumers that will be expected to over-utilise the product (where possible) and to what extent these consumers will accept lifespans shorter than the planned DFO lifespans for the average consumer. Heavily brand conscious companies were seen to build in some element of safety factoring to their DFO to compensate for this, and the potentially disastrous effects that it could have.

4. ECODESIGN PRINCIPLES & PRODUCT LIFESPAN

The linking principles used in this context are similar to those used in the links determined between Value Engineering and other design applications (Silva et al., 2004)

One of the most important differences between DFO and Ecodesign is that DFO focuses very much on the product usage lifespan, and takes no consideration of events after product obsolescence, other than the primary objective of getting the consumer to buy a replacement product from the same manufacturer again. Ecodesign considers a much broader timespan, both before and after the usage phase, in order to satisfy the overall driving principles behind environmentally friendly design.

Although certain ecodesign principles such as designing for durability and longevity are diametrically opposed to the principles for DFO, other ecodesign principles can be seen to be complementary, if they are given a fair and equal consideration at the design stage, alongside the considerations for DFO. The complementary principles equate well with those previously determined as being of significant importance to SME's (van Hemel & Cramer, 2002) and of those deemed to be capable of very successful integration into new product development strategies (Johansson, 2002). Examples of such principles are energy conservation (if a product is economical to use during its pre-determined lifespan, this can only be seen as enhancing the consumer perceptions of the product, as long as the consumer is aware of the economical nature of the product). This should therefore go some way towards addressing the DFO objective for a replacement purchase from the same manufacturer.

Another ecodesign principle that can be seen to be complementary is that of recycling, as opposed to disposal to landfill. If a manufacturer offers incentives for product return at the end of its lifespan (e.g. discounts on new replacement products in exchange for the old product) and part of the incentive is also product recycling then the consumer will "feel good" about returning the product. With both current and impending EU legislation on disposal/recycling these strategies do need to be given quite serious consideration anyway by product manufacturers.

Re-use is also another consideration (if not for the whole product, which would be difficult to design for, at least for easily removable parts of the product). This will be considered in the following brief case study for a lawnmower design that has had DFO principles built into it originally, but that currently has very little in the way of ecodesign principles built into it.

5. CASE STUDY – CYLINDER LAWNMOWER

This case study will look at the way ecodesign principles could have been included as part of the original design in a complementary fashion to some of the DFO principles that have been used in the design.

As stated previously dynamic parts offer the most potential for DFO and particularly the "heart" of the product itself (the motor and power transmission system as shown in Figure 2.)
This currently is integrally fastened into the pressed steel sideplate for the lawnmower. As a result it is very difficult to disassemble for recycling purposes (mainly for the zinc diecastings and copper motor windings).

Figure 2. Power transmission system (with belt removed for clarity)

The motor is sandwiched between a lower and upper injection moulding, which are fastened via self tapping screws to the sideplate (see Figures 3 and 4 as follows). By judicious redesign of the lower plastic moulding this could be made to incorporate significantly more features from the upper moulding, and also be snap fitted into the sideplate. The upper moulding could then be reduced to a simple plastic latch and single screw fastening motor cover, allowing access to the motor if required (e.g. to clear any debris ingress into the motor housing), but also allowing for quick and easy disassembly of the sideplate, with the motor and transmission attached, for further dismantling into component parts for recycling. As a sub-assembly this would be easier to dismantle now, as it could be jigged accordingly for disassembly. The removed plastic mouldings could then also easily be shredded for recycling.

Figure 3 Upper moulding for motor cover housing

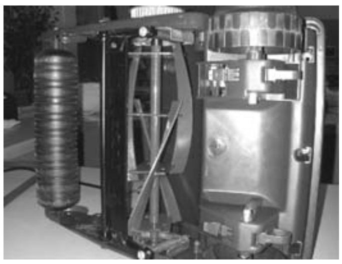

Figure 4 Lower moulded cover for motor housing

The use of Alternative Function Fulfilment (AFF) techniques (van der Zwan & Bhamra, 2003) can also be employed.

An item like the grass collection box (shown in Figure 5) could be retained for reuse once the lawnmower is obsolete. This reuse could potentially take one of two forms. The grassbox could either be retained as a general garden waste collection container (e.g. for weeding in the garden), or could potentially be used as a spare grassbox for the replacement lawnmower purchased (following the obsolescence of the original lawnmower). This would, of course, require that the mounting area for the grassbox on foreseeable future designs should also be capable of safely incorporating obsolete used grassboxes. The advantages of this would be that there is then further incentive for the consumer to purchase the latest version of the same product to replace the original obsolete product, and there would also be labour saving from having two grassboxes in terms of reduced numbers of trips to empty full grassboxes during product usage.

Figure 5 Grass collection box

The handle assembly (shown in Figure 6) could also be potentially considered as a reuse item. For example the supply cable could be made easily detachable by the use of a plug connector at the handle switch. On obsolescence this cable could then be used as an extension cable to use with the new replacement lawnmower. The handle tubing itself could be designed to be capable of being reassembled into a framework to support garden waste bags for collection of garden refuse and could even potentially utilise the wheels/roller from the original product to make it mobile as well!

Figure 6 Handle Assembly

6. CONCLUSIONS

Whilst it may not be readily apparent that there is potential for the use and application of ecodesign principles in the design of FMCG products that are deliberately designed for obsolescence, there is felt to be scope for consideration to be given to this area, and for these principles to potentially be included in a DFO strategy.

The advantages that the incorporation of these principles could offer can be seen to be in the aspects of providing partial reuse for components/sub-assemblies of the product, and improved disassembly procedures to enable easier recycling. By improving disassembly there is then more incentive for manufacturers to consider taking back products after obsolescence (which EU legislation is already forcing them to do anyway in a number of cases) and for consumers, there is the advantage of the "feel good" factor about doing something towards protecting the environment, which can only help towards persuading them to buy a similar replacement product from the same manufacturer.

The timed phasing of new product development lifecycles to ensure new models are available as older ones become obsolescent also becomes extremely important for consideration by manufacturers using DFO strategies. The introduction of "product waves" (Ryan & Riggs, 1997) both affords and complements this approach to longer term NPD strategies within organisations with planned product obsolescence in mind.

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