

# The design process of coffee creamer portion packaging concepts that can be correctly sorted during the recycling process.

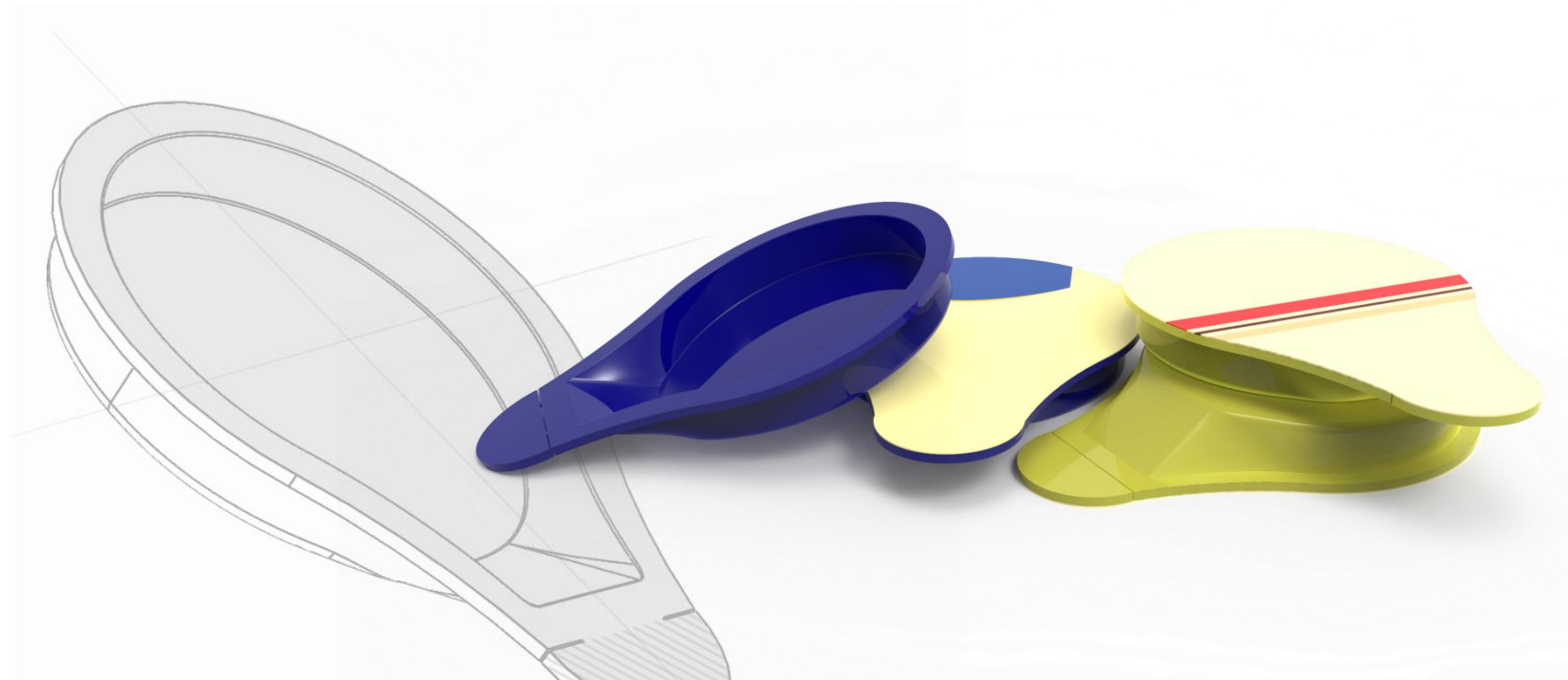
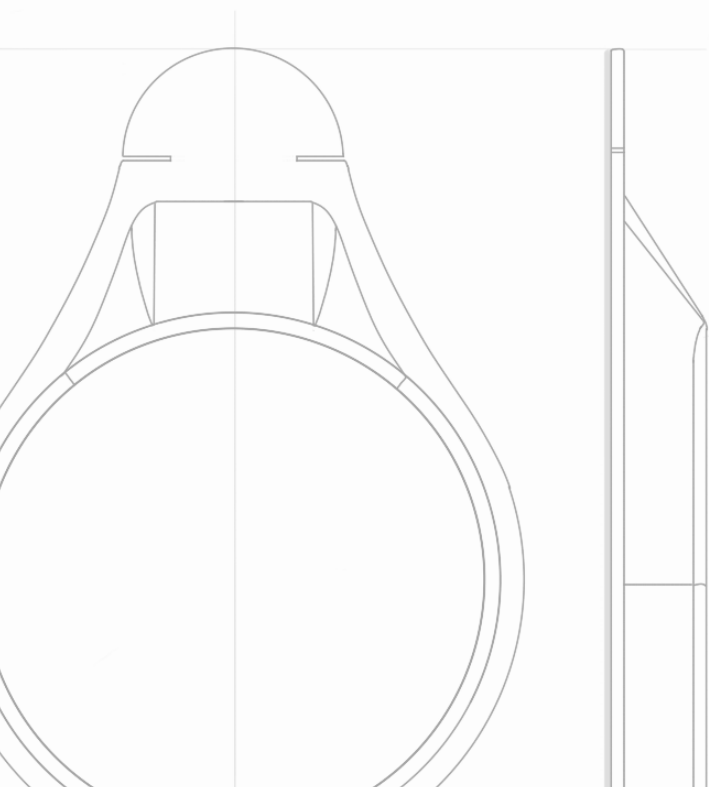
Bachelor thesis assignment  
Industrial Design Engineering – University of Twente

*Author*

Brittany Joyce Müller

*In collaboration with*

FrieslandCampina Research and Development



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## Author

Brittany Joyce Müller  
s1991159

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Faculty of Engineering Technology

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## Assessment committee

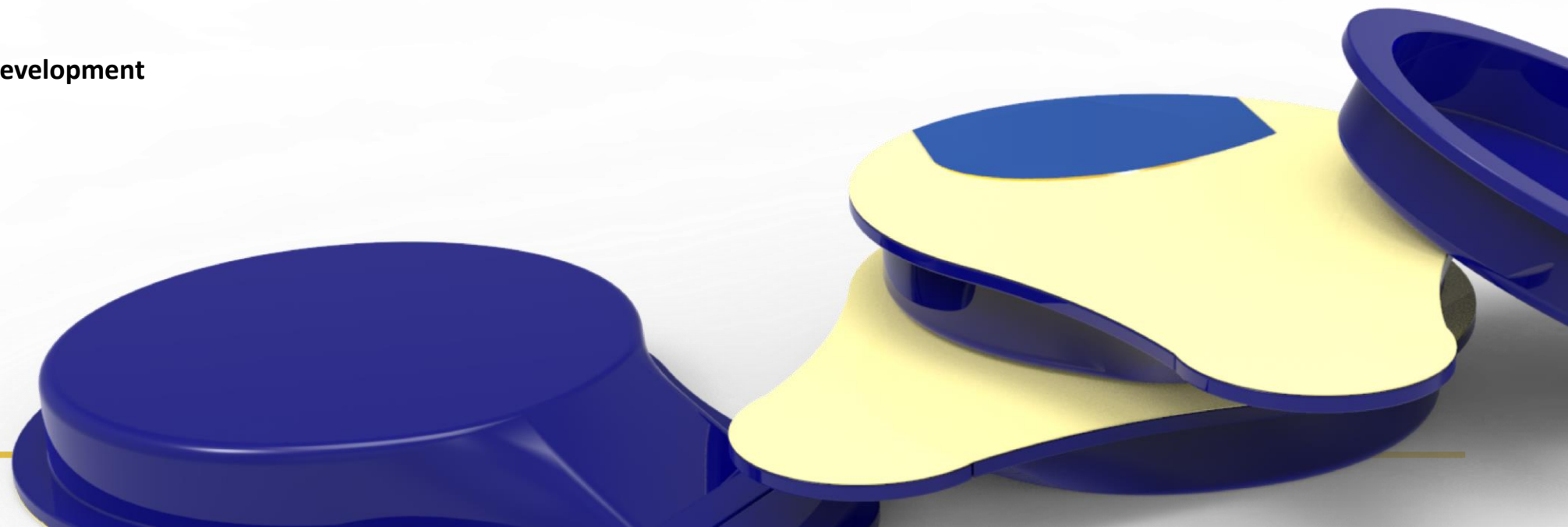
Chair: Prof. Dr. Ir. R. ten Klooster  
University supervisor: Dr. A. Karahanoglu  
Client supervisor: T. Mulder

## University of Twente

Drienerlolaan 5  
7522 NB Enschede

## FrieslandCampina Research and Development

Bronland 20  
6708 WH Wageningen



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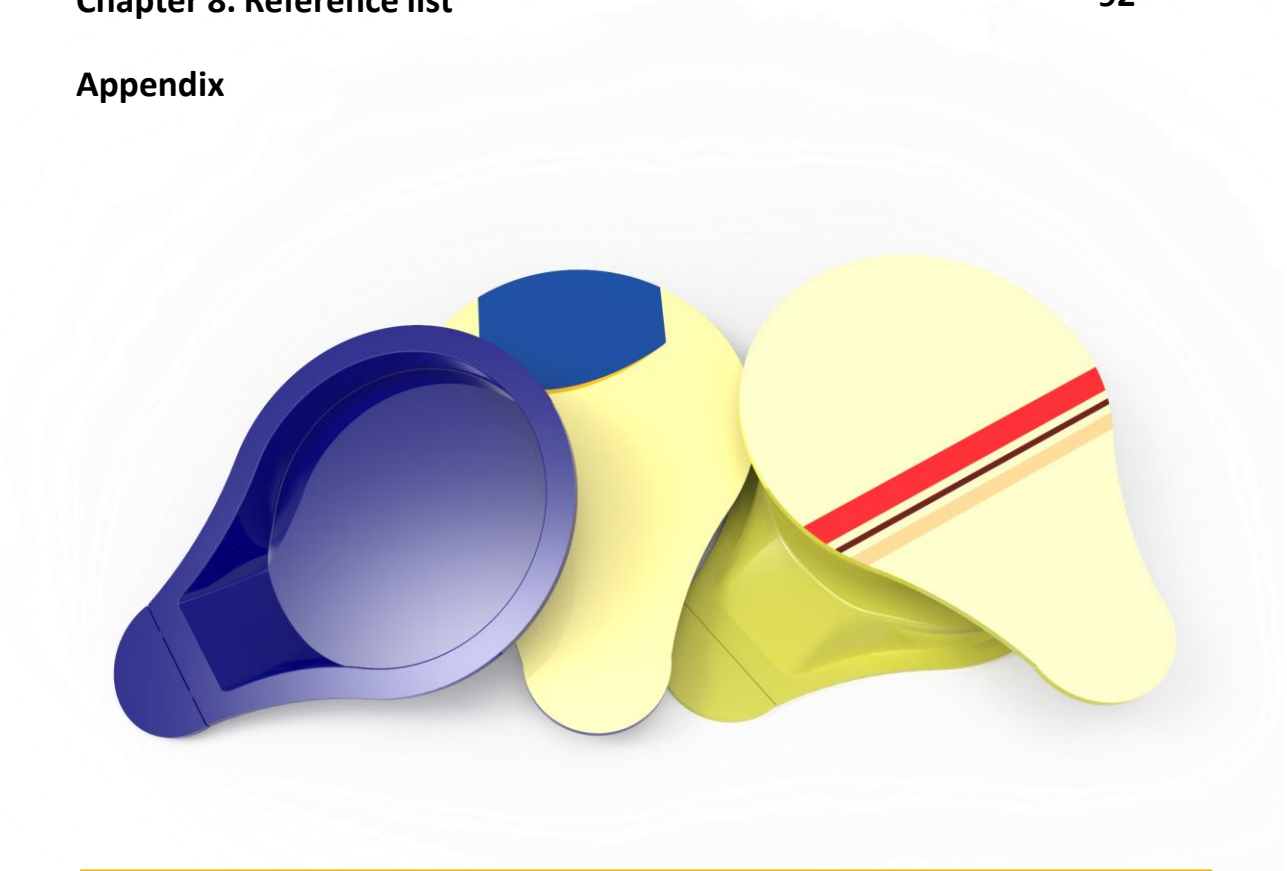
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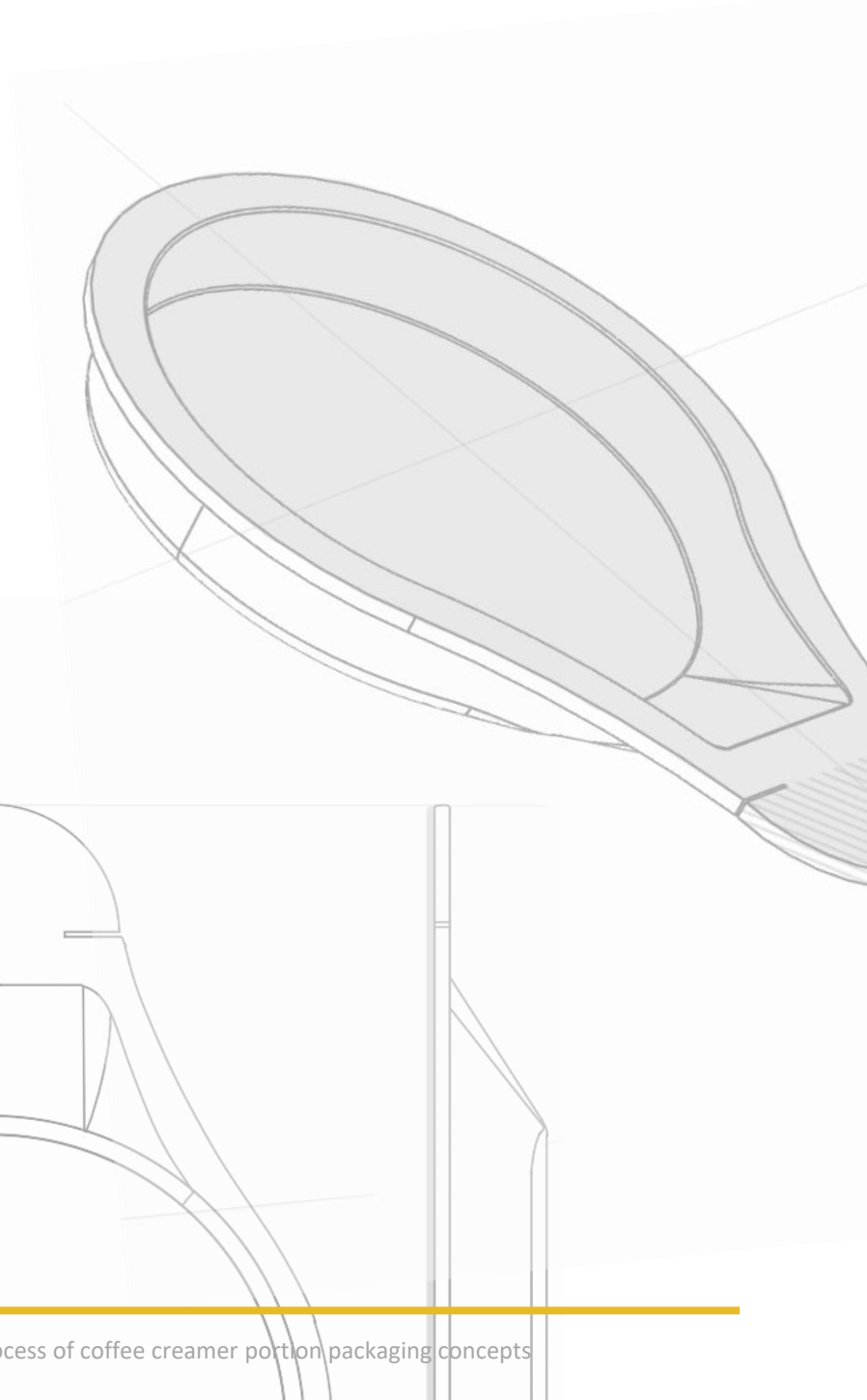
## Summary

The goal of this project was to create coffee creamer portion packaging concepts that can be correctly sorted during the recycling process and fit the user group. For this project, I collaborated with the packaging development department of FrieslandCampina and worked together with the marketeers of Nutroma and Friesche Vlag. Both brands are part of the cooperation FrieslandCampina and sell coffee milk products.

To answer the main research question, *What type of alternative coffee creamer portion packaging concepts can be designed that are correctly sortable in the recycling process and fit the user group?*, I first analysed the user group of coffee creamer portions. I gathered information by means of existing User & Attitude research, conducting small user experience research, creating experience maps, and filling in value proposition canvasses. This information resulted in a list of user pains and design opportunities of the current coffee creamer portion packaging sold by FrieslandCampina. The pains and design opportunities were, in turn, translated to a list of requirements. Meeting these requirements ensured that the packaging concepts fit the user group. Next, literature research was performed to analyse current recycling processes. The recycling process can be divided into three steps: Collecting, sorting and recycling. Only when post-consumer packaging can adhere to all these steps, it is considered to be recyclable. Due to time limitations, the project focussed on the first two steps. The sorting processes practices in Europe are analysed and translated into a separate requirement list. When all these requirements are met, the post-consumer packaging can be correctly sorted.

The design process was followed up by the ideation phase. I performed a small market analysis to analyse and compare existing portion packaging regarding appearance, user convenience, material, and if the packaging could be correctly sorted during the recycling process. Next, I hosted multiple online brainstorm sessions with members of the packaging development team of FrieslandCampina. The generated ideas were based on the defined requirements and worked out by means of design sketching. Next, these packaging ideas were altered and/or combined to create five packaging concepts. During an online meeting with the marketeers of Nutroma and Friesche Vlag, three of those packaging concepts were chosen since they showed the most potential regarding feasibility and fit the current portfolio of the brands the best. The chosen concepts were then worked out in more detail. I first defined the dimensions with the help of SolidWorks, a CAD modelling software. The software allowed me to create realistic dimensions for the packaging that met the defined requirements. I created mock-ups of the three concepts to get a feel for the feasibility and ease of use of the packaging.

During the detailing process, I talked to several packaging experts that helped me with defining realistic features for the packaging concepts. All information and knowledge gathered resulted in one of the concepts being discarded. The other two concepts ended up being really similar. They featured the same material, production technique, and opening method. The only difference was the shape. Therefore, the two concepts were considered as one. Thus, the main research question is answered by means of one detailed packaging concept. This concept can function as a starting point for future research into recyclable portion packaging.



# Chapter 1. Introduction

For my Industrial Design Engineering bachelor thesis, I collaborated with the company FrieslandCampina. FrieslandCampina has many different brands which are sold all over the world. The brands I focused on during this project are Nutroma and Friesche Vlag, both active in coffee milk products. This first chapter contains the introduction of FrieslandCampina and the project aim, followed by the derived research question and corresponding sub-questions.

## 1.1 FrieslandCampina

The main business objective of FrieslandCampina is 'Nourishing by nature'. Their mission, as they describe it on their official website, is 'to strive for better nutrition for the world's consumers, a good living for our farmers, now and for generations to come' (FrieslandCampina, n.d.). The packaging development department of FrieslandCampina plays an important role in achieving this mission. Packaging provides storage and conservation possibilities of these valuable nutrients and makes it possible to transport it all over the world. To comply with the last part of their mission, *now and for generations to come*, FrieslandCampina aims to have its entire packaging portfolio to be reusable, recyclable or both by 2025 and fully circular without fossil fuel emissions by 2050 (FrieslandCampina, n.d.).

Realising this mission will not only have positive effects on the environment but will also meet the increasing demand for sustainable products and packaging. In the current socially conscious society, consumers, employees and stakeholders are beginning to prioritize corporate social responsibility (CSR) when choosing a brand or company (Schooley, 2020). CSR is a business practice that incorporates sustainable development into a company's business model and has positive effects on social, economic and environmental factors (Schooley, 2020). Offering recyclable and/or reusable packaging boosts the CSR image among consumers and other stakeholders, resulting in a higher profit and an increase in (loyal) consumers (Plastics Recyclers Europe, n.d.; CSR study, 2017).

## 1.2 Environmental impact of food packaging

Food supply chains are one of the main contributors to several pressing environmental problems, such as climate change, eutrophication, and loss of biodiversity (Molina-Besch et al, 2019). The contribution of the packaging to the overall environmental impact in food supply chains is contentious. The environmental impact of food packaging can be divided into two categories; direct and indirect (Molina-Besch et al, 2019). Direct environmental impact is the impact caused by the production process and the end-of-life of the packaging. The indirect environmental impact of food packaging is caused by its influence on the food product's life cycle. For a long time, the focus has been on the direct impact of packaging, resulting in legislation and research into packaging prevention (Molina-Besch et al, 2019). This focus shifted due to food waste debates.

Packaging, when designed accordingly, can stop degradation and can elongate a products shelf life up to three times (Extending shelf life via packaging, n.d.). The protective function of packaging is deemed to be an important environmental benefit (Molina-Besch et al, 2019).

Several studies have shown that in certain cases, the environmental benefit of decreased food waste exceeds the environmental impact caused by the use of additional packaging material (Molina-Besch et al, 2019). Thus, the indirect environmental impact of packaging is of greater relative importance in many food supply chains than its direct environmental impact (Molina-Besch et al, 2019). However, this does not mean that the direct impact of packaging can be neglected. The production and end-of-life of the packaging still affect the environment. To minimise this impact and use of resources, linear packaging should be converted into circular packaging. This type of packaging consists of materials that can be reused in a continuous loop, see Figure 1. A fully circular economy contributes to less waste material, fossil fuel usage and greenhouse gas emissions, thus limiting the direct impact of food packaging (Government of the Netherlands, n.d.).

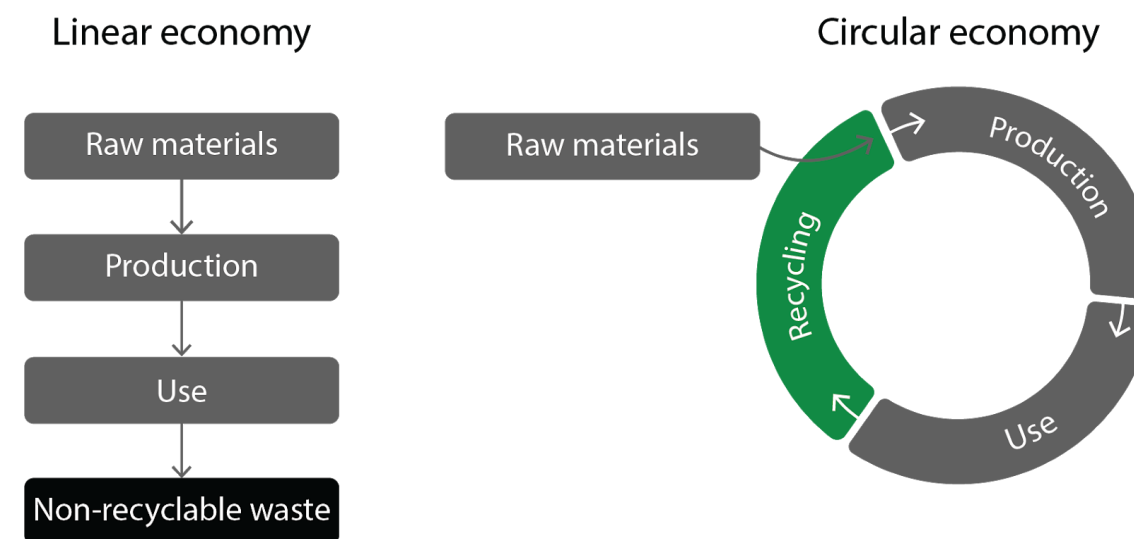


Figure 1. Left: Graphic representation of a linear economy. Right: Graphic representation of a circular economy (Government of the Netherlands, n.d.).

### 1.3 Project aim

The aim of this project is to contribute to a fully recyclable or reusable portfolio of FrieslandCampina. I will focus on the coffee creamer portion packaging, also known as coffee creamer cups, of the brands Nutroma and Friesche Vlag. The individual cups are currently not recyclable due to their size and material. The current recycling methods practised in Europe filter out waste material smaller than 50 millimetres, irrespective of the material type (KIDV, 2019). Thus, the cups are filtered out of the recycling process and are burnt for energy recovery. The aim of the project is to find alternative packaging designs for coffee creamer portions that can be correctly sorted during the recycling process and bring value to the coffee drinking experience of the users. Due to time limitations, the focus will be on the primary packaging.



Figure 2. Left: Primary packaging of coffee creamer cups from the brand Friesche Vlag. Right: The secondary packaging of coffee creamer cups.

### 1.4 Research questions

In order to achieve the previously described aim, a main research question has been formulated. In order to answer this research question, insights into the user characteristics and recycling processes are needed. Therefore, three corresponding sub-questions have been formulated.

Main research question: What type of alternative coffee creamer portion packaging concepts can be designed that are correctly sortable during the recycling process and fit the user group?

1. What user-profiles match the users of coffee creamer portions from the brands Nutroma and Friesche Vlag?
  - a. What are the characteristics of coffee creamer users?
  - b. What motivates users to use coffee creamer portions?
2. What are the packaging requirements and design opportunities that can be derived from the user-profiles and user experiences?
3. What are the requirements post-consumer packaging has to meet in order to be correctly sorted during a recycling process?

### 1.5 Overview of the report

The following chapters answer the research questions in chronological order. Figure 3 visualises the content of the report. The first phase of the report consists of gathering requirements by means of user experience research and literature research. Next, the ideation phase took place. Chapter 6 answers the main research question by explaining the conceptualization phase and visualising the final concept. The last chapter discusses the limitations of the project and describes the recommendations for future research.

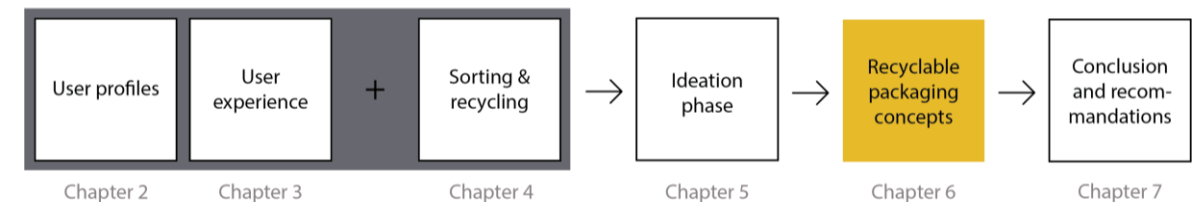


Figure 3. Overview of the report.

### 1.6 Approach

The main research question was answered with the help of the sub-questions. The first sub-question regarding the characteristics of coffee creamer portion users was answered by means of literature research and existing user experience research conducted by Friesche Vlag and Nutroma. The results of the user experience research of Friesche Vlag focussed more on the rational aspects of the coffee drinking experience, while the research of Nutroma focussed more on the emotional user drivers of coffee creamer. Missing information was added by means of literature research. The results were combined to create complete user profiles. These user-profiles were made according to guidelines found in literature.

The second sub-question, “*What are the user pains and design opportunities that can be derived from the user-profiles and user experiences?*” was answered by means of small user experience research and the use of design tools. Different aspects of the defined user profiles were analysed by different tools. The difference between rational and emotional users was analysed by creating *user experience maps*. This tool visualised the thoughts and emotions of the users during the process of purchasing and using the packaging. Comparing user experience maps of different users resulted in an overview of the differences and similarities between the users. The similarities and differences between the primary and secondary users of coffee creamer cups were analysed by means of a *Value Proposition Canvas*. This tool was used to analyse the user's jobs, pains and gains. Once again, the results of the different users were compared and the differences and similarities were mapped.

The results of both tools were combined to create a complete overview of the user experience of the coffee creamer cups. From this overview, the relevant pains and potential design opportunities were filtered out and in turn translated into requirements to serve as a starting point during the ideation phase.

The last sub-question, *“What are the requirements packaging needs to meet in order to be recyclable?”* was answered with the help of literature research. Guidelines and recycling processes of different sorting facilities were analysed and translated into packaging requirements.

In chapter 5, the ideation phase is visualised and explained. The first step in this phase was market analysis, where single-use portion packaging of different brands was analysed to research possibilities and gain inspiration. Besides individual brainstorm sessions, several group brainstorm sessions were performed with members of the packaging development department of FrieslandCampina (n=5, 6). The brainstorm sessions were based on the defined packaging requirements. The results are visualised and worked out by means of design sketching. These ideas and sketches were then used to create three concepts. The opinion of the marketeers of Friesche Vlag and Nutroma played an important role in this process. The concepts were then worked out in more detail and altered accordingly to meet as many requirements as possible. In the end, the main research question, *“What type of alternative coffee creamer portion packaging concepts can be designed that are correctly sortable during the recycling process and fit the user group?”* was answered by means of one detailed concept design.



## Chapter 2. User-profiles

In order to generate alternative packaging designs that fit the main user group, insights in the users of coffee creamer portions and their behaviour are crucial. If there is no clear image of the (potential) users, products and packaging have a high chance of failure on the market (User profiles, 2014). The insights are presented in the form of user-profiles. A user-profile is a collection of information that describes the various attributes of a user and helps with understanding who you are developing your product or packaging for (Hasan et al, 2013; User profiles, 2014). In this chapter, the three steps of creating a user-profile are discussed; (1) gathering information about the users, (2) understanding the type of user, and (3) making the user profiles (User profiles, 2014).

### 2.1 User information

The first step is to gather information about the users of coffee creamer (portions). All presented facts and data in this section originate from User and Attitude (U&A) research conducted by Friesche Vlag and Nutroma. First, the motivations of general users of coffee creamer are discussed. In section 2.1.2, the user motivations of coffee creamer portions are discussed. Friesche Vlag did research on the rational drivers, while Nutroma focused more on the emotional drivers of using coffee creamer (portions). Another important factor to mention is the origin of both brands. Friesche Vlag is a Dutch brand with the majority of Dutch users, while the Belgian brand Nutroma has a majority of Belgian users. In this report, there is no distinction made between the nationalities of the users.

#### 2.1.1 Coffee creamer users

According to the U&A study of Friesche Vlag (2016), most Dutch coffee creamer users are males between the age of 45 and 65 (n=1008). The consumer research of Nutroma (n=1032) shows similar results but extends the age category to consumers above the age of 65. The complete data set of age profiles can be seen in Appendix A. Consuming coffee and milk in coffee is a routine well embedded in everyday life. The majority of people who prefer consuming coffee with milk do this all the time. Note that the mentioned milk refers to all types of milk used in coffee, including coffee creamer. When we are specifically analysing the drivers of coffee creamer use, taste preference and indulgence of the coffee moment are mentioned the most. The rational and emotional user drivers of coffee creamer are visualised in Figure 4 and 5. The rational drivers refer to rational reasons to consume coffee creamer, while the emotional drives refers to how coffee creamer makes the users feel. Participants of the U&A study of Friesche Vlag mentioned that coffee creamer completes the taste of coffee, the creamy mouthfeel, and full flavour. Results of Nutroma show that users feel like they want to indulge or treat themselves.

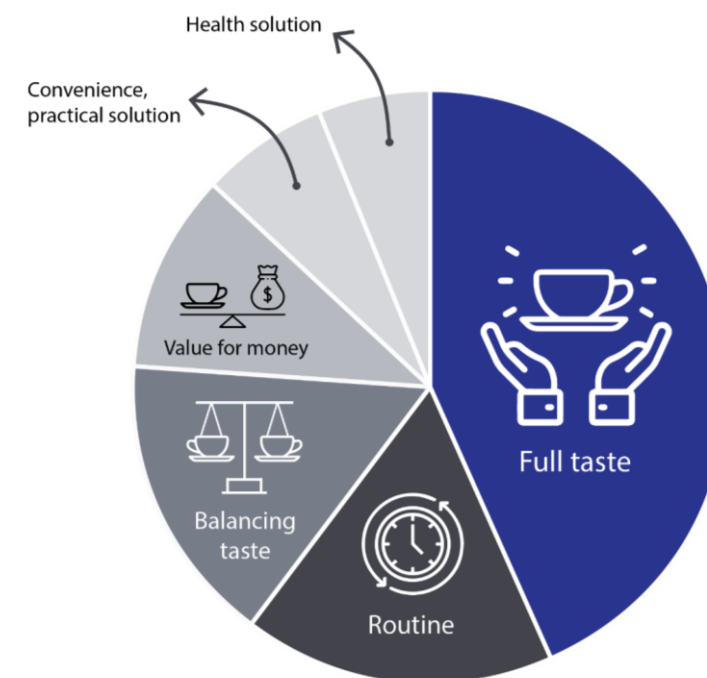


Figure 4. Rational drivers of consuming coffee creamer. Friesche Vlag, n=1878

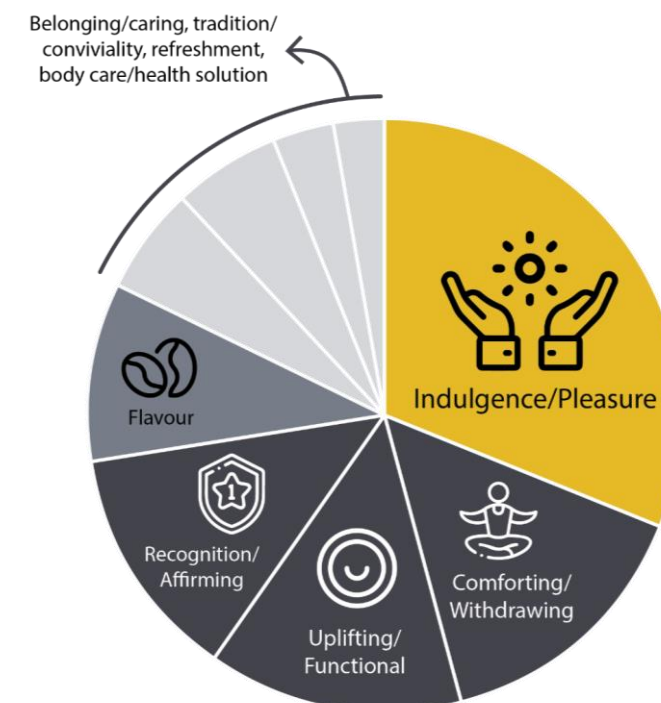


Figure 5. Emotional drivers of consuming coffee creamer. Nutroma, n=112

Coffee with milk is consumed throughout the day, with peak moments in the morning, early afternoon and evening (n=2399). The overall amount of consumed milk in coffee is similar across weekdays and the weekend. The only measured difference is that the consumed amount of coffee with milk is higher in the morning on weekdays than at the weekend. When specifically looking at coffee creamer use, the majority of participants mention that they use coffee creamer at least once a day, see Figure 6. The participants who only use coffee creamer use it much less frequently (n=362/66). One of the reasons is the availability. Research shows that the consumption of coffee creamer is lower during working hours (n=2399). While at work, the majority of the participants consume coffee with milk from the coffee machine. As the day progresses, drinking coffee with milk becomes a more social engagement and less of a routine moment. Coffee creamer and regular milk are used equally often during these social engagements.

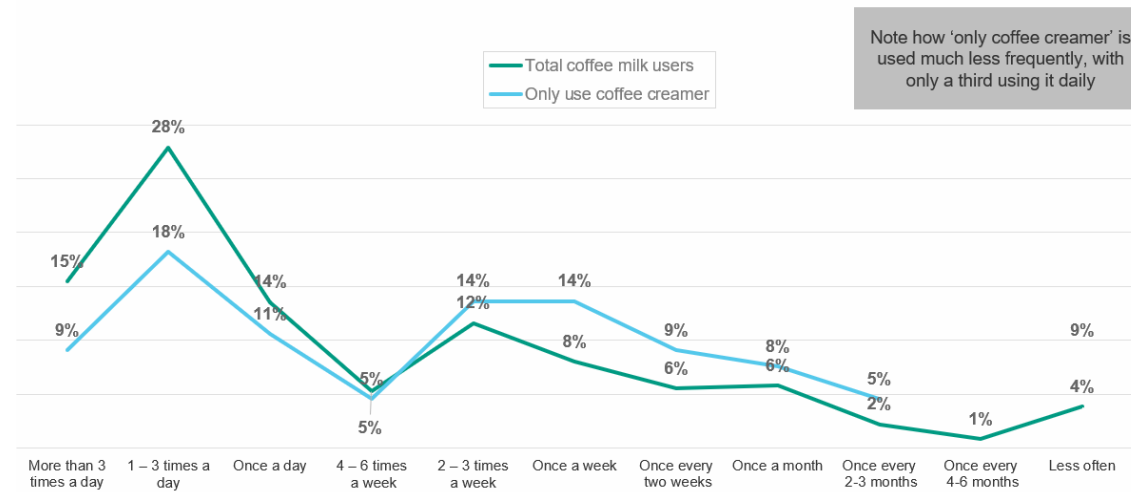


Figure 6. Consumption frequency. Nutroma, n=362/66

Due to the routine nature of drinking coffee, most (milk in) coffee is consumed at home and at work (n=2399). Figure 7 shows that 93% of the participants usually drink their coffee at home. Research (n=847) with participants who evaluated coffee with coffee creamer show similar results, indicating that coffee creamer is mostly consumed at home. Besides the routine nature of coffee moments, the large percentage of usage at home is also driven by those older than 65 years old. This data can possibly be explained by the amount of time people in this age category spend at home due to retirement. According to the research of Nutroma, the large majority of coffee creamer is purchased in supermarkets. Research into the purchase location (n=438) shows that only a small proportion of people have free access to coffee creamer at work. The purchase drivers of coffee creamer are visualised in Figure 8. The biggest purchase drivers are habit and brand perception.

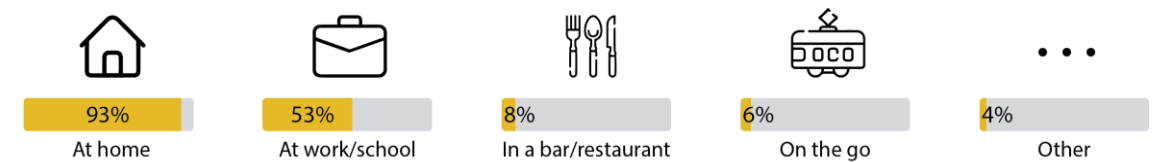


Figure 7. Consumption location of coffee creamer. Friesche Vlag, n=2399

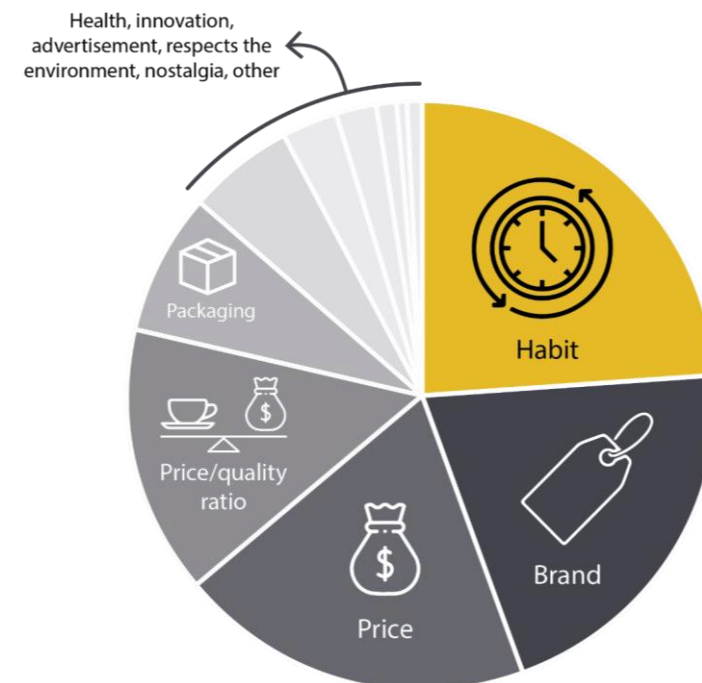


Figure 8. Purchase drivers of coffee creamer. Nutroma, n=438

Coffee or milk in coffee is most often consumed alone or together with a partner, see Figure 9. This corresponds with the earlier mentioned locations, which in turn corresponds with the routine nature of drinking coffee and milk in coffee. Due to this routine, consumers and users adopt a more functional approach towards brands. When choosing the brand of coffee enhancers, users prioritize ease of use and the quality of the offered product. Parameters such as fat content and variety are less valued. In Figure 10, the brand desire drivers are ranked in order of importance (n=1409). Several drivers, such as the ease of use and price, are not only related to the content, but refer to the packaging as well. In the next section, the user drivers of coffee creamer portions are discussed.



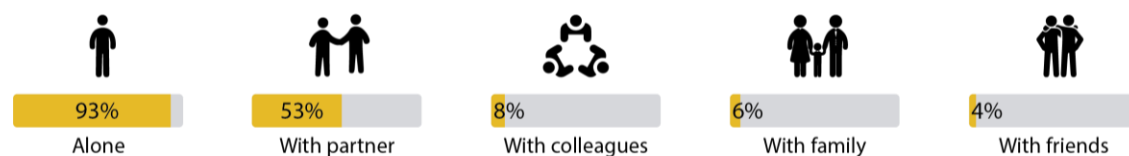


Figure 9. Consumption occasion. Nutroma, n=2399

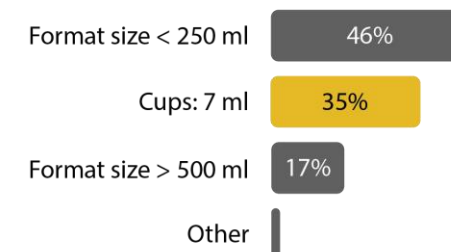


Figure 10. Drivers of brand desire. Friesche Vlag, n=1409

### 2.1.2 Coffee creamer portion users

The portfolio of FrieslandCampina contains different types and formats of coffee creamer packaging. The packaging format, size, appearance and ease of use play a role in the purchasing behaviour of users. When buying coffee creamer, 13% of the users indicate that the type of packaging is a purchase driver (n=438). Nutroma's user research into the buying preferences of coffee creamer packaging formats (n=362), showed that the majority prefers to purchase small formats which contain less than 250 millilitres, see Figure 11. Consumers who only use coffee creamer showed a strong preference for cups due to their convenience regarding storage, consumption and transport. The research of Friesche Vlag contained a similar research question, asking the participants which coffee creamer packaging they use the most (n=2399). The majority of participants answered that they use packaging with dimensions between 445 to 500 millilitres the most, followed by the cups containing 7 millilitres. Both types of research show that portion packaging is not the most preferred or used format size, but a close second.

#### Preferred format size. Nutroma, n=362



#### Most used format size. Friesche Vlag, n=2399

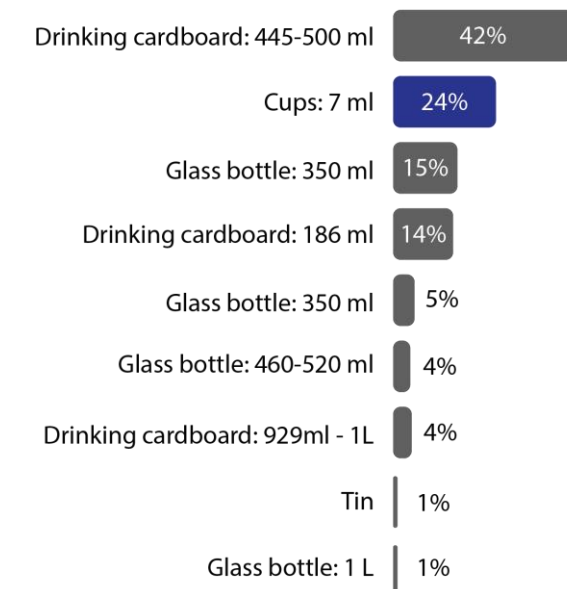


Figure 11. Left: Preferred format size of coffee creamer packaging. Right: Most used format size of coffee creamer packaging.

In terms of preferred packaging type, the research of Nutroma shows that coffee creamer users prefer glass equally as much as plastic cups followed by drinking cardboard (n=362). The U&A research of Friesche Vlag did not specifically ask the participants their preferred packaging type but incorporated this in the previous question of which format size they use the most. From this we know that the majority of the participants (n=2399) use drinking cardboard packaging the most, followed by cups and then glass. These results are conflicting with the results of Nutroma. This can possibly be explained by their different packaging portfolios. Nevertheless, cups scored high again on the preference and frequency used scale. FrieslandCampina currently offers two types of coffee creamer portions: plastic- and aluminium cups. Both are not recyclable due to their size. This will be elaborated on in chapter 4. During the research of Nutroma (n=362), participants were asked which material they prefer for their cups. A slight majority of 54 per cent answered aluminium. Argumentations for this choice include perceived recyclability and the quality of the conserved content. These results show that people are aware of the environmental impact of packaging.

Research (n=362) amongst users of coffee creamer indicated that coffee creamer is mainly used because of its taste and texture. On a secondary level, it's about sociability for friends and family. A segmentation exercise showed that consumers categorize products based on their size and pack format when buying for specific occasions.

Participants indicated that they like the physical appearance of coffee creamer cups and mentioned that it provides a festive atmosphere. In addition to that, presenting a coffee creamer bottle or cups on the table draws more attention to the quality of coffee and provides more enjoyment to the social moment. When using coffee creamer out of home, participants indicated that they like the use of cups due to their fancy appearance and the moment of indulgence.

To gather a complete list of user drivers of coffee creamer portions, additional research into the use of single-use packaging was needed. With the help of literature research and review sites, rational drivers of single-use packaging were analysed. The found drivers were verified with the brands Nutroma and Friesche Vlag to test if they were applicable to coffee creamer cups. The complete list of user drivers of the cups, both rational and emotional, are listed in the table down below. There is no research performed regarding the priority of the drivers.

Drivers		Specification
Rational drivers	Small format	Usage convenience
		Desired amount of content
		Storage convenience
		Transport convenience
	Dietary awareness	Portion/calorie control and nutrition (real or perceived)
No food waste or waste of money	No unwanted leftovers	
Emotional drivers	Hygiene	Single use, no spoiled leftovers
	Appearance	Individual use
		Festive atmosphere
		Draws more attention to the quality of the coffee
		decoration for on the table
	Sociability	Being a good host for guests
		Presenting good quality

Figure 12. User drivers of coffee creamer portion packaging.

## 2.2 User categories

The second step in the process of creating user-profiles is analysing the type of users. The users of coffee creamer portions can be divided into two categories: retail and Out Of Home (OOH). The category retail refers to the sale of coffee creamer cups to consumers in relatively small quantities for use and consumption rather than for resale. The OOH category refers to companies, such as restaurants, bars and coffee-houses

that purchase coffee creamer cups intended for resale. Interesting to note is that Nutroma sells more coffee creamer portions in the OOH category than the retail category, while for Friesche Vlag the opposite is true.

It is important to consider a range of users, to ensure that the product will work for 80% of the (potential) population (User profiles, 2014). Analysing the primary, secondary and tertiary users of the product ensures that all stakeholders are considered. Primary users are during this project defined as individuals who have direct contact with the product, both content and packaging. Secondary users are the individuals who come in intermediary contact with the product. Tertiary users refer to people who only have contact with the (post-consumer) packaging. In Figure 13, these user categories are defined for OOH and retail users.

	Primary users	Secondary users	Tertiary users
Retail	End-users who use coffee creamer cups inside their homes	Stakeholders who are responsible for the purchasing-decision making of coffee creamer cups (retailers)	Packaging producers (FrieslandCampina)
		Consumers who solemnly purchase coffee creamer cups for guests and visitors (not personal users)	Recyclers and sorters
		Transporters	
OOH	End-users who use coffee creamer cups outside their homes in public places	Stakeholders who are responsible for the purchasing-decision making of coffee creamer cups for OOH moments: coffee merchants, restaurants, bars, cafeterias etc.	Packaging producers (FrieslandCampina)
		Transporters	Recyclers and sorters

Figure 13. Primary, secondary and tertiary users of coffee creamer portion packaging.

All three categories are important to consider in the design process. The recyclable packaging alternatives have to comply with the wishes of the primary and secondary users in order to ensure that the product is used and keeps being used. The tertiary users have a large influence on the material and size choices of the alternative packaging due to the process constrictions of recycling and production methods. The requirements the packaging has to meet in order to comply with the recycling processes are discussed in chapter 4. The user profiles are based on the primary and certain secondary users.

## 2.3 Conclusion

Now that the user characteristics, drivers, and types are known, four user profiles can be generated. Coffee creamer cup users are categorised based on the found usage and purchase drivers (User profiles, 2014). Within every user profile, two categories can be made; users who value the rational aspects of coffee creamer cups and the users who prioritize the emotional aspects of coffee creamer cups.

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### 1. Primary retail users

- A. Rational users: Users who value the rational aspects of coffee creamer cups
- Users who prefer using coffee creamer cups due to their ease of use.
  - Users who prefer using coffee creamer cups due to the consistent amount of content.
  - Users who care about their diets but prefer the taste of coffee creamer over the taste of other types of coffee milk. They use coffee creamer cups due to their convenient size.
  - Infrequent users of coffee creamer who are willing to pay extra to avoid food waste and a waste of money.
  - Users who value hygiene and prefer using coffee creamer cups due to the individual and single-use aspects.
- B. Emotional users: Users who prioritize the emotional aspects of coffee creamer cups
- Users who use coffee creamer cups due to their appearance. They like to present the cups on the table to create a festive atmosphere: a time for indulgence and relaxation.
  - Users who value being a good host/hostess. They want to treat their visitors with good quality and create a special moment.

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### 2. Primary OOH users

- A. Rational users: Users who value the rational aspects of coffee creamer cups
- Users who use coffee creamer cups due to the lack of available alternatives.
  - Users who prefer using coffee creamer cups due to their ease of use.
  - Users who value hygiene and prefer using coffee creamer cups due to the individual and single-use aspects.
- B. Emotional users: Users who prioritize the emotional aspects of coffee creamer cups
- Users who use coffee creamer cups due to their appearance. They like the festive appearance of cups on the table: a time for indulgence and relaxation.
- 

Besides the primary users, it is also important to define the user-profiles for some secondary users. For the OOH category, it is interesting to look into the purchase decision-making users, since they directly influence the used format size of coffee creamer by their customers. For the category retail, it is more interesting to look into the stakeholders who solemnly purchase cups for visitors. The remaining secondary users, listed in Figure 13, are neglected since they are less influential on the final packaging design. The full list of usage and purchase drivers for each individual category can be found in Appendix B.

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### 3. Secondary retail users: Users who solemnly purchase coffee creamer portions for visitors

- A. Rational users: Stakeholders who value the rational aspects of coffee creamer cups
- Individuals who purchase coffee creamer cups due to the storage and transport convenience of the small format.
  - Individuals who value hygiene and prefer using coffee creamer cups due to the individual and single-use aspects.
  - Individuals who are willing to pay extra to avoid food waste and a waste of money.
- B. Emotional users: Users who prioritize the emotional aspects of coffee creamer cups
- Individuals who use coffee creamer cups due to their appearance. They like to present the cups on the table to create a festive atmosphere: a time for indulgence and relaxation.
  - Individuals who value being a good host/hostess. They want to treat their visitors with good quality and create a special moment.

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### 4. Secondary OOH users: Purchase decision-making users for public facilities

- A. Rational users: Purchase decision-making users who value the technical aspects of coffee creamer cups
- Users who purchase coffee creamer cups due to the storage and transport convenience of the small format.
  - Users who purchase coffee creamer cups in order to avoid food waste and thus a waste of money.
- B. Emotional users: Purchase decision-making users who prioritize the emotional aspects of coffee creamer cups
- Users who purchase coffee creamer cups due to their appearance. The cups fit the aesthetic and brand identity of the restaurant, bar, cafeteria, etc.
  - Users who purchase coffee creamer cups to meet the wishes of their customers and present a quality service.
-

## Chapter 3. Packaging requirements & design opportunities

In this chapter the second research question, “*What are the packaging requirements and design opportunities that can be derived from the user-profiles and user experiences?*” will be answered. The user-profiles are defined and described in the previous chapter. User experiences are based on the usability of a product or packaging and describes to what extent users are satisfied with it (Norman & Nielsen, n.d.). In this section, the user experience is analysed by means of small user experience researches and different tools, including User experience maps and a Value Proposition Canvas. The findings are then translated into requirements which in turn serve as a baseline for the ideation and conceptualization process.

### 3.1 Predefined requirements

Before looking into the user experiences of the current coffee creamer portion packaging and translating these to requirements, it is important to know if there are any predefined requirements. FrieslandCampina, in consultation with Nutroma and Friesche Vlag, defined requirements regarding recyclability, volume and other packaging aspects, which can be seen in Figure 14. Requirements regarding safety and other food packaging regulations are important to consider when designing the alternative portion packaging. Size restrictions are also important to know. The alternative packaging should be designed to contain 7 millilitres of coffee creamer. Note that the packaging should also contain a certain amount of air. The amount of air depends on the production technique, shape and opening mechanism of the packaging. During the production process, the individual portions are mechanically filled up with coffee creamer. Due to the transport movements in between filling up and closing the packaging, the packaging is not filled right up to the top to avoid spillage. Leaving room for air also increases the ease of use of the packaging. Besides the safety aspects of the packaging, recyclability is the most important predefined requirement.

Predefined requirements	Specification
1. The primary packaging meets all European food safety regulations.	European food packaging regulations regarding safety can be found on the official website of the European union (European commission, n.d.).
2. The primary packaging and corresponding opening mechanism are safe to handle.	The primary packaging is safe to use and handle for consumers between the age of 16 till 65+ years old.
3. All components of the post-consumer primary packaging can be correctly sorted in Europe.	All specifications regarding this requirement can be read in chapter 4.

Figure 14, part A. Predefined requirements

Predefined requirements	Specification
4. The primary packaging provides content density for 7 millilitres of coffee creamer.	The packaging consists of a minimum amount of packaging that is sufficient for the packaging requirements of the product (European commission, 2019).
5. The primary packaging fits the content characteristics.	The primary packaging consists of features that fit the characteristics of the coffee creamer currently sold by Friesche Vlag and Nutroma.
6. The primary packaging design is suitable for mass production.	The primary packaging consists of features that are feasible for mass production.

Figure 14, part B. Predefined requirements

### 3.2 User experience

In this section the results of two small user experience research are discussed. The first user research (n=30) was conducted amongst Dutch coffee creamer consumers between the age of 16 and 64 years old. The research was conducted by means of an online survey and focussed on the general user experience of coffee creamer cups. The questions and answers of the survey can be found in Appendix C. Within this research, there were no restrictions on the brand of used coffee creamer portions. The participants had to write down the advantages and disadvantages of their user experience with coffee creamer cups. The listed advantages matched the user drivers found and described in chapter 2, including sociability, appearance, ease of use, and avoiding money and food waste. The written down disadvantages resulted in some useful insights. Participants indicated that they regularly use more than one coffee creamer cup per serving, which results in a conflicting feeling. One of the participants mentioned, “...you can only choose the amount [of coffee creamer] to a certain extent, without opening more [coffee creamer cups] but that feels strange and seems to defeat the purpose of coffee creamer cups”. This conflicting feeling results from the single-use aspect of the coffee creamer portions, but seems to be less prioritized than sociability, appearance, and ease of use of the packaging.

The most mentioned disadvantage of coffee creamer cups was the amount of (plastic) waste material. People are aware of the environmental impact of packaging. To illustrate, one of the participants mentioned, “[coffee creamer cups] consist of relatively much plastic which is bad for the environment.” In addition to that, more than 90 per cent of the participants indicated that they prefer leaving the aluminium foil attached to the cup. A possible explanation could be the perception of additional waste material. Another explanation could be the disposal convenience since one thing is easier to dispose of than two.



The second small user research (n=9) focussed on the ease of use of the current coffee creamer portion packaging, especially the opening mechanism. Participants between the age of 33 and 77 were asked to film their hands while opening Friesche Vlag coffee creamer cups. These film fragments were analysed together with the information the participants wrote down regarding the opening steps. From literature we know that hand function decreases with age in both men and women, especially after the age of 65 years (Carmeli et al, 2003). The main user group of coffee creamers consists of people around and above this age. Thus, it is not surprising that the most frequently mentioned disadvantage of the packaging included the dimensions. The opening tab was deemed too small and thus difficult to hold. The dimensions of the current coffee creamer portions packaging of Nutroma and Friesche Vlag can be seen in Figure 15. The opening method itself was described as easy or very easy by the majority of the participants (n=7). The participants also encountered no difficulties when removing a single portion packaging from the sleeve. In the retail category, coffee creamer portion packs are usually sold in sleeves where multiple cups are attached to each other. Before you can use one of these cups, users have to snap off one portion packaging of the sleeve by bending in two directions. A disadvantage of this process is the possible unwanted tearing of the aluminium foil, affecting the preservation possibilities of the affected cups.



Figure 15. Dimensions of the current coffee creamer portion packaging.


The last interesting thing to address is the intuitive use of the built-in opening mechanism of the current coffee creamer cups. The current portion packaging can be opened by snapping off part of the plastic tab. This part of the tab is attached to the aluminium foil, resulting in an opening gap where the content can flow out of, see Figure 16. The film fragments showed that three participants tried to open the packaging by tearing the aluminium foil without snapping the tab. For these users, the incorporated opening mechanism was not intuitive. Intuitive use of products and packaging concerns utilising knowledge and skills gained through other products or experiences (Blackler et al, 2003). This means that intuitive packaging design should have features or functions that the users have encountered or experienced before. Thus, the participants who did not use the built-in opening mechanism, probably never encountered such a system before. They had to figure out the unfamiliar features of the packaging, which resulted in a more time consuming and effortful experience.



Figure 16. Built-in opening mechanism of the current coffee creamer portion packaging.

### 3.3 User experience maps

Based on the defined user-profiles, user characteristics and the information described in the previous section, two user experience maps were made to visualise and understand what the users experience when using the current coffee creamer packaging. With the help of this design tool, the similarities and differences between rational and emotional users were analysed. The goal was to find and resolve the pains of their user experiences (What is user experience mapping? n.d.). The first user experience map, see Figure 17 on the next page, is based on a user who values the rational aspects of coffee creamer cups. Figure 18 visualises the user experience of an individual who prioritizes the emotional aspects of coffee creamer cups. Personas were added in order to describe the type of user and his or her goals in life.



**Henrie Vinken**


Henrie is a 72-year-old man who lives in Belgium together with his wife. He is retired and spends most of his days at home tending the flowers in his garden. He prefers to drink his coffee with coffee creamer, but due to his high cholesterol levels, he has to limit his intake.

**Goals**

Enjoy coffee moments with his wife, without too much hassle.

	Purchase coffee creamer format	Open secondary packaging	Open primary packaging	Pour content in coffee	Enjoy coffee moment	Dispose of empty packaging
Location	Retailer	Home				
Actions						
Thoughts	"The cups have the ideal format, I save money and avoid food waste." "Cups will not take up much space in the cupboard."	"I hope that all cups are intact." "I hope I don't tear packaging the wrong way, like last time."	"My hands are shaking too much so I use a sharp object to open the cup." "I hope I don't spill anything."	"One cup of coffee creamer is exactly the right amount for my coffee." "It is hard to get all content out of the cup."	"Coffee creamer completes the taste of coffee." "Cleaning up the mess distracts me from enjoying the moment"	"Spilling the leftovers on the way to the trashcan is really annoying." "This is relatively much waste per serving."
Coffee creamer related emotions	Pleased	Worried	Hopeful	Happy	Cheerful	Irritated
Packaging related emotions			Irritated	Irritated	Distracted	Displeased
Pains	The cups are relatively more expensive than the larger formats. Individuals pay more for less product.	Tearing the packaging the wrong way. A lot of secondary packaging for few remaining cups.	Small format makes opening the packaging challenging. Spilling content.	Not being able to access all coffee creamer inside the cups, resulting in unwanted leftovers. Spilling content.	The (empty) packaging distracts the user from enjoying the coffee moment.	Possibility of spilling leftovers on the way to the trashcan. Relatively much packaging for small amount of content.
Design opportunities	Packaging that adds more value to the coffee drinking experience, which in turn justifies the price difference.	Re-design outer packaging so cups are easily accessible and users are not hindered by too much material.	Packaging that allows people within all age ranges to easily access the coffee creamer inside without spilling content.	Packaging designed in such a way that there are no unwanted leftovers after pouring.	Packaging that does not distract the user at all or distracts the user from worrying about the possible spillage.	Packaging is easy to dispose of and does not require multiple steps, e.g. disposing of multiple parts or cleaning up spilled content.

Figure 17. User experience map of a rational user.



**Mara Bakker**

Mara is 42 years old and lives together with her husband in the Netherlands. She works as an accountant and likes to spend time with friends and family. She always has some coffee creamer cups in her cupboard in case she receives guests.

**Goals**

Create a moment of indulgence for her guests and wind down while chatting with her friends.

	Purchase coffee creamer format	Open secondary packaging	Open primary packaging	Pour content in coffee	Enjoy coffee moment	Dispose of empty packaging
Location	Retailer	Home				
Actions						
Thoughts	"I always buy the coffee creamer cups in case I have unexpected visitors." "The cups look nicer than the other formats."	"The sleeve is made from plastic, maybe I should consider buying the carton or glass packaging."	"I use the tab to open the cup, it is very easy." "I know this brand of coffee creamer will impress my visitors."	"How many cups should I offer my visitors?" "I hope I don't spill coffee creamer on the table, like last time."	"The cups on the table look fancy." "I like to treat my visitors and create special moments."	"This is quite a lot of plastic, are these cups recyclable?" "The small separate parts are annoying to dispose of."
Coffee creamer related emotions	Confident	Disappointed	Happy	Excited	Happy	Disappointed
Packaging related emotions				Conflicted	Annoyed	Annoyed
Pains	The cups are relatively more expensive than the larger formats. Individuals pay more for less product.	The sleeve is made from plastic and emphasizes the environmental impact of the packaging.	Packaging without the familiar brand indicators. Not knowing the quality of the product you offer to guests.	Relatively much waste material per serving, making the use of multiple cups conflicting. Spillage before and after use.	Not bringing enough coffee creamer cups to the table when preferring more coffee creamer.	The packaging is not recyclable. Post-consumer packaging consists of multiple parts to dispose of.
Design opportunities	Packaging that adds more value to the coffee drinking experience, which in turn justifies the price difference.	Re-design outer packaging and provide the user with a feeling of comfort: they are buying an environmental friendly product.	Packaging should remain the luxurious appearance and show the familiar brand identity markers.	Packaging that allows the content to be portioned according the users' wishes, avoids spillage and is reusable or recyclable.	Packaging containing multiple coffee creamer cups with a fancy appearance when standing on the table.	Re-design packaging in such a way that it is recyclable, can be disposed of as one piece and still have a luxurious appearance.

Figure 18. User experience map of an emotional user.



The user experience maps visualise the necessary steps to achieve the personas' goal: enjoy a coffee moment. The process is divided into six steps; (1) purchase, (2) open secondary packaging, (3) open primary packaging, (4) pour content, (5) enjoy the coffee moment, and (6) dispose of the packaging. Transport of the product and removing the individual cups from the sleeve are not taken into account. During every step in the process, the personas' thoughts are written down and the corresponding emotions are visualised. Within this section of the experience map, a distinction is made between the emotions regarding coffee creamer and the emotions regarding the packaging. In order to create the optimal user experience, the packaging should not negatively distract the user from enjoying its content. When analysing the emotion flows of both experience maps, one can see that the packaging evokes negative emotions while the emotions regarding coffee creamer are positive. This deviation between the emotion flows, the emotions themselves, and the thoughts are used as a guideline to find user pains and design opportunities.

The second step visualised in the user experience map addresses the secondary packaging of coffee creamer cups. The secondary packaging promotes the products and facilitates product identification (Functions of packaging, n.d.). It is the main visual when purchasing coffee creamer cups and thus strongly influences the perception of the product. Due to the increasing awareness of the environmental impact of packaging, both evident in literature and survey results (n=30), it is important to consider the whole appearance of the product (Schooley, 2020). Pains of the secondary packaging will be considered during the ideation process, but the focus remains on the primary packaging. For example, the pain of not being able to choose the amount of coffee creamer when using cups. This particular user pain is not easy to solve since taste preferences are unique for every person. When users are not satisfied by the amount of one portion, they can open another one or use a different format size available on the market. Opening another cup feels conflicting due to the relatively high amount of waste material per serving. This pain can be solved by designing recyclable coffee creamer portion packaging and communicating this to the users. Besides the volume being a predefined requirement, the demand for coffee creamer (portions) is not high enough to add different portion sizes to the portfolio of FrieslandCampina.

The first noticeable difference between rational and emotional users, besides their motives to purchase coffee creamer cups, is that emotional users are driven by the opinion and needs of others while rational users are more individually driven. Impressing visitors and environmental impact are big pain points for Mara whereas spillage and ease of use are the biggest pain points for Henrie. Mara values what others think and strives to be a good hostess. Meeting the wishes of the visitors and providing good quality are important factors. She experiences conflicting feelings when offering multiple cups to her visitors; she wants to be a good hostess, while at the same time

she knows the environmental impact of single-use packaging. Mara has an overall more positive user experience than Henrie, especially when opening the primary packaging. This can be explained by the age difference between Henrie and Mara. As earlier mentioned, elderly people experience a harder time when dealing with small products. Another difference is noticed when both users reach their goal. The appearance of the packaging improves the coffee drinking experience of Mara whereas Henrie's experience is negatively influenced. Irritations while opening the cups and spillage, distract Henrie from fully enjoying his coffee moment.

Similarities between rational and emotional users that can be derived from the experience maps are related to their pains. Both users find the secondary packaging bothersome. Mara dislikes the plastic appearance which emphasizes the environmental impact of the packaging and Henrie dislikes the functional aspects of the packaging. Another shared pain point is not making optimal use of the portioned coffee creamer, whether by unwanted leftovers or by taste preferences. The amount of waste material, as discussed in the previous section, and spillage are also pains for both users.

### 3.4 Value Proposition Canvas

In this section, a different approach to finding user pains and design opportunities is used. A Value Proposition Canvas, see Figure 19, is filled in (Van der Pijl, 2019). The previously used tool focused on the differences and similarities between emotional and rational users. The content of this tool will focus on the differences between the primary and secondary users in the OOH and retail category. The goal of a Value Proposition Canvas is to find out which product aspects resonate with the users. The tool consists of two parts; a value map and a user map. The user map shows what the users need and want from the product while the value map shows what the product can offer. A fit is created between the value map and user map when the goals and wishes of the users are met with design solutions (Van der Pijl, 2019).

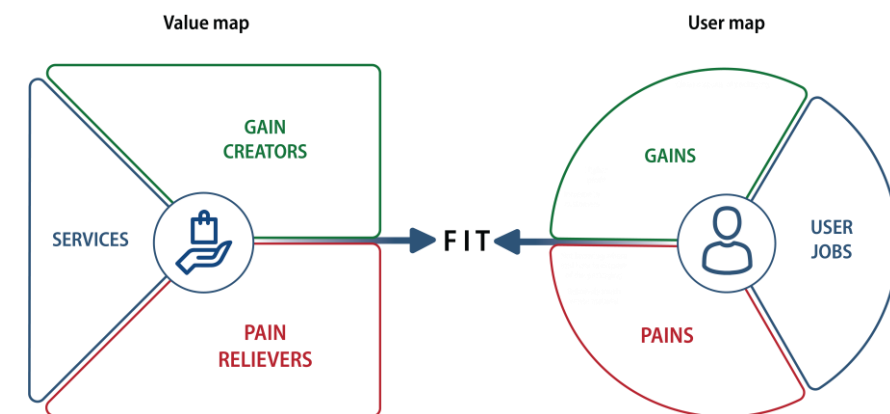


Figure 19. Empty Value Proposition Canvas

### 3.4.1 User map

Each user profile has gains, pains and jobs to be done (Van der Pijl, 2019). User jobs refer to the functional, emotional and social tasks users want to get done. Gains refer to the positive outcomes the user expects when the job is getting done and user pains are problems the users face when trying to get a job done (Van der Pijl, 2019). The full list of jobs, pains and gains of the primary and secondary retail users can be found in Appendix D. The primary users are the end-users who come in direct contact with the product, including the coffee creamer and packaging. The secondary users are the individuals who come in intermediary contact with the product. For retail, this category consists of retailers, individuals who solemnly buy coffee creamer cups for visitors, and transporters. In this tool, the retailers and transporters are neglected. The jobs, pains and gains of the primary and secondary OOH users can be found in Appendix E. Within the OOH category, the secondary users consist of large-scale purchase decision-makers and transporters. Similar to the retail category, the jobs, pains and gains of the transporters are neglected.

Figure 20 shows the user maps of primary and secondary users. The similarities and differences between the user types are visualised by means of different colours. The shared jobs, pains and gains are indicated with the colours blue, red and green respectively. The light grey colour indicates that the job, pain or gain only applies to the OOH user, while the dark grey colour indicates that it only applies for retail users. In this way, similarities and differences between these user types can be easily spotted. Interesting to note is that the user job “purchase product” is shared amongst all user categories, each for different reasons and circumstances. A corresponding pain is a bad price/quality ratio.

Another interesting similarity to note is that all user categories consider environmentally harmful packaging as a pain. People become increasingly aware of the direct environmental impact of packaging. As explained in the introduction of the report, the corporate social responsibility (CSR) image among customers and other stakeholders becomes increasingly important (Schooley, 2020). Customers, employees and stakeholders are prioritizing CSR when choosing a brand or company (Schooley, 2020). Offering recyclable packaging and promoting this to its customers will prove beneficial for the secondary OOH users. The main difference between primary and secondary users can be seen in the list of user jobs. Secondary users do not typically make use of the product and will thus not perform tasks such as opening and emptying the packaging. However, user convenience is still highly valued by this type of user since they value being a good host and want to meet the customer’s or visitor’s wishes when presenting coffee creamer cups, whether on a small or large scale.

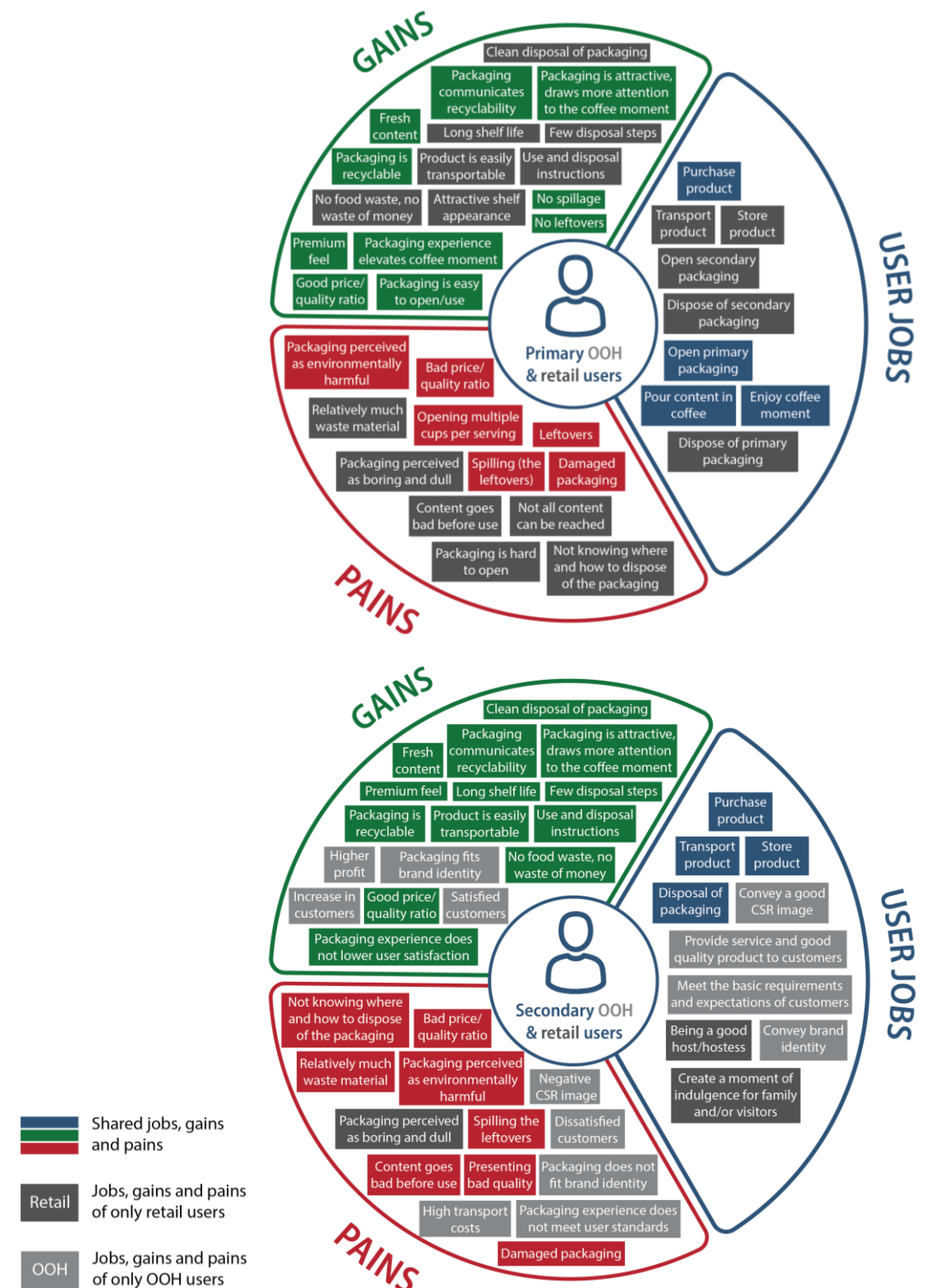


Figure 20. Top: User map of primary OOH and retail users. Bottom: User map of secondary OOH and retail users.

### 3.4.2 Value Map

A value map describes the attributes the product should have in order to create a fit between user and product. It consists of three parts; products & services, pain relievers, and gain creators. Since we analyse packaging, the first category has to be slightly altered. It originally answers the question “What are the products and services you can offer your customers so they can get their job done?” (Van der Pijl, 2019). The altered category lists all services the packaging should offer in order to accomplish the defined user jobs. These services are derived from packaging functions (Functions of packaging, n.d.). The category gain creators list the packaging attributes that can create the gains listed in the user map. The category pain relievers refer to the attributes of the packaging that can relieve the pains the users experience while getting their jobs done. Gain creators and pain relievers can be considered as design opportunities.

Value maps can be filled in and used in different phases of the design process. During this project, the value map is filled in before the ideation phase and is used to derive design opportunities for every user category. These design opportunities are translated into requirements. Figure 21 and 22 on the next page show the value maps that create a fit with the earlier defined user maps. The same colour identification as described in the previous section is used. When analysing the figures, the services, gain creators and pain relievers are similar for both primary and secondary users. A few are only applicable to specific user types, for example, *the primary packaging is customizable*, is only a pain reliever for secondary OOH users. Comparing the figures, one can conclude that the different user-profiles do not require different packaging concepts.

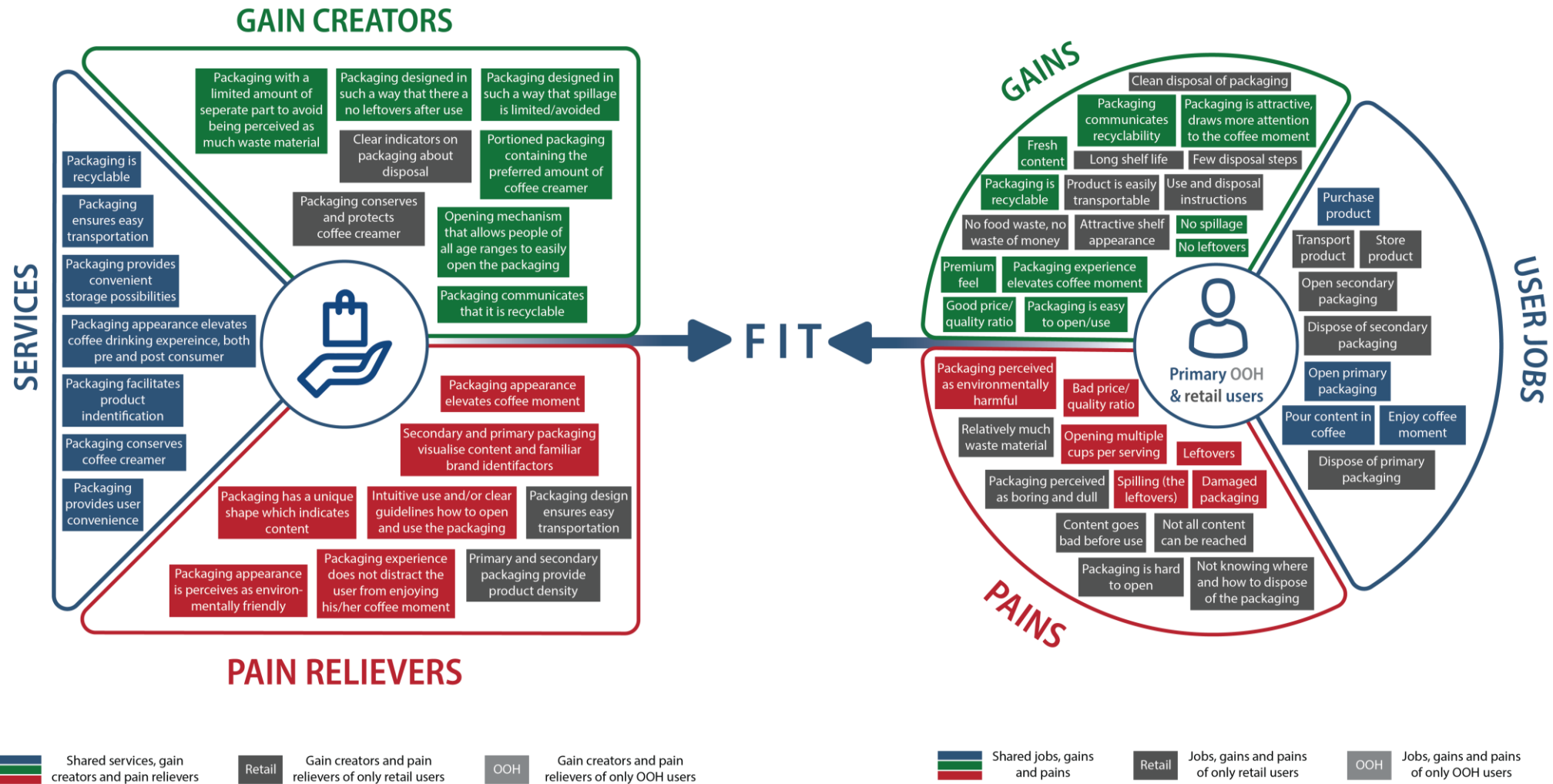


Figure 21. Fit between user map and value map of primary users.



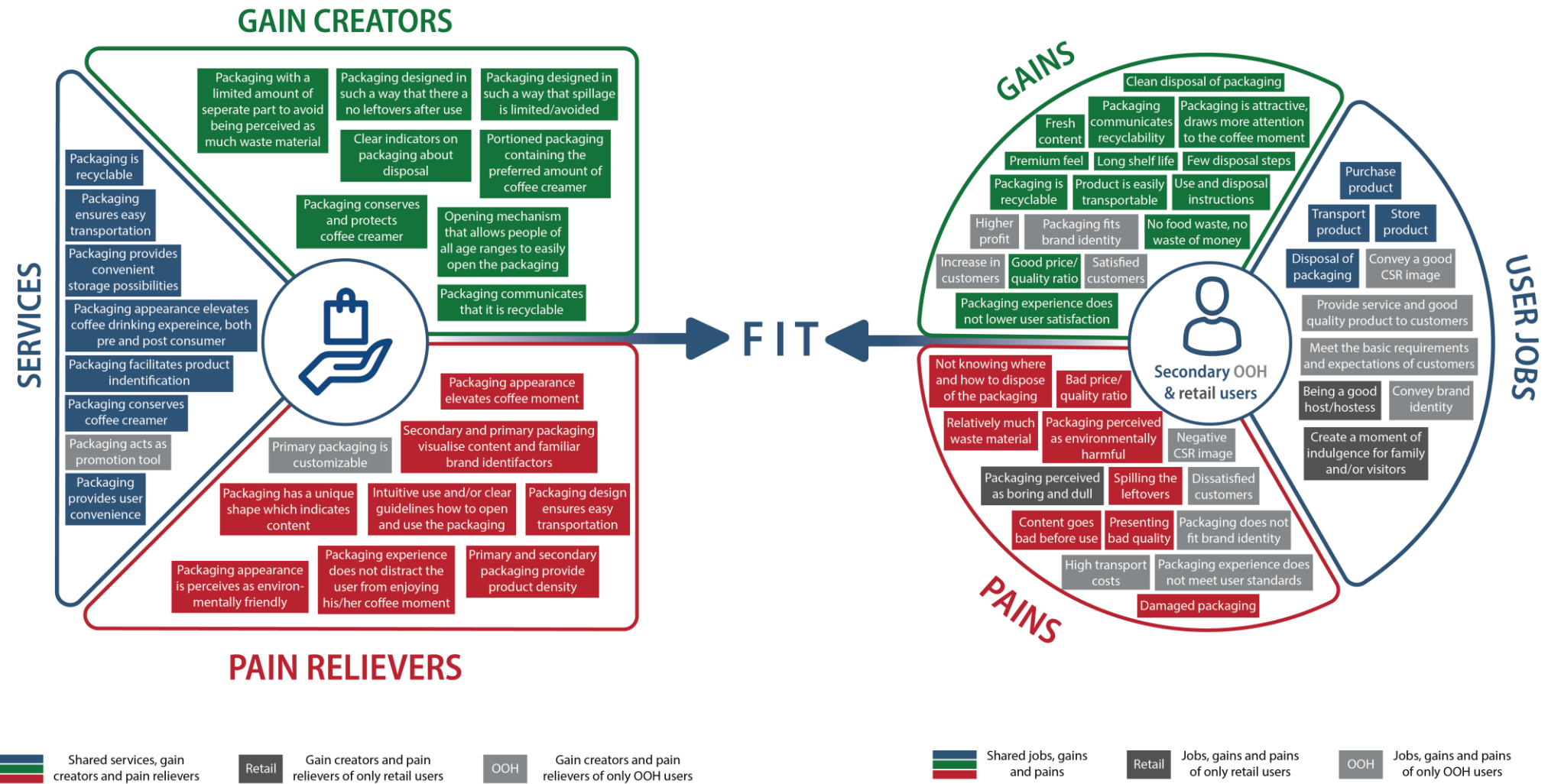


Figure 22. Fit between user map and value map of secondary users.

### 3.5 Conclusion

The small user research and the results of the experience maps and the value proposition canvas created a clear image of the user experience of coffee creamer portion packaging. The full list of pains and design opportunities that are derived from the experience maps and the value proposition canvas can be seen in Appendix F. These pains and design opportunities are in turn translated into requirements, which can be seen in Figure 23. The requirements are ranked according to priority, based on the MoSCoW method. The MoSCoW method is a prioritization technique for managing requirements (ProductPlan, n.d.). The name is an acronym that stands for four different categories: Must-haves, Should-haves, Could-haves, and Wishes. The predefined requirements discussed in section 3.1 are must-haves that are non-negotiable needs for the packaging. Should-haves are requirements that are not necessary for the packaging to function but add significant value to the user experience. They can be described as performance improvements and minor bug fixes. Could-haves are not necessary for the core function of the packaging and have a much smaller impact when left out. The wishes are requirements that are not a priority for this specific time frame and are often referred to as ‘will not have at this time’.

Most of the found pains and design opportunities are translated into should-haves. The pains that reoccur in multiple user experiences within different user categories can be considered as most influential. When these pains are relieved, the general user experience of coffee creamer cups will be improved. The recurring pains for all user profiles include bad price/quality ratio, spilling coffee creamer during use, dull and cheap appearance, and the environmental impact of the packaging. These pains are translated into should-have requirements. One of the must-have requirements states that the packaging can be correctly sorted during the recycling process. The last phase of the recycling process is outside of the scope of this project. Thus, a requirement stating that the packaging is recyclable is categorized as “will not have at this time”. The perception of the primary packaging in terms of recyclability is also listed as a wish since the final deliverable consists of concepts. The user pains that are not recurring for multiple user profiles are listed as could-haves. The must-haves and should-haves are the focus points during the following steps in the design process.

Must-have requirements	Specification
1. The primary packaging meets all European food safety regulations.	European food packaging regulations regarding safety can be found on the official website of the European union (European commission, n.d.).
2. The primary packaging and corresponding opening mechanism are safe to handle.	The primary packaging is safe to use and handle for consumers between the age of 16 till 65+ years old.
3. All components of the post-consumer primary packaging can be correctly sorted in Europe.	All specifications regarding this requirement can be read in chapter 4.
4. The primary packaging provides content density for 7 millilitres of coffee creamer.	The packaging consists of a minimum amount of packaging that is sufficient for the packaging requirements of the product (European commission, 2019).
5. The primary packaging fits the content characteristics.	The primary packaging consists of features that fit the characteristics of the coffee creamer currently sold by Friesche Vlag and Nutroma.
6. The primary packaging design is suitable for mass production.	The primary packaging consists of features that are feasible for mass production.

Should-have requirements	Specification
1. The packaging is easy to open for all ages within the user group.	The dimensions and/or surfaces intended for hand placement have to be larger than the dimensions of the current coffee creamer portion packaging.
	The packaging has clear affordances to aid in the opening process.
	The opening mechanism resembles existing coffee creamer portion packagings or resembles commonly encountered packaging experiences.
2. The packaging material meets the preferences of the users.	The packaging is made from either glass, drinking cardboard, aluminium or plastic according to user research (Nutroma, n.d.; Friesche Vlag, 2016).
3. The packaging allows the users to dose the content.	The packaging design and opening mechanism allow the users to dose the content in a satisfactory way.
4. The packaging design ensures a limited amount of unwanted leftovers.	The packaging design and opening mechanism allow the users to reach all content when this is preferred.
	The used material, coating and or layers allow an easy content flow.

Figure 23, part A. List of packaging requirements.

Should-have requirements	Specification
5. The design of the packaging limits or prevents spillage during and after use.	The packaging design should aid the pouring experience.
	The opening mechanism should simplify the opening process and avoid spillage.
	The packaging design allows people to place their hands or fingers in such a way that there is no pressure on the content during the opening process.
	The shape of the packaging allows placement on a flat surface in a fixed orientation which allows the content to remain inside the packaging.
6. The packaging design is suitable for the defined user occasions.	The design of the packaging allows users of the retail category as well as the OOH category to comfortably use it.
	The packaging should be designed for single-use or when possible multi-use packaging that can be portioned in a hygienic way.
7. The (post-consumer) packaging is presentable during coffee moments.	The dimensions, shape and appearance of the packaging allow it to be placed on a flat surface without spilling the content.
	The packaging design allows it to be used in both OOH and retail situations.
	The packaging appearance provides a premium feel.
8. The post-consumer packaging is easy to dispose of.	The post-consumer packaging should consist of less than 3 separate parts.
	Disposing of the post-consumer packaging can be done in less than 3 steps.
	The (secondary or primary) packaging clearly shows how and where to dispose of the packaging components.
9. The packaging has a similar price/quality ratio as the current packaging.	The packaging has a similar price range as the current packaging: € 0,49 - 0,61 for 10 x 7 ml.
	The packaging should have a similar premium feel like the current packaging.
10. The primary and secondary packaging are convenient to store and transport.	The secondary packaging should resemble the current packaging dimensions: 250 x 90 x 20 mm.
	Primary packaging should provide a similar shelf life as the current packaging.
	Primary packaging can be stored at room temperature.
	Primary packaging provides content density.
	Primary packaging is efficiently stackable and protects the content adequately.

Could-have requirements	Specification
1. The primary packaging provides product identification.	Visual packaging aspects show similarities to the current coffee creamer (portion) packaging of FrieslandCampina.
2. The primary packaging is customizable.	The brand logos, font type and colours of the primary packaging are customizable for OOH use.

Wishes	Specification
1. All components of the post-consumer (primary and secondary) packaging can be recycled in Europe.	Requirements regarding the full recycling process have to be defined.
2. Primary and secondary packaging communicate that it is recyclable.	Primary and secondary packaging coerces people into collecting the post-consumer packaging accordingly.
	Advertisements, written explanation or labeling informs the user about the recyclability of the packaging in such a way that user can dispose of it accordingly.

Figure 23, part B. List of packaging requirements.



## Chapter 4. Correctly sortable packaging

This chapter addresses the last research question: *“What are the requirements post-consumer packaging has to meet in order to be correctly sorted during a recycling process?”*. First, the general recycling process of packaging material is discussed. Next, the sorting process of waste material is researched by means of literature research. The found sorting processes are translated into packaging requirements. When met, these requirements ensure that the post-consumer packaging can be correctly sorted during the recycling process.

### 4.1 General recycling process

Recycling is the process of collecting and converting waste materials into new materials and products (Environmental Protection Agency, n.d.). The recycling process can be divided into three steps: Collecting, Sorting, and Recycling (Plastics Recyclers Europe, n.d.). Only when packaging or its materials can adhere to all these steps, it is considered to be recyclable. The three steps can differ per country, city and even per recycling facility (FrieslandCampina, n.d.). Thus, it is currently impossible to design packaging that can be globally recycled. Therefore, the focus will be on the European market. In order to answer the sub-question, it is only necessary to look into the collecting and sorting processes of packaging waste. The last step in the recycling process is outside the scope of this project. The information provided by the Netherlands Institute for Sustainable Packaging (KIDV) is used as a guideline during this research. This organisation works with representatives of the packaging industry and independent experts existing of scientists from different universities (KIDV, n.d.). The KIDV works conform to European standards.

In Europe, six categories of recyclable packaging waste streams are collected; glass, paper/cardboard, plastic, ferrous and non-ferrous, and drinking cardboard (Brouwer et al, 2019). In order for the packaging to be considered as recyclable, it has to be composed in such a way that it can be collected in one of these categories and is picked up by recognized waste-collecting facilities (KIDV, 2019). There are several reasons that can prevent or limit the collection of post-consumer packagings, such as individual and demographic factors of households, the packaging design, and how waste management is handled and presented by local municipalities (Jomehpour & Behzad, 2020). It is not determined by law how waste material has to be collected. To illustrate, some municipalities collect plastic packaging separately, while other municipalities collect plastic packaging, metal and drinking cardboard (PMD) together, see Figure 24. Municipalities can also opt for a collection process of general waste, where the valuable recyclable materials are collected afterwards in sorting facilities. European guidelines regarding the collection of post-consumer packaging can be found on the official website of the KIDV (KIDV, n.d.).



Figure 24. Collection possibilities. PMD stands for plastic, metal and drinking cardboard packaging.

The collected waste materials are transported to sorting facilities, where the individual waste streams are separated and sorted accordingly. To make the sorting process easier, there are a few guidelines that should be considered during the collection process. The collected packaging should be empty and when possible closed, to avoid contamination of other collected waste material. Another guideline states that empty packaging should not be stacked or inserted into each other but can be made compact. This makes mechanically sorting the different materials easier.

### 4.2 Sorting process

When the post-consumer packaging complies with the collection requirements, it is shipped to sorting facilities. Each individual waste stream is sorted with different processes and sorting machines. The previous chapter discussed the requirements of the to-be-designed packaging. One of the should-have requirements states that the packaging should be made from either glass, plastic, aluminium or drinking cardboard. Research shows that packaging made from plastic or drinking cardboard has a considerably lower carbon footprint than glass bottles due to material and weight (TAPPwater, 2019). Due to these relatively high greenhouse gas emissions and the transport and safety disadvantages, the possibility of glass packaging for the to-be-designed portion packaging is discarded. Therefore, only the sorting processes of the PMD waste stream will be discussed. The sorting processes are different within every sorting facility, but the used technologies are generally comparable. The waste management organisation SUEZ was chosen to function as a baseline to describe the general sorting process of the PMD waste stream. SUEZ has several waste management facilities in Europe, including the Netherlands and Belgium (SUEZ, n.d.). The information provided by SUEZ is combined with the guidelines of the KIDV to create a clear understanding of the sorting process of the PMD waste stream in Europe, see Figure 25.

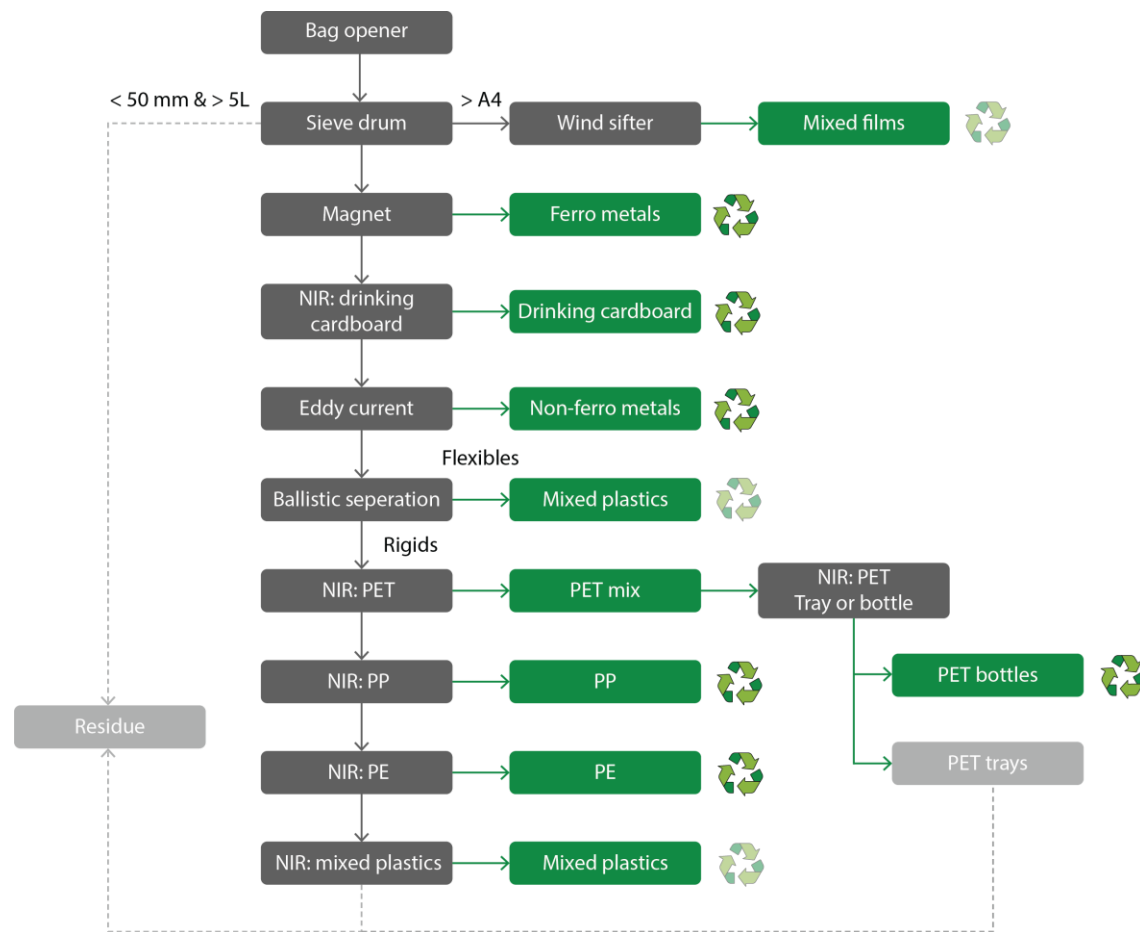


Figure 25. Sorting process of the PMD waste stream.

The PMD waste material is collected in plastic bags. A full list of waste material that belongs in these bags can be found on the official website of SUEZ. Upon arriving, the plastic bags are mechanically opened without damaging the content. The waste stream is then transported to different sorting processes and separation machines by conveyor belts. The packaging is considered to be recyclable when all its components can be correctly sorted into their corresponding material category (KIDV, 2019). When the packaging components do not meet the requirements and are filtered out of the sorting process, it ends up as residue. These waste materials are considered to be non-recyclable and are incinerated for energy recovery (SUEZ, n.d.). The individual separation steps are discussed in the following paragraphs.

#### Sieve drum

The first step in the sorting process is a sieve drum. This machine separates the waste material based on geometry. The waste material is transported into a rotating cylinder which is referred to as a trommel (Masias Recycling, n.d.). The trommel has holes

which are used to separate the smaller pieces from the larger waste materials. Trommels are available with different hole diameters. The sieve drum used by SUEZ separates pieces smaller than 45 millimetres, which are then transported to another sieve that filters out all waste material smaller than 20 millimetres. The pieces bigger than 20 millimetres are transported back into the sorting stream. This does not happen in all European waste management facilities. Therefore, the KIDV defined stricter guidelines. They created a tool, which can be used to check the level of recyclability of packaging. This *Recyclecheck*, states that packaging should be larger than 50 millimetres and smaller than 5 Litres (KIDV, 2019). Packages that do not meet these requirements are filtered out of the sorting process, irrespective of material type. The packaging ends up in the residue pile. This is also the case for the current coffee creamer portion packaging of Nutroma and Friesche Vlag.

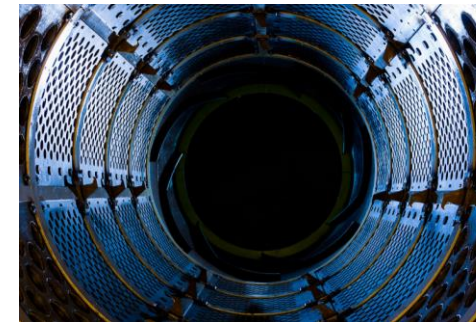


Figure 26. A sieve drum.

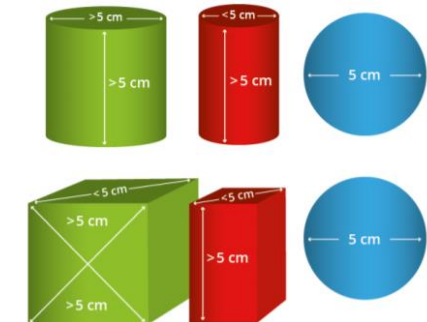


Figure 27. The post-consumer packaging has to be larger than 50 millimetres in two directions at the time of sorting.

#### Wind sifter

Waste material larger than A4 format inside the sieve drum is sucked out by a wind sifter. This sorting machine separates the waste with the use of air streams. The separation is based on the different densities, shapes and sizes of the waste material. Inside the wind sifter, there is a separation drum that provides the separation between the heavy and light materials. Due to the dependence of air drag on object size, shape and weight, some materials are pushed over the separation drum, while other materials fall through the airflow. In this way, different types of films are sorted.

#### Magnet

This sorting process sorts the ferrous materials from the waste stream, by means of a magnetic pulley (Gotro, 2017). Packaging made from ferrous materials, such as soup cans, contain iron and are magnetic. Packaging consisting of ferrous materials stick to the magnetic pulley. When the conveyor belt is rotated in such a way that the gravity is stronger than the magnetic connection, the ferrous materials drop, see Figure 28. All waste material without magnetic properties is dropped onto another conveyor belt.

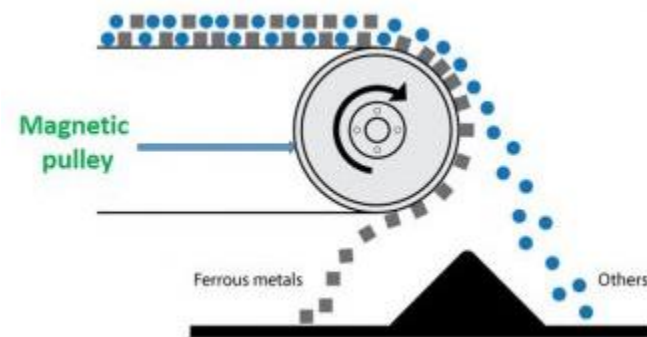


Figure 28. Schematic overview of ferrous material sorting.

### Eddy current separator

An Eddy current separator sorts non-ferrous materials, such as aluminium, out of the waste stream. This separating technique is based on a magnetic field which is induced by a rapidly rotating electromagnetic inside a non-metallic drum. When non-ferrous materials pass over the drum, the magnetic fields create Eddy current in the non-ferrous metals (Gotro, 2017). The Eddy current repels the non-ferrous materials of the conveyor belt and over a splitter for separation. The remaining waste stream of plastics drops onto another belt and is transported to the next separation process.

If the current aluminium coffee creamer portion packaging ends-up at this sorting machine, it is sorted as non-ferrous material. The current cup made from plastic is not, even though it features an aluminium layer. The aluminium layer, assuming that the majority of the foil is still attached to the cup, is not thick enough for the packaging to be influenced by the Eddy current (RecyClass, n.d.; KIDV, 2019). Ideally, the different materials should be collected separately so they can be sorted accordingly.

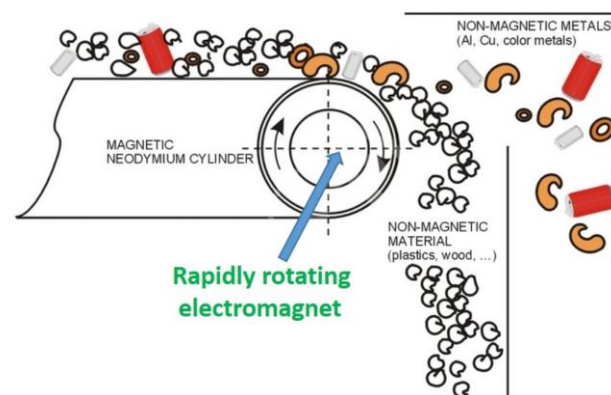


Figure 29. Schematic overview of non-ferrous material sorting.

### Ballistic separation

This separation technique separates materials based on their shape. A ballistic separator is a mechanical sorting device that oscillates, causing a separation between the flexible and rigid waste materials (Tinsley equipment company, n.d.). The ballistic separator consists of mesh panels that can also filter out small remaining waste material, such as pieces of glass. The flexible materials end up in the mixed plastics category, while the rigid materials are transported to the next set of separation steps. During this sorting step, problems can occur when the packaging is heavily contaminated. For example, when a flexible packaging contains a lot of leftovers, it can react as rigid packaging. Heavily contaminated waste also needs more time to clean. It is therefore recommended that the post-consumer packaging is fully emptied before it is disposed of.

### Near-infrared radiation scanners

The next step in the process sorts the remaining waste stream based on material type. Most sorting facilities use near-infrared radiation (NIR) scanners for this sorting step. NIR scanners use the electromagnetic spectrum in a range between 760 and 2500 nanometre, which is invisible for the human eye. In this wavelength range, the NIR scanners are able to detect different types of materials based on their molecular vibrations (Zheng et al, 2018; Steinert, n.d.). When a specific material is detected by the NIR scanners, it is blown off the conveyor belt by pressurized air streams onto another separate conveyor belt. Some sorting facilities make use of additional technologies to improve recognition. These technologies are still under development and thus not widely used yet. Therefore, NIR scanners are the norm for sorting requirements.

The packaging types that are currently sorted are polypropylene (PP), polyethylene (PE), polyethylene terephthalate (PET) and drinking cardboard (KIDV, 2019). Note that there is a distinction made in PET packaging. PET bottles are recyclable. All other packaging made from PET, referred to as PET trays are currently not recycled. Drinking cardboard is a specific type of packaging composed of cardboard, PE and a thin layer of aluminium (Recyclenow, n.d.). All material that does not belong in these four material categories is sorted as mixed plastics or end up in the residue pile. Materials that cannot be recognized by the NIR scanners are not sorted and therefore not recycled. NIR scanners sort the packaging based on the material of the main body. When the main body is obstructed from view by labels, sleeves or tags, the packaging is sorted in the wrong material category. Another factor that influences sorting by NIR scanners is the colour of the main body. The general added pigment to create a black surface, referred to as carbon black, does not reflect the NIR but absorbs it (KIDV, 2019). Thus, carbon black packaging is not detected and therefore not sorted. Other colours can be detected, the lighter the colour the more efficient the sorting.

All sorted waste material that can be recycled is pressed into bales and shipped to the corresponding recycling plants. The materials sorted as residue are burnt for energy recovery. When the to-be-designed packaging is made from plastic, it should ideally end up in the PP, PE or PET drinking bottles category. Other plastic types are currently sorted in the mix category or end up in the residue pile (KIDV, 2019). Other acceptable categories are drinking cardboard or non-ferrous metal if the packaging is made from aluminium.

### 4.3 Conclusion

Post-consumer packaging has to meet four main requirements in order to be considered recyclable: (1) The packaging consists of materials that can be collected by recognized waste-collecting facilities, (2) the packaging can be correctly sorted into its corresponding material type, (3) the packaging can be processed into raw materials, and (4) the recycled raw materials have an unambiguous composition and can be used to create new products and packaging (KIDV, 2019). The first two requirements are important to meet in order for the packaging to be correctly sorted. The last two main requirements are outside the scope of this project.

The main body of the current plastic coffee creamer cups is made from polystyrene (PS). This material type is currently not sorted separately in Europe and therefore not considered recyclable. The material of the portion packaging can be relatively easily changed to a material that is classified as easy recyclable according to the KIDV. The current aluminium portion packaging already consists of material that is easy to recycle. Once the packaging consists of recyclable material, it can be collected accordingly. For the packaging to be correctly sorted into its corresponding material type, it has to meet several requirements which are summarized in Figure 30. Note that the requirements are not ranked according to priority since they are all equally important in order for the packaging to be sorted correctly. The biggest challenge to overcome is enlarging the dimensions of the packaging in such a way that it will not be filtered out of the sorting process by a sieve drum, while still meeting the defined volume requirement.

Collecting requirements (PMD)	Specification
1. Post-consumer packaging is made from materials that fit within the recognized recyclable packaging waste streams and is picked up by recognized waste-collecting facilities.	Packaging components are made from PP, PE, PET bottles, aluminium or drinking cardboard.
Sorting requirements (PMD)	Specification
1. The post-consumer packaging is larger than 50 millimetres in two directions at the time of sorting.	-
2. Flexible post-consumer packaging made from plastic is not larger than A4 format.	Flexible packaging refers to packaging whose shape can be readily changed. A4 format refers to 297 x 210 millimetres.
3. Rigid post-consumer packaging made from plastic is not larger than 5 Litres.	Rigid packaging refers to packaging that remains their shape under (light) pressure.
4. The material of the packaging and its components are detectable for NIR scanners.	The main body of the packaging is not coloured carbon black. The main body of the packaging is not obstructed from view by e.g. labels, tags or sleeves.
5. The packaging or its components are not classified as PET trays.	PET trays are packaging materials made from PET, which are not classified as PET bottles.
6. Aluminium parts on plastic packaging are not thicker than 5 µm (RecyClass, n.d.).	-
7. The post-consumer packaging should be free from embedded or trapped metals.	-

Figure 30. Collecting and sorting requirements.











## Chapter 5. Ideation phase

In this chapter, the ideation phase is described. The goal of this phase was generating as many ideas as possible with the requirements as a guideline. First, a market analysis was performed to gain insights into the possibilities of material choice, appearance and format size. Next, several brainstorm sessions were performed, individual as well as with a group. The group brainstorm sessions are documented in section 5.2. Based on the results of the brainstorm sessions, explorative research was performed by means of design sketching.

### 5.1 Market analysis


The market analysis focussed on single-use portion packaging with different opening mechanisms, which can be seen in Figure 31. The featured packages all contain fluids of different consistencies. The single-use portion packagings of different brands were analysed and compared in terms of appearance, storage possibilities, user convenience, and material. The packages were also analysed to see if they could be correctly sorted during a recycling process. The information regarding appearance is based on the visual elements of the specific packaging featured in Figure 31. The sortability was analysed by means of the defined requirements discussed in the previous chapter. The packagings are classified according to the colour classification of the KIDV Recyclechecks (KIDV, 2019).

Most of the analysed portion packagings cannot be recycled due to their size. The packagings that are recyclable are larger than 50 millimetres in two directions and made from valuable recyclable material. An interesting similarity between the user convenience of the analysed packaging is that half of the opening mechanisms only require one hand to open the packaging. These packaging typically have a bigger format, which makes holding the packaging more comfortable and requires less pinch strength than the current coffee creamer cup. Another interesting thing to note is that most of the packages remain in one piece after opening. For example, V-shapes has a patented opening mechanism that requires one hand and no separate waste material. A disadvantage of these kinds of opening mechanisms is the small opening, which can result in undesired leftovers when the content has a thicker consistency. Another disadvantage is the lack of control when pouring the content. Users are not able to control the amount of coffee creamer that comes out of the packaging. Individuals who prefer less than the packaged amount value the option to dose the content. The triangle coffee creamer packaging of Arla is relatively more difficult to open since it requires both hands. Users have to peel off a seal sticker to reveal a pre-cut opening hole, which ensures a more tailored pouring experience (Tetra Pak, n.d.).

	Nutroma	Arla	Snapsil	MasterFoods	eXpack	V-Shapes
						
Content	Coffee creamer	Coffee creamer	Coffee liquid concentrate	Tomato sauce	Cleaning conditioner	Hand sanitizer
Appearance	The packaging has a luxurious and classic feel to it due to the gold colours, logo and font type. Content is easily identified due to classic cup shape.	The packaging has a festive feel to it due to the interesting shape and the green colour palette. It also appears as sustainable due to the nature aspects.	Packaging has a classic cup shape. The dark brown colour in combination with the bright red give the packaging a warm 'coffee moment' appearance.	Packaging has the classic red colour and tomato, resulting in fast product identification. The sauce is divided amongst two containers.	The shape of a tube is imitated, which makes product identification easier. The white and light blue shapes give the packaging a soft and fresh appearance.	Packaging has a simple squared, flat shape. The white and blue colour palette and clean font type result in a simplistic and calm appearance.
Volume	7 ml	20 ml	6 - 30 ml	14 ml	10 - 50 ml	0.2 - 40 ml
Storage possibilities	The individual cups are connected in a sleeve* and are easily stackable due to flat top and bottom surfaces.	The individual packagings can be stored into a squared shape due to triangle format.	Similar storage possibilities as coffee creamer cups. Sleeve possibilities are unknown.	Similar storage possibilities as coffee creamer cups. Due to flat sides, easy to stack against each other.	Small, flat and flexible format results in convenient storage possibilities. Individual packaging is stored horizontally.	Flat squared shape is ideal to store; provides a lot of product density.
Opening mechanism	The small and thin opening mechanism requires both hands, precise hand eye coordination and enough pinch strength.	Opening the packaging requires two hands to peel of seal. Bigger packaging results in easy pouring and less spillage.	The Snapsil opening mechanism requires only one hand, no pinch strength and no precise hand eye coordination.	Opening the packaging requires only one hand and pinch strength. Clean pouring, no spillage but high chance of leftovers.	Similar opening mechanism as coffee creamer cups, but makes use of tearing. Less chance of spillage due to small opening.	The V-shape opening mechanism requires only one hand and almost no pinching strength. Easy and clean pouring.
Material	Two types: Aluminium cup with aluminium foil. Plastic cup (PS) with aluminium foil.	Packaging is made from drinking cardboard and does not exist out of multiple parts, e.g. a screw cap.	The entire cup is made from PS with a thin topfoil.	All components of the packaging are made from plastic. The type of plastic is not classified.	The packaging is made from plastic. The amount of packaging layers and type of plastic are not classified.	Plastic film. The type of plastic is not classified.
Can the packaging be correctly sorted into a recyclable material category?	Individual cups are too small (<50 mm) and are filtered out of the sorting process. PS is not recyclable in Europe.		The packaging is filtered out of the sorting process (<50 mm) depending on volume. PS is not recyclable in Europe.	Packaging is larger than 50 mm in two directions. Due to unknown material, no clear conclusion can be drawn.	The packaging is filtered out of the sorting process (<50 mm) due to small width.	 **

\* Sleeve refers to multiple coffee creamer cups which are connected to each other by the use of plastic tabs.

\*\* This information is based on the official website of V-Shapes. The website states that the packaging is recyclable, no additional research was performed to verify this.

 Packaging consists of material(s) that disturb the recycling process or packagings of which the format hinder the recyclability.


 Packaging is classified as easy recyclable according the KIDV measures.

Figure 31. Market analysis.

## 5.2 Brainstorm sessions

Now that there is a basic understanding of existing packaging, all gathered knowledge and insights, described in the previous chapters can be combined to start defining ideas. I started this process by hosting two online brainstorm sessions with several members of the packaging development department of FrieslandCampina (n=6,7). The material used to guide the brainstorm sessions can be found in Appendix G. The participants were asked to brainstorm about four specific design requirements; (1) sortability during a recycling process, (2) opening mechanism, (3) spillage, and (4) appearance. In between these brainstorm sessions, there was room to share and explain ideas in order to create the opportunity for participants to add things or build further onto the ideas of others. Before every brainstorm session started, background information was provided with the help of personas. To illustrate, for the category *opening mechanism*, I used the persona Henrie to visualise that elderly people struggle with opening the packaging.

### Correctly sortable portion packaging

The first brainstorm session focussed on generating design solutions for portion packaging that can be correctly sorted. The goal was to come up with solutions that increased the dimensions of the current portion packaging while maintaining the required volume of 7 millilitres. The results of the brainstorm are summarized in Figure 32 and some of those ideas are visualised in Figure 33. The ideas mainly included variations on the dimensions of the current coffee creamer packaging and variations of how multiple portions can fit into one packaging.

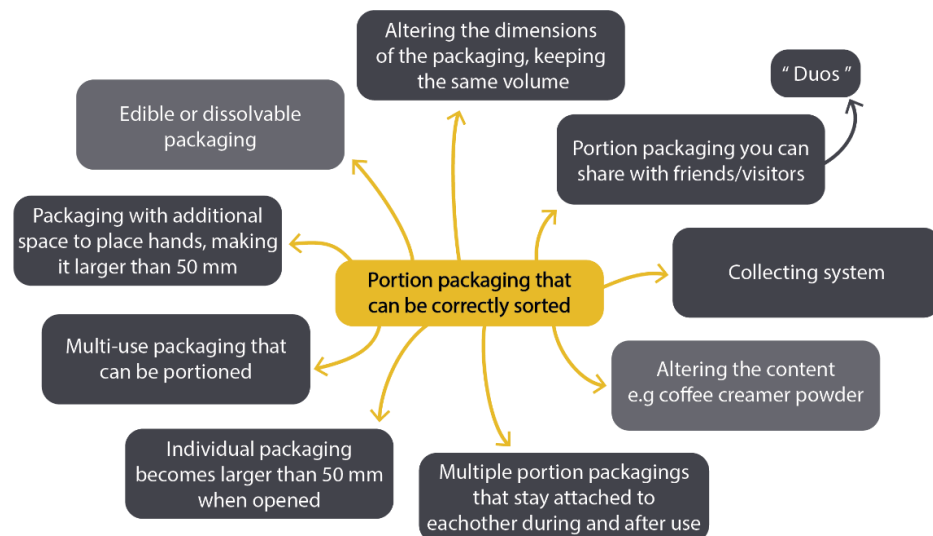


Figure 32. Brainstorm results about portion packaging that can be correctly sorted.

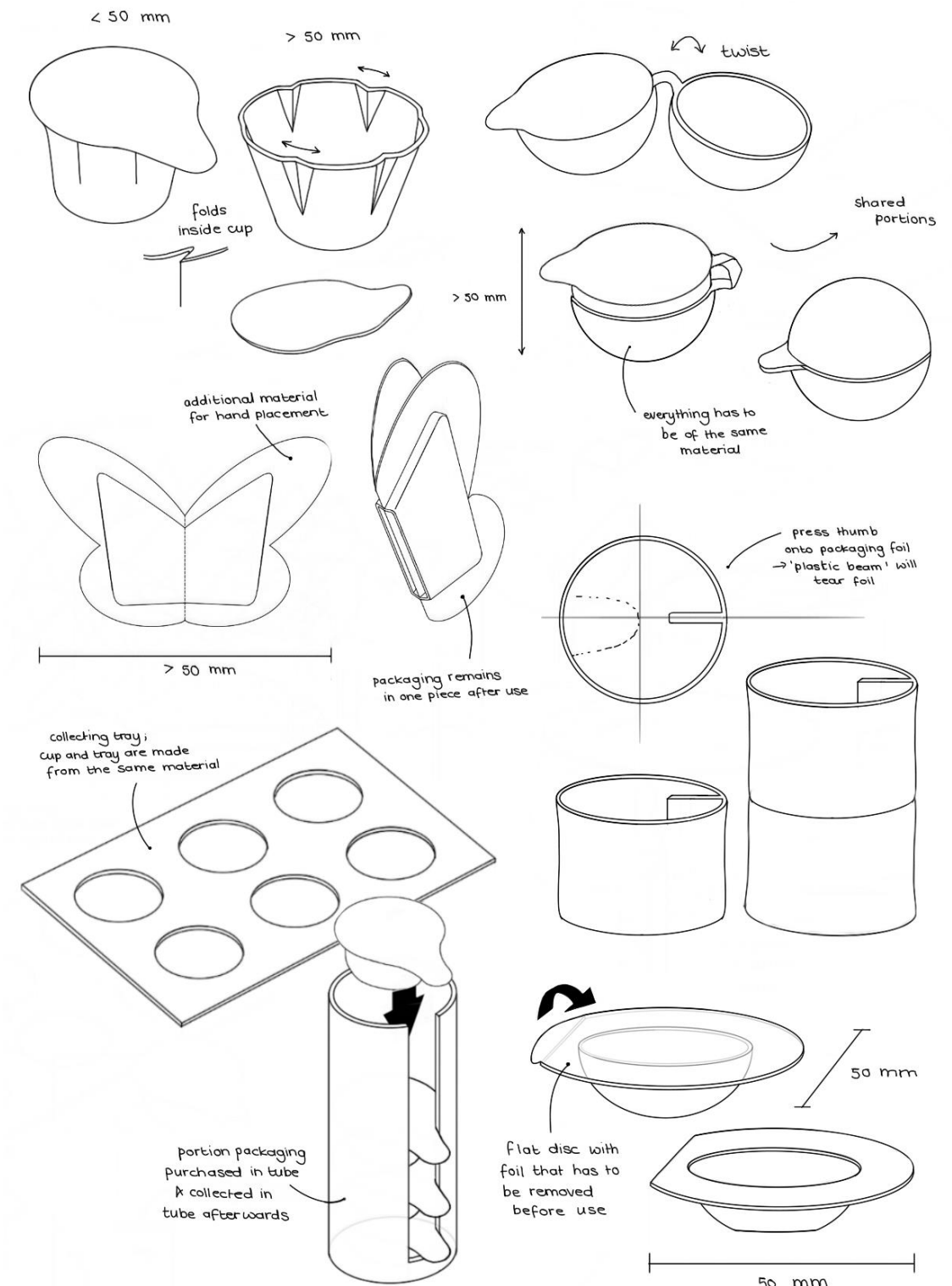


Figure 33. Sketches visualizing ideas regarding sortable packaging.



The lighter coloured boxes in Figure 32 contain ideas that were discarded in hindsight. The first discarded idea was to alter the content. If the liquid coffee creamer was replaced by coffee creamer in a powder form, it could be pressed into shapes like sugar cubes. These are easy to use and do not require opening a small packaging. The pressed coffee powder cubes can also be stored in high quantities, resulting in relatively less needed packaging material. The idea was discarded since one of the must-have requirements state that the packaging design should fit the characteristics of the coffee creamer formula currently sold by FrieslandCampina. The other idea that was neglected included dissolvable or edible packaging. Creating and manufacturing some kind of barrier that dissolves when dropped in hot beverages will discard the need for a primary packaging entirely. Similar to pressed coffee creamer powder, this concept does not require opening a primary packaging. In 2017, scientists of Germany's Martin Luther University of Halle-Wittenberg managed to create dissolvable packaging for coffee creamer portions (Nield, 2017). The packaging is not yet available on the market since it does not meet the safety and health requirements of food packaging. Other disadvantages list the taste of the barrier, not being able to dose the amount of content, and relatively short shelf life. Therefore, dissolvable packaging is discarded for this project but might prove useful to look into in the future.

### Opening mechanism

The second brainstorming session focused on increasing the ease of use of the opening mechanism. The participants could neglect the previous restrictions about recyclability and focus on generating ideas regarding the opening mechanism. A summary of the brainstorm results can be seen in Figure 34. The majority of ideas were built upon the current opening system. Enlarging the current tab or lining it up asymmetrically will aid the user when opening the packaging. Other solutions include a dispenser or a tool that users purchase once and aids in the opening process of the packaging. Graphical indicators such as colours, bending lines or texture can serve as affordances that simplify or aid the user in the opening process. Some of the ideas are visualised in Figure 35.

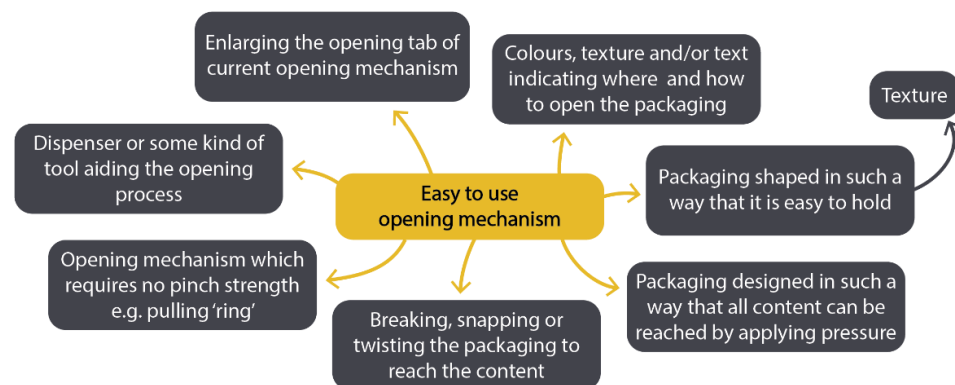


Figure 34. Brainstorm results about opening mechanisms.

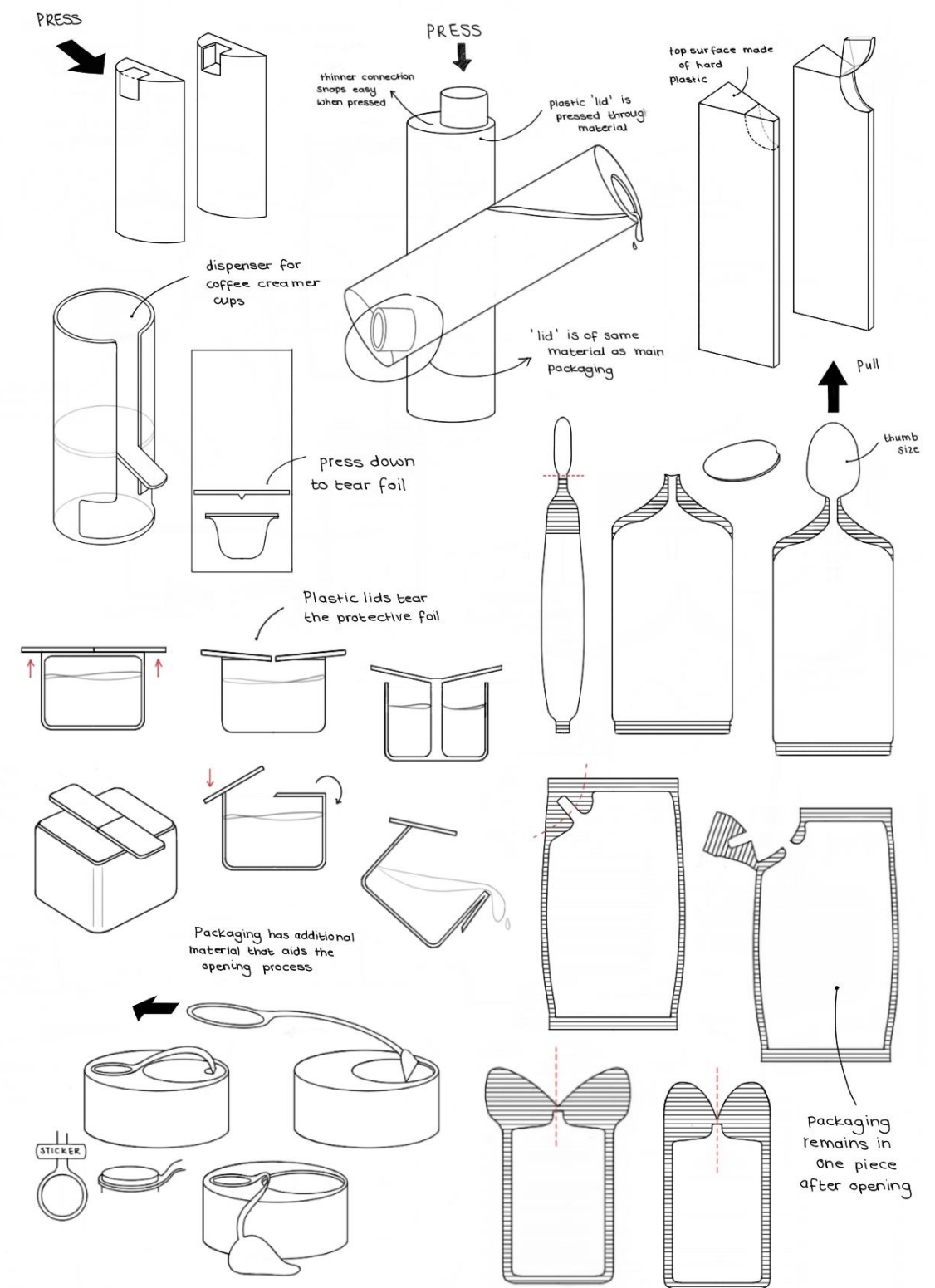


Figure 35. Sketches visualizing possible opening mechanisms.

### Prevent/limit spillage

This brainstorm session continued with finding solutions for the ease of use of the packaging, but this time specifically for preventing spillage. Ideas were discussed that addressed spillage during use, as well as after use. Reseal stickers or stiffer foil to reseal the packaging after use were named as solutions. Note that these ideas will not increase the shelf life of the product but prevent spillage during the disposing process. Design solutions regarding the spillage during use consisted of a dispenser or packaging features that help the user control the content flow. Other ideas addressed the placement of the hands when opening the cup. When pressure is applied to the main body of the packaging while opening it, the chance of spillage is higher than when no pressure is applied. Specifically designed tabs or external material the users can hold while opening the packaging can solve this problem. Packaging designs where users can decide the diameter of the opening hole themselves can also aid in preventing spillage. All ideas generated during this brainstorm session are summarized in Figure 36.

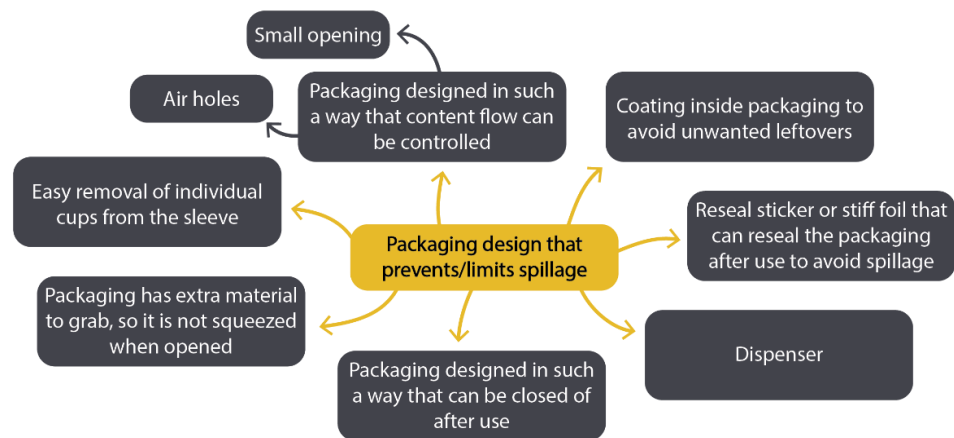


Figure 36. Brainstorm results about packaging features that prevent and/or limit spillage.

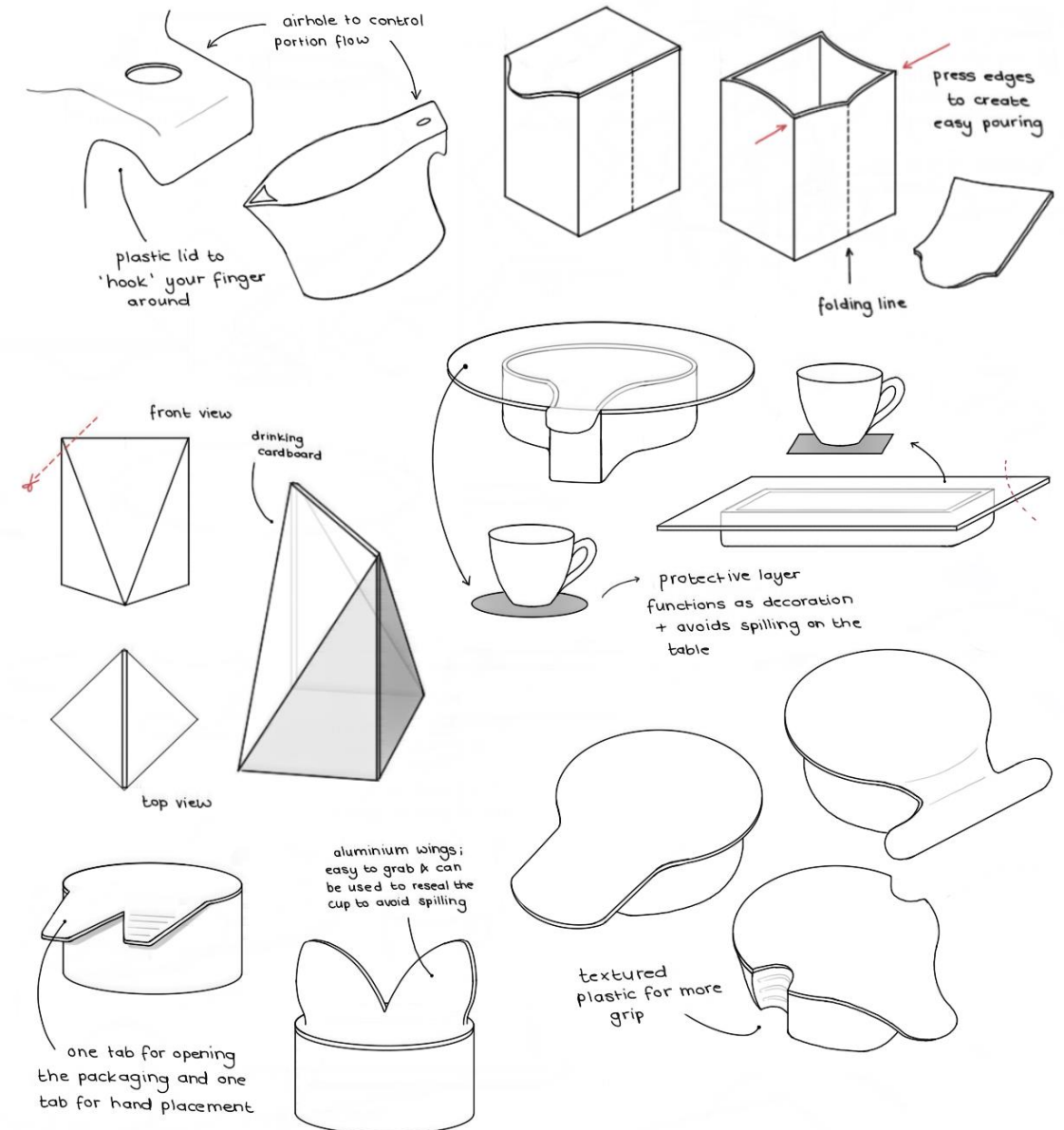


Figure 37. Sketches visualizing possible packaging features that can prevent and/or limit spillage.

### Appearance

Figure 38 shows the results of the brainstorm session that focussed on the appearance of the to-be-designed portion packaging. Similar to the previous sections, all restrictions regarding recyclability, opening mechanism and spillage could be neglected. Interesting to note is that during this brainstorm session, the secondary packaging was also addressed. Especially for retail users, the appearance of the secondary packaging is important. Ideas of this brainstorm session include a personalisable dispenser and variations on the individual packaging shape, as well as the shape multiple portion packaging make together. The participants thought of ways to create a premium feel. Ideas included shiny surfaces, indicators of the premium brand and making the packaging a collectors item.

### 5.3 Conclusion

The ideation phase resulted in a collection of ideas based on certain requirements. The market analysed provided insights into existing single-use portion packaging and different opening mechanisms. The brainstorm sessions helped with generating diverse ideas. Visualising potential ideas by means of design sketching helped with getting a feel for the feasibility of the packaging designs. In the next chapter, ideas and packaging designs are combined or altered in order to create feasible packaging concepts that meet as many requirements as possible.

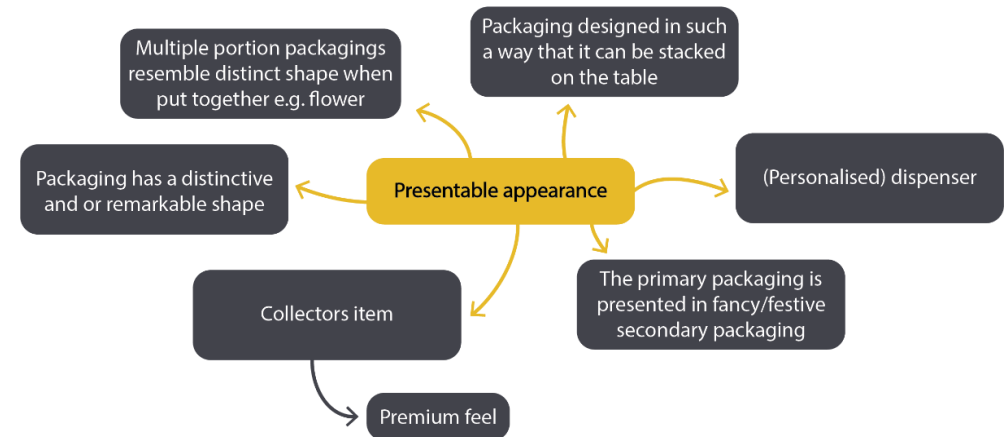


Figure 38. Brainstorm results about packaging appearance.

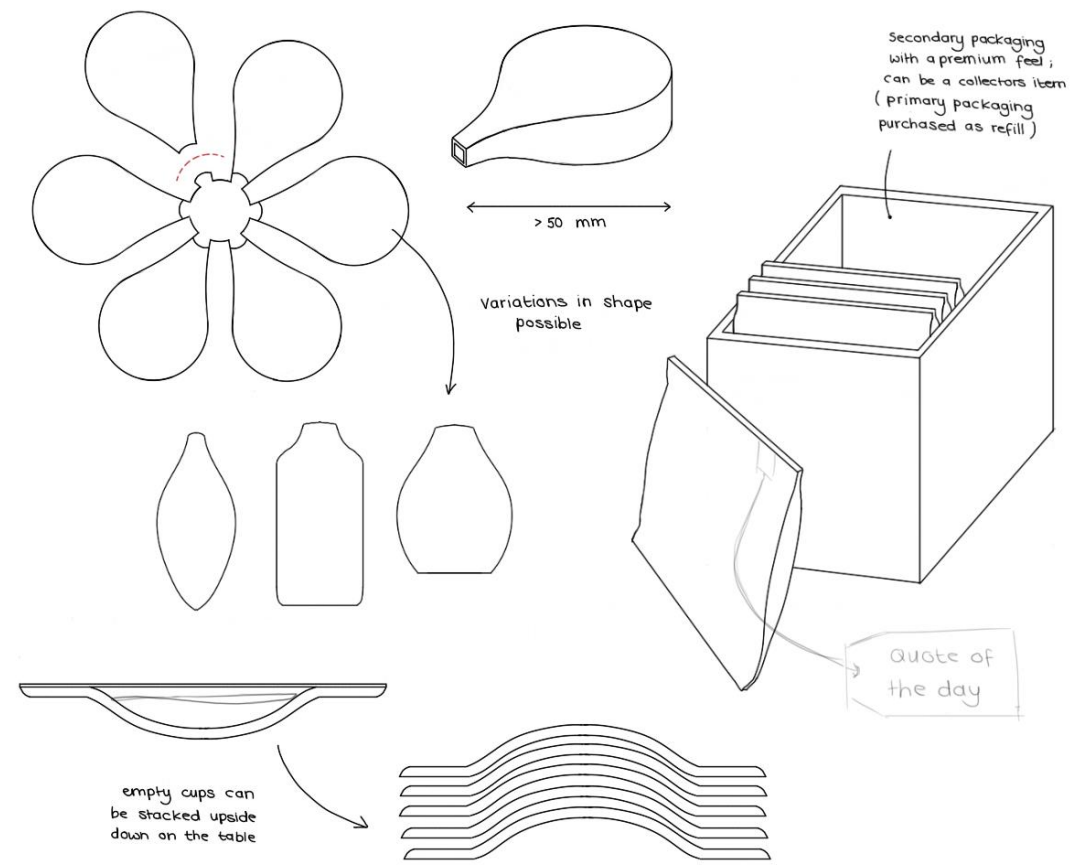


Figure 39. Sketches visualizing possible designs for the primary packaging appearance.



## Chapter 6. Conceptualization phase

In this chapter the main research question “*What type of alternative coffee creamer portion packaging concepts can be designed that are correctly sortable during the recycling process and fit the user group?*” will be answered. The generated ideas from the ideation phase were assessed based on the defined requirements. The must-have requirements had the highest priority during this process. Section 6.1 describes the selection process of five concepts and visualises the results. Next, the defined concepts are assessed based on the opinion of the marketeers of Friesche Vlag and Nutroma. The chosen concepts are then defined in more detail, which resulted in one final concept design. Chapter 7 discusses the recommendations for the next steps in the design process.

### 6.1 Defining concepts

The ideas generated during the ideation phase are assessed based on the defined requirements. First, all concepts were evaluated based on complexity. Since the packaging should be suitable for mass production, all complex designs with multiple (moving) parts were discarded. Another must-have requirement is that the packaging can be correctly sorted. The dimensions of the packaging are thus very important. A collection service for packaging that does not have the required dimensions is discarded since it requires setting up a complex service system for a large area. To comply with the should-have requirements, the packaging design should prevent spillage during and after use. Therefore, packaging made from flexible materials, such as sachets, were discarded. Flexible packaging spills easy due to the pressure that is applied to the content when holding the packaging. The ideas regarding the opening mechanism were also assessed on complexity and safety regulations. Ideas that required users to indirectly touch the coffee creamer with their hands were discarded.

Aspects of different ideas were combined to create packaging concepts that meet as many requirements as possible. The following paragraphs provide descriptions of five defined concepts. Each concept is explained and visualised by means of design sketching. A small summary is provided of the requirements the packaging concept does or does not meet. This summary also provides insights into the reasons behind defining the concept.

#### Concept 1. External opening tool

This concept consists of an external tool that aids the users in opening a simplified coffee creamer portion packaging without a built-in opening mechanism. Two worked out ideas of possible external tools are visualised on the next page in Figure 40 and 41. The figures show two marketing options; an external tool that is supplied in the same secondary packaging as the coffee creamer portions or an external tool that users have to purchase separately from the coffee creamer packaging. By making use of an external tool, the concept meets the requirement that states that the packaging should

be easy to open and helps to prevent spillage. The packaging itself can meet the sorting requirements and does not need to have a built-in opening mechanism. This can prove beneficial for the production costs and makes the packaging also very suitable for mass production. Making use of an external tool to open the packaging also means that the packaging can consist of one part and can also be disposed of as such. This makes mechanically sorting the packaging easier and increases the ease of use of the packaging since users only have to dispose of one piece of waste material. To meet the wishes of the emotion users, the external tool can be designed in such a way that it provides a premium feel and a festive atmosphere when displayed on the table during coffee moments.

Figure 40 visualises a possible design for an external tool that is supplied with every coffee creamer portion purchase. The external tool is shaped like a disc and functions as a funnel. The disc has to be pressed against the bottom of the packaging. The packaging is designed in such a way that by applying force to the disc and the packaging tabs, an opening hole in the bottom surface of the packaging is created. Simultaneously, when pressure is applied on the tabs, the material breaks slightly, creating air holes, which enables content flow. The primary packaging itself does not require a built-in opening mechanism but does require additional material where pressure can be applied during the opening process. This additional material can also create the dimensions needed for the sorting requirements. To make the packaging easier to open, additional affordances, such as texture or colour can be applied to the packaging surface.

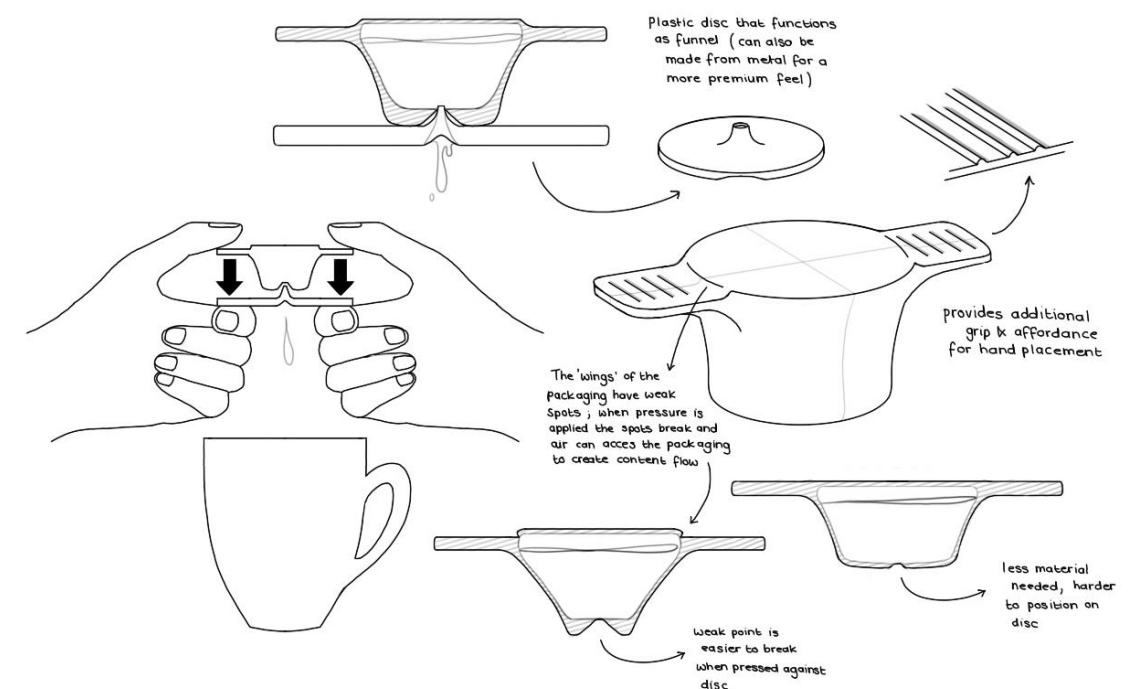


Figure 40. Concept 1: External tool that is supplied with the users purchase.



Figure 41 visualises a possible design for an external tool that users have to purchase separately. This concept is more cost-intensive in the short run but has a longer product life. The design of the concept is based on an existing tool designed for cracking walnuts. The tool is used to open the packaging by perforating it on two sides, letting air in to enable content flow. This tool is easier to handle than the first concept due to the size of the handles. The packaging does not require a built-in opening mechanism and does not need space for hand placement. To meet the dimension requirements, the primary packaging has to be shaped like a flat cylinder. This can, in turn, prove beneficial for transport and stackability.

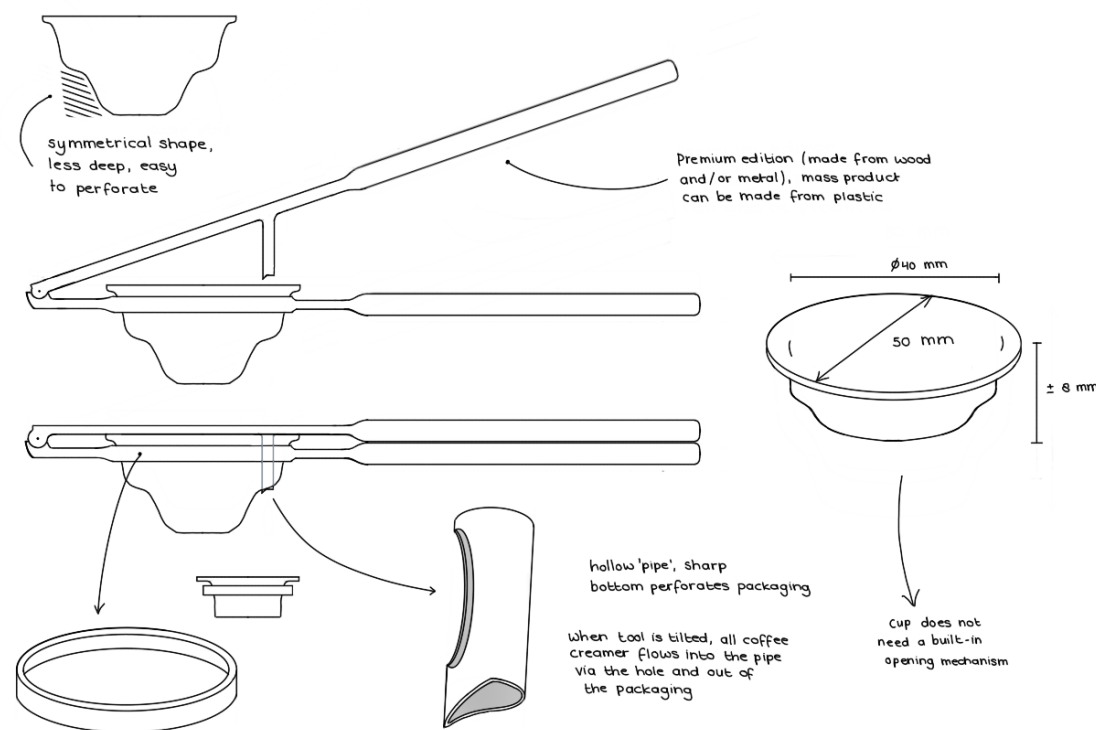


Figure 41. Concept 1: External tool that users must purchase separately.

A disadvantage of both types of external tools is that a new production line has to be created for the primary packaging as well as the external tool. This can prove to be quite cost-intensive and can translate to a higher cost price of the coffee creamer portions. Other disadvantages of the use of an external tool include user freedom and safety regulations. Since the packaging can only be opened by an external tool, it limits the freedom of the users to use it anywhere at any time. This concept might prove difficult to implement for the OOH category. The tool is an additional factor that can get lost and needs to be cleaned after use. Users are also forced to use all the supplied content since dosing it is not possible with the suggested concept designs. In terms of safety regulations, the use of an external tool is also not optimal. The tool makes direct

contact with the coffee creamer and enables users to indirectly touch the coffee creamer. The tool also features sharp edges to perforate the packaging. These can potentially harm the users when used incorrectly.

## Concept 2. Dispenser

The second concept is an automated dispenser. A possible design of a coffee creamer dispenser can be seen in Figure 42 on the next page. The dispenser stores a primary packaging that contains multiple servings. Once empty, a refill packaging can be purchased at a retailer to replace the empty packaging. The dispenser is designed in such a way that it only works with the packaging designed and manufactured by Nutroma and Friesche Vlag. The implementation of packaging inside the dispenser, instead of a built-in compartment for coffee creamer, is more hygienic and requires less maintenance. By making use of an automated dispenser, several pain points are eliminated. Spillage before and after use, as well as unwanted leftovers, are prevented due to the automated process. In addition to that, the single-use aspect of the packaging is converted to a multiple-use packaging, solving the pain point of relatively much waste material per serving. The larger dimensions make sorting the post-consumer packaging and opening the packaging easier. A dispenser is also a solution for dosing the content in a satisfactory way without unwanted leftovers or spillage.

The dispenser and corresponding coffee creamer packaging can be produced in many different sizes. A small-scaled dispenser can be used at home. Primary and secondary retail users, as well as secondary OOH users, have to purchase a dispenser. The dispenser can be placed on the table and function as decoration to elevate the coffee drinking experience. Having a dispenser with a premium feel can function as a showpiece and can indicate that the provided coffee creamer is of high quality. A larger dispenser, which can contain more coffee creamer, can be more suitable for out of home use, depending on the amount of coffee creamer sold. With the use of a dispenser, several new requirements need to be added to the design. The primary packaging has to be designed in such a way that the remaining coffee creamer is sealed airtight and meets the safety and hygiene requirements. In addition to that, the packaging should be able to conserve the coffee creamer outside of the refrigerator and provide relatively long shelf life for the content.

Disadvantages of a dispenser are the extra costs and limited user freedom. Similar to the previous concept, the use of a dispenser limits the users from enjoying coffee creamer at any time and location. Users also have to install, refill and clean the machine themselves, which might not prove suitable for the relative older main user group. Users also need to have available space in their kitchen to place this machine. For infrequent coffee creamer users, the purchase of a relatively expensive dispenser might be too high of a threshold.

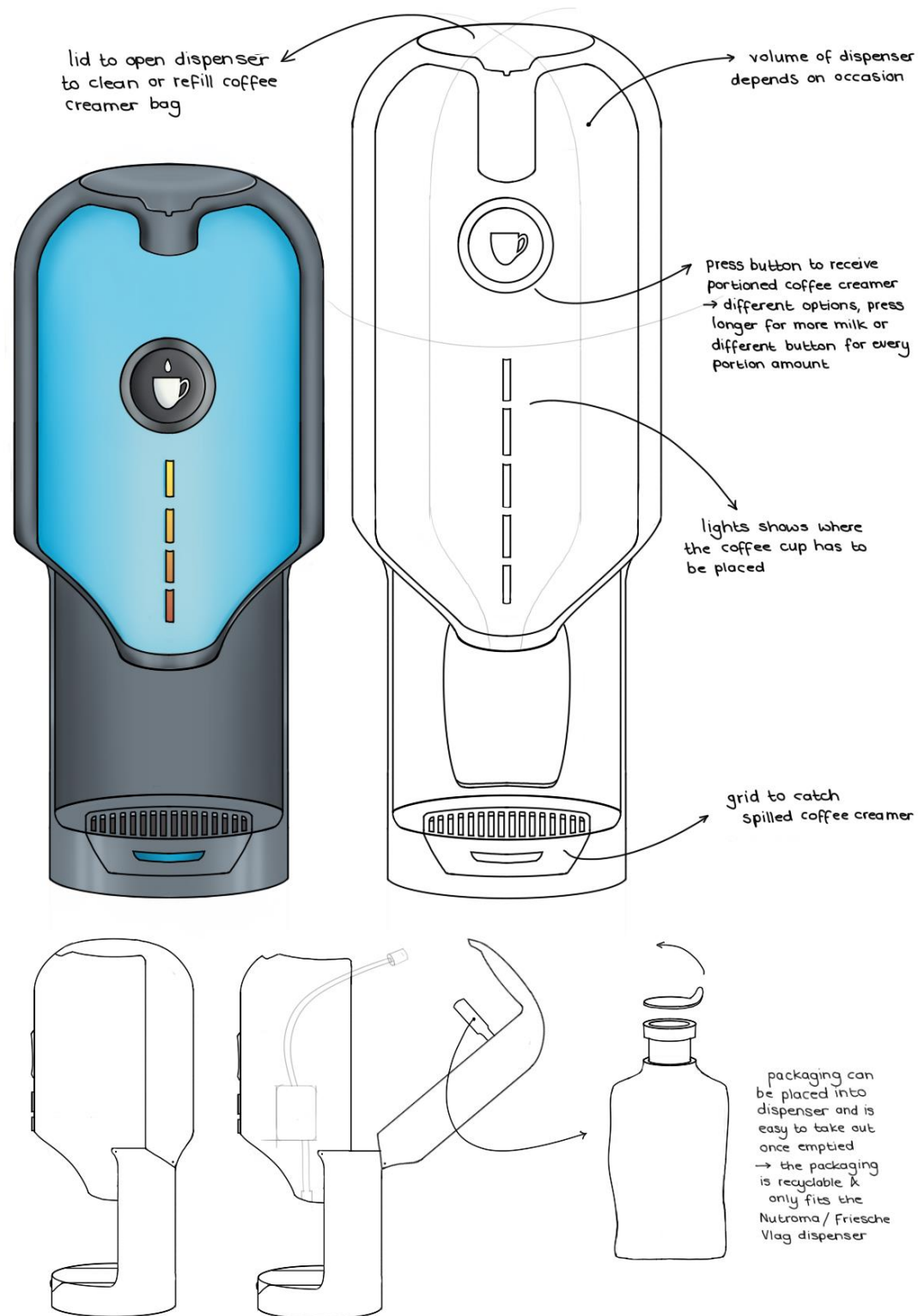


Figure 42. Concept 2: Automated dispenser.

### Concept 3. Flower-shaped plastic portion packaging

Figure 43 shows the third recyclable packaging concept. This concept is based on an idea generated during the brainstorming regarding the appearance of the packaging. The concept resembles a flower to indicate the sustainable background of the coffee creamer. The packaging consists of two different parts; the middle part and multiple portions. In order for all parts to be correctly sortable, they have to be larger than 50 millimetres in two dimensions. The individual portions are made from a relatively flexible material and can be emptied by means of applying pressure. The middle part connects all portions together and simultaneously works as the opening mechanism. To open one of the portions, users have to hold the middle part with one hand, while they snap off a portion packaging with the other hand. Most of the pressure during this process can be applied to the middle part to avoid spillage. The opening mechanism is based on the sleeve of the current portion packaging. The small user research described in chapter 3, indicated that participants encountered no difficulties while removing one portion packaging from the sleeve. Once the portion packaging is snapped off, an opening gap is created to pour the coffee creamer out of the packaging. The design contains two tubes; one for air to flow in and one for coffee creamer to flow out. The user can dosage the content by pressing the preferred amount of times. When all packages are used, the middle part can be disposed of.

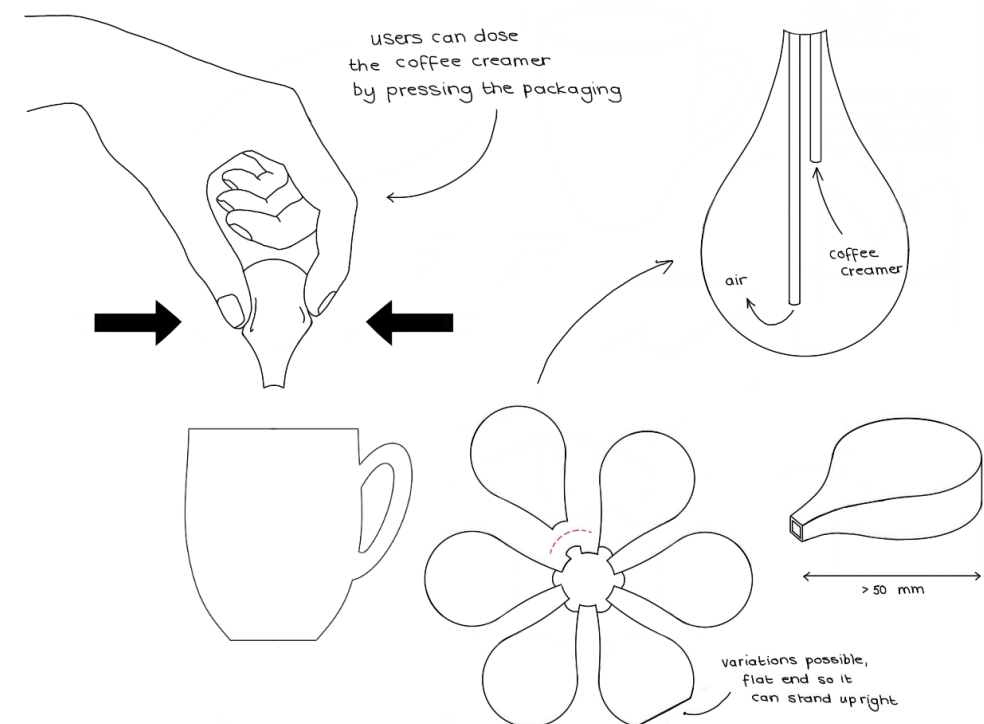


Figure 43. Concept 3: Flower-shaped plastic portion packaging.

Since the packaging consists of multiple portions, it might not be suitable for all OOH occasions. This design might work in certain OOH occasions where the packaging can be displayed on the table or service area, but this takes up relatively much space. Another disadvantage of this packaging is the pressure needed to empty the packaging. This might prove troublesome for the main user group since it requires some strength in fingers and can affect the texture of the content. The coffee creamer has to be squeezed out of a relatively small gap which can cause the coffee creamer to foam.

#### Concept 4. One-piece plastic portion packaging

This concept is a solution for correctly sortable packaging which is easy to open and dispose of. The packaging consists of one part and remains in one part after use. The concept is visualised in Figure 44 and shows a similar appearance as the current coffee creamer portion packaging sold by Nutroma and Friesche Vlag. This can provide easy product identification. The tab is elongated to provide more space for hand placement and act as a lever during the opening process. When pressure is applied in an upwards motion, the tab snaps open and creates a gap for the coffee creamer to flow out of. The tab can be folded over due to a built-in hinge. When folded over, the tab shows ribs which function as an affordance to place your thumb or finger of preference on top of the packaging. This creates an easy pouring experience. After use, the tab stays attached to the main body due to a built-in hinge. This concept can be used in both retail and OOH occasions as well as on-the-go.

The packaging concept provides space for seven millilitres of coffee creamer but uses additional material to improve the ease of use of the packaging. This additional material is not needed to ensure that the packaging can be correctly sorted. This additional material might also be perceived as unsustainable. Another disadvantage addresses the intuitive use of the opening mechanism. When the opening mechanism resembles a frequently experienced action, users need less time to figure out how it works. Since this opening mechanism does not resemble the current coffee creamer portion packaging, users might need more time or instructions when they first encounter this packaging design.

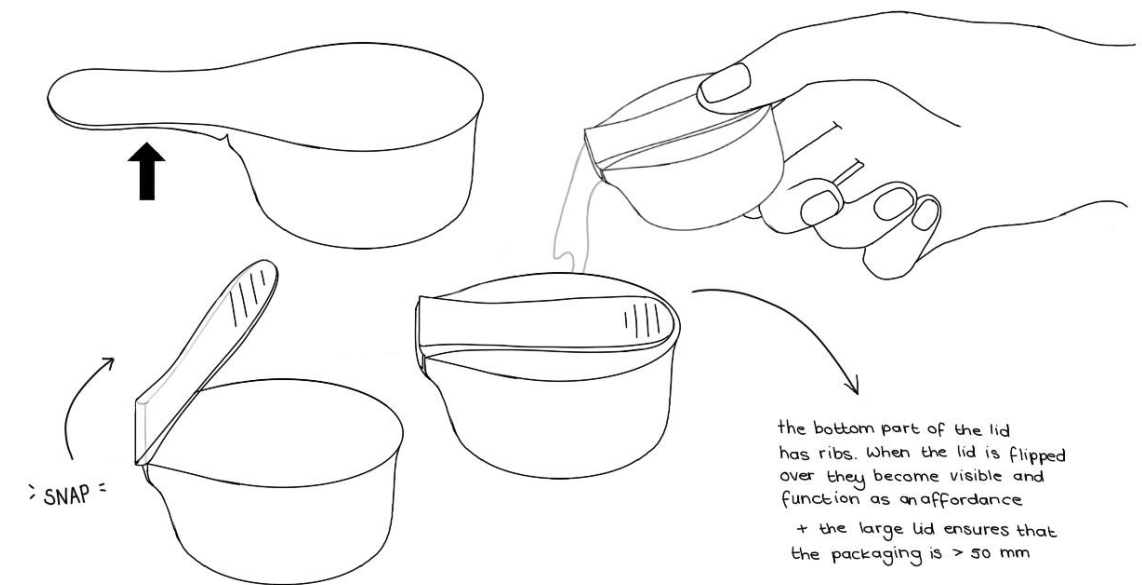


Figure 44. Concept 4: One-piece plastic portion packaging.

#### Concept 5. Portion packaging made from drinking cardboard

The last concept is based on the existing coffee creamer portion packaging of Arla (Arla, n.d.). This packaging is made from drinking cardboard which is a valuable recyclable material. It can preserve coffee creamer at room temperature. The packaging is also immediately perceived as sustainable since the material is well-known for its recyclability. Figure 45 and 46 show two possibilities for this concept: Packaging with a built-in opening mechanism and packaging without one. If a built-in opening mechanism is desired, only a few options are possible due to the material characteristics. For example, tearing, snapping or breaking drinking cardboard is not possible. The portion packaging can make use of existing opening mechanisms, such as a screw cap or a hinge cap. These opening mechanisms are usually sealed airtight with aluminium foil which has to be removed before use. Making smart use of the portion aspect of the packaging, the hinge cap can perforate the foil by being pressed into the packaging, essentially destroying the cap. Since it is a single-use packaging, it does not need to function multiple times. A screw cap can rip open the aluminium foil when it is screwed off. The built-in opening mechanism can also consist of a seal foil that has to be peeled off the packaging (Tetra Pak, n.d.). When the foil is removed, it reveals a pre-cut opening hole.

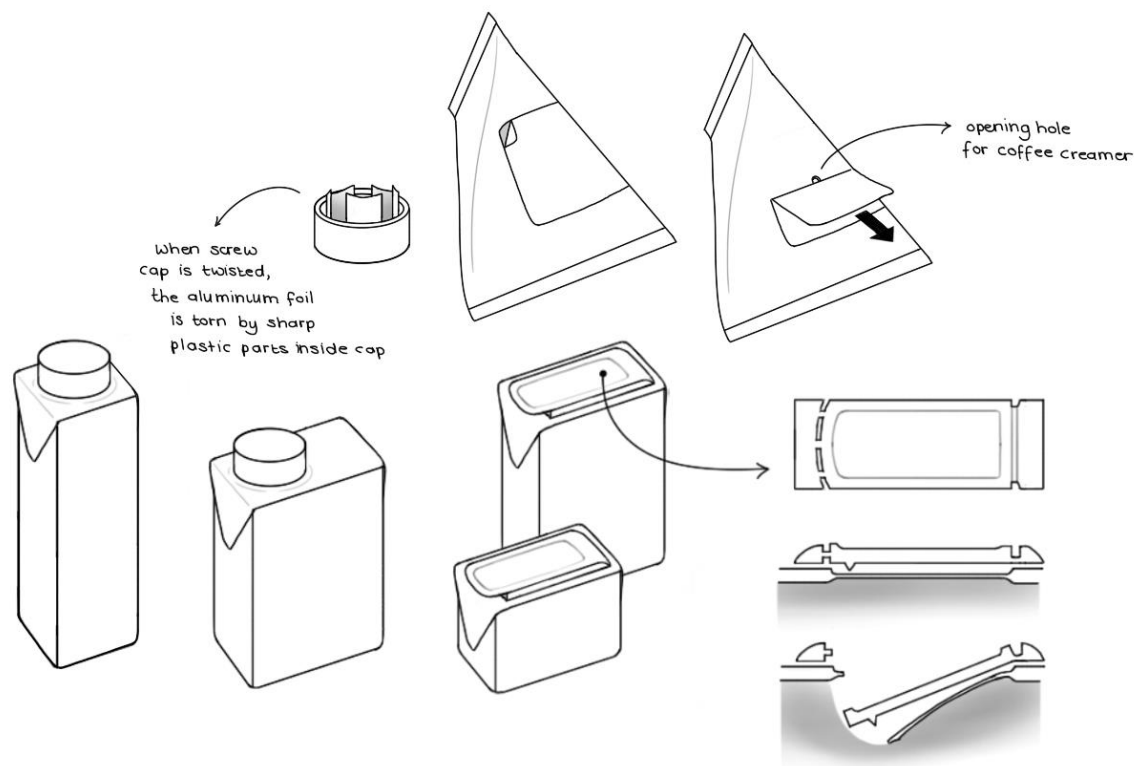


Figure 45. Concept 5: Drinking cardboard packaging with built-in opening mechanism.

Figure 46 shows possible designs of drinking cardboard portion packaging without a built-in opening mechanism. They can be opened with a sharp object such as scissors. An advantage of drinking cardboard packaging without a built-in opening mechanism is the lower cost price and the possibility to choose the size of the opening hole and thus the speed of the content flow. A disadvantage is that it limits the freedom of the user since an external tool is necessary. For retail users, scissors are a common household item and thus not an additional purchase. For primary OOH users, especially the ones using the coffee creamer portion packaging on-the-go, the use of scissors proves to be a limiting factor. Similar to the first concept which consists of an external tool, the use of scissors might not meet the safety regulations. Another disadvantage of this concept is the possible separate part that has been cut off. This part cannot be correctly sorted anymore due to the small size.

The biggest drawbacks of packaging made from drinking cardboard are the shape and format size limitations. The current production techniques only allow the packaging to be squared, envelope or triangle shaped. The production techniques also do not allow the packaging to be smaller than 20 millilitres, almost three times the required volume (Tetra Pak, n.d.).

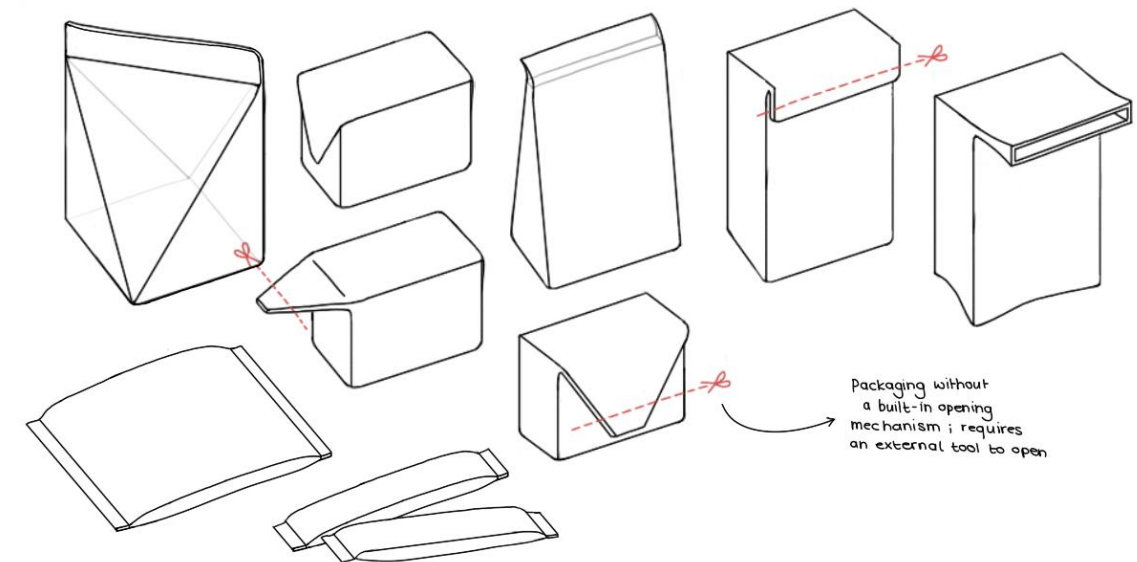


Figure 46. Concept 5: Drinking cardboard packaging without built-in opening mechanism.

## 6.2 Assessing the concepts

The next step in the process was to verify with the marketers of the brands Nutroma and Friesche Vlag if they saw potential in the defined concepts. During an online meeting, I presented the five concepts with their corresponding pros and cons and explained why certain choices were made. The presentation material can be seen in Appendix H. After explaining the concepts, I left room for the marketers to explain their opinion regarding feasibility and how well the concepts could (potentially) match with their brand portfolios.

The marketer of Friesche Vlag saw the most potential in the third and fourth concept since these concepts stay close to the current packaging. The concept with the elongated tab fits the current portfolio of the brand the best and meets the expectations of the users. The concept has a similar appearance as the current coffee creamer portion packaging and corresponds with the more conservative target group. The use of an external tool was deemed too complex in use due to an additional component. Hygiene and storage space were also factors that influenced this decision. The purchase of a dispenser was deemed to be too high of a threshold for coffee creamer users. In addition to that, research showed that users already struggle with counter space due to an increasing amount of kitchen appliances, such as a coffee machine, blender or toaster (Wadhvani & Saha, 2016). This threshold is lower for OOH use. However, since Friesche Vlag has the most users in the retail category they saw less potential in this concept. The portion packaging made from drinking cardboard was also discarded, due to the necessary increase in portion size. The brand offers a



variety of coffee creamer format sizes, the smallest being 7 millilitres followed by a packaging containing 140 millilitres. Friesche Vlag saw no potential in adding a format size in between those two.

The marketer of Nutroma also saw the most potential in the plastic portion packagings as well as the drinking cardboard concept, especially the one with a built-in opening mechanism. Friesche Vlag discarded the drinking cardboard concept due to the increasing size. For Nutroma, this is less of an issue. Nutroma saw much potential for this packaging to work and thus asked me to explore the possibilities regarding format size. Additional feedback included the shape of the packaging. The preference goes out to the portion packaging with more structure. The little envelope shaped packaging from the concept drawings looked too cheap and not premium enough. The concept where an external tool has to be implemented was discarded with similar reasoning as Friesche Vlag. Nutroma also saw no potential in the dispenser concept. Designing and the production of such a machine takes too much time and the demand for coffee creamer is too low for this concept to work. Nutroma sells the most coffee creamer portions in the OOH category. In OOH occasions, coffee creamer portions are offered more as a service than a necessity. Thus, portion packaging for both OOH and retail categories is the best solution.

### 6.3 Detailing the chosen concepts

In this section, the chosen concepts are worked out in more detail regarding usability and feasibility. The concepts made from plastic are first modelled in SolidWorks, a computer-aided design (CAD) modelling software. This software allowed me to define realistic dimensions for the packaging by calculating the intended volume. Note that the individual packages are designed to contain 7 millilitres of coffee creamer with a margin of  $3 \cdot 10^3$  cubic millimetres for air. In order to figure out the realistic dimensions for the drinking cardboard packaging, I performed some literature research regarding the possible content volumes and talked to representatives of Tetra Pak, a big drinking cardboard manufacturer. Once the dimensions are defined, mock-ups of the concepts were made to create a feel for the usability and feasibility of the packaging.

#### 6.3.1 Flower-shaped plastic portion packaging

The first step of defining the concept consisted of determining the dimensions required to contain 7 millilitres of coffee creamer and be correctly sortable. Making all parts larger than 50 millimetres in two directions resulted in the packaging being 8 millimetres thick. These dimensions allowed the middle part to have space for six portions, see Figure 47. The current sleeve of coffee creamer cups is sold with ten portion packages. The secondary packaging can be a cylinder-shaped cardboard box with enough room for two flower packages to fit, resulting in a total of twelve portions.

Based on the defined dimensions, the opening hole of the portions was defined to be a rectangle of 4.25 by 11.0 millimetres with a wall thickness of 1 millimetre. With these dimensions in mind, I performed some tests with the current coffee creamer cups of Friesche Vlag. I cut various sized and shaped holes into the top layer of different packaging. By analysing the speed of the content flow and the leftovers after pouring, I noticed several things. An additional hole for airflow, as initially designed for the concept, is not necessary due to the small amount of content. However, airflow cannot be completely neglected. The packages with the larger holes were significantly easier to empty since air could get into the packaging. During the tests, I noticed that rectangular opening holes work better than round holes. The rectangular holes left room for air to flow into the packaging while pouring the content, while the round holes were almost completely blocked by the content. Another result of the test included insights into the placement of the opening hole. Packaging with holes close to the side showed easy content flow, while packages with holes in the middle were harder to empty since shaking motions were required. In conclusion, packaging with a rectangular hole of 4.25 by 11.0 millimetres showed easy content flow when slightly angled. There was no need for additional pressure to get the content out of the packaging. Further research with realistic mock-ups has to take place in order to verify these findings, but for now, the conclusion can be drawn that the concept does not require pressure to be emptied.



Figure 47. Flower-shaped portion packaging with realistic dimensions.

Another small-scale test was performed to analyse if the defined dimensions allow the packaging to be correctly sorted. Mock-ups were created with 3D printing. The original plan was to analyse if these mock-ups could be correctly sorted by a sieve drum of an actual waste sorting facility in the Netherlands. This waste sorting facility worked with a sieve drum with holes of 40 millimetres. Therefore, the dimensions of the mock-ups were scaled-down to 80 per cent of its original size. However, this plan could not be finalized due to the limited time frame and COVID-19 regulations. Therefore, a small-scale test was performed instead. A cardboard box with cut-out holes of 40 millimetres was used to resemble a sieve drum, for pictures see Appendix I. Seven mock-ups of the portion packages and one mock-up of the middle part were put into this box before the opening was closed off. Next, the box with the holes was manually turned around for two minutes to see if the mock-ups would fall through the holes. This was not the case for the individual portion packages, but the middle part did fall through. This can be caused by the fillets of the middle part, making the part slightly smaller than 40 millimetres or the distortion of the holes due to the flexible cardboard material that resembled the sieve drum.

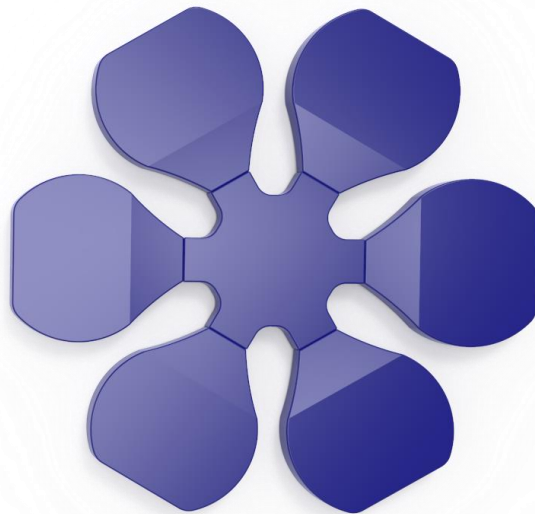


Figure 48. Top view of flower-shaped portion packaging.

The mock-ups also helped with getting a feel for the feasibility and ease of use of the packaging. Holding it and acting out how users should open the packaging made me realize that the orientation of the packaging during the opening process is important. Since the portions are detached from the middle part by making upward and downward motions, see Figures 48 and 49, it can not lay down on a flat surface. Users have to hold the packaging in the air in a certain orientation to remove one portion with the opening hole right side up. Users might not expect the portion packaging to be open immediately after it is removed from the middle part. Thus, the opening system involves a lot of steps and might even increase the chance of spillage.

The results of the small experiments lead to the decision to discard the middle part. The middle part was originally designed to attach multiple portions, function as an opening mechanism, and provide space for hand placement to prevent spillage. Since the defined opening of the packaging is large enough to pour the content without having to press it, additional space for hand placement is not required anymore to prevent spillage. The middle part required ribs to strengthen the structure so it could withstand the pressure of breaking off a portion packaging. These ribs result in even more material that does not contribute to conserving the content. The middle part not passing the sorting tests, suggests that the dimensions need to be increased even more. All these factors resulted in the decision to discard the middle part of the concept, leaving only the individual portion packaging that is not attached to one another. The flower appearance can still be created by placing the primary packaging inside the secondary packaging in a flower-like pattern.

Figure 49. Testing the usability of the mock-up.



The dimensions of the portion packages do not need to change, but a new opening system has to be thought of. In order to meet the should-have requirements of easy disposal, the packaging should consist of less than 3 separate pieces. It is therefore desired that the packaging consists of one piece. This can be achieved by making use of a built-in hinge system, see Figure 50. Users can open the packaging with one hand by pressing their thumb against the tab. Due to a built-in weak spot, the tab snaps open to create and creates an opening for the coffee creamer. The feasibility of this packaging is further discussed in section 6.4.

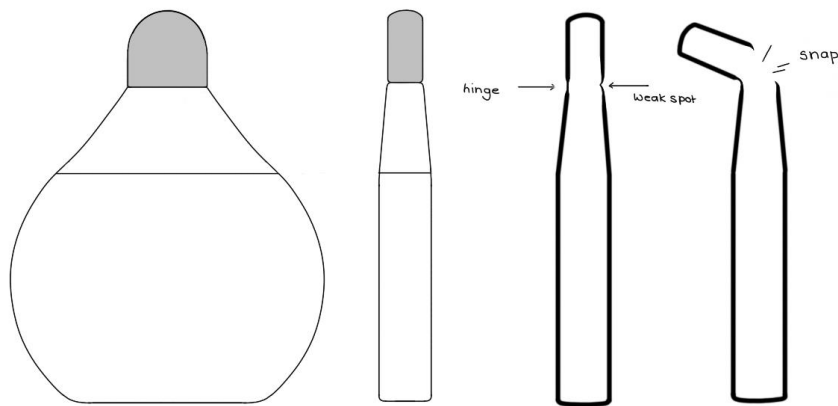


Figure 50. Altered concept design.

### 6.3.2 One-piece plastic portion packaging

Similar to the detailing process of the previous concept, the dimensions were first defined with the help of SolidWorks. The results can be seen in Figure 51. The packaging has a flat appearance in comparison to the original concept drawings. A schematic overview of the opening system can be seen in Figure 52. The figure clearly shows that the packaging consists of one part. Users have to apply pressure in an upwards motion in order for the built-in weak spot to snap. Due to the built-in hinge in the top surface of the packaging, the tab can be folded over to ensure an optimal pouring experience.

In order to test if the packaging will be filtered out of the sorting process and get a feel for the usability of this product, the SolidWorks model was used to make mock-ups with a 3D printer. The used 3D printer operates a technique that involves the solidification of photo-sensitive resin by means of a UV light. This technique does not allow big hollow spaces since it traps the resin. To solve this problem, the top surface of the SolidWorks model was removed to get rid of the hollow area, see Figure 53. This made me realize that manufacturing the real product would be very hard and expensive. Since the packaging design has to be suitable for mass production and have a similar price/quality ratio as the current packaging, the concept was altered.



Figure 51. One-piece plastic portion packaging with realistic dimensions.



Figure 52. Schematic overview of the opening mechanism.



The new concept looks similar to the mock-up. It consists of a cup and a foil that seals the packaging. Since the old opening technique that featured a hinge will not work with a thin seal, a new opening mechanism has to be implemented. Chapter 3 discussed the user experience regarding opening the current coffee creamer portion packaging. The results included that the packaging dimensions were too small, but no problems were encountered with the actual opening method. Enlarging the current opening mechanism will thus increase the user experience of the packaging and meet the corresponding should-have requirement. A disadvantage of this new concept is that the coffee creamer will travel down the tab when the user tilts the packaging. Possible design solutions can be seen in Figure 54. The elongated tab can be used to hold the packaging while the content is poured into a coffee, similar to the workings of a spoon. Another possibility is altering the packaging design to change the direction of the content when pouring. These solutions are both side dependent. When users are left-handed, the design of the spout has to be in the opposite direction as when someone is right-handed. Therefore, these design possibilities were discarded.

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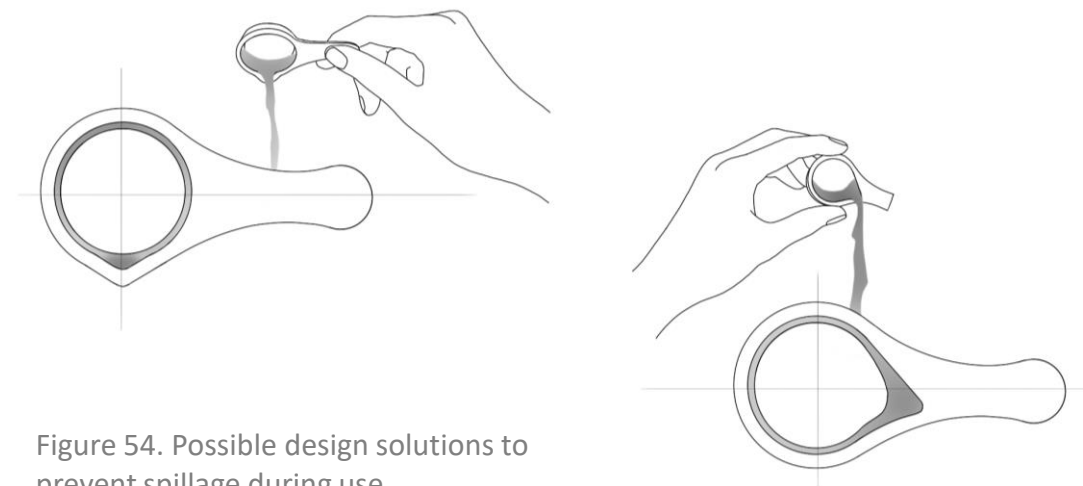


Figure 54. Possible design solutions to prevent spillage during use.

By holding the mock-ups and acting out the new opening method, I realized that the elongated tab could bend easily due to the relatively small thickness and lack of support. Due to the flexibility of the elongated tab, applying force will result in bending of the material instead of snapping. This can be solved by decreasing the length of the tab. This will also solve the problem of coffee creamer travelling down the tab and requires less material. Figure 55 shows sketches of the new concept design. The current coffee creamer cup is visualized as a reference for the size. The dimensions of the tab are clearly larger and thus easier to hold. The feasibility of this packaging is further discussed in section 6.4.



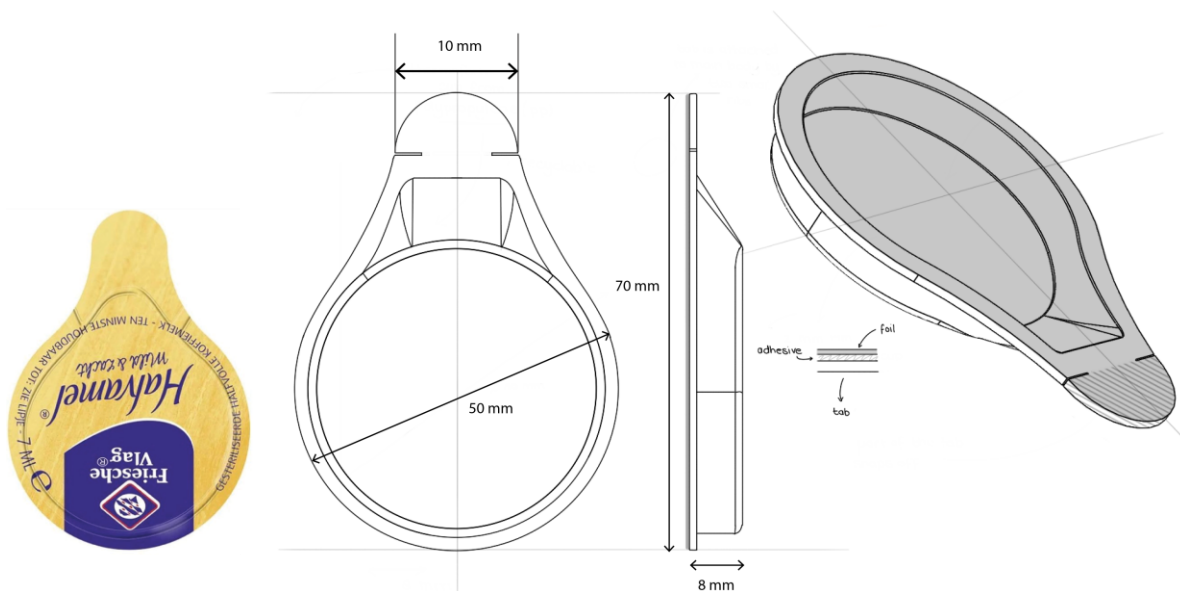


Figure 55. Sketch altered concept design.

### 6.3.3 Portion packaging made from drinking cardboard

Packaging made from drinking cardboard has size and format limitations due to the material characteristics and available production techniques. Additional research was performed to analyse possible format sizes that are feasible to manufacture. The official websites of three big drinking cardboard manufacturers were consulted. The website of Tetra Pak states that the smallest food packaging they manufacture is part of the Tetra Classic® Aseptic range and can contain 65 millilitres (Tetrapak, n.d.). The other drinking cardboard manufacturers, SIG and EloPak start their product range with even larger volumes (SIG, n.d.; EloPak, n.d.). The coffee milk portion packaging of Arla contains 20 millilitres and is manufactured by Tetra Pak, specifically the Tetra Classic® Aseptic line (Arla, n.d.; Tetrapak, n.d.). This shows that packaging smaller than 65 millilitres is possible. In order to figure out if packaging made from drinking cardboard can be manufactured to contain 7 millilitres, I scheduled a meeting with Tetra Pak (Tetra Pak, n.d.).

Before talking to representatives of Tetra Pak, I first tried to define the dimensions needed in order for the packaging to contain 7 millilitres by making mock-ups. I utilized packaging made from drinking cardboard with an original content volume of 65 millilitres. I cut open the packaging and refilled it with 7 millilitres of water. Then, I reclosed the packaging and left some room for air. This experiment is in no way exact but provided me with insights about the dimensions of a cardboard packaging containing 7 millilitres of coffee creamer. The results can be seen in Figure 56. The mock-up of the packaging turned out to be 60 by 60 by 2 mm. With these dimensions in mind, I talked to the key accountant manager and the marketing manager diary of Tetra Pak. They explained that current production techniques do not allow the

packaging volume to be smaller than 20 millilitres. However, they are planning a new production line to create triangle-shaped packaging with a volume of 15 millilitres which can be underfilled to 12 millilitres. This is still two times the required content volume. Tetra Pak plans to have these kinds of packaging on the market by 2023. The new packaging will also feature a built-in opening mechanism consisting of a paper-based pull tab. This tab has to be peeled off the side of the packaging, creating a predefined opening hole. The paper-based opening seal and the material of the packaging itself are classified as easy recyclable. In conclusion, portion packaging made from drinking cardboard can contain a minimum of 12 millilitres. This does not meet the volume requirements. Research into the desired amount of coffee creamer portions has to take place before this type of packaging can be considered. For now, this packaging concept is discarded.



Figure 56. Mock-up of portion packaging made from drinking cardboard.

## 6.4 Material and production technique

The next step in the process was to verify with an expert if the new detailed concepts were feasible regarding material and production technique. I scheduled an online meeting with a development specialist of FrieslandCampina. During this meeting, I showed the SolidWorks files of both concepts and asked him the possibilities regarding manufacture processes. He suggested using polypropylene (PP) for both concepts. From chapter 4, we know that this material is classified as easy recyclable. A characteristic of PP is that it does not break when repeatedly bent (Creative Mechanisms, 2016). In other words, the material does not snap or break easily. This means that a built-in opening mechanism that has to snap open under pressure is not feasible. Thus, the opening mechanism of the flower-shaped portion packaging has to be adapted. The development specialist suggested changing the opening location, see Figure 57. In this way, the packaging has more surface area that prevents it from falling over when placed on a flat surface. It also ensures enough space to attach a PP seal foil to the packaging. The main body itself can be made by thermoforming. These materials and production techniques are feasible and classified as easy recyclable.

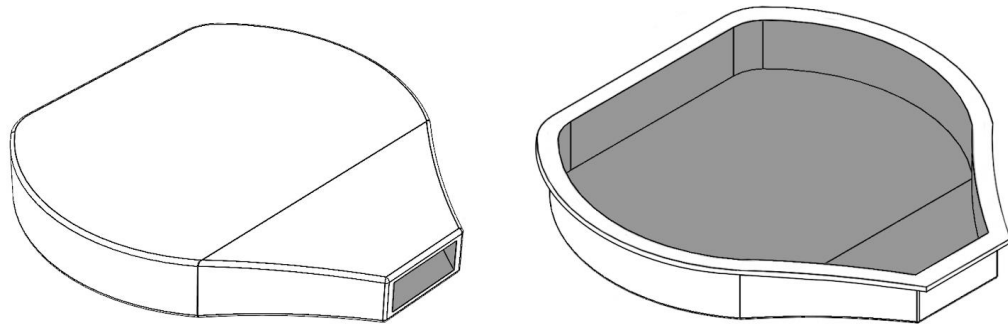


Figure 57. Alterations regarding the opening hole.

The other concept can be manufactured in a similar way. The existing recyclable cheese packaging FrieslandCampina developed can serve as a proof of concept. This packaging is also made from PP and sealed with a PP seal foil. Since PP does not break easily, snapping of part of the tab might not work. This feature can be removed, but this results in the opening mechanism just being a thin foil. This might even decrease the ease of use of the packaging. Therefore, the development specialist suggested leaving the design as is and adding a step in the production process where the tab is almost cut through except for two small spots. Research has to be conducted regarding the size and width of these small spots needed in order to snap easily.

All alterations necessary to make the concepts feasible resulted in a really similar appearance and opening method. Both concepts can be manufactured by

thermoforming the main body and sealing it off with a seal foil. Both concepts are almost identical apart from the shape. A tab that has to be snapped off can be added to the flower-shaped portion packaging concept to increase the ease of use. Due to the similarity, the decision has been made to consider the two concepts as one. During the online meeting discussed in section 6.2, the marketeers showed their preferences for a design that resembles the current coffee creamer cup. Therefore, the shape of the left packaging concept will be used to further explain and visualize the concept in the next section.

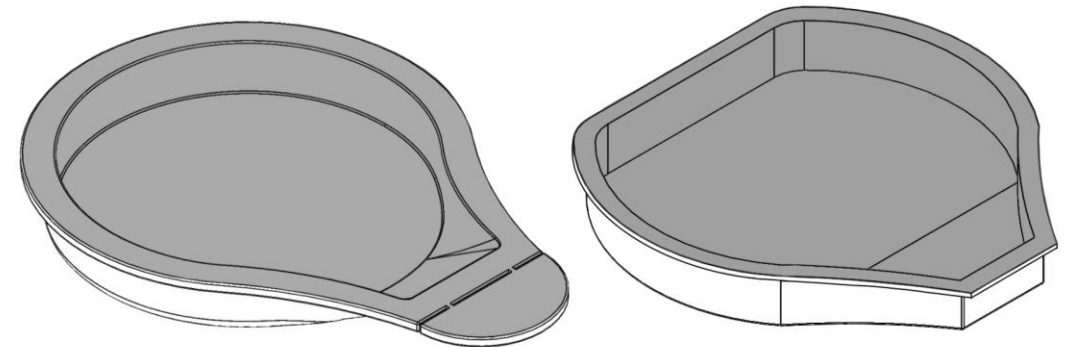
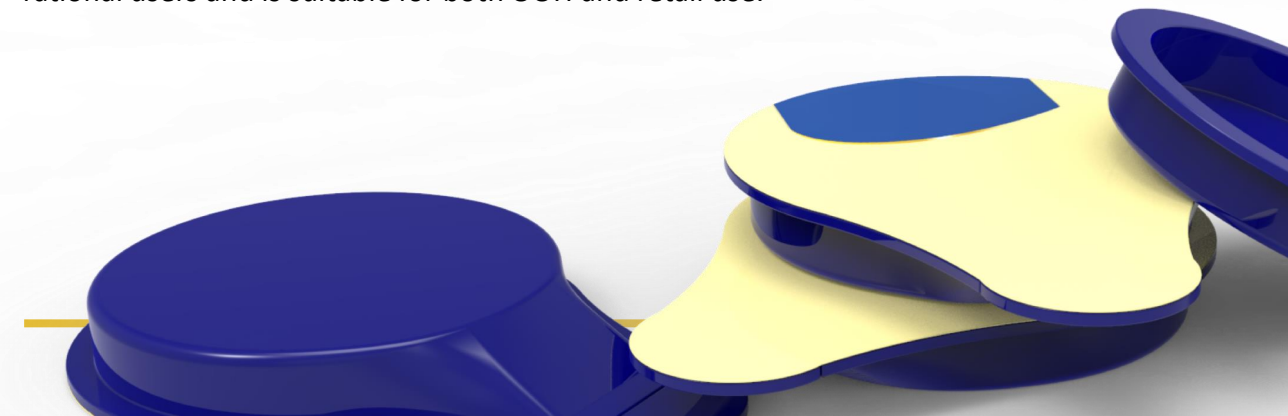


Figure 58. The two concepts ended up being really similar.

## 6.5 Final concept

This section discusses the final coffee creamer portion packaging concept. Renders of the final packaging design can be seen in Figure 59. The packaging concept is an improvement on the current coffee creamer portion packaging of Nutroma and Friesche Vlag. The concept has a similar appearance as the current cups which resonates with the conservative user group. The packaging is made from all recyclable material and the dimensions meet the sorting and content volume requirements. Since the used material does not break easily, the portions are not sold in a sleeve. The packaging meets or aims to meet all requirements which ensure that the design fits the user group. The requirements are based on the user-profiles defined in chapter 2. By meeting the requirements, the packaging matches the wishes of emotional and rational users and is suitable for both OOH and retail use.



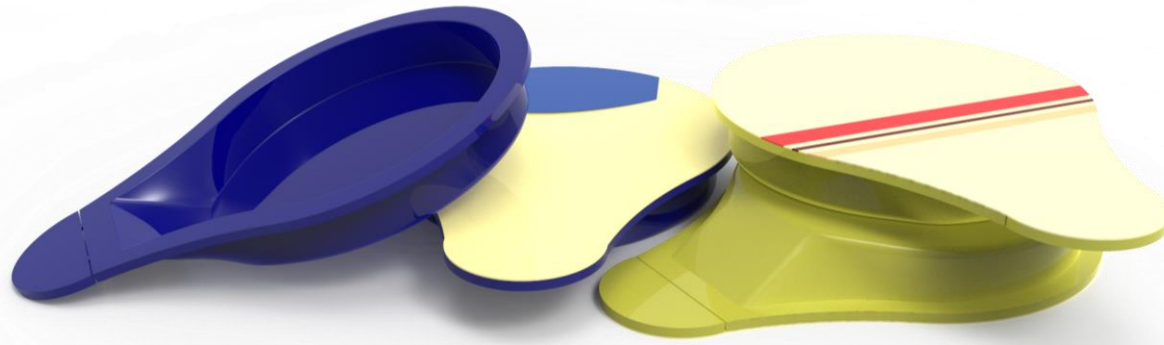


Figure 59. Visualization of final packaging concept.

Figure 60 visualises which must-have and should-have requirements have been met. Some requirements are categorized as to be determined (d.t.b.). These requirements are important to meet in the future. Meeting all European food safety regulations largely depends on the materials of the packaging that come in direct contact with food. The material composition necessary to conserve coffee creamer must be determined in future research. Realistic prototypes of the concept have to be made in order to analyse and test if the packaging and corresponding opening mechanism are safe to handle. The next t.b.d. requirement states that all packaging components can be correctly sorted in Europe. During the design process, the sorting requirements are taken into account, which resulted in a packaging concept that can be correctly sorted in theory. Physical tests have to be performed in order to find out if the post-consumer packaging still meets the sorting requirements in realistic user scenarios. To illustrate, when the foil is completely detached from the packaging, it reshapes and will no longer meet the sorting requirements. The last t.b.d. must-have requirement states that the packaging must fit the content characteristics. The shape of the packaging does fit the content. Further research into the material and possible necessary additives need to take place before this requirement can be met.

The packaging concept meets almost all should-have requirements. The ones that are listed as to be determined include avoiding spillage, the price/quality ratio, easy opening, and storage. The packaging design is larger which makes it easier to hold than the current coffee creamer portion packaging. This can result in less spillage. However, a lot of other

Must-have requirements	No	t.b.d.	Yes
1. The primary packaging meets all European food safety regulations.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2. The primary packaging and corresponding opening mechanism are safe to handle.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
3. All components of the post-consumer primary packaging can be correctly sorted in Europe.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
4. The primary packaging provides content density for 7 millilitres of coffee creamer.	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
5. The primary packaging fits the content characteristics.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
6. The primary packaging design is suitable for mass production.	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Should-have requirements	No	t.b.d.	Yes
1. The packaging is easy to open for all ages within the user group.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2. The packaging material meets the preferences of the users.	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
3. The packaging allows the users to dose the content.	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
4. The packaging design ensures a limited amount of unwanted leftovers.	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
5. The design of the packaging limits or avoids spillage during and after use.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
6. The packaging design is suitable for the defined user occasions.	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
7. The (post-consumer) packaging is presentable during coffee moments.	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
8. The post-consumer packaging is easy to dispose of.	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
9. The packaging has a similar price/quality ratio as the current packaging.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
10. The primary and secondary packaging are convenient to store and transport.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Figure 60. Must-have and should-have requirements that have been met.



factors are involved in avoiding spillage such as the force that is required to open the packaging. Tests with realistic mock-ups have to take place in order to verify if the packaging really limits spillage during use. The packaging design does not have a specific feature that prevents or limits spillage after use. Spillage after use can be limited when the users make the opening hole small. Graphic design or affordances can help achieve this. However, a small hole also means that the pouring experience is affected. In short, users can choose how big they make the opening hole and can thus indirectly avoid spillage after use. The price/quality ratio of the packaging depends on the production technique and materials used. The goal was to create a premium looking packaging. The price has to be determined further in the design process. Another t.b.d. requirement states that the packaging should be easy to open. The concept makes use of a similar opening system as the current coffee creamer portion packaging. During the user experience research, this opening method was defined as easy. Only the dimensions of the cup were deemed too small. The new packaging design solves this problem by enlarging the dimensions of the tab that has to snap off. Tests have to be performed to verify how much force is needed to snap off a tab made of PP. The tab ensures that users don't have to grab thin foil. The last to be determined requirement states that the primary and secondary packaging should be easy to store and transport since this is one of the user drivers of coffee creamer portions. Meeting this requirement depends on the characteristics of the used material and the design of the secondary packaging. Both are not defined yet.

## 6.6 Conclusion

The conceptualization phase resulted in five diverse concepts. During an online meeting with the marketeers of Friesche Vlag and Nutroma, three of those concepts were chosen to work out in more detail. These concepts had the most potential regarding recyclability and feasibility and fit the brand portfolios the best. The dimensions of the three concepts were first established by performing literature research and by making use of a CAD modelling software. Mock-ups were created to get a feel for the usability of the packaging. Several packaging experts were involved to define the concepts in such a way that they became feasible to manufacture. During the detailing process, problems were encountered that needed to be fixed by design alterations. In the end, the portion packaging made from drinking cardboard was discarded since it could not meet the volume requirements. The other two concepts turned out to be similar due to the necessary alterations. This clearly visualised what type of packaging concept fits the user group and can be correctly sorted during the recycling process. Thus, the main research question is answered by means of a detailed packaging concept.



## Chapter 7. Conclusion & discussion

The main goal of this thesis was to find alternative packaging designs for coffee creamer portions that can be correctly sorted during the recycling process and fit the target group. In order to achieve this goal, 3 sub-questions have been answered. The first sub-question states *“What user-profiles match the users of coffee creamer portions from the brands Nutroma and Friesche Vlag?”* In order for me to answer this question, I had to research the characteristics of coffee creamer users and figure out what the user drivers of coffee creamer portions are. All information is based on U&A studies conducted by Friesche Vlag and Nutroma. Lacking information was added by means of literature research. While collecting all data, there was no distinction made between Belgian and Dutch consumers. This might be interesting to look into since this can affect certain requirements. Overall, the sub-question has been answered in a satisfactory way.

The second research question, *“What are the packaging requirements and design opportunities that can be derived from the user-profiles and user experiences?”*, was answered by means of small user experience research and the help of two design tools. The user experience research resulted in a list of user pains and design opportunities which were in turn translated into requirements. Due to time limitations and a lack of knowledge, the defined requirements are often not measurable. In order to still use these requirements as a guideline, the current coffee creamer portion packaging was used as a comparison. Future research should revise the defined requirements and make them measurable when possible. For example, the requirement of easy opening refers to the opening mechanism of the current coffee creamer cup. Future research can specify this requirement with a maximum amount of force needed to open the packaging. The should-have requirements are mainly based on U&A studies and small user experience research. These small user experience research do not have the number of results to be of significant value. Thus, the defined requirements have to be verified, preferably by user experience research consisting of a sufficient number of participants.

The last sub-question, *“What are the requirements post-consumer packaging has to meet in order to be correctly sorted during a recycling process?”* has been answered by means of literature research. Due to the COVID-19 regulations and time limitations, the defined requirements could not be verified in practice. For future research, the whole recycling process should be considered. Research into the appearance of the packaging and how it influences the collecting behaviour of consumers might prove useful to look into. The recycling phase, where the sorted material is converted into new material, is also very important to consider. Only when the packaging and its components can adhere to the collection, sorting and recycling steps, it is considered to be recyclable. Therefore, follow-up research should look into the recycling steps and define corresponding requirements before moving along with the design process of the concept.

Answering the sub-questions was followed up by an ideation and conceptualization phase. The brainstorm sessions during the ideation phase proved to be really helpful. I would recommend this method for similar research that is conducted in the future. The conceptualization phase resulted in three different packaging concepts. At that point in time, the concepts were designed to fit the user group but were not detailed enough to say if they met certain requirements. When conducting similar research regarding the design of packaging, I would recommend researching suitable materials and their characteristics before starting with the conceptualization phase. This would have helped me with defining more realistic packaging concepts from the beginning.

The main research question states: *“What type of alternative coffee creamer portion packaging concepts can be designed that are correctly sortable during the recycling process and fit the user group?”* By meeting almost all defined requirements, the packaging can be correctly sorted and fits the characteristics of the users. Most of the alterations of the concepts regarding material are based on the feedback of packaging experts. The feedback essentially resulted in one packaging concept design, which, in my opinion, answers the main research question in a satisfactory way. Follow-up research should address the used materials, define requirements for the production techniques and recycling process, and conduct user experience tests with the main user group.

When looking into the production techniques, I would recommend revising the design of the main body. The packaging is now designed to fit 7 millilitres of coffee creamer and 3 10<sup>3</sup> mm of air. The necessary amount of air can change according to the specific characteristics of the used production process. When the amount of air changes, the dimensions of the packaging have to be altered accordingly. The dimensions of the packaging are also important for the opening method. The previous recommended user experience tests should focus on the opening mechanism. From the small user experience research, we know that opening the current packaging is “easy” or “very easy” (n=7). Due to the use of PP, the tab is harder to snap off. Research should find out how thin or thick the connecting pieces should be. If this opening method does not work, other opening mechanisms have to be thought of that meet the defined requirements. The user experience tests will also prove if decreasing the tab prevents the content from travelling down the tab when the packaging is used. If not, different shapes for the packaging can be considered. The shape of the final flower-shaped portion packaging concept might be an option.

The final packaging concept is designed to be correctly sortable. However, no significant tests were performed to prove this statement. Future research should focus on the collection process of small plastic waste material. It is important to know how users dispose of the packaging. For example, users might crumple the packaging before

disposing of it. The post-consumer packaging might also be crumpled during transportation. This influences the sorting process. I also recommend that future research focuses on how users open the packaging. If the foil is completely removed from the packaging, it no longer meets the dimension requirements and is thus not recyclable. Thus, for the whole packaging to be correctly sortable, the foil should stay attached to the packaging. If it turns out that most users completely remove the foil, research into ways to prevent this should take place.

My last recommendations regarding the final concept include the secondary packaging and the marketing of the primary packaging. One of the user drivers of coffee creamer portions is the convenience regarding storage. The secondary packaging plays an important role in this. When the main body of the packaging is made from PP, connecting the portions together as a sleeve is not feasible. I recommend looking into possible secondary packaging designs made from a material that is easy to store and recycle. Marketing of the new concept design should explain why the new, more sustainable packaging consists of more plastic. The larger dimensions of the new packaging might be perceived as unsustainable and will defeat the goal of the redesign of the packaging. I recommend marketing the new concept and explaining why this packaging is more sustainable than the current packaging.

Before moving on with the design process of the final concept, I recommend conducting research regarding the desired volume for a portion. The U&A study of Nutroma already showed that there is an increasing demand for milk in coffees. Research has to find out if this is also the case for the main user group of coffee creamer portions. When the answer is yes and the preferred portion volume is larger than 12 millilitres, portion packaging made from drinking cardboard can be a great solution from a sustainable perspective. Research of Tetra Pak shows that drinking cardboard packaging has a significant decrease in CO<sub>2</sub> emissions compared to a general plastic coffee creamer cup (Appendix J). The CO<sub>2</sub> emissions of the worked-out concept design and a drinking cardboard packaging should be compared to make the final decision. RESPAKKT, an existing tool that tests the sustainability of packaging developed by FrieslandCampina, can help with making this decision. Other factors that can influence this decision include limited possibilities regarding format shape. The shape of the drinking cardboard packaging can not be altered and can thus not serve as a way for Friese Vlag and Nutroma to distinguish themselves from competitors. The opening method, peeling off a paper-based foil, might also be difficult to use for the main user group. Edible or dissolvable packaging might also prove interesting to look into, but I recommend doing so in a much later time scale. At the time of writing, the packaging does not meet the food safety regulations. This dissolvable layer has a lot of potential since it does not require a primary packaging. This decreases the use of plastic or other packaging material significantly. Edible packaging is also extremely easy to use since users just have to drop it in their coffee.

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# APPENDIX A

## Type of coffee milk consumption by gender & age subgroups

	Male (n=177) (a)	Female (n=214) (b)	Flanders (n=287) (a)	Wallonia (n=151) (b)	16 - 24 y.o. (n=57) (a)	25 - 34 y.o. (n=55) (b)	35 - 44 y.o. (n=59) (c)	45 - 54 y.o. (n=103) (d)	55 - 64 y.o. (n=109) (e)	65+ y.o. (n=55) (f)
Coffee with milk – no specialty	38%	42%	43%	34%	49%	47%	32%	42%	37%	36%
Coffee creamer	36% B	19%	26%	24%	11%	15%	25% A	29% AB	28% AB	40% AB
Cappuccino	16%	16%	13%	21% A	25% D	20%	19%	11%	15%	13%
Latte macchiato	4%	13% A	10%	9%	11%	7%	12%	10%	11%	4%
Caffe latte	5%	8%	5%	10%	2%	9%	8%	7%	7%	7%

Figure 1. U&A study conducted by Nutroma

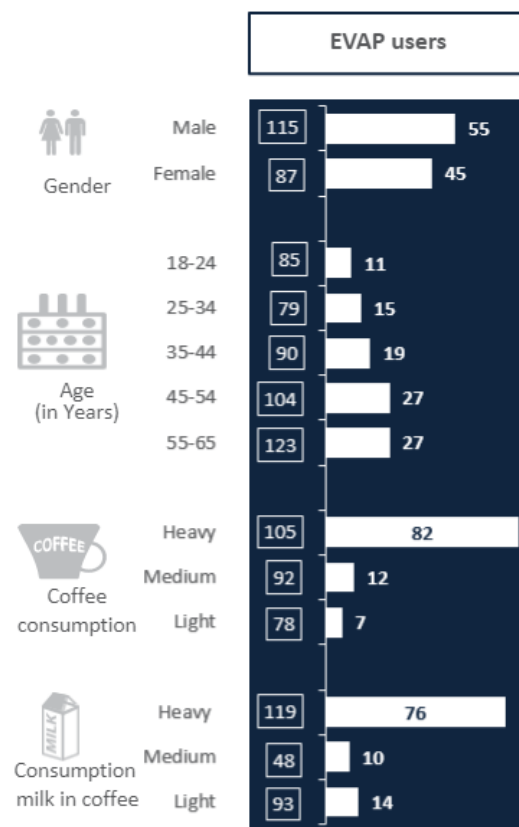


Figure 2. U&A study conducted by Friesche Vlag, n=1008.

# APPENDIX B

## Usage and purchase drivers of each individual user category

Technical drivers	Specifications	Priority
Sociability	Being a good host/hostess for family and friends	0.59
	Presenting good quality	
Less food waste	No leftovers	0.22
	Waste of money	
Small format	Storage convenience	0.15
	Transport convenience	
	Portability and on-the-go transport	
Appearance	Usage convenience	
	Festive atmosphere	0.4
	Draws more attention to the quality of the coffee	
Dietary awareness	Decoration for on the table: it is fancy	
	Portion/calorie control and nutrition (real or perceived)	0
Hygiene	Single use, no spoiled leftovers	0
	Individual use	
Availability	It was offered to me	0
	There was no other alternative	
Variety	Users feel in control of portion sizes	0
	No commitment to large quantity of one item	
	Use of products otherwise not consumed --> Nostalgia: "It takes me back to my childhood days"	

NOTE: low base size, n=30

Figure 3. User drivers of coffee creamer cups: PRIMARY RETAIL USERS.

Drivers	Specifications
Availability	It was offered to me
	There was no other alternative
Appearance	Festive atmosphere
	Draws more attention to the quality of the coffee
Small format	Decoration for on the table: it is fancy
	Portability and on-the-go transport
Hygiene	Usage convenience
	Single use
	Individual use

Figure 4. User drivers of coffee creamer cups: PRIMARY OOH USERS.

## APPENDIX C

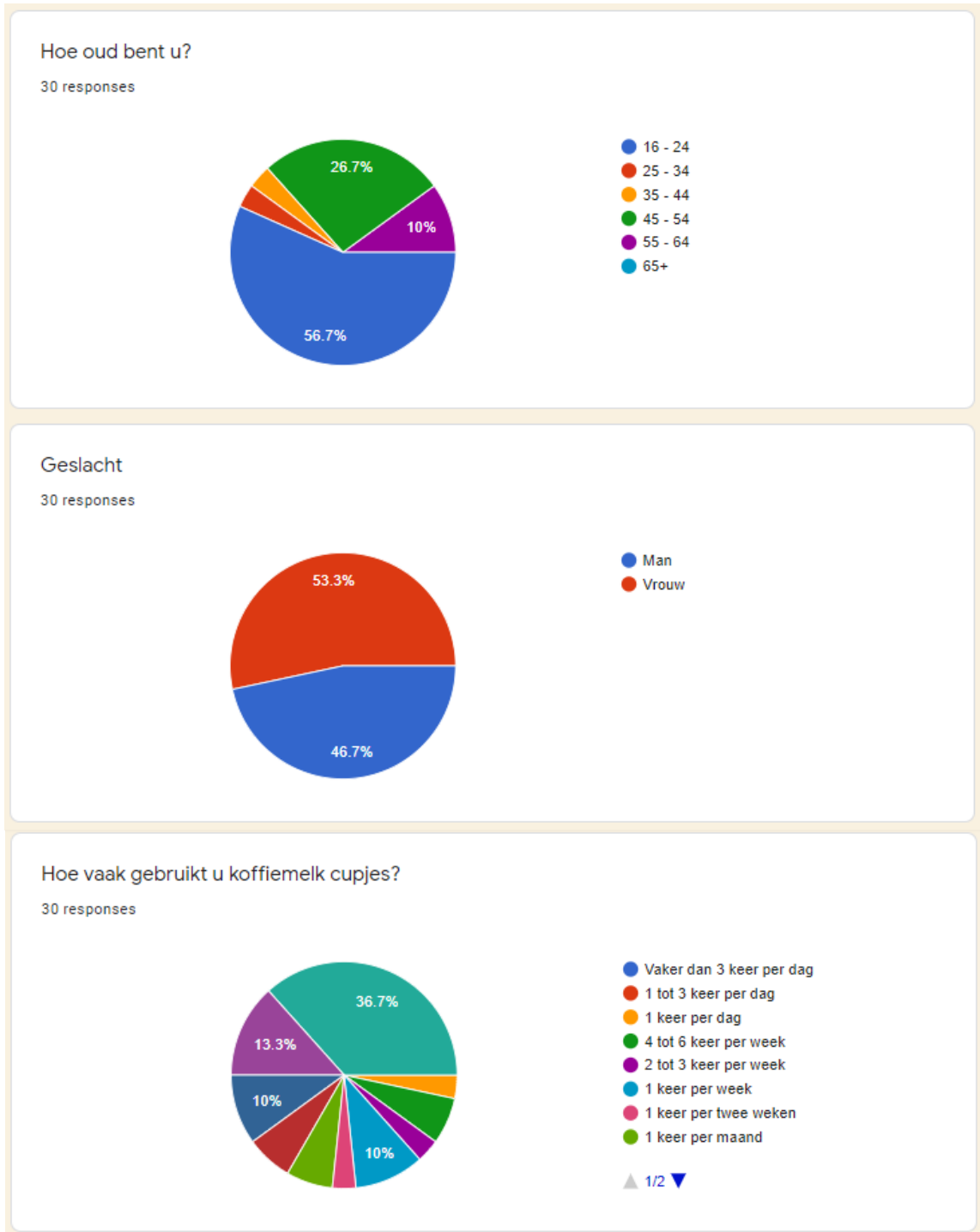
## General user experience research of coffee creamer cups, n=30

Drivers	Specifications
Sociability	Being a good host/hostess for family and friends Presenting good quality
Less food waste	No leftovers Waste of money
Small format	Storage convenience Transport convenience Portability and on-the-go transport Usage convenience
Appearance	Festive atmosphere Draws more attention to the quality of the coffee Decoration for on the table: it is fancy
Hygiene	Single use, no spoiled leftovers Individual use

Figure 5. User drivers of coffee creamer cups: SECONDARY RETAIL USERS.

Drivers	Specifications
Small format	Storage convenience Transport convenience
Less food waste	No leftovers No waste of money
Appearance	Festive atmosphere Draws more attention to the quality of the coffee Decoration for on the table: it is fancy
OOH service	Being a good host/hostess for consumers Presenting good quality Meeting the consumers wishes

Figure 6. User drivers of coffee creamer cups: SECONDARY OOH USERS.



Waarom gebruikt u of heeft u koffiemelk cupjes gebruikt in huis? Kies de optie die het beste bij u past.

27 responses



Hoe maakt u de cupjes open? Kies de optie die u het vaakst gebruikt.

29 responses



Als u bij de vorige vraag 'anders' heeft ingevuld, ligt dit dan kort toe.

1 response

telt "ik wil m er helemaal af trekken maar hij scheurt altijd" als anders?

Omschrijf een voordeel (top) van het gebruik van koffiemelk cupjes tegenover het gebruik van andere koffiemelk verpakkingen

29 responses

1. Je hebt precies genoeg voor 1 kopje
2. Omdat het bij ons in huis niet gebruikt wordt en we dus alleen koffiemelk voor gasten in huis hebben is dit handiger ivm hoeveelheid en houdbaarheid.
3. Handig voor gasten als je zelf geen koffiemelk drinkt
4. Het is makkelijk in gebruik en er hoeven geen pakken koffiemelk weg gegooid te worden wanneer deze over datum zijn ivm weinig gebruik van koffiemelk.

5. Ik gebruik je op vakantie. Ik heb dan geen koelkast en de cupjes kunnen buiten de koelkast bewaard worden.
6. Gemakkelijk, en ziet er leuker en gezelliger uit dan een groot pak
7. Blijft houdbaar doordat je geen grote verpakking opent.
8. Het is makkelijk als er bezoek komt, ik bespaar geld door niet een grote verpakking te kopen die toch niet op komt
9. Minder Voedselverspilling
10. Consistentie in hoeveelheid koffiemelk.
11. De cupjes zijn makkelijk te bewaren en handig voor 1 persoon
12. Langer houdbaar en makkelijk bij visite.
13. Het is handig om een kleine portie te kunnen aanbieden
14. makkelijk, geschikte hoeveelheid, hygienisch
15. Het gaat niet snel over datum omdat het in porties verpakt zit en is daarom ook makkelijk te portioneren, en weet je precies hoeveel calorieën dit bevat.
16. Geen restjes / open verpakking die niet wordt gebruikt
17. Geen hele verpakking openmaken, lang houdbaar
18. Houdbaar, schoon, handig, niet in koelkast
19. Het neemt minder ruimte in beslag op tafel
20. Sustainability
21. Verbruikshoeveelheid per verpakking
22. Het is een stuk sfeervoller op tafel en portioneren is simpel.
23. Houdbaar en handig als je zelf geen koffiemelk gebruikt
24. Kleine verpakkingen zijn handig voor gasten
25. 1p verpakking
26. Ik gebruik de melk zelf niet, dus heb het alleen in huis voor bezoek. Als ik voor bezoek een gewone verpakking zou gebruiken, zou ik iedere keer een heel flesje moeten aanbreken. De rest zou dan bederven.
27. Bespaard ruimte
28. Lang houdbaar en klein verpakking
29. Precies genoeg

Omschrijf een nadeel (tip) van het gebruik van koffiemelk cupjes tegenover het gebruik van andere koffiemelk verpakkingen

27 responses

1. Veel afval
2. Afval!!!
3. Een grootverpakking is makkelijker in gebruik. Een cupje is meer werk om te openen en moet je daarna weggooien.
4. Elke keer moet je iets in de prullenbak gooien

## APPENDIX D

### User jobs, pains and gains of primary and secondary retail users

5. Wanneer je koffie verkeerd drinkt, heb je al snel twee of meer cupjes nodig waardoor koffiemelk in cupjes weer duurder is.
6. Vaak moet ik meerdere cupjes gebruiken anders vind ik de koffie te sterk, en je hebt meer afval
7. Bij het verplaatsen kan er wat smeren en je kan maar tot bepaalde mate zelf de portie bepalen (zonder meerdere open te breken, maar dat voelt vreemd en lijkt in te gaan tegen het doel van zo'n cupje)
8. Plastic afval
9. knoeien, afval
10. Meer afval slechter voor milieu
11. Je kan gemakkelijk morsen en je moet de verpakking meteen weggooien
12. Duurder?
13. Het heeft minder zin als je veel kopjes van melk wilt voorzien
14. veel plastic afval
15. Veel afval, als je minder dan de afgemeten portie wil gooi je de rest waarschijnlijk weg, ongezellige uitstraling.
16. meer plastic afval, neemt meer ruimte in
17. Meer materiaal, ziet er goedkoper uit
18. Verpakking, rommel, lekt na
19. Meer rotzooi dan een grote verpakking
20. Ze zijn lelijk
21. Veel afval, staat lelijk, meer gedoe
22. Na elk gebruik moet je de verpakking weggooien
23. Relatief veel plastic is slecht voor t milieu
24. Heel veel plastic afval
25. Extra afval
26. Plastic

	User jobs	Pains	Gains
Primary users	Purchase product	Bad price/quality ratio	Good price/quality ratio
RETAIL		Price	Shelf appearance recalls positive emotions
	Transport product	Packaging is damaged during transport	Product is easily transportable
	Store product	Content goes bad before use	Long storage time
			Fresh content
	Open primary (and secondary) packaging	Packaging is hard to open	Ease of use: content is easy to access
		Not all content can be reached: leftovers	All content can be accessed
		Feeling conflicted when opening multiple cups	Amount of content of one cup meets taste preferences
		Feeling embarrassed when asking for multiple cups when visiting friends/family	
	Pour coffee creamer in coffee	Spillage when pouring	No spillage when pouring
	Enjoy coffee moment	Being distracted from the coffee moment by the packaging experience	Positive packaging experience elevates coffee moment
			Packaging looks fancy on the table and draws more attention to the coffee moment
	Dispose of primary (and secondary) packaging	Spilling the leftovers on the way to the trashcan	Disposing the packaging without having to clean up anything
		Relatively much waste material	Not having to perform additional steps when disposing of the packaging
		Not knowing where and how to dispose of the packaging	Clear indicators on packaging showing where and how to dispose of the packaging
		The packaging is perceived as environmentally harmful	Packaging is recyclable
			Packaging is perceived as environmentally friendly

Figure 7. User jobs, pains and gains of PRIMARY RETAIL USERS

	User jobs	Pains	Gains
Secondary users	Purchase product	Bad price/quality ratio	Good price/quality ratio
RETAIL		Price	Shelf appearance recalls positive emotions
	Transport product	Packaging is damaged during transport	Product is easily transportable
	Store product	Content goes bad before use	Long storage time
	Create a moment of indulgence for family/visitors, being a good host/hostess	Product and/or packaging experience does not meet the wishes of the visitors	Visitors are enjoying themselves without being distracted by the packaging experience
		Packaging is perceived as boring and dull	Packaging looks fancy on the table and draws more attention to the coffee moment
		Present visitors with bad quality product	Present good quality to family/visitors
	Dispose of primary (and secondary) packaging	Spilling the leftovers on the way to the trashcan	Disposing the packaging without having to clean up anything
		Relatively much waste material	Not having to perform additional steps when disposing of the packaging
		Not knowing where and how to dispose of the packaging	Clear indicators on packaging showing where and how to dispose of the packaging
		The packaging is perceived as environmentally harmful	Packaging is recyclable
			Packaging is perceived as environmentally friendly

Figure 8. User jobs, pains and gains of SECONDARY RETAIL USERS





		1.15 Not knowing where and how to dispose of the packaging	2.15 Clear guidelines on packaging about disposal
		1.16 Having to perform additional steps when disposing of the packaging	2.8 Packaging design ensures that spillage is limited/avoided
			2.13 Packaging design that can be resealed after use, to avoid spillage
			2.14b Packaging with a minimum amount of separate parts and/or the possibility of leaving the separate parts attached
	Emotional users	1.17 'Dull' and cheap appearance of primary packaging	2.17a Packaging with a fancy and festive appearance which emphasizes the coffee drinking moment 2.17b Packaging design indicates content
		1.18 Environmental impact of packaging, packaging perceived as environmentally harmful	2.18a Recyclable packaging design 2.18b Packaging design has visual indicators showing that it is recyclable
		1.19 Packaging without familiar brand indicators, not knowing what kind of quality you offer to visitors	2.19 Packaging design has familiar brand indicators
		1.20 Product and/or packaging experience does not meet the wishes of the visitors	2.20 Packaging design ensures ease of use (see pains primary users)
<b>OOH USERS</b>			
		<b>Pains</b>	<b>Design opportunities</b>
Primary users	Rational users	1.1 Price	
		1.2 Bad price/quality ratio	
		1.21 Availability	
		1.6 Primary packaging is hard to open due to small size, tearing the aluminium foil the wrong way	2.6a Packaging that allows people within all age ranges to easily and comfortably access the coffee creamer inside 2.6b Intuitive use and/or clear guidelines how to open and use the packaging
		1.7 No flexible portions, feeling conflicted when opening multiple cups	2.7 Portion packaging that contains the right amount of coffee creamer for a variety of coffee types
		1.8 Spilling coffee creamer during use	2.8 Packaging design ensures that spillage is limited/avoided
		1.9 Remaining leftovers after use; content cannot be reached	2.9 Packaging design ensures that all content can be reached
		1.12 Being distracted from the coffee moment by the packaging experience	
	Emotional users	1.17 'Dull' and cheap appearance of primary packaging	2.17a Packaging with a fancy and festive appearance which emphasizes the coffee drinking moment 2.17b Packaging design indicates content
		1.18 Environmental impact of packaging, packaging perceived as environmentally harmful	2.18a Recyclable packaging design 2.18b Packaging design has visual indicators showing that it is recyclable
		<b>Pains</b>	<b>Design opportunities</b>
Secondary users	Rational users	1.1 Price	
		1.2 Bad price/quality ratio	
		1.3 Packaging is damaged during transport	2.3 Packaging design ensures easy transportation
		1.22 Transporting the packaging demands high costs	
		1.4 The product goes bad before use (waste of money and food)	2.4 Packaging design ensures optimal conservation of content
		1.8 Spilling coffee creamer during use	2.8 Packaging design ensures that spillage is limited/avoided
		1.13 Spilling the leftovers on the way to the trashcan	2.13 Packaging design that can be resealed after use, to avoid spillage
		1.14 Relatively much waste material	2.14a Packaging that is easily foldable or made compact after use to avoid filling up the trashcan to fast 2.14b Packaging with a minimum amount of separate parts and/or the possibility of leaving the separate parts attached
		1.15 Not knowing where and how to dispose of the packaging	2.15 Clear guidelines on packaging about disposal
		1.16 Having to perform additional steps when disposing of the packaging	2.8 Packaging design ensures that spillage is limited/avoided 2.13 Packaging design that can be resealed after use, to avoid spillage 2.14b Packaging with a minimum amount of separate parts and/or the possibility of leaving the separate parts attached

Figure 11, part B. User pains and design opportunities.

	Emotional users	1.17 'Dull' and cheap appearance of primary packaging	2.17a Packaging with a fancy and festive appearance which emphasizes the coffee drinking moment 2.17b Packaging design indicates content
		1.18 Environmental impact of packaging, packaging perceived as environmentally harmful	2.18a Recyclable packaging design 2.18b Packaging design has visual indicators showing that it is recyclable
		1.19 Packaging without familiar brand indicators, not knowing what kind of quality you offer to customers	2.19 Packaging design has familiar brand indicators
		1.20 Product and/or packaging experience does not meet the wishes of the customers, dissatisfied customers	2.20 Packaging design ensures ease of use (see pains primary users)
		1.23 Packaging does not fit the brand identity of public facility	2.23 Packaging is to some extent customizable
		1.24 Packaging affects the CSR image negatively	2.18a Recyclable packaging design 2.18b Packaging design has visual indicators showing that it is recyclable

Figure 11, part C. User pains and design opportunities.




# APPENDIX G

## Presentation material used during brainstorm sessions (n=6, 7)

Brainstorm session

**Recyclable** coffee creamer portions



**Recyclable**

The current packaging is not recyclable due to its **size** and **material**




Polystyrene (PS)  Aluminum 

Some examples



V-Shapes


Brainstorm session 1 

**Goal: Packaging that is recyclable; > 50 mm**

🕒 7 min

**Recyclable material**


FrieslandCampina currently offers two types of coffee creamer portions: plastic- and aluminium cups.



Polystyrene (PS) Aluminum

Aluminum is recyclable, PS is not. Changing the material of the cups will not solve the problem...

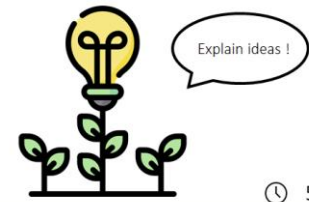
**Recyclable size**



Sieve drum

The first step in the sorting process filters out all waste material smaller than 20 millimeters, irrespective of material type. This waste material ends up in *residue*, which is burned for energy recovery.

**Goal: Packaging that is recyclable; > 50 mm**



Explain ideas!

🕒 5 min

Henrie 

Brainstorm session 2 

Retail: Users who purchase coffee creamer for personal use (majority of users is around the age of 65)

**Goal: Packaging that is easy to open for all users.**

🕒 7 min

**How to solve the problem**



Why not just remove the cups from the portfolio? FrieslandCampina offers a variety of recyclable coffee creamer format sizes

There is a demand for coffee creamer portions

Technical drivers	Specifications
Small format	Usage convenience
	Desired amount of coffee creamer
	Storage convenience
	Transport convenience
	Portability and on-the-go transport
Dietary awareness	Portion/cup size control and nutrition (real or perceived)
Less food waste	No leftovers
Hygiene	Single use, no spoiled leftovers
	Individual use
Emotional drivers	Specifications
Appearance	Festive atmosphere
	Draws more attention to the quality of the coffee
	Decoration for on the table: it is fancy
Sociability	Being a good host/hostess for family and friends
	Presenting good quality


**Goal: Packaging that is easy to open for all users.**



Explain ideas!

🕒 5 min

Margret 

Brainstorm session 4 


OOH users

**Goal: Packaging that functions as decoration for on the table.**

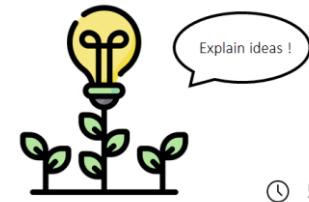
🕒 7 min

A variety of people use coffee creamer portions

Retail use	Out Of Home use
Users who purchase coffee creamer for personal use	Users who use coffee creamer cups outside their homes; work, restaurant, etc.
Stakeholders who purchase coffee creamer for visitors (no individual use)	



**Goal: Packaging that functions as decoration for on the table.**



Explain ideas!

🕒 5 min

**Thank you so much for your contribution !**

Please send all sketches, ideas or written down concepts to my email address:

britt.muller@frieslandcampina.com





## APPENDIX I

Sorting test that resembles a sieve drum

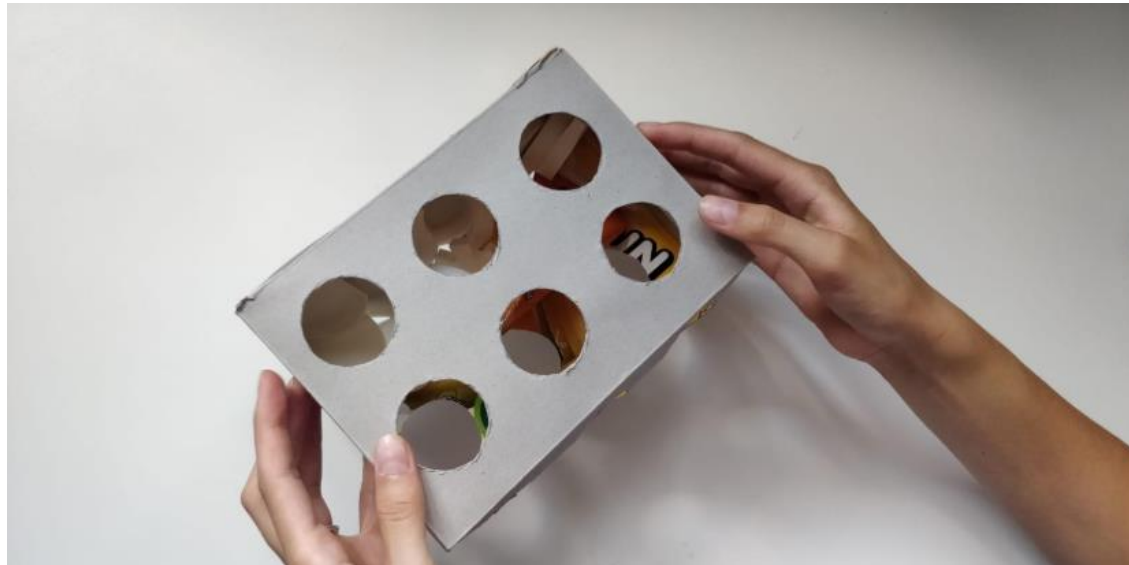


Figure 12. Cardboard box that resembled the workings of a sieve drum.

## APPENDIX J

CO<sub>2</sub> emissions of drinking cardboard packaging vs. plastic packaging



### Tetra Classic and the environment

lower CO<sub>2</sub> emissions vs. current and much lower than the alternatives

Indicative carbon footprint index per 1000 litres of product

