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Beyond (eco)design: current approaches to sustainable packaging design

Dr. Renee Wever

Design for Sustainability group, Delft University of Technology, the Netherlands

Department of Design and Manufacturing Technology,University of Limerick, Ireland

Abstract

Packaging has always received a lot of attention within the field of design for sustainability. The classical approach has been to mainly focus on reducing the impact of the packaging. This approach stems from the ill-informed position that packaging is superfluous, or at best there only for marketing reasons. This is a rather guild-based approach that, if taken to extremes, would lead to complete elimination of packaging, or at most a quintessential brown paper bag. In industry reality though, the packaging design is seen as a way to differentiate, to stand out from the competition. That view is at odds with the sustainability view. Also, through fulfilling its other functions, such as protection of the packed product, packaging contributes to sustainability.
This paper discusses several other approaches, such as circular economy as an alternative perspective on sustainability, prevention of food waste as an alternative design priority, and the eco-cost value ratio as an alternative assessment method. Subsequently, the alternative assessment method, the so-called eco-costs/value ratio, or EVR, is elaborated upon. By comparing the eco-burden of a packaging with the value created, it allows aligning sustainability and marketing performance. Hence, it shows an approach to design for sustainability that is more in line with business reality. In this paper several packaging examples are used, but this method is applicable for all sorts of designs, such as furniture design and service design, as will be briefly discussed as well.

Keywords

Ecodesign, green design, life cycle assessment, packaging design, food waste, eco-efficient value creation, cradle-to-cradle, circular economy

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Introduction

Packaging has always received a lot of attention from environmentalists. For several decades a strong focus has existed on the reduction of packaging itself, and of packaging waste in particular. The traditional approach is to strive to minimize the packaging as much as possible. This results in approaches such as thin-walling. This type of applied ecodesign is also called eco-efficiency, striving to do more with less. This focus is partially the result of the focus in the packaging legislation of the European Union.

This view on packaging is rather guild-based, in the sense that packaging is said to be at fault. This perspective does not do justice to the many functions that packaging fulfills, such as the conservation of food that would otherwise go bad.

In recent years a more balanced view on packaging and sustainability is emerging, which will be discussed in this paper. First, as an introduction, the classical approach to sustainability assessment for packaging will be discussed. Subsequently, different views will be discussed, starting with different philosophies on what should be the objective of sustainable design, namely cradle-to-cradle and circular economy. Subsequently, a different priority in sustainable packaging design, namely the prevention of food waste will be discussed. Finally an alternative approach to assessing sustainability for packaging will be discussed.

Life Cycle Assessment

Different packaging alternatives can be compared using so-called Life Cycle Assessment (LCA). In LCA the in- and outputs of a given system, in terms of materials and energy, as well as the resulting emissions are analyzed and related to environmental effects to allow comparison of alternative solutions. This could for instance be applied to comparing single-use packaging to refillable packaging. LCA can also help designers in determining which aspects of a current design are most in need for improvement. LCA was for instance used to determine that for durable goods, such

as consumer electronics, transportation volume results in more impact, through its influence on transport, than the materials used for the packaging (Wever, 2009; Wever, 2011). However, LCA does not fully cover all aspects of sustainability, as becomes clear from the discussion on the assessment of carrying bags presented by Lewis et al (2010). One of the aspects that isn't covered in LCA is the social aspect of sustainability (Nordin & Selke 2010, Wever & Tempelman 2009). Although not a limitation of LCA, the method has been strongly associated with the eco-efficiency approach of ecodesign; the optimization of the status quo.

Cradle-to-cradle & circular economy

The traditional approach of eco-efficiency and optimization using LCA has been criticized for only trying to be 'less bad', instead of good. Alternative approaches, such as cradle to cradle (McDonough & Braungart 2002) and circular economy (a concept introduced by the Ellen MacArthur foundation based on earlier ideas such as cradle-to-cradle and industrial ecology) strive to work towards an envisioned future where materials stay in either the biological system or the industrial one. This leads to activities where the re-use of a product is stressed more than the re-use of the materials. And in recovery of materials, the potential of getting it back and using it again is more important than minimizing the packaging from the start. Minimal packaging might for instance use complex laminates, which allow the designer to use very little material, but proper recycling of the material would become impossible, as the layers cannot be separated again.

Such thinking in industrial and biological material cycles, has strengthened the efforts in making packaging compostable and/or biodegradable. By allowing materials to go through the biological cycle, laminates are possible, as long as they decompose quickly enough to basic chemical substances. This may appear a sensible approach, but one needs to realize that composting is only truly helpful if a nutrient-rich product remains. If a polymer degrades into CO_2 and H_2O only, composting is less sensible, as it waste the energy that could have been recouped through incineration.

Food waste

Another current topic related to sustainable packaging design is the topic of food waste. A considerable percentage of the food grown and bought is wasted. Estimates vary

widely but are always substantial. Part of the food waste occurs in underdeveloped countries due to a lack of proper packaging. In developed countries a lot of food is wasted by over-consumption. People buy too much, leading to their stock going bad, or simply going over the best before date. As consumers have lost their ability to judge whether food is still edible, the passing of the best-before date is sufficient reason for them to discard the (often still packed) food. People also prepare too much for a meal, and they do not know how to deal with the left-overs, thus also resulting in a lot of food being wasted. Many consumers have also lost the knowledge about how to properly store food (e.g. inside or out of the fridge), resulting in food going bad sooner.
Packaging design can also make a difference in the amount of food that will (likely) remain in the emptied package. Silvenius, et al (2013) show the importance of including the influence of the packaging design on the amount of resulting food waste as a factor in assessing the sustainability of that design. Finally, many packages contain more food than is used in one meal, resulting in opened packaging, with food that starts to go bad. The environmental impact of the packaging is usually substantially lower than the impact of the packed product (INCPEN 2009, Silvenius, 2013). Yet, packaging design can have an influence on food waste. Better packaging can result in a more distant best-before dates (here also smart packaging with adaptable best-before dates are an interesting development), better *reclose-ability* can assist in a slower deterioration of food in opened packaging, better *emty-ability* can help not wasting a residue and clever portion packs can help not exposing too much food before it is eaten. Hence, reduction of food waste may be a more relevant target for sustainable packaging design, than the reduction of the packaging itself.

Sustainable behavior

Packaging design that helps consumer waste less food touch upon another interesting sustainable design strategy, that which aims at creating sustainable behavior (e.g. Lilley, 2009; Lockton, et al 2010, Wever 2012). The idea here is to stimulate users, through the design of the packaging, to behave in a more sustainable fashion. This thinking can be applied to see how people use emptied packaging for secondary purposes (Langley et al 2011), how to design systems for consumers to be willing to work with refillable packaging (Lofthouse et al 2009) and how to design packaging to help prevent littering behavior (Wever et al 2010).

Eco-efficient value creation

As stated in the introduction, packaging has been a target for environmentalists. The continuous strive to reduce packaging and packaging waste is not in line with the business perspective on packaging. Besides its functions which are highly important from a sustainability point of view such as the prevention of product loss, the packaging also has to fulfill a marketing role. It is a differentiator that helps a producer to distinguish their product from the competitors' products. Hence, as a final example of a more modern way to look at packaging and sustainability, this paper will discuss an approach that balances marketing and sustainability in a quantified way (this approach has been previously presented in Wever & Vogtländer 2013a & 2013b).

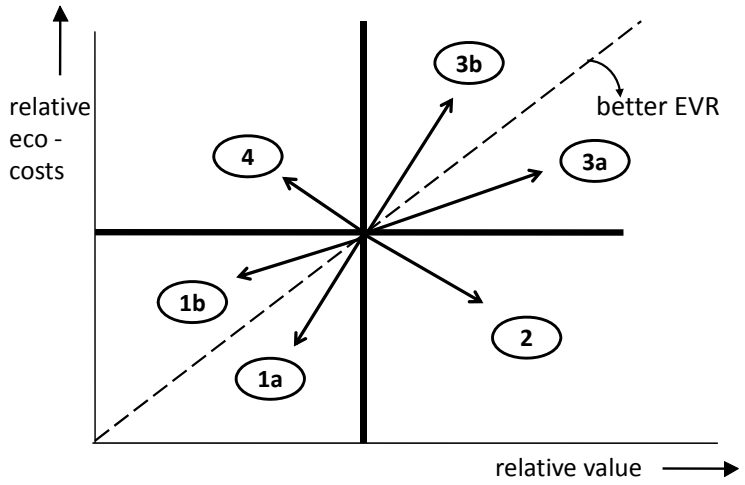
To achieve differentiation from competitors, packaging designers vary materials, printing and shapes. Such designs go beyond the bare minimum necessary for protecting the packed product, and result for instance in added convenience for the user. This approach to packaging design is perpendicular to the classical sustainability perspective that calls minimal packaging. Life Cycle Assessment is incapable of including such differences in convenience. Only when the different packaging solutions would result in different spoil or waste rates for the packed product, the use scenario might play a role in the LCA.

The method presented here, and for which the details can be found in Wever & Vogtländer (2013a & 2013b), strives to assess the functionality (expressed in the form of value created) provided per unit of environmental impact. It consists of a form of fast-track life cycle assessment, resulting in a single indicator. In this case the single indicator is expressed in euros, representing the costs of undoing the impacts caused by the creation of a product, service or in this case packaging. These eco-costs are subsequently compared to the value created, thus resulting in an eco-cost / value ratio. The objective of the designer subsequently is to optimize this ratio.

For a detailed explanation of the methodology behind the EVR model we refer to previous publications, in particular the open access publication introducing EVR to the field of packaging (Wever, Vogtländer 2013).

New designs can relate to a reference product in multiple ways. The value can go up or down, and simultaneously the eco-burden can rise or fall. The figure below presents the resulting directions. Obviously, direction 2 is ideal, and direction 4 should be avoided at all cost.

In packaging, the creation of additional convenience will often mean that you are either in 3a or 3b. Here 3b is to be avoided, as it generates limited value at substantial eco-burden. At the same time, 3a improves the EVR, by creating substantial value at limited cost in additional eco-burden. This way, EVR allows comparing packaging solutions that score differently in functionality, something that LCA is not capable of.



The potential directions of innovations in terms of EVR
as compared to the reference product (Wever & Vogtländer, 2013a)

To demonstrate the possibilities of the method, two product portfolios will be analized. Here, products were selected that are relatively simple to assess themselves, namely salt and bottled water (this is a self-chosen limitation for clarity, not a limitation of the methodology per se).

For the bottled water a portfolio of 5 different bottles was used for the table salt a portfolio of 3 pack sizes was used (see Figure on next page).

For the bottled water the portfolio consisted of two 0.5 liter bottles (one with a sprtscap), a 0.75 liter bottle with sportscap, a 1 liter bottle and a 2 liter bottle. The salt portfolio consisted of a 1 kg paper bag, a 600g table jar and a 125g table jar. The data were calculated to equivalent values for 1 kg and 1 liter equivalent.

The eco-cost of the paper bag are so low, that they easily compensate for the lower value, resulting in an EVR of 0.0076. The EVR of the 600g bottle is roughly tenfold that of the paper bag, namely 0.073. The small bottle, subsequently, performs a bit better than the larger bottle, with an EVR of 0.046.

The two described portfolios, with on the left bottled water and on the right table salt (Wever, Vogtländer, 2013b)

Hence, from an EVR perspective the preferred order of these packaging solutions would be the paper bag first, followed by the small 125g bottle, and the 600g bottle last. When compared with classical LCA (for which the eco-costs by themselves are a good indicator), the paper bag would also score best, but the eco-cost per kilo of delivered salt are better for the 600g bottle than for the small 125g bottle.

The EVR scores of the water bottles are: 0.053 for the 0.5l with normal cap, 0.037 for the 0.5l with sports cap, 0.050 for the 0.75l with sports cap, 0.060 for the 1l and 0.051 for the 2l bottle. This gives an order of preference based on EVR of: 0.5l sports cap, 0.75l sports cap, 2l, 0.5 normal cap and finally the 1l. The preference based on eco-costs per liter of water (and thus regular LCA) would be: the 2l, the 1l, the 0.5l with normal cap, the 0.5l with sports cap and finally the 0.75l with sports cap. Hence, here the results for classical life cycle assessment and EVR assessment run much wider apart, thus presenting an additional perspective on packaging and sustainability that is better in line with the business perspective of packaging as a differentiator. (this results paragraph is copied from Wever & Vogtländer 2013b).

Conclusion

This paper has discussed current approaches to sustainable packaging design, trying to go beyond ecodesign. It addressed alternatives to the eco-efficiency approach in the form of cradle-to-cradle and circular economy. It discussed priority setting in suggesting that prevention of food waste may be a more relevant target than minimization of packaging (waste). It touched upon current work being done in designing for sustainable behavior. And finally, it covered alternative assessment methods for determining the sustainability performance of packaging designs.

Both the different perspectives on sustainability (cradle-to-cradle and circular economy) and the eco-cost value ratio method are of course not limited to application in the field of packaging. Many examples can be found in scientific literature as well as wider media that discuss application in other design domains. Recent publications on the EVR method cover applications related to cork furniture and tourism services (Mestre & Vogtländer 2013, Vogtländer et al, 2013).

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