

# Paper and Cardboard Packaging Ecodesign and Innovative Life Cycle Solutions

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**Abstract.** This paper discusses the findings of the research project, which explored paper and cardboard packaging ecodesign and innovative life cycle solutions in Latvia. The present article focuses on theoretical background of ecodesign that is aligned to packaging in order to create universal model and guidelines for its implementation in Latvia. The mixed research method has been used in this paper - interviews, document analysis, modelling and surveys. Ecodesign of paper and cardboard packaging in Latvia plays a significant role in the sustainable development for which interdisciplinary and in-depth knowledge as well as the cooperation of all involved parties is required – Latvian enterprises, packaging designers and manufacturers, printing houses, recycling companies, society and public sector. The proposition of the work is to encourage cooperation between them in order to create clusters of knowledge and innovation. Cooperation with non-governmental organizations, associations, higher educational institutions and research institutes is required at the same time maintaining social campaigns, especially for the youth.

**Keywords:** ecodesign, sustainability, product life cycle, paper and cardboard packaging.

## I. INTRODUCTION

Until the beginning of this century most important aspect of production was cost efficiency. At the moment product's impact on the environment and more efficient use of resources becomes more important in entrepreneurship.

World trends change in order to search paths for long term development. Therefore, the shift in different values of design also takes place. This is examined not only from economic and social perspectives, but also from the environmental one, by creating not merely the products but their life-cycles. The important aspect of this process is innovation which is possible to integrate in every period of the cycle in order to develop not only environmentally friendly products and reduce costs, but also increase competitiveness with creative ideas.

In every stage of production process design takes an important role, which implies not only functional and aesthetic, but also intangible value. One of the important aspects of product is packaging whose main functions are protection, containment and identification. Packaging is separated from the product before or at the consumption process. Two of the most important materials of packaging are paper and cardboard. Production and recycling processes of paper and cardboard have their life-cycles which should be analysed in the context of ecodesign in order to create environmentally friendly and sustainable product life-cycle.

At increasing demand for sustainable products, the manufacturers have to pay more attention to design and product life cycle which allows for improvement in the

production and innovations in order to create more environmentally friendly items and for the sake of resource economy. It is possible if buyers, manufacturers and designers cooperate and create mutual understanding of business, manufacturing and design processes.

At the same time as the result of economic downturn Latvian society has established understanding of the needs of resource economy and this is appropriate moment when the issue of ecodesign requires actualization for such practices to continue.

The purpose of the work is to summarize the theory of ecodesign and align it to the life cycle of packaging in order to create universal model and provide guidelines for implementation in Latvia.

## II. METHODOLOGY

There are qualitative methods used in this research – interviews with the participation of the specialists, theoretical research methods, document analysis, comparative analysis of scientific literature, modelling and quantitative data collection method, e.g. surveys without authors' direct participation.

The data obtained from the Latvian paper and cardboard packaging industry – manufacturers of packaging, printing houses, packaging designers, Latvian Union of the Designers, Design Information Centre, Latvian Association of Packaging, Latvian enterprises, recycling companies and society – has served as the basis for conducting the present research.

## III. MEANING OF ECODESIGN IN PAPER AND CARDBOARD PACKAGING

Questions about protection of the natural resources have to be solved at the early beginnings of the product development process and product's influence on environment in its life cycle has to be evaluated. Ecodesign is significant direction towards implementation of manufacturing with less resource wasted [1].

Ecodesign is product and service development in order to minimize the impact on the environment in the whole product life cycle at the same time ensuring functionality, quality, costs and aesthetic design.

Ecodesign is a strategic design management process that is concerned with minimizing the impact of the life cycle of products and services (e.g. energy, materials, distribution, packaging and end-of-life treatment). This involves assessing, prioritizing and then designing out problems, or designing new solutions. These solutions can range from specifying renewable materials, reducing the energy during usage to innovating the business model [2].

The aim of the ecodesign is to reduce consumption of the resources, to use eco friendly materials, to optimize product

manufacturing, distribution and usage as well as ensure the management at the end of the life cycle – recovery, recycling or disposal [3].

Crucially ecodesign can make a direct difference to the bottom line through reducing costs, increasing innovation, attracting investment, improving brand position and enhancing business communications. As a strategic design management process, ecodesign can also help companies proactively comply with environmental legislation [4]. Moreover ecodesign is a never ending process that may be improved over and over again.

Ecodesign also takes into account social impacts in the production and consumption of products and services, making a significant contribution to sustainable development. Communicating and building ecodesign thinking into future product development is crucial. By challenging the status quo, ecodesign plays a key role in the global move towards a more sustainable economy [5]. And the concept of development is understood not only as the growth of manufacturing, GDP or prosperity but also development of social and economical sector at the same time ensuring preservation of natural ecosystem and sustainable environment [6].

The most recurring topic within the ecodesign literature and ecodesign innovation is that of the “life cycle principle”. The lifecycle of a product is a holistic concept where all the stages of a product “life” are considered (material extraction;

production; distribution; use and disposal). Lifecycle thinking is a powerful tool to visualize, define and reduce the overall impact of a product [7].

Van Hemel (1998) with Brezet (Brezet and Van Hemel, 1997) proposed a series of ecodesign strategies and principles described within the LiDS wheel (Life cycle Design Strategies). As an integrated tool, the LiDS wheel aims to present strategies for both the incremental and the radical approaches to ecodesign, and to redesign of existing products or for new and innovative concepts. [8] As such, the LiDS Wheel is a comprehensive summary of ecodesign strategies at every stage of the product design and development and represent all types of ecodesign. (Table 1)

*Paper and cardboard packaging, importance – functions*

Design has everlasting impact on development and change. Aptitude for integrated eco awareness has become a need in design practice. Designers are not only stylistic innovators but they also tend to solve problems [9]. Sustainability in its essence is the main challenge for designers. Role of design in this new context is more challenging than before. In order for designers to fulfill this condition they need wide and in-depth knowledge about materials and process, the practical use of products and packaging and divestment [10].

TABLE I  
VAN HEMEL’S ECODESIGN PRINCIPLES AND STRATEGIES (VAN HEMEL, 1998)

<b>Ecodesign principles</b>	<b>Ecodesign strategies</b>
1. Selection of low impact materials	Clean materials Renewable content materials Recycled materials
2. Reduction of materials usage	Reduction in weight Reduction in volume
3. Optimization of production techniques	Clean production techniques Fewer production steps Low/clean energy consumption Less production waste Few/clean production consumables
4. Optimization of distribution system	Less/clean/reusable packaging Energy efficient transport mode Energy efficient logistics
5. Reduction of impact during use	Low energy consumption Clean energy source Few consumables needed Clean consumables No waste of energy/consumables
6. Optimization of initial lifetime	High reliability and durability Easy maintenance and repair Modular/adaptable product structure Classic design Strong product/user relation
7. Optimization of end-of-life	Reuse of product Re-manufacture/refurbishment Recycling of materials Safe incineration (with energy recovery) Safe disposal of product remains
8. New concept development	Shift to service provision Shared product use Integration of functions Functional optimization

#### *Paper and cardboard packaging, importance – functions and purpose*

Packaging and environment have always been perceived as incompatible by creating obvious conflicts. Packaging industry uses vast amounts of land in order to transfer products to households. The need for stricter control mechanisms and rules are needed to limit wasteful or inappropriate use of materials in packaging. This tendency has gained importance in recent years [11].

On the other hand packaging is an important instrument in marketing. Each product has a need for packaging, often cardboard or paper, therefore the industry constitutes significant share of world's economy.

Packaging has three general functions – protection (also to protect copyrights), integrity and identification and goals – provision, storage, stability, transfer, opening (resealing), secondary usage and disposal. Accordingly each of these functions and goals can be expanded for eco-friendly and sustainable packaging [12].

#### IV. THE NEED FOR IMPROVEMENT OF PAPER AND CARDBOARD ECODESIGN MODEL IN LATVIA

Having analysed the results of surveys and interviews, a few directions for improvement of paper packaging ecodesign in Latvia have been proposed. Almost all parties are involved, namely Latvian entrepreneurs, which order paper and cardboard packaging; designers; producers of packaging; recycling companies and society in general. After taking into consideration functions and purposes of packaging, paper and cardboard packaging can be perceived in the context of ecodesign, accordingly creating environmentally friendly life cycle. At the same time, paper and cardboard life cycle is a counterpart of paper packaging ecodesign. In order to encompass all aspects of environment and alternatives of paper and cardboard design production starting from choice of resources, preparation of materials, production, distribution, usage, secondary usage till disposal and creation of new concept, it is needed to develop model which reflects not only paper packaging life cycle but takes into consideration functions and purposes needed. At the time theory of management control does not provide universal model which could help to evaluate aspects of packaging and create understanding about packaging design and the way how to decrease amount of resources consumed by every party involved.

As the result, the authors combine two theories and models – Caroline van Hemel and Hans Brezet “LiDS Wheel” (1997) and packaging theory, including functions and purposes in order to reflect these dimensions in the most convenient way. Packaging functions and purposes have to be taken into consideration in order to create packaging design, while covering every stage of life cycle. They have to be in mutual interaction. It is important to consider which function or purpose is the most important at every stage of life cycle while aligning it to the required dimension.

This model shows opportunities and is directed towards development because every stage has unlimited development and improvement possibilities. It gives opportunity not only

weight improvements but also product and process innovation. Also every strategy has impact on environmental, economic or social aspects. Accordingly this model can be used by designers, managing directors, producers and technologists. It also can be used as visual material for encouraging cooperation. Moreover, this model can be used by designers to consider visual and functional dimensions of packaging, choice of material and personification, amount of packaging and resource economy. Management theory can determine more easily which characteristics of packaging are the most important, which are of the most importance for clients. It can also widen horizon considering other dimensions of packaging which many entrepreneurs have not thought of when creating strategy. In this way the model is also contemplating educational function. Manufacturers of packaging have opportunity to consider how to decrease the consumption of resources by decreasing amount of actions, combining functions or searching for innovative ways how to save energy by using recycling at the manufacturing process. Circle of paper and cardboard strategy is universal and adjustable both for the management, designers, and producers of packaging by determining purposes of packaging and by identifying opportunities how to create more environmentally friendly packaging and save resources at the same time encouraging understanding between parties involved.

However, each particular stage of paper and cardboard ecodesign strategy can not be referred to the single involved party because in almost every stage cooperation between entrepreneurs, designers, manufacturers, recycling companies, consumers, i.e. society, governmental and non-governmental institutions and research laboratories is required. At the same time this model provides the large potential for development in each of the stages for both product and process innovation.

#### V. MAIN CONCLUSIONS OF THE RESEARCH

As the result of the work the purpose of the research has been accomplished. The theory of the ecodesign has been summarized and aligned to the life cycle of the paper and cardboard packaging, the universal model has been created and guidelines for the implementation have been provided.

Ecodesign of paper and cardboard packaging in Latvia has a significant role in the sustainable development for which interdisciplinary and in-depth knowledge and cooperation of all involved parties is required – Latvian enterprises, packaging designers and manufacturers, printing houses, recycling companies, society and public sector [13].

#### *Paper and cardboard packaging manufacturers and printing houses*

There are more and more eco friendly technologies used by Latvian paper and cardboard packaging manufacturers and printing houses. Most of the companies have implemented European Union and other certificates in order to compete in the foreign markets. Paper and cardboard packaging material, processing technologies and other processes are strictly controlled but there are still possibilities for development towards ecodesign, such as use of materials, printing technologies, size and constructions, cardboard coating and other processes.

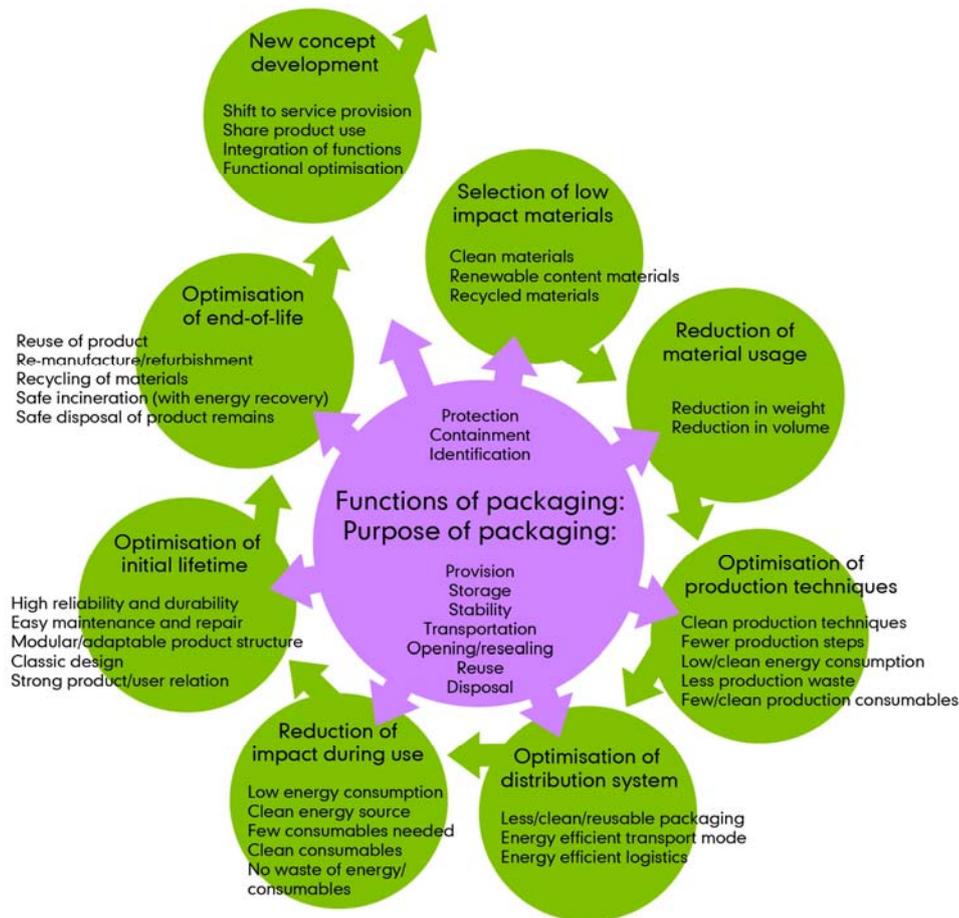


Fig. 1. Wheel of the paper and cardboard life cycle strategies.

### Packaging designers

There are only some professional packaging designers and technologists in Latvia. However the graphical design in Latvia is in comparatively good quality, the most of the new designers lack practical knowledge and experience in the specific packaging field. In addition designers do not have basic knowledge about marketing that is necessary for packaging design and ecodesign itself.

### Latvian enterprises

The management of the company defines the essence of the ecodesign and its strategies. Therefore entrepreneurs need exhaustive and interdisciplinary knowledge about the design, ecodesign, the process of production and influence on the environment from each alternative.

Entrepreneurs in Latvia have different level of knowledge about packaging design and that is dependent on size and experience of company. The main problem appears in the lack of marketing and professionalism skills required for delegating tasks to designers. There is a lack of competence managing resources. On the one hand – economy where it is inadmissible, on the other – rising the expenses of packaging without any significant reason, besides leaving the impact on environment in the second place. Entrepreneurs in Latvia influence technological environment and its limited options that impact the choice of materials and packaging size. There

is a lack of small packaging lines as well which means slowing down development in production process. Besides, economic downturn has made corrections at the technological packaging development.

As the result of collaboration of Latvian enterprises, designers and manufacturers of packaging, there is significant incompleteness, regarding environmentally friendly and healthy packaging design – bad construction and inappropriate choice of cardboard. There are many resources used in production process and there is dense use of colors.

### Paper and cardboard waste management

Paper and cardboard waste management in Latvia is more developed than other sorts of waste. It is because these materials are easier to recycle or remanufacture. There are some manufacturers in Latvia that recycle and remanufacture paper and cardboard packaging into paper products, design products and paper pulp packaging. And the most common motivation for companies in Latvia to sort paper or cardboard waste and put it out to recycling is tax redemption.

### Society

One of the most driving forces of ecodesign is society but there is a necessity for long and determined educational work. Progress of ecodesign is directly related to habits of society that has been changed in the recent years. Results of the

research have proved that design of the packaging has the great influence on customers making a choice in the market. People consider that environmentally friendly products have more added value, but only half of them would choose products if there would be eco friendlier packaging and only half would pay more because of this reason. On the other hand most of the entrepreneurs are demand driven and without it will not think about environmentally friendly packaging. Therefore, it is important to educate society to make an impact in the future.

## VI. RECOMMENDATIONS

The main recommendation is to encourage collaboration between involved parties in paper and cardboard design industry – designers, packaging manufacturers and entrepreneurs to exchange information, knowledge and latest trends in design, innovation, technologies and materials. The cooperation with non-governmental organizations, associations, higher educational institutions and research institutes in order to make clusters of information is required, at the same time maintaining social campaigns, especially for the youth.

In order to promote cooperation between designers and entrepreneurs in a long term and enhance understanding the interdisciplinary theory is needed, as well as the opportunities for education and practice should be available. On the one hand, ensuring basic design studies for prospective entrepreneurs and on the other hand providing courses in marketing, including ecodesign principles, sustainability and environmentally friendly innovation, for designers.

Latvian entrepreneurs should think about the latest trends in packaging and go a step ahead of competitors. They should think about clever packaging, innovative solutions and services creating competitive advantage and developing packaging design on a new level, transferring existing technologies, innovations and practices and expanding the market. Entrepreneurs should learn more about ecodesign and be more creative because not all of the innovations increase costs and expenses. The aim is to reduce them in a long term. The following tendencies in the world packaging design should involve following priorities – simplicity (reduction, convenience), identity (belonging), health (wellbeing), aesthetics (design), meaning (sustainability, intelligence).

When moving towards complete packaging ecodesign it is not enough to educate society and bring forward goals of regeneration. Public sector should analyze instruments which create economic motivation to decrease consumption of materials and ways that enable to do it. Therefore more

participation is needed from public sector in order to encourage development of more sustainable ecodesign.

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### **Sabīne Koklačova, Dzintra Atstāja. Papīra un kartona iepakojuma ekodizains un inovatīvi dzīves cikla risinājumi**

Līdz šā gadsimta sākumam vissvarīgākais ikviena produkta ražošanas nosacījums bija ekonomiskais izdevīgums. Tagad arvien būtiskāks kļūst jautājums par produkta ietekmi uz vidi, kā arī resursu efektīvāku izmantošanu uzņēmējdarbībā. Mainoties sabiedrības domai, pasaules tendencēm un meklējot ceļu uz ilgtspējīgu attīstību, mainās vērtības arī dizaina aspektā. Tas tiek apskatīts ne tikai ekonomiskā un sociālā, bet arī vides kontekstā, pie tam, veidojot nevis produktus, bet produkta dzīves ciklus. Viena no produkta būtiskām sastāvdaļām ir iepakojums, kura galvenās funkcijas ir aizsardzība, ietvērums un identifikācija. Papīra un kartona ražošanai un pārstrādei ir savs dzīves cikls, kuru iespējams apskatīt ekodizaina kontekstā, lai veidotu videi draudzīgu un ilgtspējīgu produkta dzīves ciklu.

Darba mērķis ir apkopot ekodizaina teoriju un pielāgot to papīra iepakojuma dzīves ciklam, lai izveidotu universālu modeli un izstrādātu vadlīnijas tā ieviešanai Latvijā. Pētījumā izmantotās metodes ir kvalitatīvā pētniecības metode – brīvās intervijas ar pētniecības autora tiešu piedalīšanos, teorētiskās pētīšanas metodes - tiesību un informācijas dokumentu analīze, salīdzinošā zinātniskās literatūras analīze, modelēšana. Kvantitatīvā datu vākšanas metode bez pētniecības autora tiešas līdzdalības – anketēšana ar aizklātās un atklātās formas atbildēm. Pētījuma bāze ir Latvijas papīra un kartona iepakojuma industrija - iepakojuma ražotāji, poligrāfijas uzņēmumi, iepakojuma dizaineri, Latvijas Dizaineru asociācija un Dizaina Informācijas centrs, Latvijas Iepakojuma asociācija, uzņēmumi, kuriem ir nepieciešama papīra iepakojuma dizaina izstrāde saviem produktiem, papīra otrreizējās pārstrādes uzņēmumi un sabiedrība.

Galvenā atziņa un secinājums ir, ka papīra un kartona iepakojuma ekodizaina attīstībai Latvijā ir nozīmīga loma ilgtspējīgas attīstības virzienā, kam ir nepieciešamas starpdisciplināras un padziļinātas zināšanas un visu iesaistīto pušu sadarbība - gan iepakojuma pasūtītāju, gan dizaineru, gan iepakojuma ražotāju, un aktīva sabiedrības izglītošana, kas veicinās pieprasījumu pēc videi draudzīgiem produktiem.

Galvenais priekšlikums ir veicināt sadarbību iepakojuma industrijas saistīto pušu – dizaineru, uzņēmēju, iepakojuma ražotāju starpā, veidojot zināšanu, informācijas, inovāciju pārneses punktus, kā arī veicinot sadarbību ar asociācijām, nevalstiskajām organizācijām, augstākajām izglītības iestādēm un zinātnes institūtiem, tajā pašā laikā veicot sabiedrības, it īpaši bērnu, izglītošanu.

#### **Сабина Коклачева, Дзинтра Атстая. Экодизайн бумаги и картонной упаковки и инновационные решения жизненного цикла**

Вплоть до начала нынешнего столетия важнейшим условием для производства продукции была экономическая выгода. Со временем все более существенное значение начали приобретать вопросы влияния продуктов производства на окружающую среду и наиболее эффективного использования природных ресурсов.

С изменением общественного мнения, тенденций экономического развития, которые все больше стали ориентироваться на экологичность продукции и долгосрочное использование ресурсов, изменились и понятия о ценностях и подход к использованию материалов в области дизайна упаковки изделий. Основные функции упаковки – защита от повреждений, удобство транспортировки и использования и идентификация изделия.

Процесс производства и переработки бумаги и картона имеет свой жизненный цикл, который следует рассматривать в контексте экодизайна, направленного на создание изделия, сохраняющего экологичные свойства на протяжении всего жизненного цикла.

Цель исследования – обобщить теорию экодизайна с целью применения ее к жизненному циклу бумажной упаковки, создания универсальной модели и разработки основных направлений для ее введения в Латвии.

В исследовании использован качественный метод – свободные интервью с непосредственным участием автора исследования, методы теретического изучения – анализ правовых и информационных документов, метод сравнительного анализа научной литературы, моделирование, а также количественный метод сбора данных без прямого участия автора исследования – анкетирование с ответами в открытой и закрытой форме.

Основной вывод и заключение, сделанные в результате исследования, состоят в том, что развитие в Латвии экодизайна упаковки из бумаги и картона имеет важное значение в направлении долговременного развития, и для этого необходимы междисциплинарные и углубленные знания и сотрудничество всех сторон, вовлеченных в производство упаковки – заказчиков, дизайнеров, производителей, а также эффективные меры в области просвещения общественности, стимулирующие спрос на продукцию, сохраняющую экологичность на протяжении всего жизненного цикла.

Основное предложение состоит в стимулировании сотрудничества всех сторон, связанных с производством упаковки (заказчиков, дизайнеров, производителей) путем создания каналов распространения знаний, информации, инноваций, а также в установлении сотрудничества с ассоциациями, негосударственными организациями, высшими учебными заведениями, научными учреждениями и в проведении общественных образовательных мероприятий среди взрослых и детей.