Expectations and Challenges of Consumer Package Customisation

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Abstract

Package customisation offers plenty of ways to add value into packaging. New functional characteristics and targeted messages can be created to consumer packages in order to create added value in the package itself by utilizing the latest digital printing techniques. This means, for example, that personalised and up-to-date product information, announcements or advertisements can be as an integral part of a package. Also new kinds of logistic and anti-counterfeit systems, based on the potentiality of digital printing methods, coding and detection systems, and information networks, can be developed for the optimisation of the supply chain. But there are also several challenges to overcome - like questions of print quality management, compatibility of printing materials, package converting and costs of digital printing - before on-demand packaging production printing can be fully executed.

In this paper we present different aspects of our packaging research and especially the utilization and potential of digital printing in package customisation. VTT has carried out several projects aimed at the development of comprehensive systems for new kinds of package production chains. The consumer packaging issues have been studied from both packers' and consumers' point of view. Information was gathered from literature and by qualitative research. The qualitative research was carried out by interviewing packaging specialists in the packaging branch and by participating in consumer workshops.

Introduction

The importance of packaging as a source of information is unquestionable. Packaging is the messenger of product information, marketing messages, safety information for authentication, and messages for logistics needs. What makes packaging the single most effective element of consumer communication to gain competitive advantage is its proximity to end user. Packaging is an informative, practical and aesthetic way to give messages, added value and impact consumers. On the other hand, package communication has big challenges such as the amount and quality of messages, competition of consumers and authenticating of products. Limited amount of space with large amount of information is challenging, keeping in mind that good readability is an essential part.

There is a need for innovative ways to answer to these challenges. Thereby it is important to study the possibilities to customise packages. Digital printing gives an opportunity to this, because it is the key technology for flexible package production. Digital printing gives an efficient tool to boost package communication with on-demand package production, in which the production of packaging, or the whole product, does not start until the order has been received.

This paper studies both the results of packaging research and ink jet printing aspects. The objective was to look at the expectations and challenges related to consumer package customisation: what are the drivers of and obstacles to packaging development, what the targets are, and how ink jet printing qualifies with consumer package customisation. Apart from market expectations and challenges, technical matters were taken into consideration.

Research method

The research subject was studied based on research on packaging development and digital printing. The conclusions were made after considering all the gathered information from the packaging study /1/ and utilising the results from VTT's long-term research on digital printing.

Study on package development

Consumer packaging issues were studied in terms of future development needs. Information was gathered from literature and by qualitative research. The main aims of the study were to recognise and understand the future challenges and the issues that drive consumer packaging development. The study concentrated mainly on the views of packers concerning packaging development. The study aims to help develop new characteristics for consumer packages for the right targets, and to serve the parties in the packaging chain, thus creating added value.

The qualitative research was carried out by interviewing packaging specialists in the packaging branch. In addition, the study also included participation in two interactive consumer workshops focused on packaging and packaging technology development. Priority was given in the study to the views of packers. In this case, packers were felt to be the most suitable target group for studying the research area and gaining comprehensive and in-depth information, since it is they who decide how their products are packed and sold to consumers. The sample of the twelve packaging specialists was a discretionary sample. The selected companies manufacture and pack consumer goods and represent major brands in Finland. One of the goals was to have different consumer product categories (food, beverages, pharmaceuticals, cosmetics and other products) participating in the study. This was done in order to get a wider view of consumer packaging than would have been possible by focusing on one sector. *Table 1* shows the sectors of the companies participating in the study. The number of companies tells how many companies were interviewed in each sector.

Table 1. Consumer packaging sectors of the companies in the packaging development study /1/.

Sector	Number of companies
Food	5
Beverage	2
Pharma	2
Cosmetics	1
Other	2

The main criterion for choosing the persons to be interviewed was their position in consumer packaging development in the selected company. The selected persons mostly held the position of packaging specialist or a related job in packaging development (packaging development manager, packaging design manager, brand manager, etc.). The interviewees were professionals in their fields and represented the target group successfully. Therefore it is assumed that the results would not change substantially in a larger sample.

The method used was theme interview. Theme interview was chosen in order to give interviewees the freedom to talk about issues they considered important. The topics discussed with the interviewees included themes such as the drivers of and obstacles to packaging development, packaging performance and development possibilities in selected functions of packaging. The same themes formed the basis of the subsequent analysis. This meant finding the substantive issues from the data. This also meant paying attention to the matters emphasised by several interviewees. The actual analysis was done by searching for the important statements, sorting and combining them, weighing and prioritising, and drawing conclusions.

Ink jet studies

VTT has focused on various development projects in the area of digital printing since the mid-90s. The first research was to develop suitable publication paper grades for ink jet printing processes in co-operation with the Finnish paper industry. In order to do that, new research methods based on high-speed camera technology were developed, because this way it is possible to clarify dynamic interaction mechanisms between ink jet droplets and the printing surface. These are valid tools - in addition to VTT's other state-of-the-art, industrial scale ink jet equipment - for the research, for example, of printing materials.

An important research area has been the packaging applications. In the beginning, the only possibility to utilize ink jet was just to add variable information on packages, but during the first project the whole potential of the digital package production was understood and the research was aimed at on-demand package printing and package communication. An intensive co-operation with the developers of new printers, materials and applications is crucial in the area, so close relations with the industry have been established.

Results

Ink jet printing in package production

There are two possibilities to utilize ink jet printing in packaging production. In the first case, the whole package is printed digitally, so every printed package can be 100% different. In this case, the production speed is limited by the speed of the digital printing press and degree of variability, which depends on the performance of variable data printing (VDP) software and raster image processor (RIP) hardware. During recent years, ink jet printing technology in particular has developed rapidly and nowadays digital printing presses that match the speed of multicolour screen printing machines have been built and there is not much gap between digital printing and offset lithography. So the possibilities to carry out digital package production printing are getting better and better every year.

Another way to utilize digital printing in packaging production is to use ink jets to add variable information onto pre-printed packages, which are often printed with conventional methods. There are several new printing machines where ink jet has been combined with flexography or screen printing.

Why customise

Today digital printing is already used in many of the package printing market sectors. Of these, label printing is one of the most active sectors. This derives from companies will to get rid of high volumes of pre-printed labels that require stocking and inventory. In addition, point of purchase (POP) materials is an active sector and also activity is found in the folding cartons sector.

Reasons for early adopters of digital printing in the field of packaging are many. Information gathered from real on-demand package printing cases tells that among companies adopting digital printing, conventional methods were felt to be unable to accommodate changing requirements for more flexible and customised offerings. Flexibility is wanted in order to print different language versions, barcodes, logos, images and marketing messages onto product packaging while reducing costs and lowering product lead times. Also allowing making changes in packaging design at short notice and without incurring additional printing costs is desired.

Variable data printing is also a significant driving force for digital printing. Variable data printing has gained interests among such companies who pack and sell products worldwide with a variety of brands. In a situation where products are delivered to a variety of markets the requirements of many languages and regions necessitate different information on packages. Printing of several different language versions can be troublesome for a company which delivers its many different branded products all over the world. This means various brands with various languages. In addition, with various carton sizes that can make hundreds of print variations per carton size. Also the needs of the customers and the brands they prefer can often change. Sometimes it is difficult for the retailers to know which products will be sold the most and when. This situation requires customisation and on-demand printing of cartons.

Challenges in digital package printing

The flexibility of ink jet technology makes it possible to place ink jet heads at the right location in the printing or packaging process. For example, the heads can be placed in the conventional printing press after traditional printing or they can be integrated in a packaging line before or after packaging. In any case, each interface and procedure must be carefully pre-organised so that the actual work flow will go smoothly. In digital package production,

it is important to understand that digital printing does not eliminate the need for graphic reproduction. In fact, variable data printing adds complexity to an already complex process. The digital job must also be adjusted according to the target printer, so reproduction of details, colour management, the right content of text etc., still need to be taken care of. In the digital work flow, these tasks are easier and quicker to accomplish, because many of them can be automated or semi-automated.

One bottleneck in the digital package process is converting. Many converting stages are needed for packages after printing, such as scoring, die-cutting, varnishing, folding, gluing and filling. These stages should be integrated as an inseparable part of the digital work flow to avoid expensive manual work and to gain the greatest benefits from digital package production. Because the digital manufacture of packages is a new concept, there are only a limited number of suitable alternatives for most packaging applications. For this reason, converting machines must often be developed or at least tailored as part of a digital manufacturing line development project.

Ink jet printing sets strict demands on the printing material, because the image is created directly onto the surface of package. The print quality will decrease dramatically, if ink flows on the surface of coated carton or spreads in the capillary network of uncoated carton. These phenomena are especially crucial in high-speed ink jet printing where there is no time for evaporation of solvent. The rapid development of UV curable inks has given solutions for these challenges, because they offer rapid curing and this way it is possible to print directly onto difficult substrates like uncoated media or non-absorbent surfaces.

Fixed costs are lower in digital printing than in traditional printing methods, because, for example, of shorter make-ready time and lack of printing plates or cylinders, but traditional printing becomes more cost-effective as run lengths increase. In digital printing, printing itself often accounts 50% or more of all costs. So relatively slow printing speed, in comparison with conventional printing, combined with colour limitations and maintenance requirements in continuous production are some of the main constrains in the case of digital printing in packaging sector. One of the most significant factors affecting costs is the share of compact, solid print area, so this should be realized when designing packages for digital production. Improvements in ink jet printing technology together with declining colour and equipment costs should change the situation drastically.

Drivers of and obstacles to package development

To understand the issues that affect packaging development, the drivers of and obstacles to packaging development were studied from the packer's perspective. According to the interviews both the drivers and obstacles are versatile. Six larger drivers of and obstacles to packaging development were recognised *(see Figure 1)*. Some of the factors can both drive development further or pose obstacles. The consumer goods sector is a competitive sector that requires constant updating and keeping up with the pace.

The ideal position for any company is to be a forerunner. But the forerunner position is not definitive. It is very important for companies that their packages can be differentiated and stand out on store shelves. Competition combines the importance of marketing and branding. Packaging transmits a quality image of the product and the brand to consumers, while helping the product to stand out from its competitors. Also a constant tendency towards greater efficiency is seen. Streamlining is done in order to improve profitability and requires optimisation of all factors. This is a two-way street for packaging – it is a driver for development, but, due to heavy rationalisation, also presents an obstacle. Rationalisation aims for cost-effectiveness, which does not favour experimenting. It can also be concluded that short-term thinking, aiming for fast profits, does not promote long-term development.

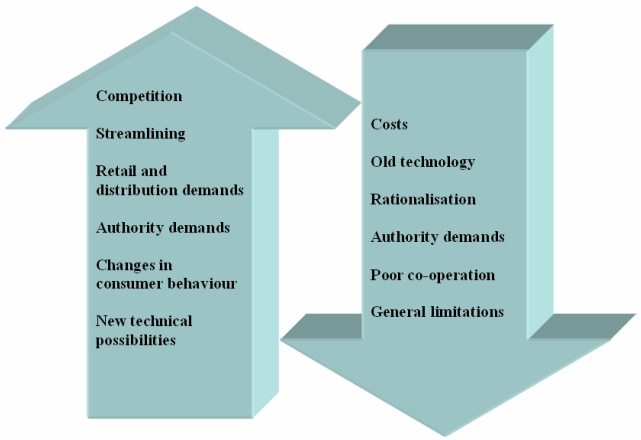

Figure 1. *Drivers of and obstacles to packaging development /1,2/.*

Authority demands - legislation and taxation - direct and control the packaging industry in many ways. In particular, constant legislative and regulatory reforms drive changes in packaging, e.g. concerning the package information or environmental requirements. The choices consumers make and general consumer trends affect packages. These effects are not always direct, but affect packaging development more indirectly. Packers make consumer studies and get direct feedback from consumers but the packer decides on the reaction to these trends. However, production method and systems can restrict the speed of respond to consumer trends and behaviour.

Because of the versatile factors affecting packages, there are also many obstacles to packaging development. In the interviews, one aspect received a lot of emphasis: the initial investment costs are big. New investments and reforms need careful consideration and cannot be rushed. The investments need to be financially realistic and justified.

The physical packaging structure is limited by the existing machines. Although there is a wide range of machines in use, old machines are particularly inflexible to change. The technology, material and machines in use are major factors in packaging manufacture. Changes in these factors are slow, due to the required big investments. On the other hand, the development of production technologies makes it possible to experiment with and mobilise new packaging alternatives. Therefore factors such as the implementation of new packaging technology, improved suitability for packaging machines, and product technology development give new technical possibilities and drive development further.

General limitations for packaging development derive from the fact that package manufacturing requires prioritisation. First

and foremost, packaging protects and contains the product. The product sets certain limitations on the packaging – the characteristics of the product or, on the other hand, the recognition of the packaging. It is feared that excessive changes in packaging may lead to situations where consumers do not recognise the product anymore. Furthermore, the influence of a strong brand obligates the packaging to have a certain look. General limitations are derived from the product, company and brand, and from retailing, distribution and the consumers. These limitations are case-specific. Naturally, other drivers can also be found, such as environmental awareness or material development, etc. On the whole, the drivers of and obstacles to packaging development can be seen to create frames for development.

The role of customisation in different package functions

The functions of packaging are categorised in groups of: product preservation, information carrier, convenience, marketing, and supply chain management. Customisation of packages has possibilities especially with the information efficiency of package prints. Consumer packaging serves the end user as a source for information. Information on packaging consists on many things such as branding, product type, amount, size, price, manufacturer, nutritional facts, preparation methods, recipe suggestions etc. All this information makes packaging the single most effective element of consumer communication to gain competitive advantage and has a huge impact on consumers. Consumer studies show that clear, easy-to-read information is one of the main functional improvement areas for consumer packaging. However, packaging function as an information carrier is complex. Small packages, multi-lingual information, authority demands and basic packaging markings make efficient package information provide challenging.

Besides from providing product information for end-users the information and messages printed in packages serve also other package functions. Messages and information printed on packages are there also for marketing, convenience, safety and supply chain management reasons. Therefore it is possible to address package customisation to serve any of the packaging functions. A scenario on customisation of package prints for different package functions is presented in *Table 2*. Expectations on customisation are gathered in the Table.

Nowadays, authenticating and anti-counterfeiting have become increasingly important packaging requirements. There is a need for innovative, cost-effective ways of increasing security with packaging. Ensuring security needs to be integrated into the beginning of the design process. Current solutions for safety assurance in packaging are for example holography, special inks, improved closure designs, sleeves, and encryption technologies. Customisation done with digital printing gives possibilities for individualizing and the use of functional materials in printed authenticating and anti-counterfeiting systems.

It is estimated that around 70 – 75 per cent of all purchasing decisions are made in store, so packaging as a marketing tool with efficient marketing messages is very important. It is a question of standing out and desirability and originality is looked for all the time. Reformation and new versions are needed especially with short life cycle season and trend products. In addition, in today's market it is important to know the product and the end user and to determine a target group – an effort to please all in the fragmented market is rarely successful.

Supply chain management derived reasons for on-demand printing and customisation derive from the growing complexity of supply chains - widening range of products and services, shorter life cycles of products, shorter delivery times, extending distances, advancing technologies, and outsourcing. These issues affect greatly in the increase of the supply chain's bullwhip effect, in which bottlenecks at the consumer end of the supply chain cause ripple effects all the way back to the supplier. The bullwhip effect means that changes in end user behaviour multiplicities in the supply chain when different parties of the chain try to resolve changes in the demand situation. On-demand digital printing gives flexibility to the situation together with the possibility to print shorter series and get products faster to market.

Table 2. Scenario on customisation of package print for different functions of packaging.

Customisation of Package Print for Different Functions of Packaging			
Information	**Marketing & Branding**	**Safety**	**Supply Chain Management**
Language versions	Target group marketing	Individualizing & coding	Flexibility
Up-to-date information	Design changes at short notice	Anti-counterfeiting	Decrease of stock and inventory
Personalisation	Campaign products & competitions	Authenticating	Shorter series
Print variations - ease to add new markings	Fast response to changes in consumer behaviour	Anti-theft systems	Faster to market
Targeted messages & instructions	Trials	Changing regulations	Lower lead times
	Various brands		Less waste
	Functional features		Decentralized production

Conclusions

Packaging performance and functioning, especially the information efficiency of package prints, require development and there is a constant need for something new. With information the challenges focus on the amount of information and markings in packages, and with safety the questions is about keeping one step ahead of the counterfeiters. With marketing and branding it is about targeted marketing, standing out, and fast response. With supply chain management it is a question of flexibility. The listed needs give good prospects for package customisation. But there are still challenges to overcome before on-demand package printing can be fully executed. Package development has certain restrictions and obstacles – like question of investment costs. From the technology point of view the challenges are in print quality management, compatibility of printing materials, package converting and costs of digital printing.

To sum up, digital printing package applications require great care to find the right balance between the printing method and production model, the material properties and the final print

quality. Due to constant improvements in technology possibilities for digital package printing and customisation are getting better all the time.

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Jali Heilmann (MSc.) is a Senior Research Scientist at VTT. In his Master of Science thesis, he developed new research methods for color electrophotography and he is also very well acquainted with other digital printing technologies, especially ink jet printing. His current research activities also incorporate technical solutions, uses and appliances for smart packages, printed electronics, electronic book technology and other new information carriers like flexible displays. He has also worked as a Visiting Scholar at the University of California, Berkeley between August 2003 and September 2004.