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Bridging the Gap between Design and Engineering in Packaging Development

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Abstract
Packaging designers often come up with splendid design proposals, without being aware of technical, marketing or economical restrictions. This leads to infeasible proposals, so many packaging design projects fail. To bridge the gap between design and marketing, a tool has been developed that shows several designs to an extensive community. Designers now have the possibility to get feedback of the target market on the design proposals. In a case study (redesigning a packaging), the tool clearly showed its advantage. This paper discusses the tool, its usage and its contribution to a more effective and efficient development cycle in packaging development.

Keywords:
Packaging, User involvement, Design, Management

1 INTRODUCTION

A strong characterization of packaging design is the amount of aspects that have to be taken into concern during the design process [1]. This asks for adequate management of the development cycle, and especially of the design and engineering decisions taken. To depict the decision process, a decision model can be used. This model -closely resembling models used in the automotive industry- aims at interrelating the different stakeholders, methods and tools (see figure 1).

In the model, marketers define the need of the consumer or at least try to and come up with a briefing for designers. Product designers and engineers have to come up with design proposals including the design of the packaging, and process engineers have to translate this all to a proper running production process. It is interesting to note the intermediary role of the engineers in the model, interrelating the different stakeholders.

With the input of human resource, the purchasing of the packaging materials and tools the production can start. Problems can be overcome by using tools like Kaizen and Six Sigma. If necessary, feedback can be given to process engineering or to product development.

Product design or development in the field of packaging design is generally managed by designers and engineers in cooperation. In this, many different views on the packaging development cycle are represented. Many designers focus on the appearance and styling of the packaging without having any knowledge or insight into technical or economical feasibility.

The reason for this is that, often, the packaging sells the product, especially in the case of fast moving consumer goods. Other specialists in the cycle may, on the other hand, focus on specialisms like material, ergonomics or filling line behaviour.

Furthermore, the development process is complicated by the fact that –in packaging development- there is a clear lack of proper education. Many designers have no idea about the hundreds of kinds of paper and board, about the use of laminates, about special paper qualities needed for wet glue labelling, about detail design aspects of glass bottles, microbiological problems related to food, permeability of plastics, etc.

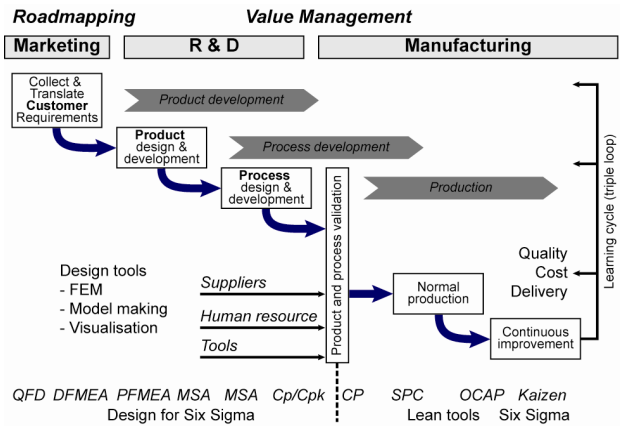

Figure 1: The decision model

This means that communication with specialists is extremely important and that there is an evident role for someone who can speak the language of all parties involved. The engineer has to translate all this into a solution that runs well on a packaging line, mostly with the expected overall equipment efficiency. If the communication process is not optimal this can lead to frustration and less effective and efficient development processes.

Nevertheless, it is expected that a development stage in a well-managed design process leads to a design proposal.

A very difficult question has to be answered at that moment is whether or not the proposed design is a successful representation of what the marketers had in mind. The immediate subsequent question is if the design will be accepted by the market.

Next to their own intuition, marketers use several tools to answer these questions. These tools encompass market research tools like in depth interviews, panel interviews with a selected group of customers, discussions with in-house panels, the use of test markets etc. The problem with many of these tools is that customers behave different from what they say they would do. It appears that the uncertainty of the outcome of research like this is very high.

Also designers and engineers have many tools at their disposal to reduce uncertainties in the realization of product-packaging combinations. Examples are final element analysis, (rapid) prototyping techniques, renderings, animations, and so on.

In many cases, the marketing tools and engineering tools are strictly dissociated. Clear advantages can be gained if the gap between marketing and engineering could be bridged in an effective manner.

Therefore, a tool is being developed to help designers and engineers to get better feedback about design proposals.

2 PACKAGING IN PRODUCT DEVELOPMENT

Packaging is being produced in tremendous amounts. Every day a West European citizen opens 7 packaging on average. This means that more than 200 million packaging are being opened every day in the EU countries. This also means that there is a high potential for a high economy of scale in this field. On the other hand, equipment is expensive and Return on Investment calculations are based on payback periods of 8 till 10 years. Additionally, it is important to note that the cost ratio between the equipment and the processed material is extremely high. Most of the processed materials are rather cheap materials (paper and board, glass, plastics with 80% PE and PP, metals like steel and aluminium), resulting in costs of cents per packaging.

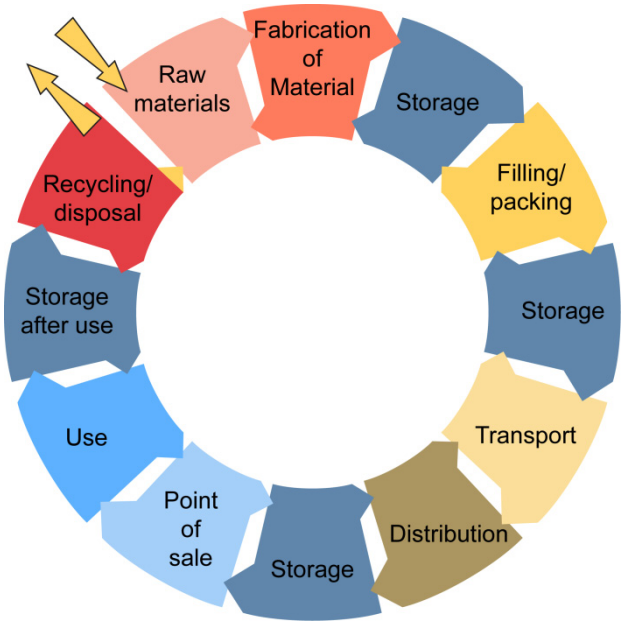

Figure 2: Simplified indication of the packaging development aspect chain [2]

Packaging plays an important role in the protection of goods, i.e. food and other fast moving consumer goods, pharmaceuticals, durables, industrial goods and dangerous goods. Looking at the economics of packaging, less than 2% of the total value of the products is spent on packaging. Consequently, for many companies, packaging is the closing entry of the development process, despite the huge importance it has in the life cycle of the product/packaging combination.

Moreover, the packaging chain is often longer and more complex than the product chain. Therefore, it can be seen as a special instrument in decision processes, referred to as the packaging development aspect chain (see figure 2.)

2.1 Packaging design

Packaging design is often mistaken for a graphical design process. This is not surprising, given the fact that for consumer products, the packaging has an unmistakable influence on the buying behaviour. Of all packaging material, at least 2/3rd is used for the packaging of food. Most food is sold in self service shops; this means that the packaging has to be the seller of the product.

However, graphical design is only one aspect of packaging development. Changing the graphic design has negligible influence on the packaging chain, because the equipment does not have to be changed and no investments have to be done. In this way a packaging design can be updated regularly and can stand for decades. Many people think that packaging design is only of importance in the fast moving consumer market. This is absolutely not true. It plays a similar role in the market of durables and industrial goods, as well in the market of pharmaceuticals. A number of illustrative examples include:

- An Apple computer is being packed in a printed box, while a Dell or Compaq computer is being packed in an undecorated brown box.
- Gerkens Cacao uses white paper bags for 25 kg of cacao to show how clean their packaging process is and to express to their customers that the chance on bacterial growth of salmonella is being reduced by their way of working.
- Pharmaceutical company Merck Sharp & Dohme tried to change their packaging design, a white box with just a brand logo into a design with coloured flowers on the packaging. Based on customer response, they swiftly reverted to the old design. This shows that also pharmaceuticals are looking for ways to distinguish themselves from competitors by means of packaging.

2.2 The decision process

In general, marketing departments decide that a packaging has to be redesigned. As the environment in which the product is sold or the after purchase feelings are influenced by the packaging design and to keep up sales, the marketer wants to have a adequate design. The design process mostly starts with a briefing. The new design or the redesign must for example look more natural, fresh, dynamic, young, green, professional, etc.

Designers then start designing and come up with design proposals. Sometimes they try to change the geometry of the packaging; this means that engineers and packaging technologists must be integrated in the project to discuss e.g. feasibility and costs. In many projects there is a certain flexibility concerning investments. If someone is enthusiastic about a design proposal, it can mean that starting points for the project change. In an ideal situation,

designers and engineers come up with a joint proposal with a high and substantiated feasibility. As uncertainties always play a role in development cycles, tools can be employed to map, control and reduce these uncertainties.

To finish the decision process finally production has to agree to the proposals and has to make estimations of the coming changes and how to anticipate them. Changes can imply additional education, routing and logistic consequences etc. Suppliers, human resource and new tooling can be part of this process. In reality the process is an activity in which the different steps are being executed in cooperation like an integrated process should do. Nevertheless, there can be seen a certain hierarchy in decisions that have to be taken.

Many tools are appropriate to guide and facilitate these processes. In figure 1 in the bottom line an enumeration of these tools is given. Examples are Quality Function Deployment, Failure Mode Effect Analysis, Measure System Analysis, Design of Experiment, Statistic Process Control, all also known as being part of approaches like Six Sigma and Lean Tools. Besides that, several design methodologies can be use to optimize this process, for instance the Stage Gate Process Model of Cooper [3].

One of the structural conflicts in packaging design is that a new design needs innovative ideas to be distinguishable in the market. Creative people can boost sales as we know from products like the IPod, but also from packaging like the pump for liquid soap or the tube packaging from Pringles. Another good example is the new beer bottle for Grolsch, introduced in 2007; the new packaging itself caused percentages of market growth in a saturated market with many competitors. The development process requires creativity, but it must be controllable. Moreover, it should not lead to infeasible designs, designs that will not be accepted by the market or that lead to frustrated engineers.

Compared to product design, for packaging design, a number of aspects have to be defined in different way. Two examples are cost and styling.

Costs

For example, often the costs of the packaging and of the packaging process do have a tremendous influence on the total price of product-package combination, while profits are marginal. This is especially true for fast moving consumer goods. Even a small change might require a substantial investment, implying a radical change in the market. An example is the toothpaste tube of the brand Theramed. In the opening of the tube a nozzle has been placed to optimize convenience. When this new design, which was much more expensive, was introduced into the market, the consumer did not see the difference nor (hardly) noticed the improvement in convenience. Consequently, the new product was rejected by the market. The total project costs were very high: not only was the tube more expensive, also the toothpaste itself had to be changed to optimize its viscosity for the functioning of the nozzle. Moreover, new equipment had to be developed for the filling process.

Styling

Another aspect that plays a role is the appearance/styling of new designs. Experiments with the design of labels of bottles indicated that changes that are hard to appoint by customers, can nevertheless strongly influence the opinion about the product as well as the willingness to pay for it [4]. In the experiment, two bottles with water with labels are compared. A design with curls in the outline of the bottle and a rather straight design were labelled with two different designs, one with a curly font and one with a straight font. People judged the quality of the water higher if the style of the label matched the design of the bottle.

3 TOOLS TO BRIDGE THE GAP

3.1 Cost price estimation

A distinct packaging characteristic for consumer products is the large quantities in which they are produced. Therefore, companies that produce packaging usually focus on a certain speciality, within a certain range. This means that it is relatively easy to deduce key figures.

Plastics

For example, a company producing plastic bottles, for the largest part out of polyethylene (PE) with a price of 1.4 euro per kilogramme, uses 1,000 tonnes of PE and the turnover is about 2.8 million Euros. This means that the added value is twice the cost price of one kilogramme PE. Consequently, a bottle of 20 grams costs about 7 cents. Prerequisites for these approximations are that series have to be large and the shape has to be more or less according to the average standard bottles. This also means that it must be able to make estimates of different sizes and for small or large series.

Because of this economy of scale and the relatively cheap materials, for most packaging a fairly accurate estimation of cost prices is possible. Therefore, a tool can be made to estimate the costs of a new packaging design based on key figures.

Corrugated cardboard

For corrugated cardboard, key figures are based on the amount of carton being used, expressed in square meters. There is a lot of difference between available qualities of cardboard, but these differences are known. The costs of direct printing do hardly influence the cost price except for working with pre-printed materials.

Folding boxboard

For folding boxboard key figures can be found based on the amount of material, also expressed in square meters. Here, the number of printed colours directly influences the cost price. Special inks and special printing effects also can influence the costs as well as the number of spots to be glued (for the so called ready-glued boxes).

Glass

For glass bottles and jars the costs can be estimated based on the weight of the design and on the price of the plastic. For glass the colour also influences the price.

Metal

Rigid metal packaging has more or less fixed prices according to the type of material, the volume and the amount of material used. Standardization determines the prices for a great deal.

Foil

Flexible plastics have to be divided into the bulk materials like PE for shrink and stretch foils and into the more sophisticated applications like multi-layer foils. In the first group, key figures are based on the weight, in the second group on the surface and the amount of printed colours.

For an engineer it is possible to estimate the amount of material used in the design of the packaging. With 3D modelling software the amount of material can be determined and the costs can be defined. This means that an engineer can give accurate feedback on the costs of the packaging quite fast and easily. Therefore, engineers can provide important input in the decision process.

3.2 Judging the appearance of design proposals

It is difficult to determine how customers judge a design proposal. Packaging design can be built up out of several elements. Tijssen [5] distinguishes seven of them in two groups: physical aspects and graphical aspects. The *physical elements* are material and shape. Changing these can cause high investments and therefore high costs. For this reason often only the graphical design is changed. The *graphical design elements* are: colour, typography, use of images, graphic devices and the use of brand marks.
An engineer can make drawings of design proposals by using 3D software and make renderings or snapshots from the drawings. By projecting the graphical design on the design, it is possible to show a realistic picture of the packaging design.

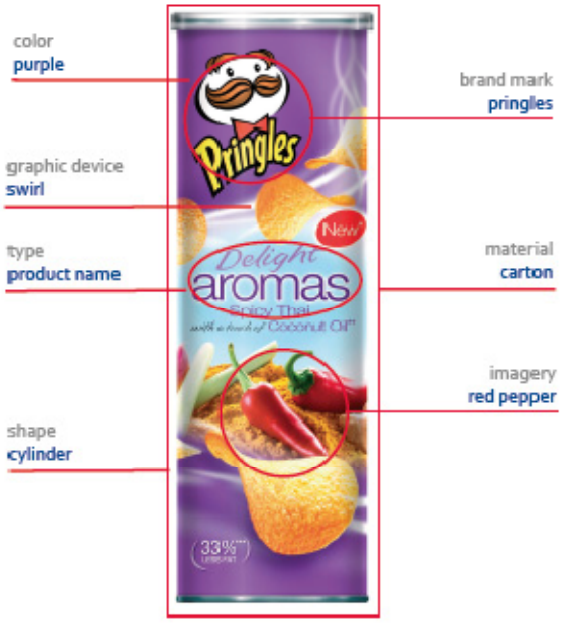

Figure 3 shows the elements that can be used to change a packaging design [5]

The graphical packaging design can be changed rather fast by using 2D software. The 5 elements can be changed separately.

Colour: different colours can be shown very fast.

Typography: different typefaces and different lay-outs can be realised quite fast although the efforts to change a design may not be underestimated.

Use of images: several images can be put on the packaging, each in different printing qualities and with different appearances.

Graphic entity: the design can be supported by many different devices like lines, shapes, coloured surfaces, dots, and so on.

Brand marks: a small detail can influence the opinion of a customer considerably. Adding a brand mark is an important example thereof.

To better assess the market acceptance of the packaging design, or to optimize the design, it would be beneficial to show the design proposal to a large group of persons. To overcome the problem that a design might be presented as if it is going to be exhibited in a museum, it must be tested in a realistic environment: among many other competitive products, in an adequate context.

Online tool

An online web tool[1] has been developed to involve an extensive community, part of the target group, in the judgement of design proposals. This is done by displaying the designs on a virtual shelf, surrounded by designs of competitors. Small changes are made in the designs of the different packaging, like changing the colour, the fonts, use of different graphical elements, adding logo's and pictures, one by one. The designs are taken up in a set of screens with pictures of the existing products. Three parameters are tested with the tool: shelf value, brand value and preference value.

Shelf Value: The Shelf Impact of a certain package within a fully packed shelf landscape. How does a package hold up within a packed shelf with competitors?

Brand Value: Does the target group recognize the proposed brand identity and values in the package.

Preference Value: Is the target group attracted towards a package when an affectional choice needs to be made?

People out of the target group have to state their preference several times by clicking on items. In several steps the following information is gathered: general details about the person, buy-in-shelf ratio, memory value, recall of position on the shelf, brand value, buy intention and preference ratio. A score model has been made to judge the outcomes of the tool.

4 CASE STUDY

A case study has been set up in which a number of design proposals were displayed on the virtual shelf. It was a realistic test with a product that –at that time- was under development, and by now has been introduced into the supermarket.

In broad lines, the model that underlies this case study, addresses amongst others a number of distinct steps:

- Preparation of the design
  (create multiple variants with a controlled, purposeful divergence)
- Selection and invitation of probands
  (based on a >2.000 candidate database)
- Categorisation of participants by means of general questions
  (target group, age, gender etc.)
- Product type analysis
  (focus on product type awareness, familiarity etc.)
- Confrontation with new packaging design
  (assess perceived healthiness, taste, brand image)
- Divergence of the new packaging design is assessed
  (determine relation between e.g. colours, font types, logos, graphics and e.g. perceived naturalness, healthiness etc.)
- Statistical analyses
  (determine the influence of small design changes on consumer perception)
- Designer feedback
  (based on the statistical analyses, the designer gets a substantiated feedback on the design in terms of the consumer perception, together with a sensitivity analysis focusing on the design changes vs. the perception)

[1] *For reasons of IP-protection, no images of the tool can be shown here*

Conclusions of the test were remarkable. For example, the tool showed that the placement of the package with the top facing the customer (instead of the side) improves the shelf value. The buying intention of one of the designed packaging scores not so good with floating (impulsive) shoppers. But, on the contrary, the same design scores relatively high when it comes to buying-in-the-shelf simulation. The shoppers with no brand preference in 50% of all cases buy the new packaging design.

A validation of the tool has been set up as well. The main conclusion was that the buying patterns in front of the virtual shelf resemble the actual purchasing behaviour in the supermarket to a great extent. The tool showed that marketers were able to quickly see consequences of different designs, which reduced uncertainties in decision making and in briefing the designers and engineers.

5 CONCLUDING REMARKS

Bridging the gap between designers and engineers with marketers can be done by using tools like a web based on line tool in which a virtual shelf is used to compared different designs and design variations. The tool made it possible to obtain information about many aspects that play a considerable role in purchasing decisions. The appearance of the packaging design mainly determines the purchasing decision; the tool can be used to optimize the design. In co-operation with designers, engineers can determine the cost prize; moreover, many uncertainties can be taken away. Although the tool needs optimisation, it has already been proven that gaps can be bridged and that design methods can be optimized.

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