



## Decision-making processes on sustainable packaging options in the European food sector

Ramona Weinrich<sup>a</sup>, Ellen Mielinger<sup>a</sup>, Victoria Krauter<sup>b,\*</sup>, Elena Arranz<sup>c</sup>, Rosa María Camara Hurtado<sup>c</sup>, Begonya Marcos<sup>d</sup>, Fátima Poças<sup>e</sup>, Salvador Ruiz de Maya<sup>f</sup>, Carsten Herbes<sup>g</sup>

<sup>a</sup> University of Hohenheim, Department of Consumer Behaviour in the Bioeconomy, Wollgrasweg 49, 70599, Stuttgart, Germany

<sup>b</sup> FH Campus Wien, University of Applied Sciences, Department Applied Life Sciences, Packaging and Resource Management, Favoritenstraße 226, 1100, Vienna, Austria

<sup>c</sup> Complutense University of Madrid, Faculty of Pharmacy, Department of Nutrition and Food Science, 28040, Madrid, Spain

<sup>d</sup> IRTA, Food Quality and Technology, Finca Camps I Armet S/n, 17121, Monells, Spain

<sup>e</sup> Universidade Católica Portuguesa, Centro de Biotecnologia e Química Fina – Laboratório Associado, Escola Superior de Biotecnologia, Rua Diogo Botelho 1327, 4169-005, Porto, Portugal

<sup>f</sup> University of Murcia, Department of Marketing, Faculty of Economics and Business, Campus de Espinardo, 30100, Murcia, Spain

<sup>g</sup> Nuerntingen-Geislingen University, Institute for International Research on Sustainable Management and Renewable Energy (ISR), Neckarsteige 6-10, 72622, Nuerntingen, Germany

### ARTICLE INFO

Handling editor: Mingzhou Jin

#### Keywords:

Sustainability  
Food packaging  
Qualitative research  
Decision-making  
Packaging design

### ABSTRACT

Food packaging improves shelf life and allows longer transportation distances in global food supply chains, but it is also responsible for huge volumes of waste. The transition to sustainable packaging by food companies has often been slow and inconsistent. How decisions on (sustainable) packaging are made within companies in the food sector remains mostly opaque to research. To explore the decision-making process and identify barriers for cleaner, more resource efficient food packaging, we carried out 17 interviews in four European countries across different food sectors using the theoretical decision-making process of Nutt (1984) as an analytical framework. Through qualitative content analysis, we found that decision-making processes often lack structure and extend over long stretches of time. Frequently, they are initiated in response to packaging material manufacturers or suppliers. Switching to more sustainable packaging often implies costly investments into new machinery. Economic sustainability takes precedence over ecological sustainability. We recommend companies move to life-cycle cost models for packaging decisions, commit to mono- and other recyclable materials, and establish structured decision-making processes with clear cut-off criteria so as to streamline implementation decisions. Our results further support a call for progressive legislation towards a circular economy in the packaging sector.

### 1. Introduction

The focus of attention in sustainable production and consumption is increasingly on (global) food systems, which encompass all elements (e.g. processes, infrastructures) and activities necessary to provide the world's growing population with food (HLPE, 2017). In this context, food packaging can play a key role in both causing and solving environmental sustainability problems. This polarizing role of food packaging has fueled social, scientific and political debate (HLPE, 2014).

The improper application, use or disposal of food packaging can lead

to profoundly negative environmental impacts. These include ever larger amounts of packaging waste (approx. 177 kg per EU inhabitant in 2020) (Eurostat, 2022a) and food waste (approx. 127 kg per EU inhabitant in 2020) (Eurostat, 2022b). Optimized packaging but also innovative business models could help reduce the environmental burden of food systems by improving, amongst others, material efficiency, reducing food waste, and increasing material circularity (HLPE, 2014; Molina-Besch et al., 2019; Wikström et al., 2019).

This fact has been recognized by the European Commission and gradually incorporated into a whole set of new provisions. Prominent is the European Green Deal (European Commission, 2019) which includes

\* Corresponding author.

E-mail address: [victoria.krauter@fh-campuswien.ac.at](mailto:victoria.krauter@fh-campuswien.ac.at) (V. Krauter).

<https://doi.org/10.1016/j.jclepro.2023.139918>

Received 4 May 2023; Received in revised form 8 November 2023; Accepted 23 November 2023

Available online 28 November 2023

0959-6526/© 2023 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

the Circular Economy Action Plan, the Farm to Fork strategy but also the EU Plastics Strategy (European Commission, 2020a,b). This increases the pressure to adopt innovative and environmentally friendly packaging solutions to reduce both food and packaging waste through, for example, reusable and recyclable materials, reduction of unnecessary packaging, or clear communications. However, looking at the progress made by companies in their packaging, it becomes clear that the transition to sustainable packaging, which can be defined as “Sustainable food packaging is an optimized, measured (quantified) and validated solution, which takes into consideration the balance of social, economic, ecological and safe implementations of the circular value chain, based on the entire history (life cycle) of the food product-package unit” is slow and inconsistent (Dörnyei et al., 2023, p. 9). Commitments are made rather than actions taken (Phelan et al., 2022; Dörnyei et al., 2023).

Consumer research on packaging is abundant as several review articles have demonstrated (Ketelsen et al., 2020; Otto et al., 2021; Weinrich and Herbes, 2023). Research into the decision-making processes of companies for packaging choices, however, is scarce. To address this gap and better understand barriers to resource efficient food packaging, we pursue these two questions.

1. What processes do companies use to make their decisions on food packaging?
2. What barriers prevent decision makers from choosing sustainable packaging options?

Pursuing these questions advances our understanding of environmental management initiatives undertaken, or not, by companies to meet the call for sustainable packaging. Our study provides clear insight into challenges and obstacles that strategic decision makers face at the operational level.

This contribution is of high interest for strategic stakeholders. Companies can reflect on their own decision-making process against those in our study and identify sustainability promoting and hindering influencing factors. Consultants can better understand decision-making process problems to address them in their services.

## 2. Literature review – scarcity of descriptive research on packaging-related decision making

Research on corporate decision-making includes normative and descriptive approaches. The former provides guidelines on how to make decisions while the latter looks at how companies really make decisions. For decisions on packaging, there are far more normative studies than descriptive ones. Normative studies on packaging decisions provide help by including criteria such as cost and various sustainability-related criteria, e.g. Foschi et al. (2020); Molina-Besch et al. (2019); Rezaei et al. (2019); Vöröskői et al. (2020). Actual decision-making is sometimes touched on in normative studies but on a rather superficial level, without supporting data, such as in the study of Vöröskői et al. (2020).

A recent review paper (Wandosell et al., 2021) that surveyed literature on the business perspective on green packaging did not find any research on decision-making or development processes, with exception of a study by de Koeijer et al. (2017). De Koeijer et al. (2017, 2019) deplored the gap between the strategic importance assigned to packaging sustainability by upper-level management and the packaging development processes on the operational level.

The few existing studies on actual decision making are based on qualitative research methods such as interviews and case studies. De Koeijer et al. (2017) are, to our knowledge, the only researchers taking an in-depth approach to the study of processes and stakeholders in packaging development. They based their results on three main cases from the Netherlands and described somewhat formalized Stage-Gate processes, internal and external drivers, team structure, and decision-making criteria. Their study focuses the environmental perspective of packaging sustainability. They found that operational

development processes are often not well-aligned with strategic sustainability goals; further, they found that sustainability ranks lower in importance than other criteria. They also described the strong role of marketers in the process and identified the role of a “sustainability guardian” (Koeijer et al., 2017). A further study, based on a survey of Dutch packaging experts, found multidisciplinary teams that include marketing professionals and have management commitment are pre-conditions for high levels of strategic and operational sustainability, while external stakeholders are less influential (Koeijer et al., 2019).

Several factors have been identified that influence if and how companies include sustainability issues, mostly environmental, in their packaging development processes (Koeijer et al., 2017; Pålsson and Sandberg, 2022). The main barriers as summarized by these studies are listed below (Koeijer et al., 2017; Pålsson and Sandberg, 2022).

### Internal.

- Lack of commitment both from management and from employees
- Resistance towards change in packaging and packaging development processes
- Costs of materials, equipment, and training
- Internal problems in interaction between departments
- Complexity of decision-making processes
- Lack of knowledge/training/experience
- Lack of tools and approaches for sustainable packaging design

### External.

- Losses in competitiveness (e.g. due to increased cost)
- Resistance by customers
- Unfavorable legislation (lack of regulation or restrictions e.g. concerning the types of materials allowed for packaging production)
- Problems with packaging suppliers (e.g. measuring the sustainability performance of suppliers)

Ruippo et al. (2022) take a different perspective. They looked at motivators that drive sustainable innovations for food packaging. Although brand owners are only a minority in their sample, the results are nevertheless insightful. The drivers they found in their interview study comprise among others business-related factors like regulations and industry norms, changing demand from customers and a positive business case for these innovations as well as personal factors such as environmental concern. Moreover, they asked their interviewees in detail about what makes a packaging solution sustainable: mitigating food loss and recyclability as specific attributes were most often mentioned.

Further, De Koeijer et al. (2017) already lamented the surprising dearth of research on organizational decision making and the factors influencing its alignment to the strategic level of the corporate strategy. Sumrin et al. (2021) reiterated the call for studies that examine factors driving decisions made about eco-innovations in the packaging industry (Sumrin et al., 2021). The urgency of these questions led us to take up this research.

## 3. Theoretical framework

The Nutt model (1984) and subsequent work by Nutt has been widely used to structure inquiries into organizational decision making (Mohaghegh and Furlan, 2020; Zhang, 2020). It is also useful for analyzing sustainability-related decision-making (Eikelenboom and Jong, 2022) as it provides a clear framework but is not limited to specific decisions. As such, we chose Nutt’s model (1984) as the framework to analyze the structure of decision-making activities in our study. Adopting this framework allows our results to be compared with other sustainability-related decision-making processes beyond packaging.

Following Nutt (1984), a decision-making process consists of the five steps shown in Fig. 1. In the first step, called formulation, a problem or



Fig. 1. Steps of the organizational decision-making process, presentation following Nutt (1984).

an issue is identified. This step aims at understanding the problem and examining needs and opportunities. In step two, concept development, alternatives to solving the problem and reaching the goals are identified. The third step, detailing, is used to analyze alternatives. The fourth step, evaluation, identifies advantages and disadvantages of the alternatives. In the fifth and final step, implementation, a decision is made and carried out. (Nutt, 1984).

## 4. Methods & material

### 4.1. Method

For this exploratory study into the complexities of decision-making processes in companies, we selected a qualitative approach. The often ill-defined structures or conflicting views on internal processes can be difficult to capture in surveys that are not based on deeper and more detailed investigations (Bakonyi, 2018). Capturing free-form responses is a way to avoid low-yield survey questions, and the open format also makes it easier for respondents to share unpleasant information (Flick, 2021).

With specific guidelines, expert interviews can be used to explore details in unknown research fields and to focus the knowledge and insights of people designated as experts on specific problems (Flick, 2021). For the present study, we chose problem-centred expert interviews for the advantage they offer to a cross-national and cross-industry approach. Our choice facilitates the comparability of results and supports the development of theoretical insight *via* inductive-deductive processes (Döringer, 2021). Interviews are guided by a set of pre-defined questions that focus attention on the topics and themes relevant to the research question (Flick, 2021). Our interview guideline was developed following the organizational decision-making process model of Nutt (1984), presented in Section 3. The guideline can be found in the appendix.

Ethical approval for the interviews was granted by the university leading this study. All participants received data protection declarations, and each signed their declaration. Before starting a conversation, the interviewer would ask participants whether they had understood the declaration and address any further questions they might have had.

The interviews were carried out in Germany, Austria, Spain and Portugal by native speakers trained by researchers who are experienced in expert interviews. The interview guideline was provided to the national teams in English and translated as well as back translated by the respective native speakers.

The interviews were conducted online and recorded using virtual meeting software between June 2022 and September 2022. The audio files were subsequently transcribed and translated into English. The interviews were subjected to qualitative content analysis according to Mayring (2022). The documents were then carefully coded using the software MAXQDA (Kuckartz and Rädiker, 2019).

To ensure coding reliability and validity, the interview transcripts were coded independently by two researchers. The categories on the first level were formed deductively from the steps in Nutt's model (1984) and presented in Fig. 1. Subsequent categories were developed inductively using a consensual coding approach, whereby the researchers compared their individual classifications (see chapter 5.2 for Formulation, 5.3 for Concept development 5.4 for Detailing, 5.5 for Evaluation and 5.6 for Implementation). Possible disparities were subsequently discussed and a consensual solution negotiated (Schmidt, 2004).

### 4.2. Material and coding

The study comprises a cross-national and cross-industry sample of interviews. The companies in our sample operate mainly internationally. Some of them only serve the domestic market with food, but most export food abroad. They all cover different food sectors, are medium-sized or large enterprises and employ 250 people or more (OECD, 2023) (see Table 1). All interviewees are directly involved in the decision-making process on new packaging solutions and have an overview of the entire process.

We conducted 17 interviews, each roughly 60 min, seven in Germany, six in Austria, three in Spain and one in Portugal. Table 1 enumerates the interviewees and lists their business unit, respective country, food sector, and corporate position.

## 5. Results and discussion

Our presentation of what we found through interviews with 17 food industry experts involved in making packaging decisions starts with identification of the unit responsible for packaging decision-making. The results and discussion section then follows the five steps of the organizational decision-making process model of Nutt (1984): Formulation, Concept development, Detailing, Evaluation, and Implementation. Overall, there were 668 codings across the 17 interviews. The interview with the fewest codings had 24, and the interview with the most had 52.

### 5.1. Decision-making responsibility

The responsibility for selecting packaging for products may lie in the sales department, in purchasing, in production, or even in R&D (which are primarily responsible for product development), but only in one company does the responsibility lie with upper-level management or a chief executive. This means there is no single identifiable department among the companies in our sample carrying responsibility for sustainable packaging. This might be due to the different, interdisciplinary strategic questions which require team members with various backgrounds such as controlling or quality management. Later in the interviews, we also found that in most companies it is unclear if there is a final decision maker or not when disagreements cannot be solved within the team. This underscores the unclear roles and responsibilities within the decision-making process, results also found by Elonen and Arto (2003).

Only one company (intv. 11; 16<sup>1</sup>) has a pre-defined decision-making process:

*"So internally there are [...] two processes, that is the product launch [...] and the then prefabricated, i.e. the then constantly further developed Excel document, where [...] all parameters of every department are mapped, where all articles are recorded, where [...] all points that are necessary for the implementation are recorded."*

The majority of interviewees (10) said that they did not have a documented process for making decision on packaging, while six acknowledged having such a process. The interviews revealed, however, that even those who thought they did, really did not. Rather, in some companies, little awareness exists of not having a defined process; in

<sup>1</sup> The first number is the interview number, the second number shows the coding point.

**Table 1**  
Overview of country, sector and expert position within the corresponding company.

Number	Country	Food sector (focus)	Business unit	Position	Company size (employees)
1	Germany	Retail	Purchase, sustainability & packaging	Manager	155,000
2	Germany	Fruits and vegetables	Research & development	Head	300
3	Germany	Meat and fish	Product management	Manager	12,200
4	Germany	Cereal and confectionary	Market research & development	Manager	250
5	Germany	Cereal and confectionary	Marketing	Executive position	250
6	Germany	Dairy	Packaging development	Executive position	7800
7	Germany	Cereal and confectionary	Quality management	Executive position	400
8	Austria	Meat and fish	Purchase	Manager	550
9	Austria	Dairy	Purchase, projects	Executive position	250
10	Austria	Other/convenience food	Sustainability	Manager	1500
11	Austria	Fruits and vegetables	Purchase	Head	600
12	Austria	Other/convenience food	Product development	Executive position	550
13	Austria	Cereal and confectionary	Purchase	Executive position	700
14	Spain	Meat and fish	Research & development	Director	1900
15	Spain	Other/convenience food	CSR & sustainability	Manager	150,000
16	Spain	Cereal and confectionary	Marketing & export	Director	300
17	Portugal	Fruits and vegetables	Marketing	Director	1500

other companies, there is awareness of not having a defined process. Nevertheless, some of these companies consider that to be an advantage, as this interviewee explained (intv. 12; 22):

*“Due to our structure, [...], we have not defined a clear workflow [...], because we are a rather medium-sized company whose strength certainly lies in the flexible handling of issues. That means, we have relatively short decision-making paths, sometimes decisions can be made and implemented quickly without a large process.”*

This interviewee does not see that structured decision-making processes can be flexible. It seems there is little awareness of the advantages that well-defined processes can have, such as clear roles and responsibilities for all team members, with checklists to accelerate decision-making processes. The strength of a company's management is positively related to the speed of its strategic decision-making (Shepherd and Rudd, 2014), and leading companies have innovated streamlined processes that refute the idea here voiced that formal processes must be slow.

In most companies, there are no regular project meetings on packaging. In one company (intv. 13; 12), there is a kickoff meeting when a project starts. In another company (intv. 15; 16), there is a regular meeting on packaging every six months. In another, the number of meetings depends on the size of the project (intv. 6; 10).

The selection of the members for the decision-making team is flexible in most companies. Table 2 illustrates the number of departments that might be involved and how frequently each shows up in our sample. Not

**Table 2**  
Process participants/decision-making teams.

Involved department	Total number of companies in which the department is involved (out of 17)
Purchasing	15
Production	13
Marketing	10
Sales	9
Quality management/quality assurance	9
Research & Development	7
Technical department/ technicians	5
CEO	5
Packaging	4
Product management	3
Controlling	3
Supply Chain Management	1
Sustainability	1
Graphic designer	1
(external stakeholders)	(23; multiple answers per interview possible)

always defined is the role of packaging manager. The responsible party might cross department lines, or belong to any one of those in the table. Having more internal stakeholders involved has been connected to having fewer rules or standardizations (Ashmos et al., 1998) for decision-making processes. Of course, packaging involves interdisciplinary interests (see also 4.1).

## 5.2. Formulation

The strategies for revising packaging or developing new packaging can be formulated as follows: Look for more sustainable packaging options mainly by reducing the amount of plastic used (e.g. intv. 10; 2), reducing the environmental impact (intv. 1; 8) or improving plastic recyclability (intv. 7; 6). The external impetuses for these processes are:

1. Market conditions: Availability of packaging alternatives (e.g. intv. 12; 2)
2. Stakeholder demand for more sustainable packaging options (e.g. intv. 7; 6)
3. Uncertainty over upcoming legal requirements (e.g. intv. 8; 2, 72)
4. New options presented by packaging suppliers (e.g. intv. 9; 4)

The stakeholder demand as well as market conditions and legal requirements for more sustainable packaging options was also found by Ruippo et al. (2022).

An internal impetus for revision packaging often develops when a product or product family is (re)launched (intv. 2; 17; intv. 16; 24). However, this procedure shows that there is not a formulation process on its own as the process is rather started by external triggers or by the marketing department when (re)launching products. Thus, there does not seem to be internal motivation to revise packaging in order to have more sustainable packaging. This may lead to the conclusion that less sustainable packaging is not seen as a problem within the companies.

One interviewee stated at the beginning of the interview, that the current equipment does not leave room for changing the packaging: *“In the past ten years, the framework here was very narrow because we could not or did not want to integrate any new packaging technology, i.e. packaging machines.”* (intv. 3; 9). Compatibility with existing machines was often mentioned in the selection criteria by other companies as well.

Outside of internal departments, several external stakeholders play a role in the decision-making process. In descending order of influence, they are: packaging suppliers, clients, retailers and engineering suppliers. In 13 of the 17 companies, the packaging supplier is a stakeholder in decision making, e.g. by making suggestions for new packaging options or innovations.

We also note in Fig. 2 the distribution of influencers from which the

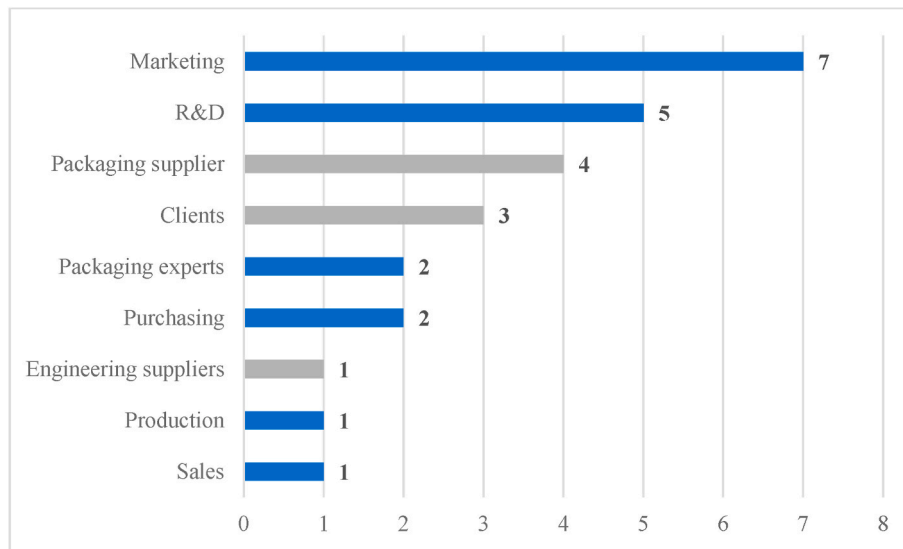


Fig. 2. Initiators of the decision-making process; notes: more than one nomination per company possible; blue colour: internal; grey colour: external. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

individual initiating the decision-making process may come.

In some companies, it is not always the same department initiating a new or revised packaging design and leading the process; it can vary from marketing to sales to purchasing. Not all the interviewees were clear on the question. That might be because the answer depends on the type of packaging decision, e.g. graphical design, or material selection. But again, we find here an unstructured process with unclear roles and responsibilities within teams, similar to [Elonen and Arto \(2003\)](#).

Starting the process seems to be an individual affair. In 8 of the 17 companies, the launch of a packaging revision starts with the marketing department. The interviewees identify this as the market demanding more sustainable packaging options: “[...] the decisive factor for marketing was that we really wanted to do something good for the environment or do something good and switched to mono material here.” (intv. 8; 2).

We were surprised by the influence of packaging suppliers. This can be explained by the fact that not all companies have R&D departments that work on packaging and that SMEs do not see themselves in a position powerful enough to impose packaging solutions on their packaging suppliers. It seems they are the most important external initiator of packaging revisions in the innovation process, which fact we consider in the next section.

### 5.3. Concept development

To find new or alternative packaging, companies need to have a concept to evaluate against other packaging options. One company carries out brainstorming at the beginning of concept development (intv. 8; 10). In another, the team completes a decision-making form called Product Concept Development. This form calls specifically for environmental assessment (intv. 11; 67). Here, initiative has been consciously taken for developing new packaging: “[...] by integrating an extra field for environmental assessment of the packaging: This form is called Product Concept Development and is therefore abbreviated PCD. A few weeks or months ago, we integrated a new assessment field there, which is called EMS, or Environmental Management System.”

Discovering information about new packaging options is managed differently by each company in our study. Fig. 3 shows the information sources named by our interviewees. The degree of active professional engagement varies greatly. Most companies rely on, or rather wait for, information provided by their packaging suppliers (intv. 9; 24: “mainly suppliers, via the usual communication channels”), but others search actively for alternative packaging suppliers by going to trade fairs, analyzing competitors, or reading magazines (intv. 6; 16: “We also conduct interviews with the suppliers. We go on site, have a look at the

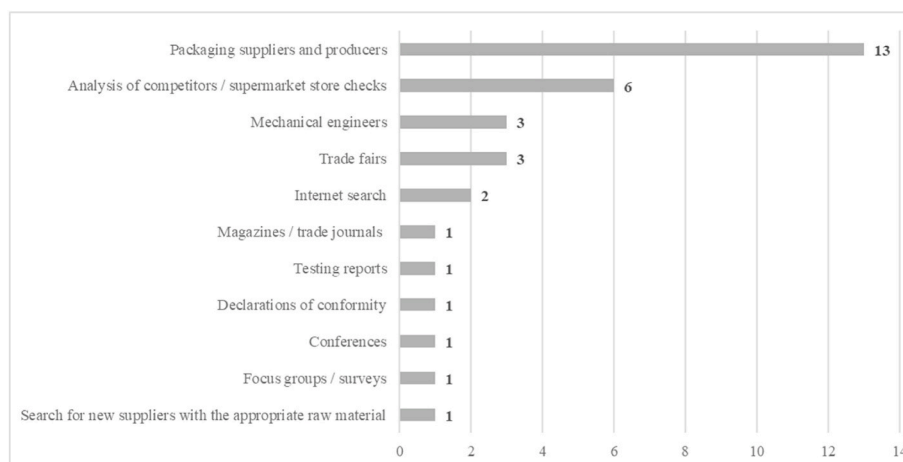


Fig. 3. Sources used for information about alternative packaging options.

supplier.”). Only a few companies search systematically for information – e.g. by carrying out interviews with packaging suppliers or machine engineers, carrying out quantitative consumer surveys, or tapping manifold sources of information – as does this company (intv. 17; 7): “So, we do focus groups, we do surveys and then we go to conferences, we get lots of information”.

This procedure of gathering information might be problematic as relying mostly on information from packaging suppliers might be biased. Further, it is debatable if persons in the purchase department with no packaging background relying on this information can be named packaging experts. This is supported by the following statements in our interviews: “[...] but it’s a very subjective assessment, I haven’t checked.” (intv. 9; 70); “[...] this is not substantiated. It is a personal opinion.” (intv. 16; 111).

Other researchers (Koeijer et al., 2017; Pålsson and Sandberg, 2022) have named a number of barriers to sustainable packaging designs that did not surface in our interviews; neither lack of knowledge, training, experience, nor an absence of tools or approaches were manifest. This is most probably because all 17 companies deploy interdisciplinary teams that stay well informed through e.g. their packaging suppliers. Beyond information, though, all our interviewees expressed a high commitment to and knowledge of sustainable packaging. However, our experts represented different countries than did those in Koeijer et al. (2017) or Pålsson and Sandberg (2022), a factor that cannot be ignored.

#### 5.4. Detailing

Analyzing packaging alternatives proceeds along several steps in all the companies represented, and the detailing process is generally time-consuming, requiring multiple iterations and reviews.

Abstracting from the sources of information presented in Fig. 3, we can say there are two ways packaging alternatives arise: either the company has seen the new material and asks the supplier about it, or the supplier has a new packaging option and suggests it to the company. Cut-off criteria for consideration are availability and cost of the alternative compared to the present material. This calculus holds especially true for inexpensive products where the packaging accounts for a high percentage of the total cost. Koeijer et al. (2017) and Pålsson and Sandberg (2022) also find prohibitive costs to be a cut off criterion.

If cost and availability criteria are met, analysis next considers technical points of view. Often, packaging alternatives have less

material and/or consist of a different material (e.g. paper instead of plastic or recyclable material). Further, the alternatives also depend on the target countries, as the legal requirements differ, e.g. in the percentage of recyclability. Moreover, the new material must run on the existing machines to limit the investment risk.

Interestingly, we see in the detailing step that there are clear cut-off criteria and that environmental sustainability aspects are not analysed first, as e.g. life cycle assessments (LCAs) are missing. However, this in strong contradiction to what is reported in 5.5., the evaluation step (cf. Fig. 4). There, the interviewees state that sustainability is the most important aspect. But we see here, it is not. This as a paradox which deserves future research: Are companies aware of this mismatch? This result further goes in line with the formulation step (5.2) where we saw that most initiatives are externally triggered.

The shortlist of candidates passing this analysis are then subjected to internal tests that deliver critical information needed to make further decisions. The objective of these tests is to determine machine runnability, shelf life of the food packaged and the possibility of using less material: “I’m trying to use a material that is mono-material and has a shorter shelf life. So, we’ll have to decide what the shelf life of this is and you’ll have to do the corresponding analysis to tell me what value I have to give.” (intv. 14; 22). Other outputs of analysis include price, quality of provided food safety, and quality of printed illustrations and text. One company describes the packaging testing process as “[...] the ageing is okay, the price is okay, [...] the machinability is okay. We do another bigger test to be sure, but just to be sure.” (intv. 4; 16). Also tested are the physical properties of the material such as rigidity, lacquer on the material, surface tension and thicknesses. In interview 10, the process is described: “Based on certificates that are usually provided by suppliers, have all migrations been carried out, does it comply with the regulations and then there is a GO from the quality department. And then you just go into dialogue with the product management, look at the price and see what. What fits best? This is done with a shortlist.” (intv. 10; 6).

When internal analyses are finished, some companies follow up with an external assessment, e.g. supply chain tests during transportation and on supermarket displays (e.g. intv. 1; 20). These procedures for transport simulation tests are common in the food and packaging industry (cf. e.g. chapter 4.4.2 in Laszlo Horvath, Byungjin Min, and Young T. Kim, 2017). A company may also choose to run a pilot with selected customers (“Then they also chose special customers, critical customers, external customers. And they were also supplied with this new packaging for a week or

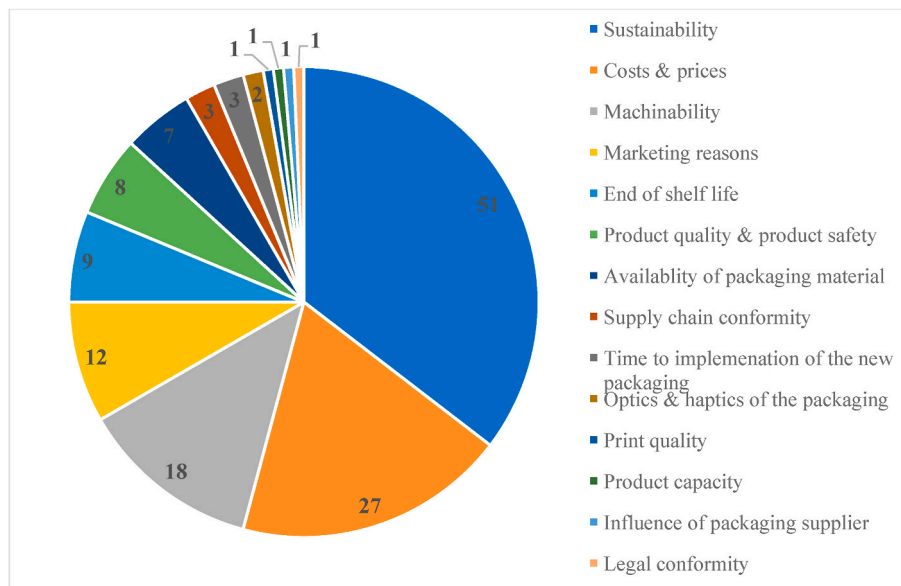


Fig. 4. Evaluation criteria of packaging material.

14 days in a pilot test. We really did a market test, so to speak, and asked them again.”; intv. 10; 22; note: refers to B2B customers).

### 5.5. Evaluation

Following the next step in the Nutt model, we asked the interviewees about the criteria by which they evaluate packaging. Fig. 4 shows the criteria named by their frequency of mention.

Considering these evaluation criteria from most to least important, using coding frequency as a proxy for importance, we identify sustainability as the most salient of the evaluation criteria (51). What sustainability means to our interviewees is represented in Fig. 5a.

Recyclability (14 codings) and reduction of material (13) dominate the sustainability concerns, with the next most frequent coding the use of mono material (itself recyclable) (5) which goes together with the study results of Ruippo et al. (2022).

Following sustainability in importance in making packaging decisions is the category of costs and prices (27, Fig. 4). Fig. 5b illustrates the relevant sub-criteria in this category.

We see the two decisive factors are the cost impact of new packaging (10), typically additive if the material is recycled or compostable, and the price of any new packaging machines that are needed (5). Connected to this price question is the machinability of the new packaging. As Fig. 4 shows, this criterion had 18 codings. “It is a machine issue; it is a machine adjustment issue [...]” (intv. 14; 54). This illustrates the relevance of machinability from both economic and technical points of view.

The need to switch to more sustainable packaging materials and alternatives as well as the associated challenge in processing them has also been recognized by other researchers (Bauer et al., 2021; Dörnyei et al., 2023; Gürlich et al., 2022). The change of packaging materials (e.g. change from multi to mono material or adopt a new material) also leads to often significantly different material properties (e.g. thickness) and thus processing requirements. Examples are mechanical properties like elasticity, seal-ability, and rejection-rate (Bauer et al., 2021; Naletina, 2021). Accordingly, the food companies are forced to adapt or replace their packaging machines, which often entail high investment costs. However, since the legal requirements are not (yet) sufficiently stable, restraint prevails here in order to avoid possible high reinvestment costs

(Naletina, 2021).

Referring again to Fig. 4, we see marketing criteria (12) and product safety (8) were the next most important criteria in the decision-making process. For marketing, several factors were rated important by our interviewees, including the transparency and size of the packaging, and the labeling of sustainable packaging. This aligns with the packaging literature, where communication is described as one of the main functions of packaging. Labels include those required by laws and regulations; those necessary for inventory control; those for product identification and brand marketing; and those added voluntarily (e.g. certification) (Robertson, 2013). Relevant examples include EU Regulation No. 1169/2011 (European Parliament, 2011) on providing food information to consumers (e.g. labeling, font size), the GS1 barcodes for business applications (GS1, 2023), communication of the environmental footprint of a product (European Commission, 2021), and catchy designs (Wiedemann, 2017).

Under product safety, the criteria most often mentioned was migration. This refers to the chemical safety of the packaging material when in contact with food. In this context, migration refers to a transfer of intentionally (e.g. additives) or non-intentionally (e.g. mineral oil components) added substances from the packaging to the product (Robertson, 2013). Corresponding specifications on the European level are, for example EC Regulation No. 1935/2004 (European Parliament, 2004) on materials and articles intended to come into contact with food or EU Regulation No. October 2011 (European Commission, 2011) on plastic materials and articles intended to come into contact with food.

In the following points, we report other criteria mentioned by our interviewees (total number in brackets) and contextualize them with the relevant literature respectively basics of packaging technology.

- Product quality (8) – represents the basic packaging functions of containment and protection of food which are prerequisite for launching a product on the market (Falkman, 2014; European Parliament, 2002; Robertson, 2013).
- Availability of resources/packaging (7) – reflects the current shortages of packaging at the wholesale level as well as the important criteria of delivery reliability and accuracy (Ivanov and Dolgui, 2022).

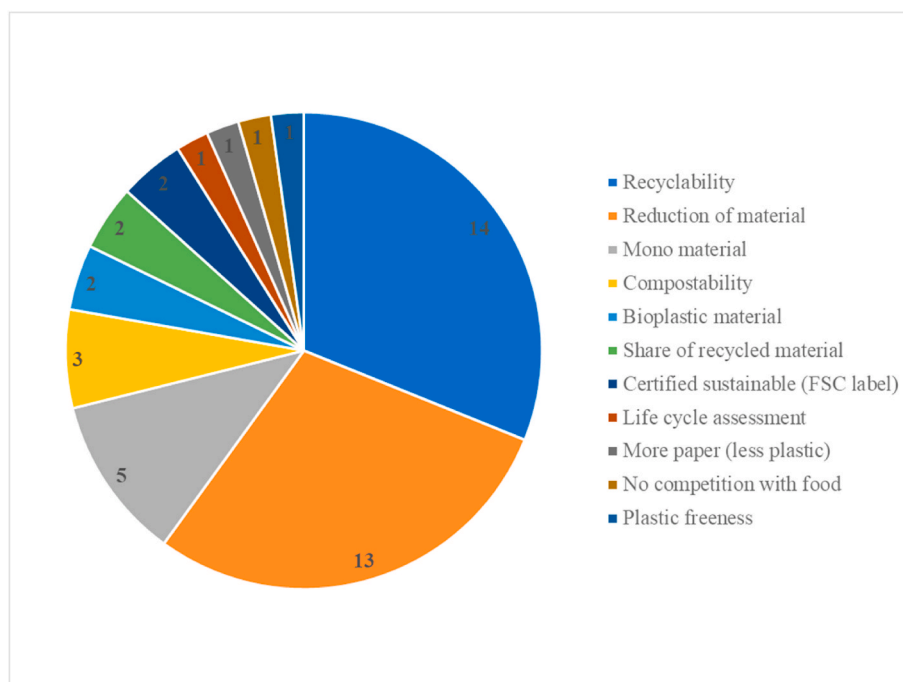


Fig. 5a. Sustainability sub-criteria in the decision-making process; note: numbers are absolute values.

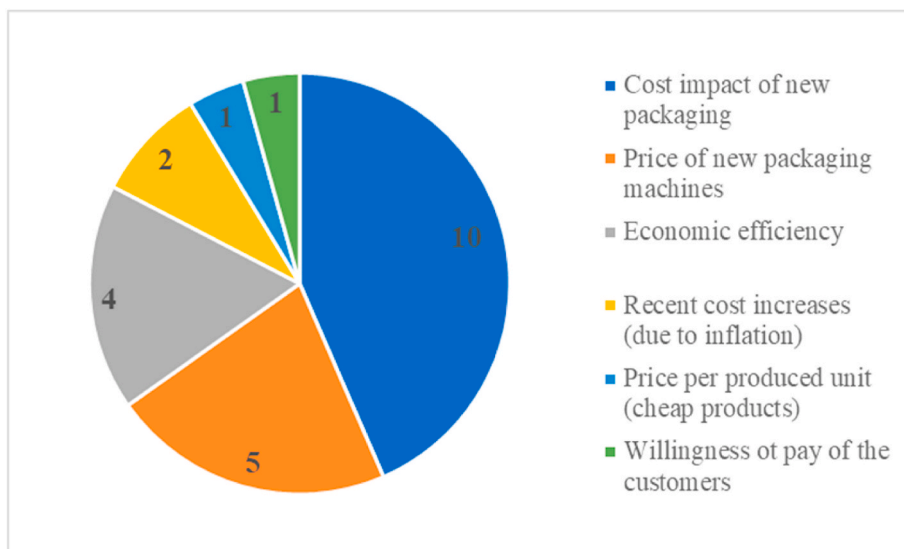


Fig. 5b. Costs & prices sub-criteria in the decision-making process; note: numbers are absolute values.

- Shelf-life (5) – refers to the most important function of packaging, namely protection of foods against deteriorative intrinsic or extrinsic factors, whether physical, chemical or microbial, and thus the ability to maintain or even prolong shelf-life. An appropriate shelf-life is key to market success. In the context of optimizing packaging with regard to sustainability, an optimum point is sought using as little packaging as possible to create the best protection for the product (Dörnyei et al., 2023).
- Tradability (4) – refers to the fact that packaging has to meet different specifications (e.g. size, form, stability, stackability) and be optimized for the intended supply chain up to retail and consumer (Wani et al., 2017; Ivanov and Dolgui, 2022; Robertson, 2013).
- Transportation (3) – similarly, packaging must continue to contain and protect food until it reaches its final destination (Wani et al., 2017; Ivanov and Dolgui, 2022; Robertson, 2013).
- Time of implementation (3) – refers to time pressure from stakeholders involved in the Fast-Moving Consumer Goods (FMCG) business (Dudbridge, 2011).

Mentioned only once include the codings for legal conformity, for evaluation of the packaging supplier, for production utilization rate, and for printing image. These are individual mentions partly covered by the aggregate categories, so not in need of further discussion. However, these aspects would be important to include in future research.

Usually, development, testing and weighting of packaging alternatives should be an integral part of a structured decision-making process (Falkman, 2014). However, the most important factors in this process are seen by the interviewees to vary widely: Price and costs (5), sustainability (2), machinability (2), product safety (2), product availability (n = 11; not every interviewee did a statement) which again confirms a rather unstructured process in the interviewed companies. This is important, since there is a contradiction between the number of mentions of sustainability criteria and the apparent low importance they have in actual decisions.

### 5.6. Implementation

We could not clearly find references to an explicit implementation decision in our interviews. With only 12 codings from 9 of the 17 interviewees, we can affirm that this step seems irrelevant for companies once a strategic decision has already been made.

However, interviewees who assessed decisions in retrospect spoke of time as a decisive factor that may affect implementation and cause

dissatisfaction and stress: “Yes, we have the problem that everyone has. We have too much work and too few employees.” (intv. 12; 42); “[...] that’s the challenge with any project, that timings are getting tighter” (intv. 9; 42). Further, there is a desire for quicker decision making (intv. 6; 32), and for an opportunity to calculate beforehand emerging costs in more detail (intv. 8; 2).

Only two interviewees could tell us what lessons their company had learned in the last decision-making process. The representative of the lone company having a pre-structured decision-making process (cf. section 5.1) stated that the process improves every quarter “It is a continuous improvement process.” (intv. 11; 43). His is the only company reporting satisfaction with their decision-making process (intv. 11; 41).

Challenges in the decision-making process produced 34 codings. The interviewees identified four potential risks and challenges, some of which also appear in the technical literature, that can abort implementing the decision made for sustainable packaging and lead the company to stay with its current packaging.

- Economic reasons (intv. 6; 26 & 30) (cf. Koeijer et al., 2017)
- Customer non-acceptance of the new packaging (intv. 1; 14)
- Technical criteria for new (expensive) machines (intv. 11; 6) (cf. Naletina, 2021)
- Sustainability trade-offs (intv. 2; 42; intv. 13; 26)

Concerning the last point, we have to say that our interviewees only addressed trade-off considerations in broad terms and some general examples. None of them mentioned an LCA or comparable data-driven instruments for weighing different and opposing effects:

“So we want to accept an increase in recyclability versus, for example, an increase in plastic weight. This is another aspect that can lead to a decision at a relatively late stage in the decision-making process to say that we will not switch.” (intv. 2; 41); “[if] the packaging material were [...] no longer recyclable, [...]” (intv. 13; 26)

This last point brings up a topic discussed in the literature, where sustainable packaging is described as needing to be effective, efficient, cyclic and safe. Since these qualities are interconnected, a change in one affects the others, so trade-offs must be considered. For example, a lightweight and high barrier multilayer material may have a lower CO<sub>2</sub>-footprint than a more heavyweight mono material, but this results in a short shelf life, or reducing packaging may lead to greater food waste, in the end causing more environmental damage. These trade-offs are also described in the study by Ruippo et al. (2022). Recently, Dörnyei et al.



(2023, p. 9) provide a holistic and updated definition for sustainable packaging which includes these trade-offs: “Sustainable food packaging is an optimized, measured (quantified) and validated solution, which takes into consideration the balance of social, economic, ecological and safe implementations of the circular value chain, based on the entire history (life cycle) of the food product-package unit”.

However, it is not clear how strong the environmental sustainability aspect of packing is implemented in the process, as we e.g. see in Fig. 5a LCAs are often not yet part of the evaluation process. Nevertheless, it is surprising that none of the interviewees raised this issue. This highlights the conclusions from above that there is a mismatch between what companies declare and what they actually do.

In almost all companies, group decisions are part of the process: “There has been no opposition, the only thing we wanted to have in that meeting was marketing consensus and that all views were considered. The packaging change strategy is not being contested internally.” (intv. 15; 34), although in some companies there are “power centers” (intv. 3; 25) which manifest the internal trade-offs between decisions driven by economic concerns and those by sustainability commitments. Opinions on the balance differ within departments as this excerpt illustrates: “First usual is the usual tension between purchasing and production against under quotation marks marketing, sales against again under quotation marks quality assurance.” (intv. 11; 62). As found by Shepherd and Rudd (2014), these tensions and trade-offs within the team can be solved or at least influenced by the top management team. Their strong commitment can be required for constructive decision-making (also cf. (Koeijer et al., 2017; Pålsson and Sandberg, 2022)). However, in our interviews, the experts reported few conflicts; in other words, solutions for disagreements can generally be found: “[...] otherwise, we discuss it as long as it takes until we come to a solution satisfactory to all. That actually also always went quite well.” (intv. 5; 60).

## 6. Conclusions

This study, a qualitative content analysis of interviews with 17 food industry experts, is the first cross-national cross-food sector study to analyze sustainable decision-making in food packaging. Two research questions drove the study.

- 1 What processes do companies use to make their decisions on food packaging?
- 2 What barriers prevent decision makers from choosing sustainable packaging options?

We identified packaging sustainability as a central issue for all interviewees. However, when it comes to trade-offs between cost and environmental sustainability, cost carries more weight in the decision-making processes. This results both from the variable costs of alternative packaging and the fixed costs of investment into new equipment. We observed that food companies take a wait-and-see approach before they dare to risk large investments.

We also observed that decision-making processes were often unstructured, and, as a result, time consuming and lengthy, often leaving the decision-making teams dissatisfied. However, we see that the multidisciplinary teams with members of different departments work together well, with most companies stating that in the end they always find consensus. However, even with multidisciplinary teams, an open question is if there is enough expertise in the companies to make well-founded decisions that comprehensively consider sustainability effects of alternative packaging solutions. The facts that data-driven approaches such as LCA were not mentioned and that packaging suppliers play a very important role in the decisionmaking process as well as the fact that our interviewees frequently expressed insecurity when asked about the source of information, leaves doubts.

Our results also show that Nutt’s model (1984) is appropriate to analyze the structure of decision-making processes in the food industry.

However, the five steps are not always explicit in making packaging decisions. While formulation, detailing and evaluation are practiced with conscious intent, concept development and implementation are much less so. Follow-up studies, both quantitative and qualitative, should focus more on these two steps to better understand the decision-making process and factors holding back a change towards more sustainable packaging.

One limitation of this study is its qualitative approach; hence, our results are more indicative than descriptive, and while not directly transferable, they are suitable for testing in a follow up quantitative study.

Notwithstanding the study’s limitations, our results permit these tentative recommendations to be made to companies in the food sector.

- Introduce a well-structured decision-making process with clear-cut selection criteria. For this, companies first need to decide what sustainable packaging is for them and which environmental and social impacts are most important in their specific line of business.
- Use life-cycle cost instead of absolute investment amounts as financial criterion when evaluating new packaging options.
- Engage in initiatives to foster circular economy in the packaging sector. Through co-innovation, alternative packaging options can be created. Initiatives can especially enable small- and medium-sized companies to gain more capacity in learning about challenges and find solutions.

Our findings also provide relevant information for political decision-makers.

- Companies are generally willing to change their way of packaging food and are aware of the challenges but do not often not follow the call for more environmentally sustainable packaging from insides’ company motivation.
- Sustainability is important to companies in all packaging decisions but not consistently implemented as e.g. LCAs are missing in the evaluation process. Moreover, financial cut-off criteria are used in earlier steps of the decision-making process, so that sustainability criteria may not gain full weight in the process.
- Our results reflect that present legislation calls for more sustainable packaging (e.g. European strategy for plastics in a circular economy strategy), but it leaves it up to the companies whether they follow the call and if so, how to respond (European Commission, 2018, 2020). We see this in our results as the environmental sustainability of packaging is not a cut-off criterion, but economic criteria are.
- An important option to consider would be permitting only fully recyclable packaging to be used.
- Only reliable, long-term legal requirements allow companies to invest in the expensive packaging machines needed for sustainable packaging.

We see the following promising future research questions.

- How does the mismatch between declaring environmental sustainability and not implementing it into the decision-making process emerge?
- Will retailers and consumers pay the required surcharges for sustainable packaging?
- How can policy draft appropriate legislation to help the food sector?
- Further, based on this qualitative research, a quantitative study should be set up where items from this study are developed for operationalization as research questions in a mixed-method approach. A working hypothesis would be that price and cost are the determining factors in a decision-making process.

**Declaration of competing interest**

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

**Data availability**

The data that has been used is confidential.

**Acknowledgements**

This article/publication is based upon work from COST Action Circul-a-bility, supported by COST (European Cooperation in Science and Technology), [www.cost.eu](http://www.cost.eu).

**Appendix**

Key question/stimuli/telling request

1) Please tell us: What was it like the last time you were involved in deciding on new packaging for a product? Could you describe this process for us?

Content aspects	Maintenance questions	Specific follow-up questions
<b>GENERAL ASPECTS</b>	<b>GENERAL ASPECTS</b>	<b>GENERAL ASPECTS</b>
<ul style="list-style-type: none"> <li>• Mapping of the complete internal process</li> <li>• Involved persons/departments</li> </ul>	<ul style="list-style-type: none"> <li>• What was the next step?</li> <li>• What was the next step in the process?</li> <li>• Can you think of anything else about this?</li> <li>• Is there anything else you would like to add?</li> <li>• Can you describe it in more detail?</li> </ul>	
<b>FORMULATION</b>	<b>FORMULATION</b> see above	<b>FORMULATION</b>
<ul style="list-style-type: none"> <li>• Problem/goal definition</li> <li>• Selection of process participants</li> <li>• Role and influence of the individual</li> </ul>		<ul style="list-style-type: none"> <li>• How was the decision problem formulated?</li> <li>• Who was involved in the decision-making process and why? Were the actors the same throughout the process?</li> <li>• What criteria were used to select the actors?</li> <li>• What was the role of each involved party?</li> <li>• What influence did the involved parties have on the decision/process?</li> </ul>
<b>CONCEPT DEVELOPMENT</b>	<b>CONCEPT DEVELOPMENT</b> see above	<b>CONCEPT DEVELOPMENT</b>
<ul style="list-style-type: none"> <li>• Information procurement</li> <li>• Type of information</li> <li>• Assessment and use of information</li> <li>• Conscious influences</li> </ul>		<ul style="list-style-type: none"> <li>• What information was obtained for the packaging decision?</li> <li>• How was the information obtained?</li> <li>• How was it used?</li> <li>• What influencing factors were consciously considered in the decision? (Environmental influences, stakeholder interests)</li> </ul>
<b>DETAILING</b>	<b>DETAILING</b> see above	<b>DETAILING</b>
<ul style="list-style-type: none"> <li>• Finding alternatives</li> <li>• Are alternatives available?</li> </ul>		<ul style="list-style-type: none"> <li>• How were the various packaging alternatives generated?</li> <li>• What alternatives were considered?</li> <li>• How were the alternatives analysed?</li> </ul>
<b>EVALUATION</b>	<b>EVALUATION</b> see above	<b>EVALUATION</b>
<ul style="list-style-type: none"> <li>• Evaluation of alternatives</li> <li>• Selection of the final alternative</li> <li>• Final decision (group, dictatorial, unofficial decision-maker)</li> </ul>		<ul style="list-style-type: none"> <li>• How was a final selection made among the alternatives?</li> <li>• Which criteria were considered and, if so, with what weighting?</li> <li>• Which environmental criteria were applied? *</li> <li>• Who made the final decision at that time?</li> </ul> <p>* This question is only asked if no environmental criteria are mentioned with the question above</p>
<b>IMPLEMENTATION</b>	<b>IMPLEMENTATION</b> see above	<b>IMPLEMENTATION</b>
<ul style="list-style-type: none"> <li>• Implementation of the decision</li> <li>• Criteria of success</li> <li>• Control after implementation</li> <li>• Process development</li> <li>• Experiences and lessons learned from the process</li> <li>• Perception of the process after the fact</li> </ul>		<ul style="list-style-type: none"> <li>• How was the decision implemented?</li> <li>• How do you assess the decision in retrospect?</li> <li>• What would you do differently in the next implementation?</li> </ul>
<b>CHALLENGES</b>	<b>CHALLENGES</b> see above	<b>CHALLENGES</b>
<ul style="list-style-type: none"> <li>• Willingness to compromise</li> <li>• Key situations</li> <li>• Unforeseen challenges</li> <li>• Group dynamics</li> <li>• Group problems</li> </ul>		<ul style="list-style-type: none"> <li>• Which challenges came unexpectedly? How were they solved?</li> <li>• What put the project most at risk?</li> <li>• When and how did compromises have to be found?</li> </ul> <p><u>In case of group decisions:</u></p> <ul style="list-style-type: none"> <li>• What problems were there in the group?</li> <li>• How were problems dealt with within the group?</li> <li>• How were different opinions dealt with?</li> </ul>

(continued on next page)

(continued)

Key question/stimuli/telling request		
1) Please tell us: What was it like the last time you were involved in deciding on new packaging for a product? Could you describe this process for us?		
Content aspects	Maintenance questions	Specific follow-up questions
		<p><b>Established decision-making process:</b>            Now that we've gone through the decision-making process once, I would still be interested to know if there is a decision-making process set by the company or your organizational unit.            If so, how does this defined process differ from what you have just described to me?</p>

## References

- Ashmos, D.P., Duchon, D., McDaniel, R.R., 1998. Participation in strategic decision making: the role of organizational predisposition and issue interpretation. *Decis. Sci. J.* 29, 25–51.
- Bakonyi, Z., 2018. Why do firms centralise their strategic decision-making during crisis? A qualitative study. *JOCM* 31, 1191–1205.
- Bauer, A.-S., Tacker, M., Uysal-Unalan, I., Cruz, R.M.S., Varzakas, T., Krauter, V., 2021. Recyclability and Redesign Challenges in Multilayer Flexible Food Packaging-A Review, vol. 10. *Foods*, Basel, Switzerland.
- Döringer, S., 2021. 'The problem-centred expert interview.' Combining qualitative interviewing approaches for investigating implicit expert knowledge. *Int. J. Soc. Res. Methodol.* 24, 265–278.
- Dörnyei, K.R., Uysal-Unalan, I., Krauter, V., Weinrich, R., Incarnato, L., Karlovits, I., Colelli, G., Chrysochou, P., Fenech, M.C., Pettersen, M.K., Arranz, E., Marcos, B., Frigerio, V., Apicella, A., Yildirim, S., Poças, F., Dekker, M., Johanna, L., Coma, V., Corredig, M., 2023. Sustainable food packaging: an updated definition following a holistic approach. *Front. Sustain. Food Syst.* 7.
- Dudbridge, M., 2011. *Handbook of Lean Manufacturing in the Food Industry*. John Wiley & Sons, New York, NY.
- Eikelenboom, Manon, Jong, Gjalte de, 2022. The Impact of Managers and Network Interactions on the Integration of Circularity in Business Strategy, vol. 35. *Organization & Environment*, pp. 365–393.
- Elonen, S., Artto, K.A., 2003. Problems in managing internal development projects in multi-project environments. *Int. J. Proj. Manag.* 21, 395–402.
- European Commission, 2011. Commission Regulation (EU) No 10/2011 of 14 January 2011 on Plastic Materials and Articles Intended to Come into Contact with Food (Text with EEA Relevance).
- European Commission, 2018. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. A European Strategy for Plastics in a Circular Economy.
- European Commission, 2019. Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions. The European Green Deal.
- European Commission, 2020a. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. A New Circular Economy Action Plan for a Cleaner and More Competitive Europe.
- European Commission, 2020b. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. A Farm to Fork Strategy for a Fair, Healthy and Environmentally-Friendly Food System.
- European Commission, 2021. Commission Recommendation (EU) 2021/2279 of 15 December 2021 on the Use of the Environmental Footprint Methods to Measure and Communicate the Life Cycle Environmental Performance of Products and Organisations.
- European Parliament, 2002. Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002 Laying Down the General Principles and Requirements of Food Law, Establishing the European Food Safety Authority and Laying Down Procedures in Matters of Food Safety.
- European Parliament, 2004. Regulation (EC) No 1935/2004 of the European Parliament and of the Council of 27 October 2004 on Materials and Articles Intended to Come into Contact with Food and Repealing Directives 80/590/EEC and 89/109. EEC.
- European Parliament, 2011. Regulation (EU) No 1169/2011 of the European Parliament and of the Council of 25 October 2011 on the Provision of Food Information to Consumers, Amending Regulations (EC) No 1924/2006 and (EC) No 1925/2006 of the European Parliament and of the Council, and Repealing Commission Directive 87/250/EEC, Council Directive 90/496/EEC, Commission Directive 1999/10/EC, Directive 2000/13/EC of the European Parliament and of the Council, Commission Directives 2002/67/EC and 2008/5/EC and Commission Regulation (EC) No 608/2004.
- Eurostat, 2022a. Packaging waste by waste management operations. [https://ec.europa.eu/eurostat/databrowser/view/env\\_waspac/default/table?lang=en](https://ec.europa.eu/eurostat/databrowser/view/env_waspac/default/table?lang=en). (Accessed 3 January 2023).
- Eurostat, 2022b. Food waste and food waste prevention by NACE Rev. 2 activity - tonnes of fresh mass. [https://ec.europa.eu/eurostat/databrowser/view/env\\_wasfw/default/table?lang=en](https://ec.europa.eu/eurostat/databrowser/view/env_wasfw/default/table?lang=en). (Accessed 3 January 2023).
- Falkman, M.A. (Ed.), 2014. *Fundamentals of Packaging Technology*, fifth ed. Institute of Packaging Professionals, Naperville, Illinois.
- Flick, U., 2021. *Qualitative Forschung - Eine Einführung*, tenth ed. Rowohlt, Hamburg.
- Foschi, E., Zanni, S., Bonoli, A., 2020. Combining eco-design and LCA as decision-making process to prevent plastics in packaging application. *Sustainability* 12, 9738.
- GS1, 2023. GS1 General Specifications. The foundational GS1 standard that defines how identification. [https://www.gs1.org/docs/barcodes/GS1\\_General\\_Specifications.pdf](https://www.gs1.org/docs/barcodes/GS1_General_Specifications.pdf). (Accessed 8 January 2023).
- Gürlich, U., Kladnik, V., Katharina, P., 2022. Circular Packaging Design Guideline. Design Recommendations for Recyclable Packaging. Version 05. September 2022.
- HLPE, 2014. Food losses and waste in the context of sustainable food systems. A report by the high-level panel of experts on food security and nutrition of the committee on world food security and nutrition, rome. <https://www.fao.org/3/i3901e/i3901e.pdf>.
- HLPE, 2017. Nutrition and Food Systems. A Report by the High-Level Panel of Experts on Food Security and Nutrition of the Committee. World Food Security, Rome.
- Horvath, Laszlo, Min, Byungjin, Kim, Young T., 2017. Chapter 4. Testing of mechanical properties for plastic packaging materials. In: Singh, P., Wani, A.A., Langowski, H.-C. (Eds.), *Food Packaging Materials. Testing & Quality Assurance*. CRC Press Taylor & Francis Group, Boca Raton, London, New York, pp. 104–123.
- Ivanov, D., Dolgui, A., 2022. The shortage economy and its implications for supply chain and operations management. *Int. J. Prod. Res.* 60, 7141–7154.
- Ketelsen, M., Janssen, M., Hamm, U., 2020. Consumers' response to environmentally-friendly food packaging - a systematic review. *J. Clean. Prod.* 254, 120123.
- Koeijer, B. de, Lange, J. de, Wever, R., 2017. Desired, perceived, and achieved sustainability: trade-offs in strategic and operational packaging development. *Sustainability* 9, 1923.
- Koeijer, B., Gelhard, C., Klooster, R., 2019. Sustainability priorities across the strategic and operational level in packaging development. *Packag. Technol. Sci.* 32, 618–629.
- Kuckartz, U., Rädiker, S., 2019. *Analyzing Qualitative Data with MAXQDA*. Springer International Publishing, Cham.
- Mayring, P., 2022. *Qualitative Inhaltsanalyse. Grundlagen und Techniken*, Neuausgabe. Beltz Verlagsgruppe, Weinheim.
- Mohaghegh, M., Furlan, A., 2020. Systematic problem-solving and its antecedents: a synthesis of the literature. *Management Research Review* 43, 1033–1062.
- Molina-Besch, K., Wikström, F., Williams, H., 2019. The environmental impact of packaging in food supply chains—does life cycle assessment of food provide the full picture? *Int. J. Life Cycle Assess.* 24, 37–50.
- Naletina, D., 2021. Recycling as a challenge for the flexible packaging industry. *J. Econ. Sustain. Dev.* 2–8, 2021.
- Nutt, P.C., 1984. Types of organizational decision processes. *Adm. Sci. Q.* 29, 414.
- OECD, 2023. *Enterprises by business size (indicator)*. [https://www.oecd-ilibrary.org/industry-and-services/enterprises-by-business-size/indicator/english\\_31d5eeaf-en](https://www.oecd-ilibrary.org/industry-and-services/enterprises-by-business-size/indicator/english_31d5eeaf-en). (Accessed 28 August 2023).
- Otto, S., Strenger, M., Maier-Nöth, A., Schmid, M., 2021. Food packaging and sustainability – consumer perception vs. correlated scientific facts: a review. *J. Clean. Prod.* 298, 126733.
- Pålsson, H., Sandberg, E., 2022. Adoption barriers for sustainable packaging practices: a comparative study of food supply chains in South Africa and Sweden. *J. Clean. Prod.* 374, 133811.
- Phelan, A., Meissner, K., Humphrey, J., Ross, H., 2022. Plastic pollution and packaging: corporate commitments and actions from the food and beverage sector. *J. Clean. Prod.* 331, 129827.
- Rezaei, J., Papakonstantinou, A., Tavasszy, L., Pesch, U., Kana, A., 2019. Sustainable product-package design in a food supply chain: a multi-criteria life cycle approach. *Packag. Technol. Sci.* 32, 85–101.
- Robertson, G.L., 2013. *Food Packaging. Principles and Practice*. CRC Press, Boca Raton, Fla, p. 3.
- Ruippo, L., Koivula, H., Korhonen, J., Toppinen, A., Kylkilähti, E., 2022. Innovating for sustainability: attributes, motivations, and responsibilities in the Finnish food packaging ecosystem. *Circ Econ Sustain* 1–19, 2022 Oct 18.
- Schmidt, C., 2004. The analysis of semi-structured interviews. In: Flick, U., Kardorff, E., Steinke, I. (Eds.), *A Companion to Qualitative Research*, pp. 253–258.
- Shepherd, N.G., Rudd, J.M., 2014. The influence of context on the strategic decision-making process: a review of the literature. *Int. J. Manag. Rev.* 16, 340–364.
- Sumrin, S., Gupta, S., Asaad, Y., Wang, Y., Bhattacharya, S., Foroudi, P., 2021. Eco-innovation for environment and waste prevention. *J. Bus. Res.* 122, 627–639.
- Vöröskői, K., Földesi, P., Kóczy, L.T., Böröcz, P., 2020. Fuzzy approach for the decision on disposable or returnable packaging. *Sustainability* 12, 7304.
- Wandossell, G., Parra-Meroño, M.C., Alcayde, A., Baños, R., 2021. Green packaging from consumer and business perspectives. *Sustainability* 13, 1356.
- Wani, Ali Abas, Singh, Preeti, Langowski, Horst-Christian, 2017. Introduction. *Food packaging materials*. In: Singh, P., Wani, A.A., Langowski, H.-C. (Eds.), *Food*

- Packaging Materials. Testing & Quality Assurance. CRC Press Taylor & Francis Group, Boca Raton, London, New York, pp. 1–11.
- Weinrich, R., Herbes, C., 2023. Consumer research on bioplastics: a systematic review. *Q Open* 3 (1) qoad013.
- Wiedemann, J. (Ed.), 2017. *The Package Design Book*. TASCHEN, Köln.
- Wikström, F., Verghese, K., Auras, R., Olsson, A., Williams, H., Wever, R., Grönman, K., Kvalvåg Pettersen, M., Møller, H., Soukka, R., 2019. Packaging strategies that save food: a research agenda for 2030. *J. Ind. Ecol.* 23, 532–540.
- Zhang, 2020. Decision-making processes in academic libraries: how did academic librarians purchase e-book products? *J. Acad. Librarian* 46, 102252.