The 6th International Conference on Life Cycle Management in Gothenburg 2013

TARGET THE USE PHASE! DESIGN FOR SUSTAINABLE BEHAVIOUR

Renström, S., Selvefors, A., Strömberg, H., Karlsson, I.C.M., Rahe U.*

*Division Design & Human Factors, Department of Product and Production Development, Chalmers University of Technology, SE-412 96 Gothenburg, *e-mail: mak@chalmers.se*

Keywords: design; behaviour; sustainability

ABSTRACT

One approach to further decrease the environmental impact of products is to target the use phase. According to the Design for Sustainable Behaviour approach different design strategies can be used to enable a more sustainable use of products by influencing the user's behaviour. The strategies suggested include matching products to users' current behaviours, enlightening users, spurring or steering the users towards more sustainable behaviours, and applying a force dimension to the products. Empirical studies demonstrate the feasibility of different strategies. However further knowledge is needed on which strategies to apply in which situations and for what problems.

INTRODUCTION

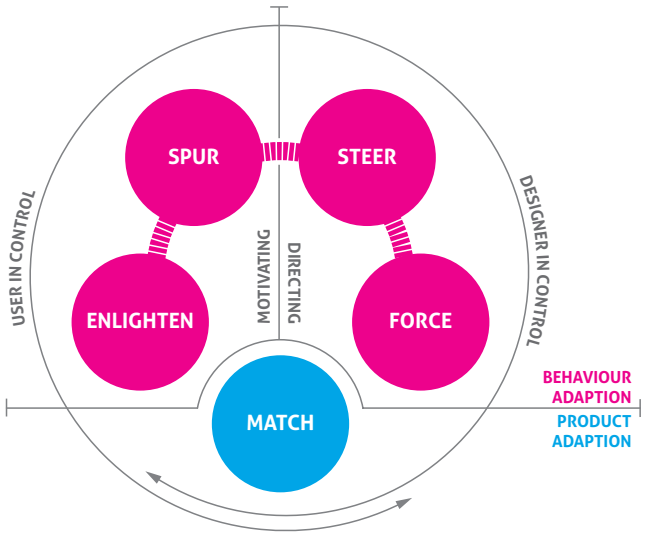
The use phase is a large contributor to the environmental impact in many products' life cycles (e.g. car use). One approach to address this is technological development (e.g. improved fuel efficiency) but this is unlikely to lead to the desired results due to e.g. rebound effects (e.g. the car is driven faster and further). Another way forward is to change people's use behaviour through changing their attitudes but recent research has shown that the relation between attitude and behaviour is weak. Yet another approach is to influence behaviour by education (eco-driving) but it has also been found that users often find it difficult to turn theoretical knowledge into actions. The Design for Sustainable Behaviour (DfSB) approach suggests that different design strategies can be used to enable a more sustainable use of products by influencing the user's behaviour at the point of interaction and hereby bridging the intention–behaviour gap.

DESIGN FOR SUSTAINABLE BEHAVIOUR

Different DfSB strategies have been brought together in a model including five main categories (Lidman & Renström 2011): Match, Enlighten, Spur, Steer and Force (see fig).

The category *Match* contains strategies for adapting products so that they fit users' existing behaviour and fulfil their goals, but in a less environmentally harmful way. Within this category, frameworks such as Life Cycle Analysis, Cradle-to-Cradle, and Biomimicry can be used in part to address the environmental impact of the use phase. However, *Match* strategies also include more tailored strategies such as functionality matching. An example of functionality matching is automotive so-called start-stop systems, a mild form of hybridisation that shuts off the car's engine when the driver stops at a red light or in a queue, and turns it on again when the driver selects a gear. Depending on

traffic and road type, fuel consumption can be reduced by 9-15% along with reduction of emissions of for instance NO_x and CO (Merkisz et al., 2011).



In contrast to *Match*, the other four categories all contain strategies that aim to change the user's behaviour in some way. The *Enlighten* category includes strategies that aim to influence users' knowledge, values, attitudes, and norms and hereby motivate them to change their behaviour. Users can be influenced for example by being informed about environmental issues, by being instructed on how to behave in a less resource consuming way, by making them reflect on the consequences of their behaviour, or by reminding them of pro-environmental values and norms in particular situations. A commonly used strategy within this category is giving feedback to the users on the consequences of their actions. In a study by Strömberg and Karlsson (2013) 54 bus drivers were supplied with an in-vehicle support system to enhance their adoption of eco-driving. The drivers were given real-time feedback on their performance on five driving parameters related to fuel-efficient driving: fuel consumption, speeding, harsh decelerations, idling, and use of momentum, so that they would be able to link what type of behaviour led to decreased fuel consumption. Through reducing for example harsh decelerations by 66% and instances of speeding by over 40% the drivers managed to reduce their total fuel consumption by 6,8% compared to baseline measurements. The drivers had a positive attitude towards eco-driving but because of other factors, such as lack of organisational support, conflicting job requirements, and technical problems with the system, the drivers gradually decreased their use of the system over the three-week trial. Their difficulties with translating knowledge into practice demonstrate the necessity to consider whether users are able to perform the behaviour they are being instructed to do.

Providing feedback on household energy consumption is a similar example of enlightening users that has proven effective (e.g. Fischer, 2008). However, combining enlighten strategies with different ways of spurring users can increase motivation and reduce consumption even further (Dwyer et al., 1993). Strategies that *Spur* more sustainable behaviour include for instance incentives and competitions that encourage and tempt users to perform a specific behaviour. During a six-months field study Selvefors et al. (2013) studied a web portal that combines enlighten and spur strategies to assess the effectiveness of this solution in influencing the electricity consumption of 23 households. The web portal aimed firstly to enlighten the users by providing real-time feedback and historical comparisons, and secondly to spur the users by including normative comparisons and goal setting incentives through energy challenges. Furthermore, the social incentives to reduce consumption were strengthen by enabling the users to post comments on the web portal and discuss energy conservation measures. The households that used the portal more regularly managed to reduce their electricity consumption by an average of 9% compared to their consumption during a corresponding period the previous year.

The study suggests that these types of solutions can motivate and spur people to reduce their consumption but there are also other influencing factors. The findings reveal that personal capabilities (e.g. financial situation) and contextual factors (e.g. available technology) impact the households' actual possibility to change their habits and reduce their energy consumption long-term.

One way of addressing the contextual factors and to *Steer* behaviours in a more sustainable direction is to consider the resource using product itself. To achieve this, the sustainable behaviour should be facilitated and be the most apparent way of using the product, for instance through clear affordances (Norman, 2002; Wever et al., 2008). More resource consuming ways of using the product should instead be made more difficult. To explore the possibility of steering through product design, two different washing detergent packages were designed with the purpose to induce moderate dosing and then evaluated in a four months field trial involving eight households (Lidman et al., 2011). The first package had an inner construction so that only a fixed amount of washing detergent poured out each time the package was tilted. For a standard wash, three such tilts were needed. This way, the users were steered and correct dosing was facilitated as the users could easily count the number of tilts. The second package contained washing detergent tablets (unavailable where the evaluation was carried out). The washing detergent tablets gave the users a simple cognitive script to follow when dosing and made it impossible to thoughtlessly pour washing detergent. In the field trial, the users of both types of washing detergent dosed as recommended. Ten participants adopted the products as they appreciated being steered towards moderate dosing and that no mental effort was needed in the procedure. However, one participant rejected the tablets, as she did not accept being steered and losing control. Thus, the findings indicate that when applying steer strategies the person's wish for control must be considered.

In the category *Force* all strategies compel the sustainable behaviour upon the users by making the undesired behaviour impossible for instance through limiting a product's functionality. An example is a washing machine that automatically adds a suitable amount of washing detergent. The difficulty with applying these types of strategies is not to make them efficient, but rather to render acceptance from users. Some users might find such a washing machine too controlling while others will accept the functionality and even find it convenient. An opportunity to acquire acceptance for products with a force dimension is to introduce innovative products with new use principles as a novel use situation may make it easier to accept that new behaviours are required.

DISCUSSION AND IMPLICATIONS

Several studies have concluded that the use phase is a significant contributor to the environmental impact in a product's life cycle. Additional studies have demonstrated the difficulty associated with changing users' behaviours. The DfSB approach offers a range of different strategies that add to the development for sustainability toolbox. The examples provide evidence of how a product can be designed to enlighten or spur a more sustainable use behaviour as well as how a particular product's design can enable or steer a user to behave in a less environmentally harmful way. The proposed model (Lidman & Renström 2011) offers a tool when designing solutions. However, in order to increase its usefulness a key issue for the future is to develop further knowledge on which strategies are most efficient in which situations and for which problems. Such a model has been proposed by Zachrisson and Boks (2010) but it has limitations as it is primarily based on user attitudes towards the

specific behavior of interest and does not consider the situational and contextual factors which have been identified as important. Ölander and Thøgersen (1995) conclude that otherwise motivated and able people will not perform a specific behaviour if the contextual factors do not provide the opportunity to perform or enable the desired behaviour.

The examples illustrate the importance of a more holistic perspective and use and user-centred approach. When designing for a certain behaviour a thorough understanding of the users, their attitudes and values, behaviours and habits is fundamental but investigations must reach the 'point-of-interaction'. Such in-depth user studies were for instance able to demonstrate how a certain principle for heating water in a coffee maker triggered a use behaviour that resulted in the water being heated not once but several times before the coffee was consumed (Thornander et al. 2011). Equally important is to understand the contextual factors that influence the users actual or perceived ability to behave in the desired, sustainable way.

REFERENCES

Dwyer, W.O., Leeming, F.C., Cobern, M.K., Porter, B.E., Jackson, J.M., 1993. Critical Review of Behavioral Interventions to Preserve the Environment. Environment and Behavior 25, 275-321.

Fischer, C., 2008. Feedback on household electricity consumption: a tool for saving energy? Energy Efficiency 1, 79-104.

Lidman, K.M.E., Renström, S. 2011. How to design for sustainable behaviour? A review of design strategies and an empirical study of four product concepts. Master thesis. Chalmers University of Technology, Göteborg

Lidman, K.M.E., Renström, S., Karlsson, I.C.M, 2011. The green user. Design for sustainable behaviour, IASDR Conference 2011, Diversity and unity, Delft, the Netherlands, pp. 1-12.

Lockton, D., Harrison, D., Stanton, N., 2010. Design with Intent: 101 patterns for influencing behaviour through design. Equifine, Windsor, Berkshire.

Merkisz, J., Pielecha, I., Pielecha, J., Brudnicki, K., 2011. On-road exhaust emissions from passenger cars fitted with a start-stop system. Archives of Transport 23, 37-46.

Norman, D.A., 2002. The Design of Everyday Things. Basic Books, New York.

Selvefors, A., Karlsson, M., Rahe, U. 2013. What's in it for the user? Effects and perceived user benefits of online interactive energy feedback. Paper submitted to the ERSCP-EMSU conference, June 4-7.

Strömberg, H.K., Karlsson, I.C.M., 2013. Comparative effects of eco-driving initiatives aimed at urban bus drivers - Results from a field trial. Transportation Research Part D: Transport and Environment 22, 28-33.

Thornander, S., Karlsson, M., Bakker, C. (2011). Predicting Energy Thieves. Proceedings from Conference on Sustainable Innovation 2011, 'Towards Sustainable Product Design', 24-25 October 2011, Farnham Castle, Farnham, UK, 193-201.

Wever, R., van Kuijk, J., Boks, C., 2008. User-Centred Design for Sustainable Behaviour. International Journal of Sustainable Engineering 1, 9-20.

Zachrisson, J., Boks, C. (2010). When to apply different design for sustainable behaviour strategies? ERSCP-EMSU Conference, Delft, The Netherlands, October 25-29, 1-20.

Ölander, F., Thøgersen, J., 1995. Understanding of consumer behaviour as a prerequisite for environmental protection. Journal of consumer policy 18, 345-345.