

Agnieszka
Cholewa-Wójcik¹
Marek Ćwiklicki
Agnieszka Kawecka
Magdalena
Wojnarowska

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IDENTIFICATION OF THE EXPECTATIONS OF SELECTED ENTITIES IN THE SUPPLY CHAIN REGARDING THE PROPERTIES OF THE DESIGNED FOOD PACKAGING

Abstract: Food and beverages packaging design are one of the factors affecting product performance on the market and in the supply chain. Identifying the most important, expected packaging characteristics for each member of the supply chain aims to integrate product aspects, packaging and logistics requirements, as well as improve the post-consumer end-of-use of packaging. The paper aims to identify an expected group of packaging features, which address joint priorities of the supply chain participants and will be regarded as benchmarks for setting food packaging design goals. Conducted qualitative research – interviews with experts, representatives of food and beverages international supply chain participants and analysis with the use of the MFA method. Common, important groups of features for all participants in the supply chain include: safety, material, ergonomics and aesthetics of the packaging. Identifying the expectations of the supply chain entities and indicating the priority properties of packaging is the basis for the cooperative packaging design process.

Keywords: Packaging design; food supply chain; supply chain; cooperation.

1. Introduction

The contemporary design approach to food packaging as products inherent in integrated manufacture makes it indispensable to take into account and adjust to volatile trends in the market, that have a considerable impact upon the consumer goods market and thus upon products offered therein. Fast emerging changes in consumption as well as the increasing demand for products and packaging, affect all the members of the supply chain since food packaging design is expected to be tailored according to their requirements (Verghese & Lewis, 2007, Cholewa-Wójcik & Kawecka, 2014). Improving competitiveness in contemporary

markets emphasizes the need for the adaptive nature of supply chains, able to dynamically adjust themselves according to changes that occur outside the chain and inside their units. According to the mentioned, supply chain members are called to collaborate and to establishing fruitful relationships to get success in their initiatives (Siemieniako & Mitreęga, 2018). It means, therefore, considering supply chains as systems of cooperating organizations capable of adjusting their collaborative approach to ensure that both effectiveness and efficiency are optimized for the chain as a whole (Dania et al., 2018). Supply chain collaboration and integration are well-established practices to reduce uncertainties

¹ Corresponding author: Agnieszka Cholewa-Wójcik
Email: cholewaa@uek.krakow.pl

and to streamline production and distribution systems (Leuschner et al., 2013), as well as to improve product quality and safety. With reference to the food supply chain, collaboration would result in reduced food loss and, thus, increased firm performance (Devin & Richards, 2018). It has been proven that there is insufficient information exchange in terms of the needs and requirements of various entities in the supply chain. The lack of identification of expectations results in a lack of consistency in taking actions aimed at designing packaging that satisfies all entities in the supply chain. (Brink, 2018; Materia et al., 2017; Nilsson & Darley, 2006; Ahmed et al., 2005). Scholars show that supply chain companies have different requirements with regard to packaging. Thus, the lack of a well-developed collaborative approach focused on the identification of groups of packaging features essential for respective supply chain members constitutes the starting point of this research. Food packaging design should consider different requirements, usually distributed at the different levels of packaging (primary, secondary and tertiary levels) not homogeneously. Identifying the most important packaging features for each supply chain member is therefore relevant to foster members' collaboration, as well as to integrate products aspects, packaging and logistics requests. In line with the mentioned, this paper aims to identify expectations concerning a group of packaging features, which address joint priorities of the supply chain participants, and will be regarded as benchmarks for the purpose of setting food packaging design goals.

In doing so, the following research were developed:

RQ1: What are the expectations of individual actors in the supply chain regarding the most important features of food packaging?

RQ2: Which group of features is common for respective chain supply members?

In order to pursue the research aim, key packaging properties and features for respective units of the supply chain through expert interviews, as a qualitative research method. Experts were from enterprise producing food and beverages, food and beverages packaging producers and distributors, waste disposal enterprise and packaging recovery organizations based in Europe. After that, collected data were managed by the mean of MFA method.

This approach will allow to develop recommendations that will ensure effective cooperation of the members of the supply chain in the field of food packaging design taking into account the expectations of selected entities.

2. Literature Review

The related literature regarding design and development of manufacture features, including packaging is extensive and widely analysed by authors representing a variety of scientific domains and fields (Dieter & Schmidt, 2012; Geissdoerfer et al., 2016, Pinheiro et al., 2018). The design-related issues are addressed in technical, environmental, marketing, methodological terms. The issue of technical design, that entails problem-solving methodology, requires decisions on many variables and parameters, requires making choices between many possible solutions at all levels, from basic concepts to the smallest detail of shape, is depicted, inter alia, by G. Dieter, L. Schmidt (2012) and A. Cholewa-Wójcik (2018). In turn, the role of environmental aspects in the design process has been the subject matter of work undertaken, inter alia, by C. Luttrupp, J. Lagerstedt (2006), T. Mc Aloone, N. Bey (2009), N. Perry et al. (2010), R. Lacoste, M. Robiolle, X. Vital (2011), Y. Chun et al. (2018). In those pieces of work, eco-design as the method of enhancing environmental

properties of manufacture, inclusive of packaging, has been mainly addressed. It has been evaluated to be prospective, mitigating the adverse impact of manufacture upon the natural environment throughout the whole life cycle long. Furthermore, design tools have been reviewed. However, the significance of marketing for the manufacturing design process is the subject matter of papers by such authors as: M. Earle, R. Earle, A. Anderson (2007), M. Solomon, G. Bamossy, S. Askegaard, M. Hogg (2010), N. Kline-Weinreich (2011), M. Borchardt et al. (2011), G. Read, P. Salmon, M. Lenné, N. Stanton (2015), S.M. Prendeville et al. (2017), P.K. Singh, P. Sarkar (2019). The aforementioned authors have paid attention, inter alia, to the fundamentals of the manufacturing design process, including: subsequent stages of the manufacturing design process, the knowledge indispensable for the process purposes, tailoring the manufacturing design to the needs and requirements of consumers. They have also paid attention to factors determining the market and financial success of a new product and have emphasized the role of the market research and consumer research in the new product design.

The related literature-derived deliberations also address the role of methods, analytical techniques and information tools in the design processes, that have been elaborated upon, inter alia, by A. Lockamy, A. Khurana (1995), D. R. Traill (2008), C.M.V.B. Almeida et al. (2010), Y. Baouch et al. (2014), D. Grajewski et al. (2015), C. Garcia- Dieguez (2015), V.P. Rodriguez et al. (2017). The authors have emphasized that the application of methods such as: qualitative, semi-quantitative, matrix, and quantitative methods constitute the factor accounting for the efficiency of construction and design work to a great extent. The authors have described the influence of computer-aided techniques such as: CAD and PLM upon the workflow of design.

Notwithstanding the multi-thematic issue of design in the related literature, this subject matter is depicted selectively, taking into account a narrow aspect of design or presenting the design process procedures referring to the specific manufacturer or a group of products. Thus, the approach to the design and development of manufacturing features, inclusive of packaging, displayed in the related literature has not taken into account the conceptual framework of the food packaging design integrated with the collaborative approach of the supply chain members. There is a noticeable lack of identification of the expectations of the entities in the beverage packaging supply chain in the literature in the field of management and quality sciences. The analysis of the conducted research and studies indicated the need to conduct own research in order to identify expectations that may be the basis for a cooperative approach to the design of food packaging by selected entities in the supply chain.

3. Methodology

3.1 Research procedure and selected sample

Specification of the packaging features commonly essential for all the units of the supply chain - from their point of view - will, on the one hand, allow to apply the collaborative approach in the packaging design process concurrently maintaining the elasticity to dynamically volatile market trends. This issue is incredibly essential due to dynamically volatile manufacturing design trends, inclusive of packaging design. The aim has been accomplished through the systemic consideration of the packaging supply chain to be a network of linked-up organizations, in which the collaborative approach to primary joint objectives of its units should dominate as far as food packaging design is concerned. The above depiction departs from the construct, that has been hitherto prevailing, according to which, the guiding task of supply chains is above all

to aim at the optimization of goods and information flow.

In order to research aims identification of the relationship of decision-making criteria set out by the packaging supply chain members with the food packaging design process, the research procedure was adopted to consist of two major stages: expert interviews and the analysis of the data obtained through them with the utilization of the multiple factor analysis method (MFA).

The first stage of the research came forward with qualitative studies by means of interviews conducted on the grounds of a pre-set scenario. For this purpose, responders being representatives were recruited from respective units of the supply chain or its environment. Those were: a representative of enterprises manufacturing packaging materials and packaging (R1), a packaging distributor (R2), a packaging user (R3), a representative of packaging waste disposal enterprises (R4), and a representative of packaging waste recovery organization (R5). Codes for responders used for marking authors of a given feature are specified in brackets. Responders were selected purposefully on the ground of positions held (managers) and professional competencies (packaging work, including designing, manufacturing, using, etc.). Interviewed experts from packaging production enterprises and food and beverages producers were from enterprises with foreign capital, operating in the international arena. The rest of them is operating nationwide, except for the waste disposal enterprise which operates locally. All of the interviewed representatives were from enterprises based in Europe. Due to diverse roles in the supply chain they played, each of them was assumed to be guided by various aspects and took into account various packaging features and properties as far as the performance of their tasks was concerned. The task of the responders was to define criteria essential for them when it comes to the food packaging design.

Beverage packaging most often offered in the market in Europe, was the object of the research (Market Research Report 2021). On the grounds of those estimates, the team of researchers selected the following kinds of packaging for the research purposes:

- PET bottle,
- laminate box,
- glass bottle,
- stand-up pouch,
- plastic can,
- polystyrene package.

At the subsequent stage of the research, each of the responders made assessment of the selected food packaging on the basis of each one's criteria using the 5-point grading scale, where 1 meant the smallest volume of a given feature in a given packaging whereas 5 – the largest volume.

3.2. Data Analysis

The MFA, which is one of the multi-factor based methods, was utilized for the purpose of the analysis since it allowed to distinguish hidden variables a posteriori, that accounted for the maximum number of variabilities or relationships in the original set of data (Pages & Husson, 2013, Abdi et al. 2013). The idea of the MFA is to integrate variables found at diverse levels of measurement, that describe the same observations expressed in the form of tables and to analyze interrelations between the tables of data. The number of variables in each set may differ and their nature may vary, too. At the same time, it is important for the variables in a given set to be of the same type. The MFA provides for structural analyses, intra-structural analyses, and analyses of structures of objects sharing one multidimensional space (Pilch & Sagan, 2014). It also allows for the identification of hidden variables in a set of data proving the largest number of relationships (Abdi, Williams, Valentin, 2013). The first step under the analysis was to distinguish factors,

based on which it was possible to describe the set of data under analysis. Next, it was possible to place products subject to assessment in those dimensions, thanks to which they were comparable. The last step was to pay attention to similarities and differences in responders' assessments. An additional analysis was carried out to depict their assessments in relation to the products under analysis. FactoMineR packages were used for computation purposes (Husson, Lê & Pagès, 2017) and Factoextra and Factoshiny packages were used for the purpose of visualization of the resulting figures.

4. Research results

Within the framework of the first stage of the research entailing the interviews with the representatives of the packaging supply chain, the responses regarding the significance of packaging features from the point of view of an enterprise represented by the responder were obtained. This also constitutes the answer to the first research question. In a result of the conducted analysis, the representative of the packaging manufacturer considered a kind of packaging material, quantity of material indispensable for manufacturing packaging, packaging mass, aesthetics of finished packaging, packaging free from defects and drawbacks, easy handling by a consumer, and effective protective function of a packaged product to be the key criteria.

The packaging distributor was the second organization that was interviewed to consider the protective function of packaged products, minimalism in construction molds and graphic layout of packaging, ecological features, easy handling of a packaged product by a final user, aesthetics of packaging, legibility of information printed on packaging, and compliance with requirements arising from mandatory standards and legal regulations to be the key packaging features.

Moreover, another representative of the supply chain was the food producer who considered the following packaging features to be essential criteria: packaging functionality, easy opening, aesthetics, ecological features, visibility of essential information, and the relationship of packaging with its price. From the point of view of the operator of the solid waste disposal system, the key packaging features were: price, packaging material transparency, packaging capacity, flexibility understood in terms of material bendability facilitating crushing of packaging, after-use neutralization ability, and ergonomics. The last one to have been interviewed was the recovery organization for which the key packaging features were: product protection, easy handling (in terms of easy opening and closing), the lowest possible impact on the environment, the harmonious and cohesive packaging design and construction mold ensuring efficient and effective logistics.

Appendix 1 contains a classification of the above features made on the basis of similarities as well as codes. The major packaging features encompass: security (OCH), informativeness (INF), the efficiency of processes (SPR), cost (KOS), material (MAT), environmental friendliness (EKO), aesthetics of finished packaging (EST), easy handling (ERG).

At the second stage of the research, the responders were requested to make assessment of 6 pieces of packaging according to the features indicated in response to the previous question (Table 1).

The subsequent stage of the research was to conduct the analysis by means of the MFA method. The features indicated by responders were incorporated into two major factors accounting for the set of data under analysis. The computation indicates that factor 1 accounts for 32% of variability in the data under consideration and factor 2 - 27% (Table 2). Therefore, the two factors were used for describing 60% of variability in variables.

Table 1. Packaging Features Assessed by Responders

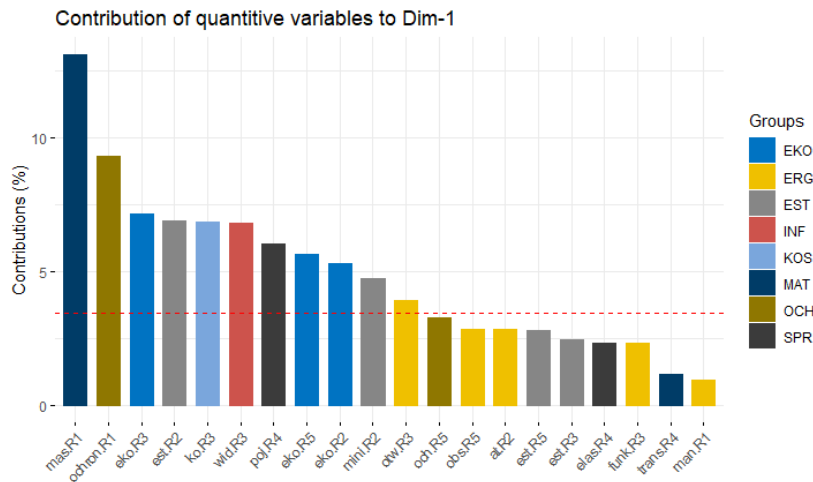
Represented Supply Chain Member	Features	PET bottle	laminate box	glass box	stand-up pouch	plastic can	polystyrene package
Packaging Manufacturer (R1)	kind of packaging material	5	2	4	2	3	5
	quantity of used material per packaging unit (cubic capacity)	5	4	4	4	3	3
	packaging mass	4	3	1	3	3	5
	aesthetics of finished packaging	4	4	3	4	4	3
	free from defects/drawbacks	4	4	4	4	4	4
	easy handling	5	5	4	3	4	2
	protective function of a packaged product	4	4	5	4	4	3
Packaging Distributor (R2)	safety	5	5	3	5	5	3
	minimalism	4	1	1	4	4	4
	ecology	2	2	4	1	3	2
	easy to use	3	3	2	3	1	5
	aesthetics	1	4	5	2	2	1
Food Producer (R3)	functional	4	5	3	4	5	4
	easy opening	4	4	3	3	4	4
	aesthetic	3	4	3	4	4	4
	ecological	2	4	5	3	3	3
	good visibility of essential information	4	5	3	4	4	4
	packaging cost, quality-price relationship	2	4	4	3	3	3
Packaging Waste Disposal Enterprise (R4)	transparency	5	1	4	1	5	1
	price	4	4	2	4	3	1
	capacity	3	2	1	1	2	3
	flexibility	4	4	1	3	2	2
	neutralisation ability	2	2	2	2	1	2
	ergonomics	5	2	2	3	3	2
Packaging Recovery Organisation (R5)	product protection	5	5	5	5	5	3
	easy handling by a consumer (keeping, opening)	5	4	5	3	4	3
	made with maximum care about natural environment	3	3	4	3	1	1
	nice-looking	4	4	4	4	4	3
	ensuring effective and efficient logistics	5	5	4	3	4	4

Table 2. Dimension-related Eigenvalues

	Dim.1	Dim.2	Dim.3	Dim.4	Dim.5
Variance	4.809	4.126	2.760	1.755	1.482
% of var.	32.205	27.629	18.484	11.756	9.926
Cumulative % of var.	32.205	59.834	78.318	90.074	100.000

In order to define the name of those two factors, the input share of respective features was utilized. In the case of the first factor, the substantial input share of 11 features was noted whereas two of them were dominant. Those were: packaging mass and product protection. Since it is difficult to specify one

common definition for them, the factor name was created using more general categories. The aforementioned features belonged to the group of packaging material and product protection, thus they were regarded as packaging material.



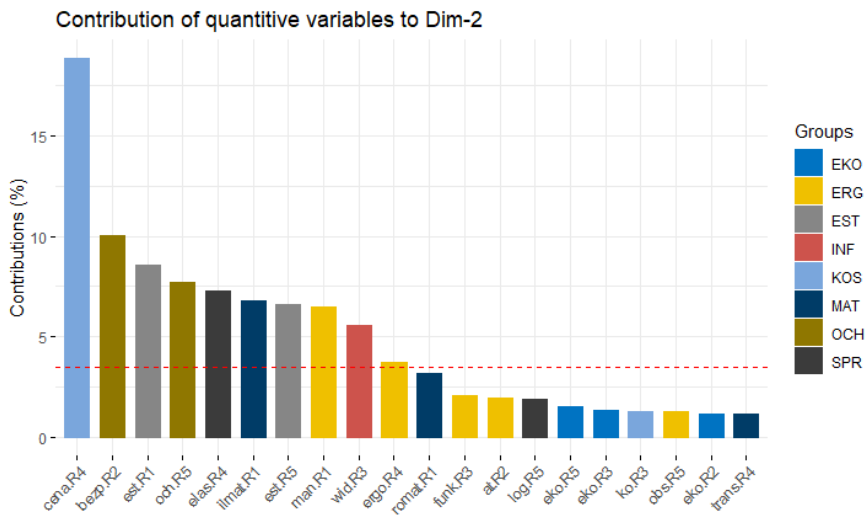
OCH – product security, INF – informativeness, SPR – efficiency of processes, KOS – cost, MAT – material, EKO – environmental friendly, EST – aesthetics of finished packaging, ERG – easy handling

Figure 1. Contribution of quantitative variables to Dim-1

Factor 2 also comprises a dozen or so specific features, out of which packaging price is dominant over the other. It serves the grounds for naming this factor as cost-related. Nevertheless, it bears noting that it is just an arbitrary definition since the remaining features incorporated into this dimension, of similar feature volume, relate to other packaging characteristics. This is proven by 9 features in excess of the expected average value if all the input shares were equal. The above deliberations

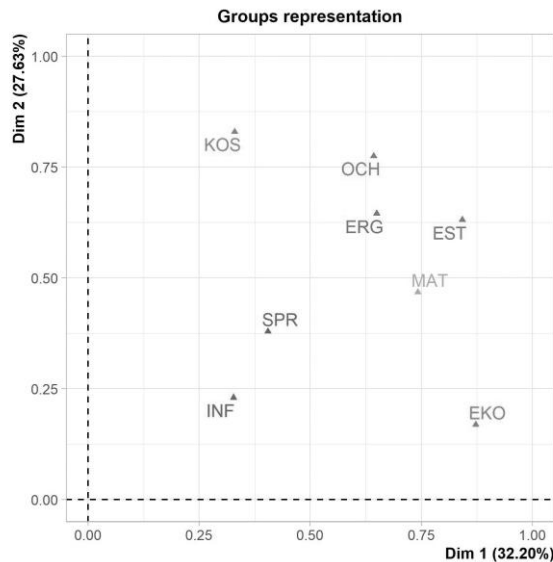
constitute the response to the second research question.

After having defined the major factors, the groups were characterised according to the factors of features set within the groups. The packaging features distinguished by the responders were grouped into 8 categories (Appendix 1). The analysis taking into account that division allows to determine the place of the created groups within major dimensions.



OCH – product security, INF – informativeness, SPR – efficiency of processes, KOS – cost, MAT – material, EKO – environmental friendly, EST – aesthetics of finished packaging, ERG – easy handling

Figure 2. Contribution of quantitative variables to Dim-2



OCH – product security, INF – informativeness, SPR – efficiency of processes, KOS – cost, MAT – material, EKO – environmental friendly, EST – aesthetics of finished packaging, ERG – easy handling

Figure 3. Distribution of Relationships of Feature Categories with Factors

The following groups of features correspond to one another in respect of factor 1 (PACKAGING MATERIAL): aesthetics of finished packaging (EST) and environmental friendliness (EKO). There is material (MAT) between them and the subsequent pair.

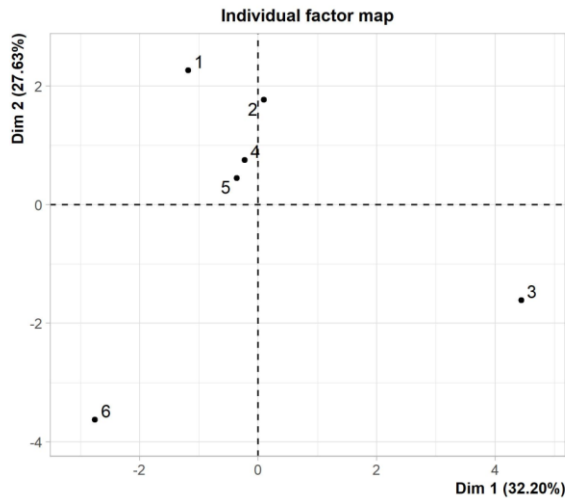
Security (OCH) and easy handling (ERG) make up the last mentioned pair of features accounted for by the factor. Efficiency of business processes (SPR), followed by informativeness (INF), and packaging cost (KOS) contribute to factor 1 to a lesser

extent. However, from the point of view of the influence upon factor 2, the group of features related to the packaging cost (KOS) and product security (OCH) dominate. Easy handling (ERG) and aesthetics of finished packaging (EST) are the two remaining substantially influencing features that contribute to factor 2 by means of the comparable input share. The cost factor is so strongly determined by one group of features related to costs. It bears noting that four groups of features substantially influence both distinguished dimensions. These are: aesthetics of finished packaging, product protection, easy handling and packaging material.

At the subsequent stage of the analysis of the research results, packaging was characterised according to the output categories and in the opinion of responders and according to their assessment, packaging 2,4 and 5 (the laminate box, stand-up pouch, plastic can)

was similarly assessed due to the factors emerged in the course of the analysis. It means that for the responders they are similar in terms of both the cost aspect and packaging material. The packaging 3 (the glass bottle) was assessed to be most related to the dimension of product protection. It was assessed to be the most corresponding to the characteristics of dimension 1 whereas polystyrene package may be regarded as least protective in the opinion of the responders.

The latter factor is related to cost aspects. From that perspective, the results obtained are not surprising to prove that the PET bottle was top-rated in respect of that dimension, which was contrary to the assessment of the glass bottle and polystyrene package. Rating of products in respect of the distinguished factors is exhibited in Figure 4.



1 – PET bottle, 2 – laminate box, 3 – glass bottle, 4 – stand-up pouch, 5 – plastic can, 6 – polystyrene package.

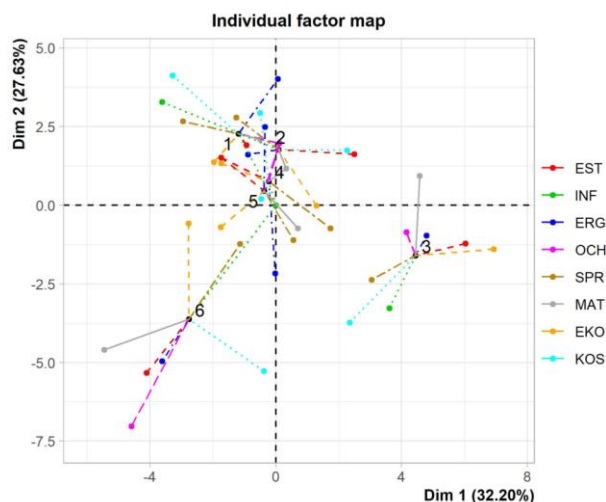
Figure 4. Rating of Objects under Analysis in Respect of Factors

Since environmental aspects constitute the pivotal issue for deliberations in this article, the assessment of products is rated in respect of the group of environmental friendliness-related features (EKO).

From the point of view of that group, the glass bottle (3) shows the strongest relationship with dimension 1, namely the protective material. It is followed by the laminate package (2). The remaining

packaging under consideration (the PET bottle, stand-up pouch, plastic can, polystyrene package) are similarly rated in respect of the relationship with factor 1. From the point of view of the relationships

of the analysed objects with the cost dimension, the PET bottle and stand-up pouch show the strongest relationship with it. The rest of the packaging shows a similar relationship with that dimension.



1 – PET bottle, 2 – laminate box, 3 – glass bottle, 4 – stand-up pouch, 5 – plastic can, 6 – polystyrene package.

Figure 5. Rating of Objects under Analysis in Respect of Factors Inclusive of Feature Categories

In order to obtain the information on differences among the responders representing a variety of the packaging

supply chain members, the responders' assessments were compared. The resulting figures are presented in Figure 6.

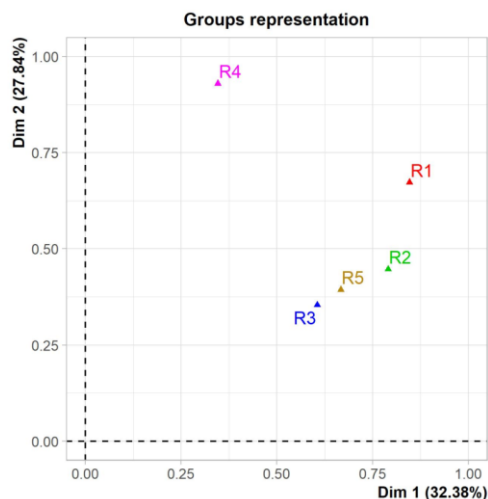


Figure 6. Comparison of Responders' Assessments in Respect of Factors

The most distinct assessment of the packaging features in relation to both dimensions, that emerged in the course of the analysis, was made by the solid waste disposal system operator (R4). The opinions of the food producer (R3), the packaging distributor (R2) and the packaging recovery organization (R5) were similar in respect of two dimensions. The first dimension related with the packaging mass and security differentiated the assessment made by the solid waste disposal system operator (R4) from the assessment made by the packaging manufacturer (R1) to the greatest extent. However, the second dimension, showing the strongest relationship with such features as the price, security, and aesthetics of packaging, differentiated the assessment made by the solid waste disposal operator (R4) from the assessment made by the food producer (R3) to the greatest extent.

5. Discussions

The research outcome is indicative of diversification of the key packaging features arising from the assessments made by respective units of the supply chain. According to the responders, the most important expected packaging features included the kind, quantity, and mass of packaging material used for manufacturing packaging, which corresponds to the technical and technological aspect of the packaging manufacture but also accounts for the effective ecological function of packaging. Furthermore, the effective protective function of packaging, aesthetics, informativeness, and functionality of packaging was considered by the responders to be essential packaging features. It is linked with the individual approach of each of the supply chain members, which is strictly focused on the implementation of specific tasks (Bix et al., 2009). Recognition of diverse expected requirements essential from the point of view of the representatives of the supply chain is indicative of the need for closer cooperation and development of

their collaborative approach to the extent of the food packaging design in order to satisfy the requirements of each of them (Petersen et al., 2006).

The key packaging features and properties for respective units of the supply chain, identified by means of the MFA method, prove the relationships between the packaging features regarded as essential. The analysis of the obtained results has allowed to distinguish common groups of packaging features and properties and has confirmed the validity of the thesis claiming that the application of the multi-factor authentication provides for indication of relationships of decision-making criteria set out by the packaging supply chain members with the food packaging design process. It is plausible to state that common and essential groups of features for all the units of the supply chain are: safety, material, ergonomics, and aesthetics of packaging (vide Figure 3). The aforementioned groups of features are strictly related to technical, social, economic, and ecological aspects that are extensively elaborated upon in the literature referring to packaging industry (Bix et al., 2009). Safety is related to the social aspect due to the direct influence on human health and life as well as to the technical aspect due to the need for efficient technological processes as well as final chemical, physical-and-chemical, microbiological properties that are characteristic for finished packaging material and ready-made packaging. It was also proven in research made by Kawecka, Cholewa-Wójcik, Sikora (2021). Material (that is its kind, quantity, mass) is strictly related to a great extent to technical aspects due to mouldability in packing machines. Apart from the technical aspect, the relationships with ecological aspects must be paid attention to because the reduction of mass and quantity of the packaging material contributes to the mitigation of the adverse impact of the packaging upon the environment (Holdway et al., 2002, Nordin & Selke, 2010, Lehmann et al., 2011). By

contrast, ergonomics of packaging was understood, *inter alia*, as easy handling. That feature is most of all related to the social aspect because it takes into account needs and requirements of consumers. Ergonomics also shows the relationship with the technical aspect for manufacturing a product that is easy to use entails development of a relevant technical and technological arrangement for the purpose of the construction mould as well as opening and re-closing constructs. Aesthetics is still another group of essential features common for the majority of the supply chain members, that constitutes the social aspect because it influences the perception of packaging and acknowledgment of quality of a packaged product by consumers (Rocchi & Stefani, 2006, Becker et al., 2011, Reimann et al., 2011, Van der Laan et al., 2012).

6. Conclusions

The design process is carried out sequentially by means of particular design stages, after the end of which the outcomes of each stage are assessed and decisions concerning the further process are made. The effective food packaging design is facilitated by a collaborative approach, that takes into account expected features of a final product which are crucial for respective chain supply members and concurrently are corresponding features. Such a perspective ensures decision-making optimisation and a comprehensive approach to the iterative course of the design process (Emblem & Emblem, 2000). Based on the research outcomes obtained, recommendations within the scope of respective stages of the packaging design process, including a collaborative approach, have been put together.

In order to make the packaging design collaborative, it is necessary to include the features and properties crucial for all of the chain supply members in the first stage of the delivery of the packaging design process (recognition and preparation of the problem).

It serves the basis for determining the tentative design goals and allows for verification and assessment of the relationship of groups of requirements of the supply chain members within the analysis of the design task concept (Bix, 2009). Therefore, it is the stage of formulating the common goal which is to make an optimal decision for all the members of the supply chain. A detailed exploration of information, concerning the potential group of recipients of the product to be created (packaging) and constituting a part of the information analysis, obtained is the guideline for searching for solutions to the design task. This stage is crucial in the design process in terms of the features and properties of the final product. It is connected with the verification of the conceptual framework which determines the possibilities and limitations in application and use of the packagings at all stages of the chain. The assessment of the proposed design solutions should be based on a close cooperation between the representatives of the members of the supply chain and be conducted on the basis of the assessment of criteria such as: legal, technical, aesthetic, ergonomic and economic aspects with the use of generation or semi-generation methods (Fuente et al., 2015). At the following stage, there is a final verification of the solution and prototype development which should include the correct relationships of packaging features and elements such as: construction form, shape, size, ergonomics, aesthetics and the cost of producing the packaging. An effective packaging prototype should provide the members of the supply chain with utilitarian and hedonistic as well as semiotic benefits (Bloch, 2011). The developed and verified packaging prototype, assessed using techniques and methods including the risk analysis, related to fulfilling the needs of the members of the supply chain, constitutes the basis for launching production and commercialisation of packaging (Aoussat, Christofol, Le Coq, 2000).

The implementation of the packaging design stages, taking into account the need to include the aspects related to the particular common key packaging features at each design stage, ensures decision-making optimization and a comprehensive approach to the iterative process of packaging design. Such a collaborative approach allows for differentiation of the product offer through the possibility of selecting the features desired by the members of the supply chain while working out a consensus on the final packaging design.

The research outcome will facilitate and support the packaging design in terms of the improvement of existing processes. It is indicative of taking into account the expectations of the members of the supply chain and providing the basis for modeling partner relations with them. For the packaging designers, the analysis that has been carried out serves the basis for developing a catalog of common features of the final product, addressing the needs of respective members of the supply chain.

The limitations of the conducted research arise from the necessity to rely on the

opinions of representatives of only one supply chain, which, on the one hand, unifies the compilation of data around similar packages, while, on the other hand, it narrows the scope of the whole research. The next limitation is the relatively high volatility of trends resulting from e.g., changes implemented in the legal regulations governing the materials used for packaging manufacturing purposes, which may impact the decision-making process as far as the packaging design and consumer attitudes are concerned. Further research concerning the assessment of packaging features is worth conducting on various scenarios of possible solutions taking into account the risk of trend volatility.

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Conflict of interest

The authors declare no conflict of interest.

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Agnieszka

Cholewa-Wójcik

Department of Packaging Science, Cracow
University of Economics, Rakowicka 27,
31-510 Krakow, Poland,
cholewaa@uek.krakow.pl
ORCID 0000-0002-5298-0210

Agnieszka Kawecka

Department of Packaging Science, Cracow
University of Economics, Rakowicka 27,
31-510 Krakow, Poland,
agnieszka.kawecka@uek.krakow.pl
ORCID0000-0003-2562-3784

Marek Ćwiklicki

Department of Public Management, Cracow
University of Economics, Rakowicka 27, 31-510
Krakow, Poland, marek.cwiklicki@uek.krakow.pl
ORCID0000-0002-5298-0210

Magdalena Wojnarowska

Department of Technology and Ecology of
Products, Cracow University of Economics,
Rakowicka 27, 31-510 Krakow, Poland,
magdalena.wojnarowska@uek.krakow.pl
ORCID0000-0001-7068-1698

Appendix 1. Features Classification

Feature	Specific Feature	Code
Nice-looking EST	Aesthetics	est.R3
	aesthetics of finished packaging	est.R1
	aesthetics	est.R2
	nice-looking	est.R5
	minimalism	mini.R2
Informativeness INF	visible essential information	wid.R3
Easy handling ERG	easy handling	man.R1
	easy to use	łat.R2
	easy opening	otw.R3
	functional	funk.R3
	ergonomics	ergo.R4
	easy handling by consumers (keeping, opening)	obs.R5
Product protection OCH	security	bezp.R2
	free from defects/drawbacks	wad.R1
	effective protective function of a packaged product	ochron.R1
	product protection	och.R5
Efficiency/Effectiveness of Business Processes - SPR	ensuring efficient and effective logistics	log.R5
	flexibility	elas.R4
	capacity	poj.R4
Material MAT	kind of packaging material	romat.R1
	packaging mass	mas.R1
	quantity of material used per packaging unit (cubic capacity)	ilmat.R1
	transparency	trans.R4
Ecological/environmental friendly - EKO	ecology	eko.R2
	ecological	eko.R3
	made with maximum care about natural environment	eko.R5
	neutralisation	uty.R4
Cost - KOS	price	cena.R4
	packaging cost, quality-price relationship	ko.R3