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REFILLABLE PACKAGING SYSTEMS: DESIGN CONSIDERATIONS

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1. Introduction

For a number of years it has been widely recognised by governments and industry that current human activities degrade the environment and cause serious negative consequences for human population's [Brundtland, 1987] and as such we need to identify more sustainable patterns of development. A reduction of the environmental impact of human activities by "factor 10" is now recognised as a key target [Simon, 1997]. Considerable research has been carried out to understand how socially and environmentally responsible behaviours can be integrated into the product development process. During the early 1990's 'green design' was the main focus for improvements of this nature, i.e. design which focuses on single issues, such as the use of recycled materials. As understanding progressed green design was superseded by 'ecodesign', recognised as being a more holistic approach which tackles environmental issues at all stages of a product's life cycle and encourages designers to think about new ways of doing things. Sustainable Design goes beyond the consideration of environmental issues and also recognises the importance of social and ethical issues in design. Literature in this field indicates that considerable and progressive body of research concerning the integration of sustainable design principles into product development exists [Fussler and James, 1996; Stevels, 1996], however there is very little evidence to indicate similar work existing in the field of packaging.

In recent years the environmental impact of packaging has become a prominent issue in the UK as it is a very visible product in the waste stream, making up around one-third of household rubbish [LRRA, 1996]. The introduction of the European Packaging and Packaging Waste Directive in 1994, which requires Member States to ensure that all packaging placed on the EU market complies with certain 'essential requirements' has made packaging a more important issue for consideration in many businesses. Over the past 40 years considerable efforts have been made to reduce the environmental impacts of packaging by focusing on issues such as light-weighting and material selection [Holdway et al., 2002]. For example, the Nescafe example illustrated in Figure 1 resulted in annual savings of 124 tonnes of metal packaging and 208 tonnes of paper and board packaging [Department of Trade and Industry, 2003]. However, although these redesign approaches are commendable and should be encouraged, they are not having a radical effect on the impact of packaging. Whilst the weight of packaging per unit of product has decreased, demographic and lifestyle changes such as smaller family size and a demand for greater convenience [INCPEN, 2001] have led to increases in the total amount of packaging used. A key report by the Environmental Services Association [2004] identified that in 2003, the total packaging waste going to landfill in the UK rose to over 10 million tonnes per annum.

The use of refillable packaging has long been cited as a possible solution to this problem, as illustrated by the support that two key British government organisations DEFRA (The Department for Environment Food and Rural Affairs) and WRAP (Waste and Resources Action Programme) are giving to research in this area at the moment. The use of refillable containers is not a new concept,

and it is widely associated with the delivery of products such as milk, beer and fizzy soft drinks across Europe, and the Americas. However in the past, attempts to extend the use of refillables beyond a few traditional areas have met with little success and as of mid 2003 no major retailers in the UK operated any schemes in the reuse of primary packaging [Darlow, 2003]. However, it is believed that recent advances in technology, particularly new forms of retailing such as internet shopping and the development of product service systems may provide the opportunity to re-evaluate the role of refillable packaging systems.

Figure 1. Before and after examples of Nescafe coffee packaging
[Department of Trade and Industry, 2003]

The findings reported in this paper have emerged from the initial investigations arising from a two year research project - 'Refillable packaging systems' sponsored by DEFRA's Waste and Resources Research Programme and carried out in collaboration with Loughborough University and The Boots Company. The project aims to investigate the feasibility of developing a refillable packaging system for a main stream product in the personal care market, which fulfils customer needs whilst attaining greater eco-efficiencies. By using the concept of product service systems the project aims to take a more radical approach to the design of refillable packaging systems and unlock the potential for greater sustainability improvements. This paper outlines the value associated with taking a product service systems approach to refillable packaging. It then presents sixteen categories of refillable packaging systems currently on the market and reflects on the different design considerations raised by these approaches in terms of the social, technological and economic related impacts.

2. Methodology

The overall aim of this applied research project is to develop refillable packaging systems using a product service system approach and investigate their feasibility within the personal care market. One of the first challenges of the project is to investigate current consumer perceptions of refills and refillable packaging and identifying organisational, cultural and other barriers to the adoption of refillable packaging. The second is to identify a suitable project area to focus on within the personal care market taking into consideration both the appropriateness of product type and the needs of the customer. This has been done by carrying out a literature review, and a review and analysis of refillable packaging solutions to draw out the different drivers and barriers associated with this approach, from a business, consumer and sustainability perspective. It has also involved reviewing Boots' customer profiles to identify potential target customers based on buying styles and product preferences. These findings and the results of further investigations into visioning refillable packaging solutions for Boots type customers, the collaborative team will identify opportunities within the

ECO DESIGN IMPLEMENTATION WORKSHOP

personal care market for refillable packaging. Following this, creativity techniques will be used to generate different systems designs options and associated packaging solutions to suit each system. A critical analysis will then be used to identify which ideas are worth carrying forward and investigating further. The most promising concept will then be tested with consumers through focus groups which draw on the use of empathic design techniques. Internal seminars will also be run with Boots to outline customer feedback on concepts and identify strategic implementation opportunities. Generic lessons for the use of refillable packaging in industry will then be drawn.

3. Product service systems

Over the last five years research has begun to focus on product service systems as a new approach in the move towards sustainability. Working with product service systems can identify new ways of delivering products and services which require changes to infrastructure and organisations which have the potential to deliver huge environmental improvements [Von Weizsacker et al., 1998]. By closing material cycles and reducing consumption through alternative scenarios of product use, they can lead to a dramatic increase in overall resource productivity. A product-service system can be defined as the result of "an innovation strategy, shifting the business focus from designing and selling physical products only, to selling a system of products and services which are jointly capable of fulfilling specific client demands" [Manzini & Vezzoli, 2002]. Product service systems do have a huge potential to result in more sustainable solutions as they take as their starting point the goal of achieving an integrated functional solution to meet the customer demands. In particular they require stakeholders to work closely together to deliver the optimum solution to the customer therefore forging new partnerships.

Companies who choose to take a product service systems approach to their business may benefit in a number of ways. Firstly, they can result in higher operating efficiency as companies use fewer materials to generate the same profit margin. Secondly, product service systems can result in improved strategic positioning due to the perceived added value achieved by focussing on the utility delivered from a product service mix [Manzini & Vezzoli, 2002]. One example of a successful case study is Allegrini S.p.A an Italian producer of detergents and cosmetics with strong environmental credentials. Allegrini developed Cases Quick a service providing added value to the product life cycle, based on home delivery distribution of detergents. Cases Quick products are taken from vans, which move from house to house on a regular route. Each family takes the detergents needed from the van in the quantity required using special containers and only pays for the quantity taken. Casa Quick customers receive a kit of plastic flasks which are easy to carry from the house to the van and can be filled up even if not completely empty. This system incorporates the product (the detergent) plus a service (home delivery) with a lower-level of customer effort. Information on how to use the products to optimise the effect and minimise the amount used, is also given to customers [Manzini & Vezzoli, 2002].

4. Design considerations for refillable packaging systems

An initial review and analysis of refillable product packaging solutions has identified sixteen broad categories of 'refills' - each offering different opportunities and challenges to business, consumers and the sustainability agenda and each having different design and logistics requirements (see Table 1). This paper focuses specifically on the design considerations associated with the different approaches, which can be considered in terms of social, technological and economic related impacts.

Table 1. Categories of refills

Approach	Description
Lightweight self contained refill delivered through dispenser	Customer buys a self contained (lightweight) refill which they take home and put into their durable dispenser.
Lighter weight refill through part reuse	Customer buys a new bottle of product and reuses the spray pump e.g. cleaning products
Empty packaging refilled in shop	Customer takes the original packaging back to the store for it to be refilled with the same product.

Self dispense	Customer takes reusable container back to the store where they refill it with the same product.
Original packaging swapped for new product	Customers return empty packaging to a unit where they leave it and pick up a new product. The old packaging is refilled for future use by someone else.
Door to door delivery – packaging replaced	Customer receives full packaging when required and leaves empty packaging for supplier to collect, when they are finished with. Returned bottles are refilled for other customer.
Deposit system	Customer returns empty packaging to supplier for a financial incentive.
Top up card	Customer pays for a service which is delivered on the production of the payment card.
Creation	Customer buys the constituent parts to make the product themselves. They buy refills to allow them to repeat the process
Door to door delivery – packaging refilled	Customer dispenses quantity required from a delivery van, using special containers and only paying for the quantity taken.
Refilled with different product	Once original packaging has been used it is refilled with a different product.
Dispensed concentrate	Customer buys a dispensing unit. They also purchase refills containing concentrated product which are delivered through the dispenser.
Dispensed product	Customer buys a dispensing unit. They also purchase refills which are delivered through the dispenser.
Concentrate mixed in original packaging	Customer buys a concentrated refill which they dilute with water and mix using the old packaging.
Fill your own packaging	Customers fill their own bottle with product in shop.
Bulk purchase	Customer buys in bulk and refills a sampler package at home.

6.1 Social considerations

The most important social consideration for the design of refillable packaging systems, is obtaining customer buy-in. Unless these systems are easy for consumers to participate in and interact with, and provide them with some form of value-added advantages, they will not be successful. In 1990 the Body Shop introduced an advertising campaign, 'Once is not Enough' which encouraged customers to return their empty bottles to a Body Shop store to have them refilled with more of the same product, for a reduced price, or return them for recycling. At this time in the UK, it was difficult for customers to recycle plastics independently as there were no curb side collections and few if any communal banks for plastics. Despite this and their inherently interested and motivated customer base, the system was withdrawn after a couple of years. The failure of this initiative indicates that the 'feel-good factor' is not enough. On reflection the key contributors to this failure appear to have been high levels of inconvenience and low incentive levels. For example, the design of the system was such that bottles had to be washed before they were returned for refilling. This meant they had to be empty and as such the customer had to wait for the product to run out before they could replace it, or stock pile bottles at home. In addition to this the refill system relied on the customer's motivation to clean the bottle and then their memory and organisational skills to ensure that they remembered the bottle on their next trip into town. Forgetting to take the bottle to be refilled would leave them short of a critical daily product (e.g. shampoo, shower gel) meaning they would be more likely to simply buy another product. In addition to this the financial reward was so small that there was little added incentive to wait until their next visit to town.

A review of existing systems indicates that customer buy-in can be achieved in a number of different ways, through added convenience, cost incentives, added value and through heightened product attachment. Increasingly there is a move towards products that make the consumer's life easier, this is demonstrated by innovations such as washing powder in single wash tablet form, ticketless airlines and internet shopping and highlighted by Allegrini's Cases Quick system described earlier. It is clear from the literature that convenience has a huge influence on whether consumers will take up a product or service. As such any system must be convenient and potentially increase customer convenience.

Financial motivation can be encouraged in a number of different ways. For products delivered by the self dispense route a common approach has been to provide a low cost, low value product. This has lead to the perception that 'loose fill' products must be low end products. However a recent innovation in this type of delivery has been to offer high cost, high quality, aspirational products

through this route, such as the oils, vinegars and other products offered by Vom Fass and the Oil & Vinegar shop. Interestingly, Vom Fass also offer added customer convenience through the provision of internet shopping.

Added value can be delivered in a number of different ways. One approach which has been neatly demonstrated by the work carried out between Royal Melbourne Institute of Technology and Blackmores [RMIT, 1997], is to create a strengthened relationship between the customer and the product. The project focused on developing a new range of packaging for cosmetic creams, with the aim of improving their environmental criteria. It resulted in two interesting solutions which radically reduced the amount of material in comparison with traditional packaging. The first solution consisted of two parts, a tough plastic outer skeleton which the customer keeps for reuse and a disposable tube make from very thin plastic, which is disposed of at the end of life. The user snaps the refill into place between the arms of the skeleton. The second solution attempted to increase the lifespan of the packaging and reduce the amount of material used. The 'jewel' type packaging was designed to be used with cheap, lightweight refills that minimise the use of materials (see Figure 2). It was designed to be attractive and valuable in the eyes of the consumer, to encourage them to refill it and keep it, rather than throw it away. Both these scenarios offer customer convenience and brand value.

Figure 2. Blackmores cosmetic packaging

In a similar way, Pampers have used a similar approach to create Kandoo toilet wipes which have a durable dispensing unit which is highly desirable to children. Value, quality and durability as well as quality of function (in dispensing) are what make these systems work.

4.2 Technological considerations

There are a number of technological issues regarding durability, material choices, communication, the refill mechanism, health and safety, and detailing to facilitate cleaning which will need to be taken into consideration when designing refillable packaging systems, though the type of system adopted will heavily influence the decisions that have to be made and how they are resolved.

Identifying the optimum durability of the packaging will be an important consideration. Dispensing units and primary packaging will have to be suitably durable to meet customer requirements – especially if customers are being asked to purchase this unit over and above the product. It might also be sensible to have a short lifetime built in the design of the refills, especially if they can be made from organic material which can be decompose. For systems which incorporate returnables, the required durability of the packaging will depend on the number of times that the packaging has to be returned for refilling, to make the system sustainable and cost effective.

The nature of the material selected will also be influenced by durability issues but will also have to take into consideration the fact that in recent years there has been a large push towards encouraging the public in much of Europe to recycle glass, plastic and paper via curb side collection facilities. As such consideration will need to be given to the material used for a refillable packaging system as there is a risk that householders might automatically recycle the packaging. At present glass and PET are the most popular materials for use in reusable packaging [Darlow, 2003]. In order to ensure that refillable packaging systems are viable, it will also be important for the packaging design to clearly communicate to the consumer *how* it should be dealt i.e. which system it belongs to and how it should remain in that system.

For most types of refillable system it will be important to ensure that primary packaging is designed to be easily refilled by the user. This will help enhance customer convenience and has the potential to delight the customer, which will further encourage adoption. Health and safety issues will also need to be considered. These will be wide ranging and the specifics will depend on the nature of the system designed. For 'dispensed concentrate' systems where customers buy a dispensing unit and concentrated refills to be delivered through the dispenser, security mechanisms will need to be in place to ensure that customers can not use the product in the concentrated format. It is likely that the types of mechanisms adopted for medical design will be useful in these instances. Health and safety issues will also impact returnable systems where customers are responsible for cleaning bottles for refilling (e.g. Body Shop system) and where companies take on that responsibility (e.g. British milk bottle system). In both cases it will be important to design packaging for cleanability. Health and safety issues will be likely to pose some challenges for refillable packaging systems as was recognized by the ASDA supermarket chain who trialled an in store refill scheme in Watford, UK. Through their system fabric conditioner was dispensed into reusable bottles via an in store vending machine. Darlow [2003] reported that health and safety issues have prevented this scheme becoming widespread – though it is not clear what these issues were.

4.3 Economic considerations

Economic issues will also need to be taken into consideration during the design of the refillable packaging systems. These include identifying the frequency of refill, in terms of what would suit the customer, what the nature of the product would dictate (e.g. toothpaste might be monthly, nappies might be weekly) and when the system breaks even. There will also need to be consideration to the logistics of managing the system and ensuring that the packaging materials are collected from the consumer and returned into the right cycles. Often refill systems are only financially viable if the customer returns the packaging, as suppliers tend to invest more heavily in the development of more durable, higher quality products. Kodak's single use camera provides an excellent example of a system which works effectively, as customers return the camera, film and packaging to processing units at the end its useful life to have their film developed. Kodak then reuse and recycle various parts of the product and packaging, allowing them to retain the value in that they invested in the high quality, durable components that they distribute to customers. Determining how to best record return cycles will be another design consideration. This could be achieved mechanically, or through the use of electronic tagging. However electronic tagging has the potential to turn every piece of returnable packaging into electronic waste (e-waste), which would be unsustainable and unwise with the recent introduction of the European waste electrical and electronic equipment directive, which requires all manufacturers of e-waste to take financial responsibility for it at the end of its useful life.

Sensible economic policy will also be needed to support the environmental sustainability of refillable packaging. Lightweight self contained refills delivered through dispenser (such as those described in section 4.1) have also successfully been used in the delivery of products such as wipes and air fresheners. In both these cases supermarkets stock both the refill and the case with contents included. Interestingly however it is often cheaper to buy a 'special offer' containing the dispenser and the refill, than it is to buy refills on their own. In other words the introductory offer which is intended to encourage buy in can actually offer a financial incentive for consumers to dispose rather than refill.

Finally, it is likely that refillable packaging systems will require a degree of 'systems design' which will require the development of new supply chain relationships. Although this is not essentially a

design consideration, it is something which should affect the design of the product as it will be necessary to consult with a wider range of representatives to ensure that the system works effectively at every stage of the process.

5. Conclusions

Utilising refill technology has a number of different benefits above and beyond the potential to reduce the amount of waste going to landfill, such as increased customer loyalty, increased perceptions of added value by the customer and the fact that "standardised packaging has the potential to reduce the costs of a reuse system for retailers, or others responsible for collection, and producers" [Darlow, 2003]. There do however raise a number of design challenges. Refillable packaging systems need to be convenient to the customer and provide them with some additional incentives such as cost benefits or added value. There are also be a number of technological issues related to durability, material selection, communication, usability, security and cleaning which will need to be written into the brief and considered within the context of the system adopted. On top of this it will be important to develop a integrated system of logistics management which is likely to require new supply chain relationships, and will also require responsible economic policy to ensure that the overall outcome is more environmentally and socially sustainable.

The challenge of designing refillable packaging systems also raises a number of interesting questions – such as whether some products are more suited to delivery through a refill system than others or whether it depends on the design solution which is offered in order to make the solutions work. It will also be important to investigate whether some customers are more likely to respond positively to refillable packaging than others? This project will provide an interesting opportunity to investigate these questions and develop a better understanding of refillable packaging systems. It will also provide an interesting opportunity to investigate how new technologies such as internet shopping, loyalty cards and an increased move to services can be utilised to help deliver the benefits of refillable packaging. The overall intention of the project is to develop prototype exemplars to demonstrate how refillable packaging systems can be delivered.

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