

Food Packaging Trends for the Refrigerator

The perspective of packaging professionals

ELISABETE OLIVEIRA

MASTER'S THESIS

Packaging Logistics
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Abstract

- Title: Food Packaging Trends for the Refrigerator: The perspective of packaging professionals
- Author: Elisabete Oliveira
- Division: Packaging Logistics, Department of Design Sciences, Faculty of Engineering, Lund University
- Supervisors: *Annika Olsson*, Professor at Packaging Logistics & *Karla Marie Paredes*, Guest Lecturer at Innovation Engineering; both from the Department of Design Sciences, Faculty of Engineering, Lund University; And *Simona Iuculano* Design Manager, Food Preservation at AB Electrolux
- Issue of study: Consumers interact with primary food packaging and the refrigerator on a daily basis, although the interaction and impact food packaging has on the design of refrigerators is not clear. The Swedish home appliances company Electrolux, manufacturer's refrigerators with the consumer needs in mind. The food packaging market is diversified in terms of formats, dimensions, functions and materials. Thus, anticipating the potential changes might help Electrolux to improve even further.
- Purpose: The purpose of this study was to explore the primary packaging trends of chilled and frozen foods in order to analyse how they might impact the design and development of future refrigerators.
- Method: A qualitative research was conducted; primary data was collected with resource to an exploratory method of in-depth semi-structured interviews of packaging professionals and to an online observation of four food categories in Sweden and in the United Kingdom; secondary data was collected by literature research. The methods resulted in inductive and deductive inferencing respectively, therefore in this study, results and discussion lead to an abductive reasoning, with conclusions generated from the collected data.

Conclusions: Convenience is one of the most important drivers of packaging changes. Other trends are sustainability, health and safety, although incorporation of technology and package / product personalization are likely to grow in importance. Primary food packaging will likely become more environmental friendly, with the use of bioplastics in detriment of glass in formats such as flexible pouches. The future will potentially have both smaller and bulkier packages, as well as portion control and multipacks. In the next five to ten years, the future of packaging will not likely be focused on the older population, new formats, incorporation of radio frequency identification, edible packaging and nanotechnology. Currently, differences between the English and the Swedish market are noticeable mostly in the type of materials used, formats and number of products available. In the future, the refrigerator development is likely to respond to personalization by exploring a new feature: detachable compartments.

Key words: Primary food packaging, refrigerator, trends, United Kingdom, Sweden

Executive Summary

Introduction

Primary food packaging is the packaging closest to the consumer serving functions of protection, convenience/utility and communication, amongst others (Pousette et al., 2014). Despite these core functions having existed for decades, the way they are offered can change as a consequence of many drivers, namely new ways of shopping, busier lifestyles, fast communications and/or environmental pressures (Ryynänen and Rusko, 2015).

Every day the consumer interacts with the primary food packaging and a refrigerator. As the food industry innovates, new packaging has to be accommodated in the consumers' home, in the refrigerator, where it continues to protect and preserve the food it contains. For Electrolux, which is "*one of the global leaders in home appliances and appliances*" and a manufacturer of refrigerators, anticipating this interaction is part of their mission, where development emerges as a response to consumer needs. Therefore, the main problem this research addressed, was to understand how the primary food packaging of chilled and frozen foods will, in the near future, influence the development of new refrigerators.

The main goal of the study was to explore the trends of the primary packaging of chilled and frozen foods, in order to analyse how are they likely to impact the design and development of future refrigerators.

This exploratory study considered three research questions: (1) how will packaging for chilled and frozen foods evolve in the near future; (2) what are the current drivers of these packaging changes and the implications for the future of packaging; and (3) how might all of these factors affect the design and development of future refrigerators? These questions were further explored into external characteristics of packaging (formats, materials, functions and dimensions) and drivers for change, such as consumers.

The research delimitations included a time frame, for the study of the trends, of five to ten years, in other words, trends for 2020-2025 and the study of two European Countries: the United Kingdom (UK) and Sweden. In addition, the type of food products analysed were the ones targeted to adults.

Methodology

A qualitative research was considered as the best approach to understand this understudied subject. The research was exploratory, connecting both the food packaging and the refrigerator and, in addition, focused on the future, on insights not published by the companies. This motivated the need for conducting in-depth semi-structured interviews, in order to have direct contact with packaging experts and gain access to personal and professional insights.

The data collection and organization of the interviews followed the seven stages presented by Kvale and Brinkmann (2009): (1) thematic conceptualization, (2) design, (3) interview, (4) transcription, (5) analysis, (6) verification and (7) reporting. For this study, thematic analysis was the chosen method to explore the collected data and also identify and describe the common themes shared during the interviews.

Observation was another form of primary data gathering by collection and analysis of packaging characteristics of four food product categories: milk, yogurt, chilled fruit juice and frozen ready meals, in the United Kingdom and in Sweden. The data was collected via online observation of e-stores and grouped in categories, such as type of material, format, volume and/or weight of the product. Then, their frequency was analyzed and results considered. The selection of these categories was based upon the fact that the interviewed experts where from these areas of food production.

Secondary data was also collected by conducting a literature review on primary food packaging and relevant keywords. The purpose, was not only to aid in the investigation of the appropriate topics for the interviews, but also to complement, and later contrast, the published content within academia to what is developed in an “*industrial*” setting.

Results and Discussion

From observation and literature research was noticeable that the current packaging in UK and Swedish stores lacks standardization. The analysis of the 4 products revealed that milk and yogurt packaging where the most different between the countries. While in the UK, the majority of 1L milk products are packaged in plastic, with a curved shape, in Sweden the same volume is packaged in paperboard, in a rectangular shape. In both countries alternatives to dairy are packaged in paperboard, with a rectangular shape. In relation to yogurt, most products in the UK, are packaged in plastic single pots of 110 to 450g while in Sweden, most yogurts are in a 1L paperboard gable top and in Tetra Top.

Chilled fruit juice is usually packaged in a 1L paperboard bottle in both countries, although in the UK, this product can also be frequently found in plastic bottles. Frozen ready meals are mainly packaged in carton, in a rectangular shape, in both countries. The disparities between formats and sizes affects the refrigerator design because it challenges the personalization and adaption of the appliance to the packaging it contains. Nonetheless, that seems to be the necessity, as consumer trends point towards the growth of individualized and customized products which are also convenient, healthy and sustainable.

Convenience was mentioned as one of the main trends for the future, both in the literature research and by the interviewees. In the literature research, convenience for a consumer means packaging that saves time and makes their life easier. In general, consumers look for easy openings and closures, multi-packs and portion control. Which is in accordance with the interviewee's perspective. It was said how, in the future, products will allow consumption at different occasions, such as "on-the-go" eating and weekend indulgence. Simultaneous, this trend relates with a consumer that will be looking for products that fit their needs, and their needs only.

Product personalization is very likely to increase in the future. For some interviewees technology will be the facilitator of that customization, by for example the incorporation of printed technology in the packaging. This will allow interactive labels to be used to send messages, targeted specifically towards the consumer interests.

Another scenario is likely to become possible with the growth of online shopping. As consumers shop online for products, a database can be recorded allowing each time a better customization of the needed amount.

Health is another trend following concern of diseases such as obesity and diabetes, but also concerns with appearance and general wellbeing. Future markets will also have to consider this trend when developing new products. As Teck Kim et al. (2014) mentioned, the rising of organic products will push the market towards antimicrobial or antioxidant activity-enhancing packaging, to increase health benefits and ensure safety. At the same time, packaging will also serve the function of providing portion control with servings that fit consumers' needs and "on-the-go" lifestyle (Teck Kim et al., 2014).

Food packaging should also be environmentally friendly (Han, 2014a) as consumers become more aware of what is sustainable and how to choose packaging that is recyclable, renewable or biodegradable (Teck Kim et al., 2014). A perspective which packaging experts agreed upon as for them, consumer perception regarding packaging has to be addressed in the future in order to shift from "unnecessary" and "waste" into something positive.

An approach to this concern can be portion control by providing smaller packages. This would increase the packaging material used, but decrease the amount of food wasted, and at the same time, would offer the convenience of not having to store an opened package.

The current adult consumer is ageing and will become a senior contributing to the proportion of the over sixty population. Today, those represent 23% of the European population, but due to reduction in fertility and increased longevity, this population segment will grow to 34% by 2050 (United Nations, 2014). A projection which is important to consider due to concerns on natural resource reduction and the need of suitable packaging for the aged consumer (Duizer et al., 2009). Nevertheless, the packaging and food industry is not addressing this age group in a particular way. For the experts, the advantages of offering a convenient package go beyond a specific target benefiting all consumers.

Considering the vision of “future packaging” by authors Gerding et al. (1996) and Louis (1999), and comparing it with the available packaging then, it was noticeable that packaging has been evolving at a slower rate than what was expected. A possible explanation relates to the conservative attitude consumers have towards packaging innovation, and to the fact that they are conformists. This combination of characteristics means that the majority of consumers follow each other’s decisions and do not want to see dramatic changes in their usual food products.

In five to ten years, packaging will suffer some changes, although very incremental. In terms of materials, the interviewees mentioned the rise of bioplastics and the decrease of glass as it become a material mainly used for premium products, especially wines. A possible alternative for the most common beverages packaged in glass will be flexible pouches, even though the current consumer perceives this format as being used in low quality products. Other formats and shapes are not likely to surge due to cost and production line limitations.

The biggest change might be in the packaging dimensions. The trend is towards smaller packages, multi-packs and packages with several compartments which will allow more variety and a wide range of flavors to be available. Bulkier packages will also increase, although not as much as the smaller ones. The intent is to satisfy the family households with 2L or 3L products. In the future, it is possible that the most frequent milk volume of today (1L) will slowly fade away to give place to bigger milk packages of 1,5 and 2L, but also smaller packages of half a liter (especially in Sweden).

Active and intelligent packaging will be present in the future, mostly in the form of time-temperature indicators and thermochromic ink. However, packages with radio frequency identification (RFID) tags, edible packaging and packaging with nanotechnology are not likely to become mainstream by 2025 because of its high cost, legislation process and consumer perception.

Despite the current packaging development process does not consider the refrigerator, in the future, the appliance might have to be contemplated as the need for improving the refrigerator “communication” with the consumer increases and packaging might have to be the mediator. Also, consumer trends demand more personalization and convenience in a market shifting from products to services. What this means is that in five to ten years the consumer is very likely to shop for a service of an organized personal kitchen instead of only a refrigerator.

The consumer would not buy a refrigerator like we know it today, but a core structure, a backbone for the shelves and compartments that fit best the products he or she will purchase online. Enabled by the online database, where the different packages are registered, a service of adaptation can evolve throughout the years by accommodating the lifestyle changes a consumer experiences.

Conclusion and further research

Food packaging and refrigerators are both in our lives, evolving to a set of consumer demands. Convenience is one of the most important drivers of packaging changes, with health, sustainability and personalization becoming increasingly more relevant in a future where technology and online shopping will set a new pace to developments.

Primary food packaging is expected to become smaller, but also bulkier, satisfying the need for portion control and new occasions. Usage of bioplastics, pouches, active and intelligent packaging are likely to increase while the use of glass and less sustainable materials is expected to decrease.

In the future, the refrigerator development is likely to respond to personalization by exploring a new feature: detachable compartments. Besides consumer trends, the motivation is also the shift of business models from products to services. However, such evolution will happen gradually in a process that requires collaboration across the supply chain.

In order to start this process, further research should consider the in-depth study of the most frequent type of products stored in the refrigerator. As an option, the establishment of partnerships between a refrigerator manufacturer and a food company / retailer should be considered. Furthermore, future studies should focus on the consumer perception of packaging in relation to the refrigerator and on the perspective of packaging professionals influencing the products in the consumer refrigerator.

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1. Introduction

1.1. Background

Every day we open our refrigerator several times, for brief moments, to search for and grab food; food that can yet be contained in another protective layer, a package. In this interaction, the package is the link between the refrigerator and the food we seek. Its path starts long before the consumer touches it and the refrigerator contains it, but even though its importance is clear to both, it is unclear whether its development and design considers the refrigerator.

For the Swedish company Electrolux[®], which is “*one of the global leaders in home appliances and appliances*”, food packaging is important to be considered due to the proximity to its consumers. The consumers are the focus of the innovation process where design is “*based on extensive consumer insight, to meet the real needs of consumers and professionals*” Electrolux (2014b), (Electrolux, 2014a). For this reason, the company has a need for more knowledge about primary food packaging in relation to the refrigerator, one of the company’s products.

On average, a person interacts with a package thirty times per day. From a brand perspective this creates thirty opportunities to communicate with their consumer, and thirty opportunities to increase loyalty and satisfaction. From the packaging development perspective, this represents a test to its usability, format, resistance; and an opportunity to improve future packages. For the refrigerator manufacturer it can help assess the need for new thermal and humidity conditions; or to test the accessibility of the products (Pousette et al., 2014). Previous research has considered the different actors in this interaction, although as far as the author is aware, no studies considering the relationship between primary food packaging and the refrigerator have been conducted.

Previous studies have focused on the development of a framework for packaging, with the purpose of considering the main participants and the factors challenging its design; other studies have focused on the consumer perception of packaging; on the relationship between food waste and packaging; the future of packaging and even the environment (Azzi et al., 2012, Pennanen et al., 2015, Goodman et al., 2008). Nevertheless, the study of how packaging might evolve and affect the design of future refrigerators has not been carried out previously (to the knowledge of the author).

How food packaging progresses is conditioned on many factors connected with the industry and the consumer. Examples include new technological developments, availability of new materials, and new consumer trends concerning design, appearance and/or the environment. Changes occur, and companies continue to innovate and research on how to satisfy their consumer in the best way.

Primary food packaging is the packaging closest to the consumer, serving functions, amongst others of protection, convenience/utility and communication (Pousette et al., 2014). Despite these core functions having existed for decades, the way they are offered can change as a consequence of many drivers, namely new ways of shopping, busier lifestyles, fast interactive communications and/or environmental pressures (Ryynänen and Rusko, 2015).

The purpose of this research is to discover trends. In other words, the intent is to understand food packaging modifications that occur in general directions, but might have an impact on refrigerators (OxfordDictionaries, 2015).

1.2. Problem formulation

As mentioned previously, Electrolux builds their refrigerators with consumer needs in mind, but nowadays the consumer preferences can change very rapidly. The market is diversified in terms of food products and shopping alternatives. There is variety in size, with offers going from small individual portions, and multipack portions, to family size and many in between. There is variety in the formats; presented as pouches, bottles and trays, as well as variety in the type of materials used.

Products are currently offered in many options, with standardization being hard to achieve. As the consumer seeks a way of standing out in the society, food items follow the same goal, trying to create value by bringing something new (Which?, 2013). In relation to packaging, this might be through the use of technology, by changing the dimensions, by having an interesting shape or even a combination of them all.

As the food industry innovates, new packaging has to be accommodated in the consumers' home, in the refrigerator, where it continues to protect and preserve the food it contains. For Electrolux, anticipating this interaction is part of their mission, where development emerges as a response to consumer needs. Therefore, the main problem this research will address, is to understand how the primary food packaging of chilled and frozen foods will, in the near future, influence the development of new refrigerators.

The exploratory study on this problem will consider the following research questions (RQ):

- 1. How will packaging for chilled and frozen foods evolve in the near future?**
 - a. What current packaging development will have the potential to be strengthened?
 - b. What will the external characteristics of packaging be, in terms of formats, materials, functions and dimensions?
- 2. What are the current drivers of these packaging changes and the implications for the future of packaging?**
 - a. What are the drivers, in relation to consumers, retailers, packaging and refrigerator manufacturers?
- 3. How might all of these factors (in packaging development and consumer behaviour) affect the design and development of future refrigerators?**

1.3. Research purpose

The main goal of the study was to explore the trends of the primary packaging of chilled and frozen foods, in order to analyse how they are likely to impact the design and development of future refrigerators.

The collected data will be used by the industrial partner Electrolux as part of their refrigerator design process. This research's theoretical contribution was with an indication of how packaging is likely to be in the future, providing knowledge which can be applied across diverse areas and serve as a connection between them. For instance, in logistics, understanding the upcoming packaging dimensions, shape and type of material could help predict suitable distributions for different categories. In marketing, the same benefits, could be addressed as new ways of interacting and / or communicating with the consumer.

1.4. Scope and Delimitations

In order to be completed in the proposed timeframe of 20 weeks, this research had to establish some limits.

As a company's research and development team usually work on solutions for years to come, a timeframe to approach the trends and the future, was delimited to the next five to ten years, in other words, to 2020-2025.

The intent was to have a time overview distant enough to be considered as part of the company's research and development, but without being overly futuristic and visionary.

The geographic location scope to this research was also defined. Two European countries were in focus: the United Kingdom (UK) and Sweden. The reason behind this choice relates to six factors: (1) Sweden was the country where the research was (physically) conducted; (2) where Electrolux's headquarters exist; (3) where several successful packaging companies were born and operate from, as for instance, Tetra Pak (Business-sweden.se, N.A.); (4) the UK food market and culture is different from the Swedish one; (5) both countries are important markets for Electrolux; and (6) both are located in Northern Europe, thus similar refrigeration needs might be shared (e.g., similar climates).

The type of food products analysed were the ones targeted to adults. Infant and children food products, and therefore their packaging, were excluded from the research scope because the market share is smaller than the adult one. For Electrolux, in general, the chosen focus of this research of studying adult-targeted food products, is more important.

The research is conducted only by one individual, with limited experience in one of the methodological approaches considered, interviews. Kvale and Brinkmann (2009) mention that interviews are a craft developed by experience, perfected with time and critical reflection. This was taken into consideration when conducting the interviews as each had learning outcomes that were used to improve the next ones.

The lack of review and feedback by other researchers might have impacted the results, as personal experience plays a relevant role in development and analysis. Nevertheless, techniques to ensure validity throughout all of the research steps were applied.

More limitations are explained further into the study, but they consider methodological details, including the number of food items analysed and the type of professionals interviewed.

2. Methodology

2.1. Research approach

To better understand and reach a solution to the problem previously mentioned, a **qualitative research** was considered as the best approach, for an understudied subject. When exploring the research questions and potential results that could arise, acquiring information directly from the packaging and food industry seemed to be a suitable strategy. Indeed, it is the packaging industry that provides the packaging material, or the packaging machines used by the food companies to protect the products, which are later marketed on the supermarkets shelves.

As mentioned previously, this research is exploratory, connecting both the food packaging and the refrigerator. In addition, this study purpose is focused on the future, on insights not published by the companies, thus the need for direct contact with the professionals that contribute to the packaging of our food products. Consumers and other relevant contributors such as packaging designers and technology/communications professionals were not considered. As Ryyänen and Rusko (2015) said “*Packaging professionals are gatekeepers who are able to change the industry*”, as they influence the products we have available by interacting with the supply chain, including the packaging suppliers, marketers and the product development teams.

Research questions RQ.1 and RQ.2 were mainly answered through the insights shared by the interviewed packaging experts (primary research) and the review of available literature (secondary research). RQ.3 was the result from the analysis of all collected data and subsequent discussion.

To have access to personal and professional insights, **in-depth semi-structured interviews** were then established as an approach to this study. Being one of the most commonly used types of qualitative research, Mason (2002) refers to it as having “*an unrivalled capacity to constitute compelling arguments about how things work in particular contexts, being capable of producing very well-founded cross-contextual generalities*” (Mason, 2002, Rosaline, 2008). Also, qualitative research goes beyond simple descriptions. The questions posed during an interview lead to arguments and explanations, to a process of understanding the interviewees beliefs (Rosaline, 2008, Mason, 2002). In this study, that is highly beneficial, as the willingness to share could be compromised if a less interactive method, such as a survey, were to be chosen.

Moreover, being an exploratory type of interview, having the simplest pre-planned structure, provides flexibility in the conversation allowing the interviewer to adapt the script by adding or removing questions according to each interviewee job position (Kvale and Brinkmann, 2009, Rosaline, 2008).

To perform the interviews, experts had to be contacted for the first time. As the author had no previous contact with the potential participants, a quantitative methodology such as a survey, could prove to be inefficient. Although it would be less time consuming, it would also be less personal, thus challenging the process of compelling the participants to share their insights with a new acquaintance.

Observation was another form of primary data collection used in this research. The intent was of analysing current food packaging characteristics, displayed on the supermarket shelf of each of the countries under study. Observation is a method that *“implies the collection of information by way of investigator’s own observation; Information [which] relates to what is currently happening.”*(Kothari, 2006) Therefore, an online observation of four food product categories was conducted.

Secondary data was also collected. The purpose was not only to aid and complement the solution to questions RQ.1 and RQ.2, but also to aid in the investigation of the topics that would be appropriate for the interview. With this theoretical review, data related to market analysis and academic research allowed a broader view of the subject. Also, it complemented, and later contrasted, the published content within academia to what is developed in an “industrial” setting.

Reasoning from the theory is a process imbued in qualitative research that will lead to inferences, to the searched conclusions (Mason, 2002, Nickerson, 2010). Understanding the data, and how it should be interpreted to produce the answers to the research questions, is crucial (Mason, 2002).

In this study, in particular, an **abductive reasoning** was chosen, as it will result from both deductive and inductive inferencing. Walton (2014) describes abductive inference as *“reasoning from a given data to a hypothesis that explains the data”*. In other words, when studying the theory a deductive method is used, moving the analysis from the general to the particular, by analysing several sources of information and then concising in the relevant subjects. At the same time, in-depth interviews and observation (the primary research) was also conducted, resulting in particular data, later analysed and generalized. This process is named inductive as the explanations and theory emerge from the provided information (Guest et al., 2012a).

As pointed out by Nickerson (2010) “Any nontrivial cognitive problem is almost certain to require the use of both deductive and inductive inferencing, and one might find it difficult to decide, in many instances, where the dividing line is between the two”. This perspective was considered, as both types of qualitative research implemented related with each other. Moreover, in an abductive method the interviewer plays a role in the research by the way it conducts and analysis it. Therefore, its educational and personal background, as well as choices during the study, influence the results in a process that “moves back and forth between our own data, our experience and broader concepts” (Mason, 2002)

2.2. Data collection

The gathering of primary and secondary data was conducted simultaneously so that both could benefit from the learnings of their application and continuous evaluation, as well as from the knowledge that was progressively acquired.

The search for secondary data was done by conducting a **literature review** on primary food packaging and relevant keywords; for instance, the consumer and future lifestyle scenarios. Online publications, reports and books, were the main sources of information in this theoretical review.

Primary data was obtained by observation and interviewing. The **observation** was of four food product categories: milk, yogurt, fruit juice and frozen ready meals, in the United Kingdom and Sweden. The selection of these categories was based upon the fact that the interviewed experts where from specific areas of food production. Namely, from companies focused on dairy (*Müller* and *Arla*), alcoholic beverages (*Diageo*), juice (*Orkla*) and frozen ready meals (*Orkla*).

To observe the packaging of this products, firstly the two retail leaders were identified by their importance on the market. In the UK it was *Tesco* with 29% of the market share. In Sweden it was *ICA* with 48% of market share (ChamberTrade, 2013). Then, the online stores were used to select the chosen food categories, observe the products and extract the necessary data.

In the case of **interviews**, its data collection and organization goes beyond the actual interview. According to Kvale and Brinkmann (2009) it should be organized in **seven stages**: (1) thematic conceptualization, (2) design, (3) interview, (4) transcription, (5) analysis, (6) verification and (7) reporting.

The **first stage** had previously been addressed by considering the purpose and themes to explore during the research although, deepening of the research questions was necessary (Figure 1).

The three main questions were further explored into sub-questions to help framing the interview for the third stage and at the same, to help the start of the theoretical framework. The sub-questions posed as a guide to be explored and developed during the research, including the analysis later on. Also, at this stage, investigation of research methods was conducted revealing the benefit of preparing the interview on the adaption of the research questions into more colloquial interview questions (Kvale and Brinkmann, 2009).

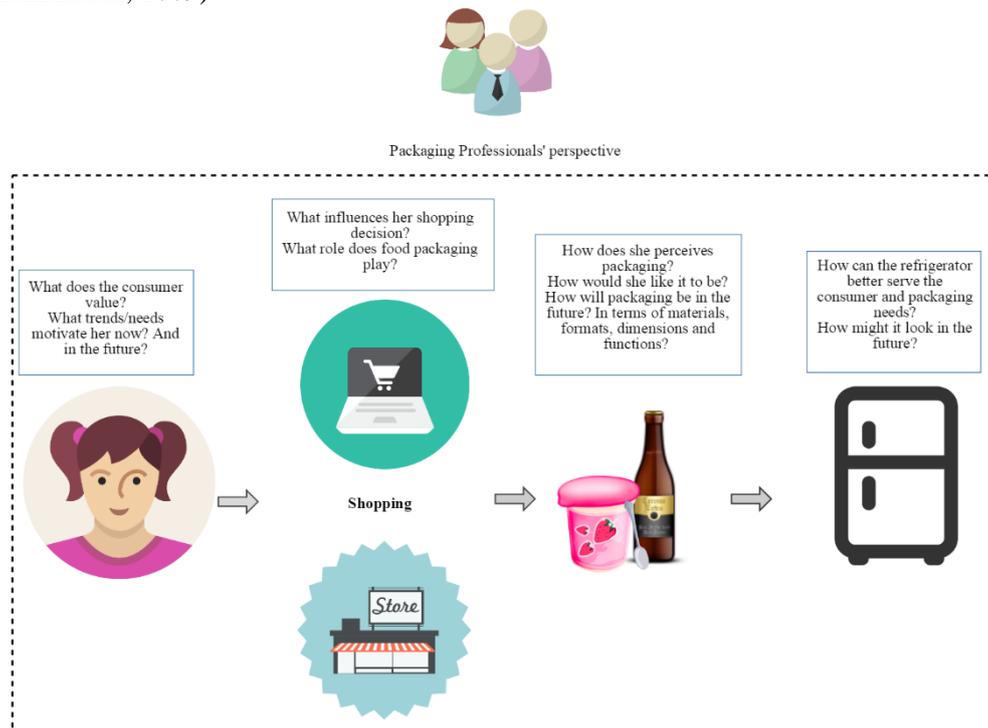


Figure 1. Schematics of sub-questions explored during the interviews and which resulted from the exploration of the three initial RQs

Designing the interview allowed to determine a duration of maximum an hour, as well as the approach, which was either in person, by Skype® or phone call. The latter was the least used method and usually took less time (around 40 minutes). Experts were selected based mainly on the following three criteria: (1) they had to work in a food packaging manufacturing company, in a food manufacturer and/or in a food retail company; (2) have a job position related with packaging, such as packaging technologist, or with innovation; and (3) perform their activity in, or have influence over the targeted countries for this research (Sweden and United Kingdom).

Extensive experience in the field of packaging was also relevant, but not decisive. Establishing contact with the potential participants was the next step. Although challenging, several professionals were contacted, mainly via e-mail.

Despite revealing interest, some did not want to participate due to a conflict with the company's confidentiality policy. Other factors, such as lack of response and availability, also influenced the number of interviews conducted.

To help ensure an ethical research, a **consent form** was asked to be signed by the participants (Appendix I). Quoting Aristotle "*the task of ethics is not to provide an abstract theory of the good, but rather to make us good*" (Kvale and Brinkmann, 2009). Hence, to ensure the author clearly communicated the purpose of the study, the public nature of the research and other relevant details, a written form was provided. This way, disclosure of personal details and the recording of the interview were subjected to their authorization.

After the arrangements, the **interview** would start with a short briefing about the study purpose, by asking the interviewee about any doubts and setting the audio recorder on (if allowed, which only happened to not be the case in one of the interviews). A semi-structured interview would then proceed following the prepared questions as a guide; as themes to be covered when the topic was suitable to the interviewees' expertise. To finalize, the interviewer would ask if any questions or comments were desired to be given, and express gratitude for the time and insights provided.

Some of the questions were specific (such as inquiring about edible packaging) to not only focus the answer within a theme (which would later relate to the research questions and the analysis), but also to avoid the use of key general words often associated with trends, such as convenience and sustainability. The purpose of those questions was to explore the possibility of certain areas being under development or, on the verge of being started, in the considered companies. The interview guide can be found in Appendix II.

The initial interviews were with professionals in packaging networks and packaging manufacturers. The collected data revealed that a slightly directed focus should be taken towards food retailers and manufacturers, as they seemed to be the influencers behind the packaging developments. Rosaline (2008) states that the research design, tools and even research questions, can evolve as the projects are set in motion. A point of view which is shared by other authors, to whom qualitative researcher should consider the knowledge and evidence collected along the process, in order to analyse deliberate on the initial research strategy. Then, if necessary, modifications should be made (Mason, 2002, Kvale and Brinkmann, 2009).

A total of **nine interviews** were conducted: Three food manufacturers, one beverage manufacturer, one food retailer, two packaging manufacturers and two packaging networks. Specifically five interviews were related with the Swedish market, three with the United Kingdoms' market and one with the Netherlands. Details about the professional information can be found in Table 1.

Table 1. Information about the interviewees

Code	Company name	Business area	Country	Position	Years of Experience
<i>MS-UK</i>	Marks & Spencer	Food retailer and producer	United Kingdom	Primary Foods Packaging Technologist and Innovation Lead	30
<i>M-UK</i>	Müller Dairy UK	Dairy products	United Kingdom	Packaging Manager Developer	16
<i>D-UK</i>	Diageo	Alcoholic beverages	United Kingdom	Global Innovation and Brand Change Manager	25
<i>O-Swe</i>	Orkla	Food producer	Sweden	Packaging Manager Developer	30
<i>A-Swe</i>	Arla	Food producer	Sweden	Packaging development engineer	25
<i>TP-Swe</i>	Tetra Pak	Paperboard Packaging Manufacturer	Sweden	Senior Technologist Specialist	39
<i>F-Swe</i>	Flextrus	Plastic Packaging manufacturer	Sweden	Business Development Manager	20
<i>PN-Swe</i>	Packbridge	Packaging Network	Sweden	Market Intelligence	30
<i>PN-NL</i>	NVC Netherlands Packaging Centre	Packaging Network	Netherlands	Manager of knowledge development and projects	8

The interview with the Dutch company (NVC) might go beyond the scope of this research. It was one of the first interviews to be conducted and therefore, the previous explanation applies. As the participant was employed at a packaging network, associated with international companies, its insights were still included in the analysis.

As stated in the consent form, the interviews were **transcribed** verbatim and sent to the interviewee, within a week, allowing him/her to amend or comment any content. No software was used to aid the transcription.

The next stage was the analysis of the interviews' data. To start, the transcripts were read several times. As Guest et al. (2012a) asserted, this process must be done to look for key words or ideas within the themes of the questions to "*help outline the analysis, before any analysis takes place*".

2.3. Data analysis

The data collected from online **observation** was grouped in categories, such as type of material, format, volume and/or weight of the product, and their frequency was analysed Microsoft Excel[®]. Attention should be given to the fact that the items available on the web store are subject to stock variations. Therefore the collected data cannot be generalized to all products, even within the observed categories.

Regarding the interviews, Roulston (2014) pointed out the "*analysis of interview data is theoretically informed and there is no one right way to analyse qualitative interview data*", by revealing that theory and methodology investigation is an interview requirement which must be taken into consideration beforehand.

For this study, **thematic analysis** was the chosen method to explore the collected data and identify and describe the common themes, either explicit or implicit. Being one of the most used types of analytical methods in qualitative research, this approach is useful in providing an understanding of complex meanings in textual data (Guest et al., 2012a).

Analysing interview data required **three phases**: (1) data reduction; (2) data reorganization; and (3) data representation (Roulston, 2014). The content was firstly read and keywords were found. To those, codes were assigned. This stage was what Kvale and Brinkmann (2009) called "concept driven coding", as the researcher already had done some literature review and codes developed in advance.

The second phase involved the reorganization of the data into tables, structuring it according to the identified themes. Lastly, the meanings of interviews were interpreted. Despite the interpreter being only the author, the statements given by the interviewees kept its true meaning (Kvale and Brinkmann, 2009, Roulston, 2014). As Roulston (2014) points out, this is a process that involves reading, reflection, writing and re-reading. At this point, when results were presented, the type of reading approach was literal. This means that the words and language used by the interviewees were mostly maintained intact (Mason, 2002).

The sixth, and next stage of the interview development was the verification, which is covered in the next section, validity and reliability.

The final stage of an interview is reporting. During the reporting an interpretative and reflexive reading was conducted between both the theoretical framework and the interview results (Mason, 2002). That way the analysis should be made in relation to prior theory and knowledge, in order to result in valid arguments (Roustson, 2014).

2.4. Validity and reliability

The verification process is a continuous one that goes from the first stage (thematic conceptualization) to the last (reporting), ensuring the validity of the data obtained (Kvale and Brinkmann, 2009). Guest et al. (2012b) refers to **validity** as being the “*notion that one is assessing what one is intending to assess*”.

When applicable, techniques to enhance validity were applied. For example, more than one method was used to collect the searched information; the participants were able to review what they had said during the interview and were allowed clarification of potential doubts; the interviews were transcribed verbatim and quotes from the participants were used to relate the information directly to the author (Guest et al., 2012b).

It should be noted that other techniques were not applied in this research, such as review of the themes by outside researchers.

The interviews’ purpose was to collect the personal view of the interviewee by the sharing of his/her insights and perspective on certain themes. By questioning this, and ensuring the author understood the purpose behind each of the questions asked, it can be assumed that the interview findings lead to transparent results (Kvale and Brinkmann, 2009, Guest et al., 2012b).

The personal aspect of performing a qualitative study delimited the **reliability** of this study, because each participant has shared perspectives that were not purely based on facts. Therefore, if this research is to be repeated, the assessments would probably differ. This relates to the facts that the questions asked slightly differed from participant to participant and the answers given relate to a future perspective influenced by current personal views. All of these factors might have influenced the reliability of the research. Nevertheless, validity is considered the most important aspect of a qualitative research, as if not valid, research results do not contribute with valuable knowledge (Guest et al., 2012b, Kvale and Brinkmann, 2009).

3. Theoretical Framework

From breakfast to dinner, every day, the consumer encounters packaging that contains food and protects it from its surroundings. In reality, food packaging goes beyond protection and serves several purposes. It preserves the food, from the moment of collection of the raw materials to the delivery of the final product at the retail store and/or the consumers' home, keeping it safe from health risks, and making it traceable along its path. Adding to this complex interaction, the environment, marketing and other consumer benefits such as convenience, portion control and price must be considered in the process (Han, 2014a).

Next, several trends influencing today's food packaging and the consumer are presented, but firstly, a short view on how trends have guided packaging development and how, in the past, packaging was expected to become ("Past perspective"). This will set the perspective for a future discussion on how packaging evolves in a fast moving world.

Then, the packaging on today's shelves is analysed and the consumers' point of view is considered ("The present"). To conclude, an analysis of how the future might look is described in "The future starts now".

The chapter organization is as follow:

- Past perspective
 - Packaging trends history
 - Looking through lenses of the past
- The present consumer view
- The future starts now
 - The vision
 - The Packaging

3.1. Past perspective

This section will explore past projections made by different authors, to understand which food packaging trends have been discussed, as far as thirty years ago.

With such analysis, a discussion on how packaging trends have evolved was started in the “Results and Discussion” chapter.

3.1.1. Packaging trends history

An analysis of past food packaging trends reveals that some functions prevail as essential. In the sixties, convenience and point of purchase marketing were the most valued packaging functions. In the seventies, the emphasis was in packaging that was light in weight, and addressed the concern (at that moment in time) on energy saving (Stilwell et al., 1991)

Thirty years ago Yokoyama (1985), as cited by Han (2014a), considered **good packaging** as the one being (1) mass produced, (2) with reasonable and efficient packaging material, (3) suitable structure and form, (4) convenient and (5) disposable.

As noted in Table 2, packaging has been evolving by focusing on different concerns, although the environment, safety and security issues, which are related to the packaging and the food it protects, have persisted and have become a necessity to a demanding consumer, and a requirement to the packaging development process (Han, 2014a).

Table 2. Food packaging functions and society issues according to time period. Source: Han (2014a)

Period	Functions and Issues
1960s ^a	Convenience, point-of-purchase marketing
1970s ^a	Lightweight, source reduction, energy saving
1980s ^a	Safety, evidence of tampering
1990s	Environmental impact (e.g., solid waste)
2000s	Safety and security
2010s	Carbon footprint reduction

^aData from Stilwell (1991).

3.1.2. Looking through lenses of the past

“With a few exceptions, the future of packaging in the next 25 years will probably be more of an **evolution** than a revolution, at least when considering advanced research work worldwide. This future includes packaging materials, packaging processes (often linked with new food processing), transport packaging and combined electronics” (Louis, 1999). His perspective was that packaging would slowly evolve as a result of a combination of packaging and technology.

In addition, other authors saw the future of packaging as a result of a **collaborative process** between all of the supply chain actors, from the food producers, the distributors and the retailers, to information technology and the consumer (Sonneveld, 2000, Gerding et al., 1996, Yam, 2000).

Today, this collaborative development can be termed “holistic approach” to packaging design (Azzi et al., 2012). Nevertheless, it can still be overlooked when variables, such as cost, become the main priority, leading to a product potentially unfit with the consumer experience (Braw et al., 2014).

In 2000, Sonneveld mentioned that “*together with internationalization and globalization the packaging industry will have to develop into an industry driven by `global service partnerships' with their clients*” highlighting the crucial impact the consumer has on packaging trends. Moreover, convenience was mentioned as the key driver of packaging development leading to packages which are “*easy-opening and re-closable; single- portion packs and cluster packs; tamper-evident packaging; dual ovenable packaged meals or meal components; modified atmosphere packaging, etc.*” (Sonneveld, 2000).

Besides convenience, other **drivers** were: (1) demographic changes towards an older population and increased number of households, although with less family members; (2) decrease in the time available for shopping and cooking; (3) health and safety; (4) more critical and sophisticated consumers; (5) more informal eating patterns; (6) growth of individualization and (7) environmental legislation (Sonneveld, 2000, Gerding et al., 1996).

Considering these drivers Gerding et al. (1996) pointed out **packaging trends** that would satisfy the mentioned needs. Some of these were of packages that are (1) easy to open to aid the older population, (2) smaller portion sizes and multi-packs to satisfy the snacking habits and smaller households, (3) environmentally friendly, (4) safe and (5) re-closable. The authors even specified that this last feature would be used for foodstuffs such as grated cheese, frozen foods and nuts.

Fifteen years ago, in 2000, the **Smart Kitchen** idea was mentioned by Yam. For him, in this kitchen, appliances such as the microwave, refrigerator and dishwasher would all be connected via a computer hardware and software with not only Internet connection, also scanner and voice recognition. This kitchen would allow the consumer to shop for groceries online and check the weather forecast. Moreover, the connection and interaction would include all non-kitchen appliances, and the consumer would be able to manage all of the household activities, even if not at home (Yam, 2000). Today, this scenario has a denomination: the *Internet of Things*.

3.2. The present consumer view

Over time, certain changes have happened in the packaging and food industry, but the consumer has remained an importance piece of the packaging development process. Consequently, this section considers the consumer's view of food packaging by researching data based on *how the consumer perceives today's packaging; what bothers him/her about it; what does he/she looks for; what does he/she values when purchasing and after it*, amongst other.

Different markets have different perceptions, consumption habits, social values etc. (Sonneveld, 2000). It is those habits and routines that help the consumer decide when facing a store full of similar products. It is the previous experience, the traditions, the desired lifestyle that motivate the purchase. Rynnänen and Rusko (2015) mention how packaging is associated with feelings and values, often times related with gift offers or childhood memories.

Consequently, when developing a food product, companies have to prioritize the satisfaction of consumer needs and customs because if those are not fulfilled, the product is likely to be unsuccessful (Rynnänen and Rusko, 2015). This perspective reaches as far back as 1996, when Gerding et al. pointed out that a packaging is conditioned by the **product requirements** (such as the need for refrigeration) and by the **consumer demands**, whether those being practical (like the product's weight) or individual (conditioned by how the product is perceived).

Food packaging can be seen by some consumers as "*annoying waste*" and a "*burden for the environment*"; notions that do not coincide with the reality. An example of the mismatch between what the consumers believe to be the amount of packaging used in a product and the reality, can be seen in Figure 2 (Marks&Spencer, 2008). It is shown that organic products and basic produce are considered to have a high amount of packaging when, in reality, they do not. On the other hand, wines used the highest amount of packaging, among the analysed products, although the consumer perceives it as using little.

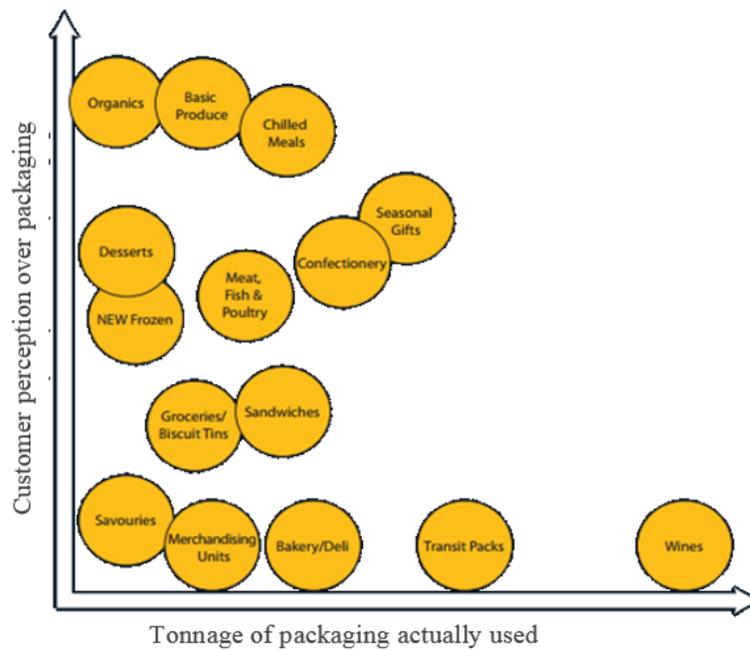


Figure 2. Consumer perception of packaging versus actual tonnage used. Source: Marks & Spencer (2008)

Nonetheless, notions are not ubiquitous as others seem to believe it is necessary to protect our everyday food products recurring to the use of packaging. A more accurate perception considering that over 90% of packaged products would not be available without its packaging (Braw et al., 2014, Caner and Pascall, 2010, Grönman et al., 2013).

The connection between food packaging and the product it contains is very tight, as both packaging and food can be perceived as the same product (as one), in an act of purchase. That prioritizes price, brand and packaging as external inputs. This is a point of view that is shared by professionals working with food packaging. Designers, researchers and technologists recognise that consumers cannot separate between packaging and the product characteristics due to the **sybiotic relationship** between them (Ryynänen and Rusko, 2015).

This product-package relationship may relate to the consumers moderately **conservative** attitude towards packaging innovation. They appreciate a renovated look, but as long as it does not compromise the familiar appeal. They learn to identify the products by associating certain cues, related with the package appearance, and then grouping similar products (Ryynänen and Rusko, 2015).

In addition, most consumers tend to be **conformists**. Müller (2007) defends that 60% of the consumers belong to the group that guides their choices based on others, on the trendsetters.

The rest of the population are consumers whose decisions are based on mainly price, safety and health (20%), as well as consumers whose decisions are according to their values and beliefs (for instance, about the environment and/or animal welfare) (Müller, 2007). These aspects characterize today's consumer, but will likely also be a part of the future ones. Thus, some aspects can be addressed.

3.2.1. The future consumer

By 2025, 47% of the European workforce will be a consumer group designated *Millennials*. This is the generation born between 1980 and 2000. Their characterization is extensive and well known in marketing subjects. Their generalization is that they are the "connected generation". The one that uses social media, shops online and purchases according to their values (like being sustainable).

As they reflect about their shopping decisions, they also consider **packaging** as a feature to be considered. 80% even considers it as an important criteria when purchasing, whereas 85% looks at packaging materials as being a part of the products' and brand experience (StoraEnso, 2015). This is the generation retailers and brand owners are focusing on now, to ensure future profits. Millennials will also rely on them (and accept their guidance) to make sustainable purchases (StoraEnso, 2015).

Apart from the younger consumer getting **older**, also the current adult consumer will become a senior contributing to the proportion of the over sixty population. Today, elders represent 23% of the European population, but due to decrease in fertility and increased longevity, this number will grow to 34% by 2050 (UnitedNations, 2014). A projection which is important to consider due to concerns on natural resource reduction and the need of suitable packaging for the aged consumer (Duizer et al., 2009).

3.2.2. Consumer needs

In 2014, a case study by Joutsela and Korhonen, using an online research community with 137 Finnish consumers, was conducted to explore the factors influencing household **food waste**. The results showed that reasons such as poor planning skills, busy lifestyles and ignoring the expiry date were aiding food wastage. Some of the consumers mentioned that is a challenge to know the right portion size suggesting smaller packages and packages with separated portions as a possible solution (Joutsela and Korhonen, 2015). Examples of comments made by the consumers were as follow: *"My hectic lifestyle might increase food waste, because I do not have the time to follow what's happening in my refrigerator. I think that the packages work just fine, I just need to sharpen up my own behaviour"*;

“I long for packages that have two compartments. You can use only one half and leave the other half waiting for another time of use. One cannot find many such packages. Why? A nice idea for a package would be one that would tell you: Hey, I’ll cook for four, but if there are fewer people eating, I’ll preserve opened for one week in your fridge. If you do not eat me by then, freeze me and I’ll be good for another six months.”

In a study, conducted by *Marketing Consultancy Consumer Network Inc.*, in the United States, over 3000 consumers were surveyed and the results demonstrated that they wanted **packaging** which saves time and makes their lives easier. They would chose a brand over another if one was more easy to store (54%), took up less space (50%), was easier to handle (48%), to pour (46%) and to detect or read (47%). Also, most participants did not care about the packaging material used, but about the functionality, *“the likelihood of spilling of the product, and the probability of injury while doing so”* (Caner and Pascall, 2010).

For the consumers, most of the **complaints** were regarding cans that are difficult to open as well as bottles and cartons that they were not able to reclose (Caner and Pascall, 2010).

The needs and desires of a consumer are many, but simultaneously particular, challenging the companies on what to compromise. Some of the researched consumer needs are revealed next.

3.2.2.1. Personalization

In a time where communications are instantaneous and information is shared easily, what used to be an expensive added benefit, exclusive to luxury brands, is today achievable (Braw et al., 2014). Having something unique, that others recognize has personal, has value for the consumer. **Individualized packages** are becoming more mainstream and as Ryyänen and Rusko (2015) said, they are *“pushing for change”* (Ryyänen and Rusko, 2015, Braw et al., 2014).

One example is the *Coca-Cola*[®] 2013-2014 campaign “Share a Coke”. During the summer, *Coca-Cola*[®] printed the most popular names in the UK, on their labels, so their consumers could share the drink with someone they cared about. The marketing campaign was a hit with more than 150 million personalized bottles sold and over 730 000 glass bottles personalized via their e-commerce store (Hepburn, N.A.). Other approaches to customize products are also possible due to the increasing knowledge in **3D printing** where the user can take the power into his/her hands and become the producer (Which?, 2013).

Müller (2007) points out that the individualization will increase as a way of expressing our lifestyle affecting all parts of it, including nutrition.

3.2.2.2. Health and Safety

Health is a major trend in today's society following concern of diseases such as obesity and diabetes, but also appearance and wellbeing. Future markets will also have to consider this trend when developing new products. As Teck Kim et al. (2014) mention the rising of organic products will push the market towards antimicrobial or antioxidant activity-enhancing packaging, to increase health benefits and ensure safety.

When it comes to health, packaging also serves the function of providing **portion control** by adapting the servings to fit the consumers' needs and "on-the-go" lifestyle (Teck Kim et al., 2014).

In the UK, the *Eatwell* plate teaches the consumer how to eat a balanced diet by showing the proportions of each major group of nutrients. Nevertheless, when it comes to the actual consumption, the recommendations are not being met, with the exception of meat, fish, eggs, beans and other non-dairy sources of protein (Figure 3) (DEFRA, 2014).

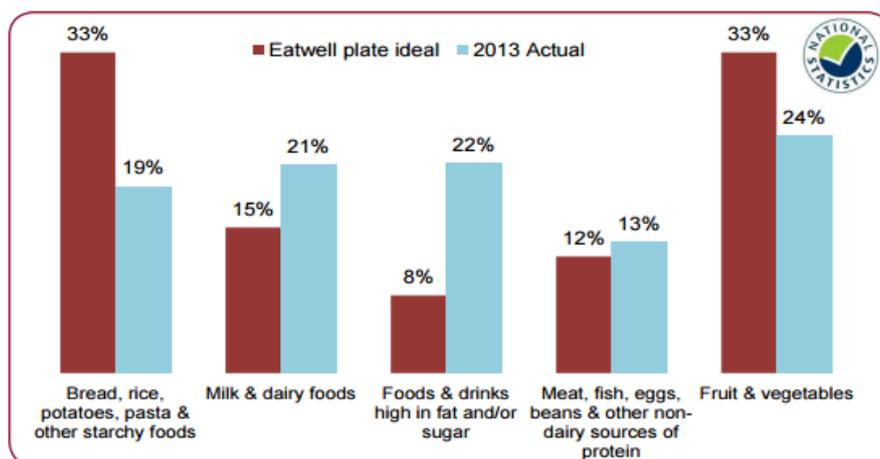


Figure 3. Comparison between the Eatwell plate recommendations and actual food consumption in the UK, 2013. Source:DEFRA (2014)

Considering that about 60% of English adults are either overweight or obese, the government goal is to help consumers closing the gap between the actual (excessive) consumption and the recommendations (NHS, 2013, England, 2014). This might lead to shifts in habits towards a reduction of milk and dairy products, foods and drinks high in fat and/or sugar as well as an increment of fruit and vegetables.

Health not only relates with the food we eat, but also with the **packaging** containing it. The possible migration of chemicals from the packaging materials to the food is a primary concern to the consumers and industry (DuPont, 2012).

Braw et al. (2014) state that “*Brand owners are looking for secure labelling that has some user-input mechanism (image sensor or touch pad) and output device (display) integrated on the same tag*”.

Han (2014a) corroborated this statement. Han believes the focus of food technologists is to revise packaging in order to increase **food safety and security**. Active packaging might be one of the ways to achieve it.

3.2.2.3. Environmental sustainability

Besides all of the above aspects food packaging should also be environmentally friendly (Han, 2014a). Consumers’ **increased awareness** guides their choices towards packaging that is recyclable, renewable or biodegradable. For example, a more sustainable alternative to metal cans can be pouches which, in total, require less energy to be produced (Teck Kim et al., 2014).

The main challenge with the environment and climate change is the fact that the impact of the emissions of the present days will be felt in the future initiating an **unpredictable** number of harmful events related with extreme weather conditions. Curran et al. (2011) defends that this phenomena “*will have serious consequences for the global value chains we depend on*”.

3.2.3. From intent to purchase

The consumer has several packaging and product requirements which are manifested at the point of purchase where approximately 73% of the goods are bought and chosen **in the moment** (Ryynänen and Rusko, 2015). Other authors estimate it to be of 66% (Azzi et al., 2012).

When it comes to a specific packaging characteristic, like color, it is estimated that 62% to 90% of the consumers buy a product based on that. And besides color, other external cues trigger the consumer and influence his/her decision. If all packages looked the same, if a **standard** was the norm, that effect would be lost (Ryynänen and Rusko, 2015).

Considering that the **store environment** and the packaging are critical factors during the consumer decision-making process, it is important to understand the consumer perception of packaging in that specific moment (Azzi et al., 2012).

In study from 2004, **attributes** such as appearance, packaging and transparency were proved as significantly more relevant at the moment of purchase, while the attributes associated with the product experience, such as taste and texture were more important after purchase. Freshness, packaging shape and colour were important in both moments (Ragaert et al., 2004).

More recently, in 2012, another study revealed that packaging shape and “touch” were more relevant after purchase (Azzi et al., 2012). A possible explanation is given by Ryyänen and Rusko (2015) who state that “*in the home environment the same package exposes quality characteristics in terms of usability. Then issues like extra information, easiness to open and close, and size of packaging become relevant. Does the package fit into a fridge? You do not think actively about these matters while shopping.*”

3.2.4. After purchase – The refrigerator

In the UK, most households have a refrigerator from one of the major brands *Beko*[®], *Indesit/Hotpoint*[®] and *Bosch Siemens*[®] (Westgarth, 2014).

When it comes to features, consumers are looking for improved **functionally** and assume that it is guaranteed. In a market research, almost 2000 Internet users, above the age of 16, who have a fridge/freezer, or intended to buy one in the next 12 months, were surveyed in the beginning of 2013. When asked to select the features they would pay more to have in their fridge/freezer, the consumers revealed they were not as interested in odour or humidity control (16% and 14% respectively) as much as they were in water, drinks, ice **dispensers** (26%) or **freshness** monitors/stock **control systems** (30%) (Figure 4) (Westgarth, 2014).

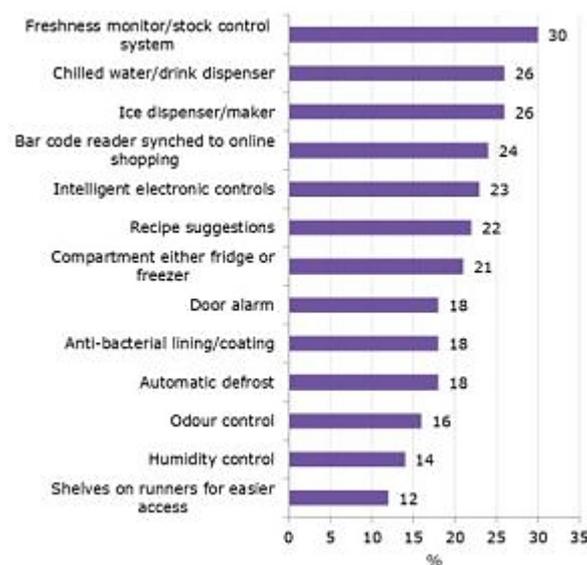


Figure 4. Features of fridges and freezers consumers are willing to pay more for in a refrigerator. January 2013. Source: Westgarth (2014)

Technology captures an important fraction of the consumers' interest. The second and third most selected feature is related with technology by inclusion of a “bar code reader synched to online shopping” (24%) and “intelligent electronic controls” (23%). The association of refrigerators and technology will benefit companies such as *LG* and *Samsung* whose market share is expected to grow in the UK, in the years to come (Westgarth, 2014).

New **refrigerators** in the market have for instance, compartments for specific products and purposes, such as temperature regulation and/or personal convenience. *Samsung* has a “fresh room” section to store fresh meat and fish at zero degrees; another compartment to store cans inside the fridge door; and *LG* has what it is called the “door-in-door”, where a section (a door) is isolated from the main one, in order to allow access of regularly needed products (Westgarth, 2014). Electrolux most recent launch includes a flexible storage system which allows the consumers to move around several detachable door compartments, alongside the fridge door (Figure 5)(Electrolux, 2015).



Figure 5. Images from Electrolux Custom Flex™ refrigerator. A) Detachable compartments; B) Compartments in the fridge door. Source:Electrolux (2015)

Such features still do not fit the expectations for a “**smart fridge**”, as it should incorporate technology to better assist the consumer. A particular definition of the concept was not found by the author, nonetheless in 2002, *LG* was developing a “smart fridge” and stated that “users could watch TV, listen to music, surf the Internet, re-stock the refrigerator on-line or check the latest news and weather – all without leaving the kitchen” (Kuniavsky, 2010).

Nowadays, these features are still not on our everyday fridge. The “**failure**” says, Kuniavsky (2010) is mainly due to three factors: (1) lack of communication of the consumer benefits (in relation to other technological products), (2) high price range and (3) different technological life cycles between the refrigerators and the incorporated technology; for instance: technology is updated frequently and computers are used for extensive periods of time. On the other hand, refrigerators tend to “*disappear into the background and are used in very brief, frequent burst*”.

3.3. The future starts now

Companies need to innovate to remain competitive in a fierce market. They need to evaluate the market and the reactions to the products currently available, in order to improve their future. Most of the current projects in research and development (R&D) are to be placed on the market in months or years to come. Therefore, the importance of understanding the present, but also the future, so that uncertainty in product acceptance, and consequent success, can be reduce as much as possible (Andriukaitis, 2015).

In the following pages results from the literature research are presented in two parts. The first part “The vision” focuses on the prospects of events that might affect packaging, described as future scenarios, and how technology can impact the changes to come. The second section “The packaging” elaborates on how packaging is expected to become in the perspective of 500 packaging professionals, as well as future changes in packaging materials, formats and functions.

3.3.1. The vision

Throughout the years, *Forum for the Future*, an independent non-profit organisation working globally with businesses, governments and other organisations, to solve complex sustainability challenges, has been anticipating the future. As a result, different scenarios have been created with the purpose of foreseeing how the future of packaging, of retail, of electronics and the consumer might be in the years of 2019, 2022 and 2025, respectively. Next, the relevant findings are described.

3.3.1.1. 2019

In 2008, a scenario report of what the *Future of Packaging* might look like in 2019 was published. The research of this British organization, led to the development of scenario based futures, for packaging and packaging waste. The results were based upon certain factors with high uncertainty and with high impact on packaging waste.

For example, one factor is crude oil price. It is not possible nowadays to know how the oil price will affect packaging in the future. That is highly uncertain. Although, it is possible to understand that its impact will be heavily felt. Other factors with potential to affect the packaging, in the near future, are shown in Appendix III where it is clear that recycling and demand for smaller portions might have a medium impact, while lightweight packaging might have a high impact (Goodman et al., 2008).

The scenarios created, considered how the different factors might lead to alternative outcomes and are categorized in slow (S), medium (M) and fast (F) changes.

In the slow change scenario (S), **smaller portions** and **convenience** food are very popular. Carbon footprint has been reducing and packaging clearly communicates this achievement to the consumers. Complementing this, is the slow movement towards light packaging materials in detriment of glass and aluminium.

Nevertheless, retail packaging formats are still far from **standardization**, compromising improvements in logistic and disposal. In part, this is due to the unwillingness of the producers and retailers to establish a full collaboration (Goodman et al., 2008).

The opposite scenario considers a fast change (F) where consumers focus on **re-use**. Packaging that last is well perceived, as consumers become aware of environmental and economic costs. While **edible packaging** gains popularity, local production increases and food import becomes very expensive (Goodman et al., 2008).

If changes happen at a medium pace (M), the world will see the **standardization** of the packaging formats. Primary packaging loses importance in **communication** as display on shelves decreases and the use of secondary packaging by the online shopping services increases. At the same time, **bioplastics** production rise due to high oil prices. Literacy on **sustainability** increases in a world where consumers are able to select their product based on environmental aspects they value, such as water footprint. A detailed product information on the online shopping databases supports this movement (Goodman et al., 2008).

With the rise of **e-commerce**, consumers, and especially young adults, are using the Internet for purchasing, while stores become trial locations for experiencing a product or trying a food sample. If interested, the consumer buys the product to soon be delivered to his/her home. Therefore products are now delivered in a “**shop and drop**” system existent in houses: a password protected refrigerated bunker area where the purchase items are left until the owner gets home. This structure represents a shift from **products to services** as the consumer does not buy the product anymore. He/she pays for a system that includes the product, the delivery and the return (if needed). A sequence of steps connected to the company and not dependent only on the consumer (Goodman et al., 2008).

3.3.1.2. 2022

According to *Forum for the Future* and the leading UK retailer *Tesco*, the retail in 2022 will have to adapt to a number of factors, namely to the increased need for **customized products**. Berry et al. (2007) mentioned the possibility “*for consumers to buy products designed for them personally: exactly the right sized cereal box for their family, clothes made to specific requirements, foods with the right nutritional balance for their health, and so on.*” (Berry et al., 2007). Also retailers are aware of the **older population** needs providing specific product lines (such as *Tesco Silver*) with “*store formats, products, and so on, all customised for older people*” (Berry et al., 2007).

Online shopping will aid in this evolution and ease the grocery shopping process, by letting the consumer order based on the recipe he/she would like to prepare. This process will be possible due to an **individual database** of the consumers’ preferences and the direct communication between pantries, refrigerators and retailers. An interaction that might raise privacy concerns (Berry et al., 2007).

While the consumer can still go to the physical store and fill their reusable containers in taps for products such as milk and hair conditioner, he/she can also have their everyday life products (like milk and bread) automatically delivered to the house. In the same way the consumer can also opt to receive a meal according to previous food consumption and diet restrictions (Berry et al., 2007).

To serve the more frequent needs and convenience, the shopping basket and packaging becomes smaller while variety increases. Even new types of packaging become popular like smart refrigerated packaging; with a small fuel cell, the product keeps itself cold revealing colour changes when not able to continue (Berry et al., 2007).

Households will shift most likely in two directions, single households and large households. In the UK single households are expected to increase 20% by 2026, while larger domestic units might bring together generations, the grandparents and the children, all living in the same home. These trends are influenced by two major factors. One is the busy lifestyle where convenience and flexibility are key. The other is the revival of the community spirit (Berry et al., 2007).

Consumers no longer feel the need to buy new products (unless they are custom made). Retailers provide “*cheap-to-run and efficient washing machines, dishwashers, microwaves, cookers, fridges and freezers, each with a lifetime supply of products designed specifically for use with them*”. The shift from selling **products** to providing **services** appeared as a brand expansion evolution, as consumers already decided on the basis of brands and not products, by the experience and recognition the brand brought to their lifestyle (Berry et al., 2007).

Technology is a big driver in this scenario. As suggested by Berry et al. (2007) “*Hi-tech fridges, cookers and disposal units can interact with smart packaging to help consumers shop, cook and eat easily. Nanotechnology allows self-cleaning surfaces and clothes*”.

Nevertheless these developments may be highly compromised by food shortages caused by environmental changes (Berry et al., 2007).

3.3.1.3. 2025

In 2011, *Forum for the future* also collaborated with the electronics company *Sony* to create new scenarios. Although this time, the focus was on world technology modifications and the year was 2025. According to the study, in 2025 **sharing** will be a must. Owing something is not the core of consumerism anymore as people reuse and adapt products. Supporting this lifestyle are the new **leasing** models offered by companies who now work in close proximity with the consumer not only to offer a product that meets consumers immediate needs, but also the future ones. Now, the intent is to build and change a product until no more options are available (Knowles and McLachlan, 2011).

Complementing this perspective is designer Jonathan Ford, in his article “*The Future of Packaging: From Brand Design to Biomimicry*”. He describes 2025 as a place where “*technology, automated home delivery and increased personalization will be providing pure product and improved personal service*”. In his perspective the brand itself will not be as emphasized, as the brand experience gains importance through use of sensorial and psychological stimuli (Ford, 2015).

3.3.2. The packaging

In a 2012 online survey conducted by *DuPont* and *Packaging Magazine*, more than 500 packaging professionals replied to several questions regarding the present and trends for 2024.

The participants’ perspective was that consumers currently value convenience and shelf appeal, although in ten years, they see consumer’s valuing packaging’s **sustainable** features, recyclability and reusability, as well as convenience. The latter is considered to always be valued by consumers (DuPont, 2012).

When questioned about what most affects their work, 59% of the participants replied **cost** while 44% said **food safety/security**. Nevertheless, in a decade the experts believe sustainability and food safety/security will dominate (51% and 37%, respectively) while cost importance decreases. Two other trends were considered to be as important today as they will be in the future: affordable technology and convenience (DuPont, 2012).

Convenience has been a key trend for decades. Even in 1999, easy opening and closures were recognized as a marketing requirements. At the time the prediction was that “*within the next three to five years the widest use of these devices will be on every type of package, for the simple reason that consumers will no longer buy packages that are difficult to open*” (Louis, 1999).

Other authors agree that transparency (in relation to product visibility), convenience, especially in the opening and closure of the product, and ready-to-use products such as oven or microwave ready package, are trends to follow (Azzi et al., 2012).

3.3.2.1. Materials

Currently **plastic** is the second most used packaging material (Teck Kim et al., 2014). Being sourced from crude oil, plastic is under environmental and economic pressure as cost of petroleum rise and are expected to continue to do so, in dramatic ways (Teck Kim et al., 2014). Nevertheless, 65% of the packaging professionals surveyed by *DuPont* and *Packaging Magazine* believed that, in 2024, plastics will continue to replace metal and glass. Sixty-five percent also believe that rigid structures will continue to be replaced by flexible ones (DuPont, 2012). Farmer (2013) has a similar perspective, as for him “*it seems the relentless rise of plastics barrier technology will further erode the glass packaging market*”. In the future, **glass** will mostly be used for added value applications as wines and spirits of prestige, in an upper price range.

To tackle the issues surrounding the use of plastic other options are being considered, for instance **bioplastics**. A product of renewable sources such as starch, polylactic acid, proteins, lipids or others, which is considered by Zhang et al. (2014) as a “*major trend for the packaging industry*” (Teck Kim et al., 2014, Zhuang et al., 2014).

Biodegradable plastics (films that decompose in the environment) are also a trend to follow (Zhang et al., 2014). In this field, innovations such as *Plantic*[®] are helping food producers to reach their goals in terms of sustainability. *Plantic*[®] is a bioplastic that degrades completely in about three weeks, when in a compost heap, and it dissolves in minutes when in water (Figure 6)(Farmer, 2013). Despite many applications, for now this specific bioplastic it is only suitable for foods and goods with water activity of 35 to 70% (*Plantic*, 2015).



Figure 6. *Plantic*[®] bioplastic being dissolved in water (*Plantic*, 2015).

Carton is also used for aseptic packaging which has been growing in sales for small-sized drinks. 30% of all aseptic carton packages in the UK are now in packs of 330mL pressured by the “on-the-go” movement. Expected to increase, this trend, also demands packaging that is simultaneously easy to open, pour and drink (Farmer, 2013).

3.3.2.2. Formats

Besides materials, formats might have some changes as stand-up **pouches** gain market. Convenience, portability and the “on-the-go” snacking, seem to be the drivers of a transition that is expected to affect billions of items in the future (McKay, 2014, Haderspeck, 2014, Farmer, 2013). Companies consider that this format will respond better to the consumer needs of placing products in the refrigerator side door or in a limited pantry space (McKay, 2014). At the same time, production and distribution are more efficient than of glass or metal. The fact that empty pouches can be easily flattened is a big advantage when compared with **glass bottles** and metal cans which cannot be flattened and require extra care in transportation, to avoid damage (Haderspeck, 2014).

Solutions to bring pouches to a broad spectrum of the food and beverages market are already being created. An examples is shown in Figure 7. The designer responded to the challenge of creating a “well perceived” pouch for **wine**, a product which is typically packaged in glass. His goal was to create an appealing package that would surpassed the poor quality associated with wines packaged in plastic or carton materials.



Figure 7. Example of a pouch innovation entitled “The Wine Pouch R(e)volution” Source: ReverseInnovation (2015)

Carton materials are used in the format “**Bag-in-box**” where a plastic bag containing the product is protected /contained by a carton box. Frequently used in wines, this format provides several servings of the amount the consumer sees fit while protecting the product from oxygen and therefore extending its shelf life (Haderspeck, 2014). It is expected that more products begin to be packaged in this type of format as it easily fits in refrigerators and cools down 65% quicker than the traditional glass bottle (Roustson, 2014).

3.3.2.3. Functions

Packaging functions have been mentioned previously. According to Pousette et al. (2014), the most important four are, according to “*containment, protection, convenience/utility and communication*” (Pousette, Löfgren, Nilsson, & Gustafsson, 2014). These functions seem to remain, but in the future, novel technologies might lead to new developments.

Active and intelligent packaging demand is expected to double from 2011 to 2021. Time-temperature indicators (one type of intelligent packaging) are anticipated to be the fastest growing due to the benefit of maintaining products fresher for longer (Lee and Rahman, 2014).

Time-temperature indicators (TTIs) inform the consumer, the retailer and/or the supply chain, if the product has been under or above a reference temperature, a situation which can relate to the presence of pathogens and overall product freshness (Figure 8). One application is in the assessment of the freezing and defrosting quality process.

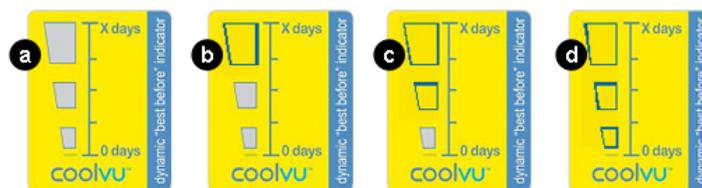


Figure 8. Example of a TTI label as a dynamic “best before” indicator. Source: Freshpoint-tti (2015)
Subtitles: a - freshly activated label, b - early mid-life label, c - late mid-life label, d - expired label

Another type of intelligent packaging with potential, uses **thermochromic ink** technology. According to the world’s largest supplier of thermochromic ink CTlinks “*temperature inks are activated at a certain temperature making colours appear and disappear*” and informing the consumer if a product has been chilled in the refrigerator or cooked for enough time (Figure 9) (Farmer, 2013, ctiinks, 2015).

Trials have been performed in beers to inform the drinker that his/her beer is cold enough to drink in one of two stages: cold and super cold. Then, it is up to the consumer to decide how he/she prefers to enjoy it. Potentially this technology will increase in microwave food to inform if the food is cooked or still needs more time in the appliance (Farmer, 2013).



Figure 9. A) Example of a label with cold-activated ink. On the right side the activation is visible, as colour stripes appear along the bottle B) Example of a cold-activated beverage tab which turns from silver to a designated colour (in this case green) when the beverage is chilled and ready to drink.

Source:ctiinks (2015)

Lee and Rahman (2014) state that **active packaging** “is designed to deliberately incorporate components that would release or absorb substances into or from the packaged food or the environment surrounding the food”. An example is the oxygen scavenging compounds which react with oxygen to reduce its concentration. This type of active packaging is frequently used and paired with another called **modified atmosphere packaging** (MAP) in which a “package possessing a film or foil barrier passively limits gas exchange by the living produce, thereby altering the headspace” (Randolph, 2007, Zhuang et al., 2014).

The main difference between these two packages is that MAP does not have an active role. In addition, active packaging usually resources several technologies, each to deal with a specific problem, while MAP only uses one technology, related with the barrier properties of a film (Randolph, 2007).

MAP’s growth potential is high, as the food industry foresees the need for more processed fruit and vegetables, more non-frozen chilled meats, more ready-to-eat meals, and more semi-processed bulk foods. When it comes to fruit and vegetables, MAP faces the challenge of preserving them fresh for longer, by conjugating the specific permeability film properties with the respiration activity of the products. Research on this matter is under development (Zhuang et al., 2014). For raw meat, MAP also brings benefits as it aids to extend the shelf life up to 25 to 30 days. To guarantee most of the products stay fresh, developments are pursued towards making it re-sealable and available in portion packs (Farmer, 2013).

More developments lead to believe promising innovations will arrive, such as active packaging with **antioxidant** properties which can help reduce the main reason of food spoilage, oxidation by the incorporation of antioxidants into, or coated onto, its packaging materials.

Also being researched is **antimicrobial** packaging, which releases antimicrobial agents (like ethanol) to prevent growth of microorganisms (Dobrucka and Cierpiszewski, 2014, Corrales et al., 2014, Randolph, 2007).

Packaging that can be eaten (or **edible packaging**) is a film, made from proteins, carbohydrates, lipids or a mixture of these, that coats a food product and can be consumed with it. Therefore, no visible residues are left for disposal. Han (2014b) believes that *“the use of edible films and coatings as primary packaging can potentially replace conventional packaging materials, partially or totally, which can reduce the overall utilization of synthetic materials”*. Some disadvantages include cost and limited functionality. The latter is related with the fact that most edible packaging is hydroscopic (has high affinity with water) and needs another type of material to enhance their functions (often times a plasticizer) (Baldwin, 2009).

RFID (Radio Frequency Identification) is considered a type of intelligent packaging and has been debated in the past as the “best alternative” to the common barcodes. Nevertheless, obstacles such as high cost, privacy concerns and reading difficulties in products with high moisture have prevented its mainstream application (Lee and Rahman, 2014).

“Nanotechnology has the potential to revolutionize packaging” (Randolph, 2007). Its use in food packaging can bring improvements to flavour, texture and /or colour of the food, as well as to the delivery of nutrients; it can allow selective barrier properties; it can aid materials to be lighter; in a way, possibilities are wide. On the other hand, its development and acceptance is very dependent on legislation, consumer perception, recycling systems, safety and cost (Farmer, 2013, Randolph, 2007). For now, the active European regulation in this manner states that the *“application of nanotechnology is prohibited even when there is no direct contact with the packaged food through the functional barrier”* (Lee and Rahman, 2014).

Other types of technologies, such as printed electronics, will serve a packaging function of communication and branding. **Printed electronics** are fluid functional materials that create an ultra-thin and flexible electronic device, when printed on a flat surface. Functional materials can be specific plastics, fluids or pastes and are printed in layers, on a thin or flexible film, which can then be integrated in several types of devices, including food packaging. An example is the printing of electrodes, with a layer of light emitters, to create glowing packaging when the consumer touches it (OE-A, 2014).

4. Results and discussion

The answers to the three research questions of this study are provided throughout this chapter. Its organization is in three main parts: the current packaging (4.1.), collected through food product observation, and the future insights, collected during the interviews (4.2. and 4.3.). In the process, the content is discussed in light of the theoretical framework.

In “Current packaging”, research was conducted to try an answer questions such as *what packages can be found in today’s supermarkets?; In the UK and in Sweden; How different are they?; and What factors are influencing those differences?.* In the section “Trends”, food packaging trends are explored in a discussion crucial to anticipate their impact on the design and development of future refrigerators. Lastly, the section “Refrigerator” focuses on insights and concepts for the future refrigerator.

4.1. Current packaging

From the materials to shapes and volumes, specific food products were investigated, namely milk, yogurt, chilled fruit juice and frozen ready meals. The purpose was to investigate the differences in the two markets analysed in this study, Sweden and UK.

4.1.1. Milk

In general, primary packaging is responsible for 8% of the energy necessary to produce, supply, store and use the milk, while the largest use of energy is at home, during refrigeration (38%). In the UK, 90% of the liquid milk is fresh pasteurized milk and has to be kept chilled (INCPEN, 2011). In Sweden, a similar situation is found although, when it comes to the packaging, differences are noticeable.

In *Tesco’s* category for “liquid milk” 219 items were found in a wide **distribution** of types of milk. 40% were flavoured milk (chocolate or strawberry), 33% were alternative “milks” to dairy (such as soy, almond and coconut milk) and 27% belonged to the regular milk category (produced from a cow and differing in the amount of fat).

In contrast, in Sweden, the discrepancy between types of milk is clear. Flavoured milk was not as available and regular milk was the most common type of milk found on the website (50% of the items), followed by alternatives to dairy (33%) (Tesco, 2015c, ICA Groupen, 2015d). Considering the packaging materials the following differences were visible.

In absolute, for all types of milk, paperboard was the preferred material in both countries (67% in the UK and 74% in Sweden), but when considering the previously mentioned proximity between types of milk in the UK, then it is visible that most of the flavoured (34%) and regular (69%) milks are sold in **plastic** bottles. Flavoured mostly in 200 to 499mL bottles and regular across a range of 1L, 500mL to 999mL and 2L bottles.

In Sweden, plastic is mainly used for 2L bottles of regular milk and 200mL to 499mL packs of flavoured milk.

In the UK, **paperboard** is mostly used to pack alternatives to dairy (97% of these products come in paperboard) and mostly for products of 1L, contrasting with Sweden where even 83% of the products are in paperboard packages (mainly gable top).

In Sweden, regular milk and alternatives to dairy are sold mostly in 1L bottles (63% and 67%, respectively). The second most frequent product is sold in 1,5L packages.

Flavoured milk is, in its majority, sold in 200mL to 499mL packages, in both countries.

It is also clear that, in the UK, there is a broader **diversity** of products (219 items and 8 different categories of volumes) while in Sweden only 54 products were found and organized into 5 categories.

A summary of the most frequent type of packaging, and its correspondent type of milk and volume, can be found in Table 3, while on Table 4, some examples of packages are shown.

Table 3. Most frequent types of material and volume for milk, in the UK and Swedish online stores.
 Source: Tesco (2015c), (ICAGroupen, 2015d)

	 UK	 Sweden
Paperboard	<ul style="list-style-type: none"> • Alternatives to dairy • 1L • Tetra Brik & Gable Top 	<ul style="list-style-type: none"> • Regular & Alternatives to dairy • 1L • Gable Top
Plastic	<ul style="list-style-type: none"> • Flavoured: 200 to 499mL • Regular: 500mL to 1L & 2L 	<ul style="list-style-type: none"> • Flavoured: 200 to 499mL • Regular: 2L
Most frequent volumes	<ul style="list-style-type: none"> • 1L • 500 to 999mL 	<ul style="list-style-type: none"> • 1L • 1,5L

Table 4. Example of the diversity of packaging types with corresponding material, volume and format, for milk, in the UK and Sweden. Source: Tesco (2015c), (ICAGroupen, 2015d)

UK			
	Regular, Plastic, 1L	Flavoured, Plastic, 471mL	Alternative to dairy, Gable top, 1L
Sweden			
	Regular, Gable top, 1L	Regular, Plastic, 2L	Regular, Tetra Brik, 1L

Besides plastic bottles and paperboard, in 2010 a trial with plastic bags / **pouches** for pasteurized milk was attempted at *Tesco* and *Sainsbury* (another UK retailer) (Brooks, 2010b, Brooks, 2010a). The format, featured in Figure 10, is composed of a plastic bag and a reusable jug, which supports the bag. Despite popular in countries like Switzerland, Canada and South Africa, no evidence of the trials' success rate was found and, five years later, it was not available for purchase at the online shop (INCPEN, 2011).



Figure 10. Milk in a plastic bag with reusable plastic jug. Product name: *JUGIT* Source: *JugCo* (2015)

4.1.2. Yogurt

The *Industry Council for Research on Packaging and the Environment* (2011) states that “Over 90% of UK households buy yogurt”. Even though single pots and multipacks have similar market shares, single pots popularity continues to grow (INCPEN, 2011).

When it comes to yogurt, **plastic** appears to be the only material used in the UK, while in Sweden its used only in 12% of the products (Tesco, 2015e, ICAGroupen, 2015f, ICAGroupen, 2015e). There is also a clear difference in the amount of products sold in both markets. 283 items in the UK and 90 in Sweden, although they both sell mostly **flavoured yogurt** (89% in the UK and 87% in Sweden).

Regarding the packaging some differences were noticeable and presented as follow. A summary is shown on Table 5.

In the **UK**, flavoured yogurt was in **single round pots** (48%) with a flat format (for the products in the range of 110-150g and 160-200g). Nevertheless the products in the range of 350-450g have a “tall format” (higher).

The second most common format is **rectangular** packaging (35%). All of these are sold in multipacks / group packs of mainly 4 pots (81%) in a “flat format”.

Sweden has a very different packaging scenario. **Paperboard** is used in all of the natural yogurts (mainly gable top and Tetra Brik) and in 88% of flavoured yogurts (with gable top and Tetra Top being the most common ones).

Considering the type of format used, it is visible that the volumes also differ in the countries under study. In Sweden, 82% of all yogurts have 1L and 7%, 1,5L. Although in the UK, plastic rectangular pots are only used for **multipacks** products, mostly in the 4x120g flat format, in Sweden, the same multipacks are in a “double format”, therefore being taller, but thinner (Tables 6 and 7).

In both countries, round plastic pots were used for individual portion yogurts. Examples of the appearance of these products can be found in Tables 6 and 7.

Table 5. Most frequent types of material and weight / volume for yogurt, in the UK and Swedish online stores (Tesco, 2015e, ICA Groupen, 2015e, ICA Groupen, 2015f)

	 UK	 Sweden
Flavoured	Plastic single pot (48%) <ul style="list-style-type: none"> • Flat: 110 to 220g • Tall: 350 to 450g 	Paperboard (88%) <ul style="list-style-type: none"> • Gable top (44%) • Tetra Top (31%)
	Multipacks (35%) <ul style="list-style-type: none"> • 4 pots / rectangular / flat 	Multipacks (8%) <ul style="list-style-type: none"> • 4 pots / rectangular / double
Natural	Round single pots (97%)	<ul style="list-style-type: none"> • Gable top (50%) • Tetra Brik (42%)

Table 6. Example of the diversity of packaging types with corresponding volumes and format, in the UK.
Source: Tesco (2015e)

		Items			
Individual					
		165g Round pot	150g Round pot	110g Corner	450g Tall
Multipack					
		2x110g Round & Flat	2x130g Corner & Double	4x125g Rectangular & Flat	4x110g Round & Double
					
		4x110g Corner & Double	6x150g Corner & Flat	8x125g Rectangular & Double	

Table 7. Examples of packaging types with corresponding volumes and format, in Sweden. Source: ICAGroupen (2015e), (ICAGroupen, 2015f)

		Items			
Individual					
		Tetra Brik 1L	Gable top 1L	Tetra Top 1L	Gable top 1,5L
Multipack					
		4x125g Double	8x125 Flat		

4.1.3. Fruit juice

In the chilled fruit juice category, both UK and Sweden package their products mostly in **paperboard** (52% and 74%, respectively) in 1L format (Table 8). The difference is that, in Sweden, the most common type of packaging is the gable top for, not only 1L packages, but also 1,75L and 2L. In the UK, Gable top is used for different volumes, for 1L and 850mL (Tesco, 2015a, ICAGroupen, 2015c).

Plastic is the other material used in both countries, although in the UK is almost as common as paperboard (48%) and appears in a wide range of volumes. This material tends to be presented with a “bottle” like shape while paperboard comes in a rectangular one (Tesco, 2015a, ICAGroupen, 2015c).

Examples of the appearance of these products, in both countries, can be found in Table 8.

Table 8. Example of the diversity of packaging for fruit juice, with corresponding volumes and format, in the UK and Sweden. Source: Tesco (2015a), (ICAGroupen, 2015c)

		Items			
Plastic					
	500mL	900mL	1,5L	2L	
Paperboard					
	1L Tetra Brik	1,5L Gable top	1L Gable top	2L Gable top	

4.1.4. Frozen ready meals

In the frozen ready meals category, Sweden had the most amount of products: 134 versus 91 in the UK (Tesco, 2015d, ICAGroupen, 2015b). Sweden is one of the biggest ready meals market in Europe, although when it comes to consumption of both frozen and chilled ready meals, UK leads with the highest consumption per capita. By searching *Tesco's* online grocery shop, the chilled ready meal category had 564 product, whereas Sweden had 126 (Tesco, 2015b, ICAGroupen, 2015a).

Sweden and UK use similar packaging for these products. Both use mainly **carton** (77% in Sweden and 90% in the UK) in a **rectangular** shape (87% in Sweden and 91% in the UK).

The second most used material is **plastic bags**, in both countries, although differences are more evident. In Sweden, plastic bags have a flexible rectangular format and are used in a diverse range of weights, but mostly for 450-800g products; On the other hand, in the UK, most plastic bags have a pyramid shape and seen in smaller portions (mainly 350g).

In general, products with weights between 380 and 420g are the most common in Sweden. In the UK, there are mainly products in the range of 350 to 400g. Examples of the appearance of these products, in both countries, can be found in Table 9.

Table 9. Example of the diversity of packaging types of frozen ready meals with corresponding formats, in the UK and Sweden. Source:ICAGroupen (2015b), (Tesco, 2015d)

		Items		
Plastic				
		Rectangular	Pyramid	Plastic tray wrapped in carton
Paperboard				
		Rectangular	Cubic	Round

4.1.5. Differences between markets

The interviewees mentioned that differences between countries are noticeable and will continue that way, in different food categories. *PN-NL* said: “most of the [differences] come from an historical perspective. It just grew that way and it is not going to be harmonized throughout the European Union”. This perspective opposes the medium change (M) scenario for 2019 described during the theoretical framework; the prediction was of packaging formats becoming standardized, mainly due to decreased importance of packaging in the stores shelves. In contrast, the information on the literature research also revealed how traditions and habits can influence food/packaging purchase (Ryynänen and Rusko, 2015).

When questioned about the differences in the packaging of UK and Sweden, and the reasons behind it, interviewees mentioned how UK is a retail driven market where private label is strong and developments are fast, but adaptable. Compared to Sweden, UK leads and sets the trends. One interviewee said that Sweden falls ten years behind England and France in terms of innovation in the food market.

O-Swe claimed that, in Sweden, several brands still have a strong market share, although some participants believed the retail brands are gaining market over them. This participant also added that the Swedish consumer is still not “on-the-go” when compared with the English.

The Swedish experts noted the importance of analysing external markets, to gain insights on future food and packaging trends. It helps the brand to be prepared for or to anticipate the market (*O-Swe*). Another difference between markets relates with the recycling/recovery systems. A participant stated that these are in place in Sweden, but not in UK where they are specific to certain locations (*A-Swe*).

Even in the answers given by the interviewees, differences between UK and Sweden were noticeable. The answers from the UK participants focused more on food waste and the recyclability/environmental issues; shifting the consumer approach to packaging and considering the negative impact environmental changes can have. Also, the “on-the-go” trend is more developed in the UK market. Therefore, its potential growth has to be put in perspective with Sweden, where this trend might never become as important.

A-Swe pointed out how in the UK a high amount of the milk bottles are made of plastic material, while in Sweden, carton is the preferred material because of the Swedish tradition of forest products. Indeed, as shown previously in this section, most of the regular milk sold in the UK is in plastic bottles and in a larger variety of sizes than in Sweden.

4.1.6. What implications can it bring to the refrigerator?

What is visible in the current packaging is a lack of standardization, not only between countries, but also within a country. This affects the refrigerator design because it challenges the personalization and adaption of the appliance to the packaging it contains. Nonetheless, that seems to be the necessity, as consumers want individualized products (this topic is further explored in the following section). The trend is very likely to affect home appliances as well which, in time, will become connected, and perhaps, the smart kitchen Yam (2000) mentioned fifteen years ago will become a reality.

As shown before, packages can be still grouped and organized into different categories and thus be an initial solution to better storage of similar products in the refrigerator.

4.2. Trends

In this section, the answer to RQ.1 and RQ.2 will be provided. Therefore, the insights from the interviews, observation and theoretical framework are presented and discussed in order to understand how packaging will evolve and what were the drivers motivating those changes. In section 4.2.1. the focus are on consumer trends, while on part 4.2.2. the focus is on packaging trends.

4.2.1. Consumer trends

During the interview, *A-Swe* indicated the main **packaging drivers** as being (1) to protect the product, (2) to provide convenience and user friendliness and (3) to be an efficient and economical packaging. A perspective that was similar to what Gerding et al. (1996) reported. For them, packaging is conditioned by the product requirements and the consumer demands. These main aspects are really the core of a packaging process that successfully serves the consumer. During the course of results and discussion, they will take center stage and be referred to several times.

As mentioned in one of the first sections of this research, past perspectives are important to reveal how packaging has been evolving in the last decades, not in terms of appearance, but core functionality. The thrive for more convenient, lightweight, safe and sustainable packaging has been present at least since the sixties. During the interviews it was evident how these still remain very important for packaging developers and food companies, therefore they are further explored in this section.

4.2.1.1. Convenience

Convenience has been mentioned as one of the main trends for the future, both in the literature research and by the interviewees. What results showed is that the meaning of convenience is broad and can be approached from several angles. It can mean easy opening, easy closure, easy storage, single portions, multipacks, active packaging, and “on-the-go” consumption, amongst others. To the consumer, convenience is generally translated into packaging that saves time and makes their life easier across a multitude of life demands.

During the interviews, *D-UK* believed that convenience could be a mixture of things. It could mean “occasion- specific”; *“It could be convenience at the point of purchase or convenience when the consumer is drinking the product”*. Thus the need for companies to do consumer research, to really understand what choices the consumer is looking for and how those translate into specific circumstances.

At Diageo, research is being conducted on how consumers will experience different occasions and how those will lead to new packaging formats. In the future, the company expects to have a very distinctive range of products targeted at a specific occasion (*D-UK*).

M-UK also mentioned occasions and how the consumer is looking for moments (and food) to indulge on; *“Certain people see it as a special occasion because it is the end of the week so they want to have a special dessert. We are seeing more trends on those areas, definitely”*. These experiences can also relate to the health trend presented during the literature research.

One of these occasions is the “on-the-go” consumption, where single portions are the main offer. *M-UK* is also focusing on this trend. “*On people being able to eat on the go, to be able to pick something up and quickly eat and have it as a snack*”. That is an area Müller is trying to increase and consumers will see more of in the future.

In an interview, single portions were mentioned as being convenient, by default (*M-UK*). Not only providing the “exact” amount of product for a specific circumstance, but also the easiness of using it only one time, without the worry of re-closing it, storing it and/or re-opening it.

If food consumption is expected to increase via the use of a convenient single portion, then consumer health, food waste and sustainability will also be affected.

4.2.1.2. Health

During the literature research, health trends and nutritional recommendations raised a question on how the consumer might behave in order to become healthier.

In the UK, the government has developed the *Eatwell plate*. A campaign which highlights the different types of food and healthy proportions for the average consumer. To achieve the ideal *Eatwell plate* consumption, a consumer has to develop new eating habits which translate into the purchase of more fruit and vegetables. As these products are mostly stored in the refrigerator, the appliance is required to offer sufficient amount of space for the accommodation of such items (NHS, 2013).

An example can be given: to achieve the *Eatwell plate* recommendations, an individual should eat at least five portions of 80g of a variety of fruit and vegetables (UK Government, 2014). This is 400g a day and 2kg a week. Depending on how many meals the consumer prepares at home, this suggests that a regular consumer could have to store 2kg of fruit and vegetables in their refrigerator.

As *M-UK* pointed out during the interview, the refrigerator should have more space: “*Especially because fruit and vegetables are now also stored in the fridge. I think that space is always too small, so when I do my weekly shopping, certainly in the summer months, I cannot put all inside, on the bottom. They have to go on the shelves. It just feels like everything that you buy in the supermarket goes into the fridge so it needs to be bigger to take all of this*”.

4.2.1.3. Sustainability and the Environment

When it comes to understanding the effect of packaging on the environment, there are different opinions: from the packaging professionals and the consumers.

For consumers, packaging might be seen as a waste of materials and energy, without a purpose. During the interview, *MS-UK* mentioned that the packaging industry “battle” is for the consumer to perceive it as a resource and not as a waste.

When looking further into details, primary and secondary packaging combined, for all goods and foods, only account for 3% of the UK's household total environmental footprint, while production of household goods and food production account for 34% and 8%, respectively (Figure 12). In addition, as mentioned in the theoretical framework, 38% of milk energy consumption is at home, during refrigeration. By considering this information it is clear that food packaging is not the main barrier to ensuring a sustainable household.

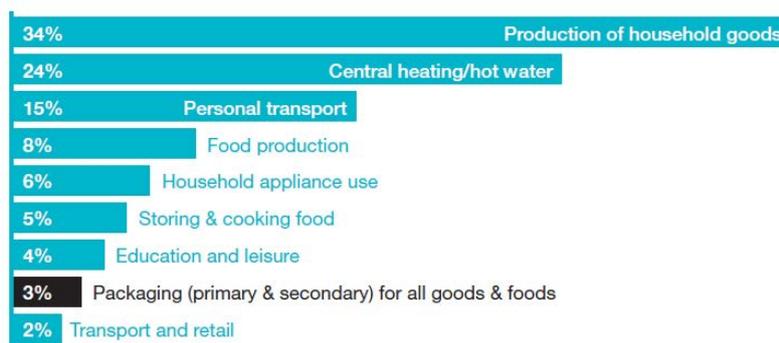


Figure 11. UK Household total environmental footprint. Source: INCPEN (2000)

Packaging professionals have a different view on packaging and sustainability. They believe that in ten years, sustainability and food safety/security will dominate as trends, while cost becomes increasingly less important. This corroborates with the literature research results and the message from the interviewees. In particular, *D-UK* stated “*the consumer is aware of materials used and environmental issues. I do not think it is a blocker to purchase yet, but is increasing and becoming more important*”.

PN-NL mentioned that the current younger generation considers sustainability as a given. To this consumer, future products have to be sustainable. “*As they see it as a requirement, companies have to either do them in a sustainable way or not do them at all*”. This links to the reported information that, in 2025, the main shoppers will be Millennials who see packaging materials as a very important product feature. They will rely on retailers to provide the best sustainable packaging and lead them to sustainable purchases. As most consumers, they cannot clearly differentiate between a product and its packaging therefore, products that do not comply with the future environmental expectations might not be supported by this consumer and possibly become unsuccessful.

On the other hand, concerns about resource scarcity and food shortages were presented in the literature review. *MS-UK* mentioned water consumption and management as a future challenge “*because water is in everything, from food production to plastic production. We use water to cool plants, to make plastic, so if we start not having water a lot of this stops. A lot of our world stops*”.

The negative implications of climate change on the world and packaging are hard to predict and a challenge to anticipate. Still they could transform the predictions described in this research in a radical way.

4.2.1.4. Food waste

In the past, the relation between food and packaging was very much focused on the protection and safety of the food (Han, 2014a). Today, food wastage has become an avoidable need, as feeding the world population will become a future challenge combined with the decrease of natural resources.

For *PN-Swe* around 25% of all wasted food could be related with packaging. Either to the expiry date, which the participant refers to as being static, and also to a packaging being unable to reclose properly. Therefore, packaging could play an important role in the future of food waste reduction. Another packaging professional relates the expiry date improvement to better food/packaging education of the consumer. The government or the supermarkets should take on this task, but also food companies suggesting the way they currently set expiry dates should be changed (*PN-NL*).

A participant says the consumers do not seem to trust their instincts and taste as much as the “use by date” or “best before” date. In the UK, this awareness issue is being worked upon. *M-UK* says the consumer is being informed of the positive role packaging can have on saving food is in process. In addition, the use of more single portions is a solution for reducing food waste. *O-Swe* participant said this topic is being discussed at the moment and that, despite being challenging to decide on which approach to take, smaller packaging would probably help.

As this topic is very much related with single portions and external packaging trends, further insights are explored in the section regarding packaging trends (4.2.2.).

4.2.1.5. Demographics

Since the beginning of the millennia, demographic changes have been addressed as a driver for packaging convenience (Gerding et al., 1996, Sonneveld, 2000).

To some interviewees, the fact that in the future, the older population will represent a bigger portion of the population, is not as much of a concern as any other consumer need. *O-Swe* mentioned that despite the design of easier to open products being beneficial for the older population, it is also for all of the remaining consumers. “*All of us would like to have [packaging] a little bit easier to open*” wherefore it is something companies strive for, without targeting any particular consumer group.

For *D-UK* and *F-Swe*, packaging design is also not considering the aging population matter, at least for now.

4.2.1.6. Personalization and online shopping

During the literature research, personalization was mentioned as a future consumer trend. *D-UK* agrees that product customization will increase, but the way a product might be personalized, might differ from today's outlook. For instance, in the future, a package can easily be adapted to the consumer in question by using technology, such as by sending specific messages through an interactive label (*D-UK*). Technology can influence packaging personalization significantly. By using online shopping, a consumer will make available his/her preferences and wishes in a personal database, which can be used to adapt the product quantity to the exact needs (Berry et al., 2007).

To *M-UK*, e-commerce will definitely play a major role in the future, although how that translates into something that is going to influence food is uncertain. Nevertheless, for this expert, being agile and adaptable is a must-have attitude for the future.

Participants mentioned that online shopping would allow more **diversity** and variety of products and **sizes** for all types of families and needs. This platform would allow products to be sold and purchased at different occasions and ways.

The same perspective was pointed out in the 2022 scenario, in the previous chapter. It was explained that online shopping would become more frequent leading to an increased variety of products in smaller packaging. At the same time, it would also save time and the environment, as no more trips to the supermarket would be needed (*TP-Swe*). Three thousand consumers share a similar view, as for them packaging should save time and make their lives easier (Caner and Pascall, 2010).

F-Swe stated that lack of **contact** with the product could affect the purchase. As the consumer does not touch and analyse the product up-close, his participation might not be as active. This perspective considers the current e-commerce structure, but the introduction of new technologies, such as printed electronics, could add a dynamic feel to the purchase.

Nevertheless, the majority of today's consumer chooses their products on the point of purchase based on appearance, packaging and transparency (Ragaert et al., 2004). How online shopping will affect this situation is still unclear.

O-Swe mentioned that the new packages being developed are focused on improving efficiency, without considering the role online shopping might play. In this company the discussion has not yet started.

Personalization also raises the question of how logistics might be affected by so many packaging possibilities and adaptations taking place at the same time. Would not standardization be a more suitable approach?

For *MS-UK*, if the world is to become more globalized, and if things remain the same, then we will probably need different formats to satisfy the local consumer. *“Therefore a shorter supply chain. I think probably what we will see is regionality: varieties of products that are only available at certain times of the year rather than all the year around.”*

In contrast, others interviewees question if there is a real challenge between standardizing and customizing the appearance of products. For *TP-Swe*, current consumers do not purchase products mainly based on their appearance. Nevertheless, research presented on the literature review contradicts this opinion.

When it comes to understanding how products will be in the future, a recurrent perspective was noticed in the literature review. There will be a shift from products to services that allow a deeper product personalization. In the future, consumers will have a different type of brand relationship. How that might influence food packaging and the refrigerator is explored in the section “Packaging Trends” (4.2.2.) and “Refrigerator” (4.3.).

4.2.1.7. What implications can these trends bring to the refrigerator?

During the literature research consumers mentioned how the refrigerator should be able to “communicate” with them so they would not have that preoccupation.

Regarding “on-the-go” foods and how they will be related with the refrigerator is uncertain. Although, if they are “on-the-go” they probably will not be stored in the refrigerator. They will be bought and eaten in the moment. The new refrigerator should therefore focus on the foods which are not “on-the-go”; on the “eat at home” meals or ingredients that are bought and have to be stored. And, if a consumer prefers to store frozen vegetables instead of fresh, then the freezer would be the section in need of more space.

Millennials expect retailers to guide them to a better, sustainable product. With increased awareness it is very likely that home appliances manufacturers would be pressured to only offer sustainable options. To ensure a product being as sustainable as it can be, a retailer will potentially have to consider all of the consumer-package steps, including home storage. The best synergy between both, the package and the refrigerator will have to be assured not only to improve consumer satisfaction, but also to reduce household energy consumption.

With increased need for personalization, more variety and dimensions will appear due to online shopping. However, a database can be used to determine what goes inside helping in the personalization of the refrigerator.

4.2.2. Packaging trends

Considering the vision of future packaging by previous authors Gerding et al. (1996) and Louis (1999), and comparing it with the available packaging, then it is noticeable that packaging has been evolving at a slower rate than what expected. A possible explanation relates to the conservative attitude consumers have towards packaging innovation, and to the fact that consumers are conformists. This combination of characteristics means that the majority of consumers follow each other's decisions and do not want to see dramatic changes in their usual food products. *MS-UK* point of view supports this hypothesis, with the statement “*If consumers were able to go with major change, we would have seen it before*”.

Other explanations for the slower packaging evolution are related with constraints in packaging innovation. The single and most important constraint, which was mentioned by the large majority of the interviewees, was cost. *F-Swe* said “*If you want to have a new packaging on the market you do not want to spend more money on it,*” which is also associated with how much the consumer is willing to pay for the added benefit.

In fact, the results from the DuPont (2012) survey of *Future Packaging Trends* point to a similar answer. 59% of the packaging experts in the study revealed that cost is the factor that most affects their current work. The second factor is food safety/security (44%) (DuPont, 2012).

Another constraint frequently mentioned during the interviews was the established production line and the fact that a new package would have to fit the same pallet size, like the previous ones.

A-Swe sees constraints as being a complex mixture of factors. For a package to be better than the older version it has to consider the products' demands. Particularly in the case of yogurts, these demands translate into temperature control and pH resistance. At the same time, packaging also has to consider the distribution requirements, the consumer needs for convenience and appearance, while at the same time setting itself apart from the competition. Each one of these factors can be a constraint in different contexts.

Challenges to innovation can be extended to the future. To understand which problems might affect packaging in the future, the topic was questioned during the interviews. Most participants mentioned the consumer perception of seeing packaging as waste as a big challenge. Likewise, the environment, cost and safety were also common concerns.

TP-Swe recalls that the consumer does not like to pay for the package. He/she pays mostly for the food. As *PN-NL* points, despite food packaging not being responsible for most of the packaging waste, it is the consumer who has to deal with it at home, so they see it as a problem and have a negative perception of its functionality. *M-UK* adds that “*certainly in the UK, packaging is very much seen as an evil*”.

As for the other responses to packaging trends, food safety, for instance, is regarded as a priority, and is considered as a challenge that packaging will always have to consider. Also, in the future, economy and water resource management might pose barriers to packaging developments (*MS-UK*).

A participant also saw the association of technology and interactive communication as a potential challenge for the packaging industry (*O-Swe*).

4.2.2.1. What to expect?

Consumer trends are very much connected with packaging trends, but in 5 to 10 years what can we expect primary food packaging to be like? Specifically in this section, the answer to RQ.1 **How will packaging for chilled and frozen foods evolve in the near future**, is provided.

Materials

The use of materials will evolve differently depending on which material is being regarded. The majority of the interviewees believe that a shift will occur from crude oil based plastic towards **bioplastics**, produced from renewable sources such as starch. *MS-UK* affirms that consumers react to additives or materials in contact with the food and “*therefore anything that is naturally derived has a better chance of being accept by the consumers*”. Although *PN-NL* remembers that plastic is cheap and serves a purpose of also enhancing the properties of other types of materials. *A-Swe* alerts to the fact that the avoidance of packaging combinations will still be important in the future.

The respondents of the DuPont (2012) survey of *Future Packaging Trends* shared this vision. In the future, plastic will replace metal and glass and will be seen in more flexible shapes. At the same time, bioplastics will grow in detriment of crude oil sourced plastics.

M-UK mentioned that at the moment there are no better material alternatives to satisfy the requirements of their current packaging (plastics). Nevertheless, Müller is aware of the need for sustainable materials.

Regarding **glass**, a dilemma exists. As it is heavy and fragile, most participants believe its use will decrease, becoming a material for only exclusive / premium products, such as wines and premium sauces (*TP-Swe*). On the other hand, consumer’s perception of glass is positive and associated with products with quality (versus plastic).

The choice of what type of material to use will be dictated by the consumer, by the need to perceive the product in a specific way, by its purpose. For instance, for an expensive wine or a gift, the consumer would likely still prefer glass over plastic (*D-UK*). *O-Swe* states “*It will be probably for higher quality [products]; higher price level in some glass jars products and then you have the plastic for maybe a family. Bigger, for the volume*”.

The alternative solution to glass will then be plastic (both flexible and rigid) and paperboard, even for wines (*TP-Swe*).

Formats

In terms of packaging formats, the majority of the interviewees mentioned that they will not change significantly (*MS-UK, TP-Swe, M-UK, A-Swe*). Variations in formats will be **incremental** and just noticeable in terms of shapes, opening, pouring and closing (*TP-Swe*). The cost associated with the production line machines is very high; therefore, formats cannot be easily modified without compromising that system and involving high investments (*M-UK*).

In contrast, *PN-NL* mentions that packaging equipment and 3D printing are becoming more versatile and will be able to produce more formats and sizes in different materials. Another challenge for packaging is the pre-establish measurements of the EURO-pallet. A standard that influences the formats and other ways of packaging innovation. To resolve this issue, *A-Swe* mentions that future formats of packages for milk, yogurt and crème fraiche might have to suffer small adjustments in terms of height while maintaining the same diameter.

The consumer is also seen as a barrier to development as they get used to a particular format (*MS-UK*). This observation has been mentioned before. Consumers are conformists and value their traditions when it comes to food. Challenging certain routines might influence purchase habits negatively.

PN-Swe mentions that flexible formats, such as **pouches** have huge potential for the future especially for beverages. *F-Swe* believes that pouches are substituting products in glass bottles and cans, such as liquid soups and sauces. The reason, *F-Swe* explains, is because flexible packaging uses less material and it is lighter.

When it comes to **frozen foods** packages, participants mentioned how they all “look the same” in the freezer section of the supermarket. Most of the products today are either in a cardboard box or a plastic bag, in a square or rectangular shape, which aids in terms of logistic, but is not good for not product/brand differentiation (*PN-NL*).

Improvements are expected to happen. *PN-NL* mentioned that the usability trend will drive the development of a better, more practical, unpacking experience. The inclusion of zippers was indicated as an option, although, of course, costs could be a barrier to a mainstream application. In parallel, the use of smaller packages or multipacks could potentially aid the one time use and/or solve the re-closure issue.

MS-UK points that in order for the format of frozen foods to change “*the consumer needs to change the way they use frozen foods*”.

Dimensions / Size

All of the interviewees mentioned before that we will start to see more products in **smaller sizes** and **portions** to satisfy the consumer needs for convenient, “on-the-go” consumption and snacking.

This trend would also benefit the increasing single households and the older population, which eats less than the younger population (*F-Swe*). *A-Swe* mentions that milk packaging might shift from 1L to 1,5L packages and *O-Swe* points out the existence of 0,5L packages as a smaller alternative.

At the same time, interviewees noted that packaging size will also increase. *A-Swe* mentions that there will be the need for “**larger family packs of maybe 2 to 3L**”. In general, it was stated that there is a need for a wider range of products, for **variety**. *PN1-Swe* states “*a product would come in, instead of two different sizes, in three or four different sizes*” which would help satisfy different needs, not only in terms of quantity, but also taste. Each family member could choose from a diversity of flavours and purchase the preferred one without implications on other family members’ preferences (*F-Swe*).

Experts alert to the fact that **multipacks**, packaging with several **compartments** and small packaging, would use more packaging, but save more food; bigger packages would contain more food, and less packaging material, but its food content would have a higher chance of being wasted.

Recently *M-UK* had a project where yogurts’ packaging size was reduced. The consumer acceptance was positive, it helped them in reducing the amount of space in the fridge. *M-UK* added that new homes being built in the UK do not offer a lot of fridge space and the appliance could actually be a under the counter small fridge.

When it comes to alcoholic beverages, *D-UK* mentioned that nowadays the consumer does not buy 1 or 1,5L bottles, as they are too expensive or inaccessible. In this sense, the future of beers and wines will also consider accessibility and portion control. This would lead to smaller sizes sold at a similar price range of the previous bigger size.

What implications can these trends bring to the refrigerator?

The results from the interviewed experts and the literature research are in agreement. In the future, glass will still be used, but mainly for products with a higher price tag. The alternative will be plastic and paperboard. In relation to the refrigerator, those changes might not represent a big influence on its design and future developments.

This perspective is in alignment with the literature research results. Trends towards the increased use of pouches are clear and, improvements on the design and quality perception of these formats have already started. At the same time, pouches, being made of flexible plastic, follow glass use reduction in detriment of plastic. Nevertheless, the benefits such a format might bring to the refrigerator are not clear, as its storage position on the appliance is uncertain. The fridge door might be an option, but then pouches would have to take the place of some other products, already being stored there.

At the same time, smaller formats will increase in response to the convenience trend. Practically this might be reflected through the use of pouches, which mostly bring benefits to the “on-the-go” consumer. At home, storage friendliness would have to be studied.

Both smaller and bulkier packages might have to be stored in the refrigerator. It is possible that today’s most frequent milk volume (1L) slowly fades to give place to milk packages of 1,5 and 0,5L. Multipacks and packages with several compartments might increase, thus demanding a new organization of the fridge space. The ubiquitous presence of both single and larger households might definitely be observed in the future. Therefore, the appliance adaption would have to consider both directions.

4.2.2.2. Functions

As stated before, packaging serves many functions. Some of these were grouped by the designation its packaging take. Therefore, in this section, professionals’ outlook on active and intelligent packaging, edible packaging and nanotechnology are described and discussed. These three main topics were discussed due to the literature review outcomes.

Active and Intelligent packaging

DK-UK mentioned that the company is already working on intelligent packaging by incorporating chips that allow communication with the supply chain, and the consumer, via mobile phones.

The interaction between the product, or brand, and the consumer would be a marketing strategy with great potential. The “*prototype Johnnie Walker Blue Label bottle uses extremely thin, electronic sensors which can tell if the bottle has been opened or not, and where it is in the supply chain. And these sensors also mean Diageo can send information to consumers who scan the bottle with their smartphones - and change that information, thanks to the sensors being always connected*”(Figure 12)(Diageo, 2015). Another participant (*O-Swe*) mentioned that the discussion concerning this topic is only starting now. Therefore, the company has no developments in this area.



Figure 12. Johnnie Walker Blue Label “smart bottle”. Source:Diageo.com

Dynamic best before dates and improved readability were stated as the main benefits of active and/or intelligent packaging with potential to grow in the future. Its implementation could be especially important in fresh products. Although *PN-NL* alerted to the fact that the information provided might be uncertain.

The current sensors are not yet good or economical enough to be implemented and trusted. “*If a sensor shows red, [the product] is not good anymore. Then there are two options; either the sensor is right and the product it is not good anymore or the sensor was wrong and it was still good and, in both cases, the supermarket is in trouble because the consumer thinks there is something wrong here*” (*PN-NL*).

Despite the benefits that active and/or intelligent packaging can bring, participants mention that they will not be cheaper than a barcode. Not any time soon. Therefore, its implementation will be limited and slow. The same thought was used in relation to RFID.

Edible packaging and “No packaging”

In some author’s perspective, edible packaging could represent a solution to the use of less sustainable packaging materials (Baldwin, 2009, Han, 2014b). However, when asked how do they see the future of edible packaging, the interviewees replied by saying that it is a “small trend” which will not become mainstream.

The same thoughts apply to retail that does not use packaging (bulk stores where packaging is present in minimal amount). The participants do not believe it will grow, although some adopters are expected. In their perspective, packaging needs to protect the products and, in reality, even the “packaging free supermarkets” have products in containers or bags, which in theory is a package (*PN-NL*).

Nevertheless, the products arriving to those stores do so in a package, so packaging will always be a part of the supply chain.

It was mentioned that when products are sold in bulk, there is more food waste, which is worse than packaging waste (*MS-UK*). In addition, packaging also has a function of aiding to serve the foods. Without it, some products could not be placed on a table and the easiness of serving food this way would disappear (*TP-Swe*).

Nanotechnology

Although nanotechnology might bring significant benefits to food packaging, experts are unsure on how soon that will happen, how costly it will be, and how the consumer will react. Indeed, the literature research revealed uncertainty regarding future developments.

TP-Swe believes that it will not happen in the next ten years, as several studies have first to be conducted to prove that nanotechnology applications in food packaging are safe. Also, it is unknown how it might affect human metabolism, and if consumers consider food products for daily consumption, the cumulative effect needs to be determined in advance, before its use becomes mainstream. This evaluation is a very long and slow process (*TP-Swe*).

The simplest use of nanotechnology was indicated to be the food content simply “sliding off” of a packaging: the use of a “nano coating”, for instance, inside a bottle of ketchup to allow all of the ketchup to be completely dispensed out of the bottle. No more food waste, recyclability concerns and unsatisfied consumers are some of the benefits.

Other applications of nanotechnology could make packaging lighter, by resourcing less material, and improve barrier properties to gases by allowing the choice of which to block and which to let go inside a packaging. Also, it may aid the killing of pathogens (*PN-Swe*).

In respect to this topic, concern was shown towards consumers, to whom it is still a scary subject (*PN-Swe, PN-NL*).

4.2.2.3. Technology

Technology is in our daily lives, as food packaging is. But, when it comes to the incorporation of technology into packaging, the experts believe it will be applied to monitor and inform about the foods’ quality, shelf life and origin. For *M-UK*, the **packaging industry** is not as advanced as the **technology industry**, although it is something the “*industry needs to do and will do*”. Firstly, by beginning the incorporation of technology in the packaging of high end products, such as cosmetics and perfumes, and slowly progressing to everyday products. Nevertheless, the technology **price** would have to reduce considerably.

MS-UK mentions that the technology drivers come from the **automotive industry**. They monitor every parameter, from the vehicle to the drivers' response. Therefore, the technology is available. Its broader application is a matter of cost.

Some participants mentioned that the **communication** between packaging and the refrigerator will be present in the future, although it is uncertain which technology will allow it. *PN-NL* mentions that RFID will not probably be applied on every product as the costs are very high. *A-Swe* also believes that RFID is not going to be implemented in the next ten years.

TP-Swe says the **barcodes** could be an optical metric reading by the refrigerator, to control the product, and communicate with the consumer, each time it goes in and out of the appliance. For consumers this would satisfy a desired refrigerator function, mentioned in the literature research: the inclusion of a barcode reader synched with online shopping (Westgarth, 2014).

F-Swe said *Flextrus* is researching on **printed electronics** applications for packaging that would allow checking the products' quality and shelf life. Besides printed technologies Malcolm Keif, a Graphic Communication professor mentions, to *Packaging Digest* magazine, how near field communication and scannable codes can help packaging become more interactive. For him "*the key is to explore what is possible now and what will be possible as technologies develop. What interactive applications would really provide value to the consumer or the consumer packaged goods? How realistic is it to develop a cost-effective solution? Everything is on the table right now.*" (Embree, 2014)

4.2.2.4. What implications can it bring to the refrigerator?

Time-temperature indicators and MAP were not specifically mentioned by the interviewees, although their benefits were stated by the experts. Therefore, in the future, more packaging features will allow better control of the products' shelf life and the communication between different supply chain actors, including the refrigerator. If products last longer, the appliance might have to aid the consumer remembering the food should be eaten before spoiling.

As far as edible packaging and nanotechnology goes, their impact on the future of packaging is uncertain. Developments and legislation will dictate their path, therefore the focus should be on other packaging trends.

With costs limiting the incorporation of technology into everyday packaging, priority should be given to applications in printed technology instead of RFID, and to applications into occasionally purchased products. This might give a competitive edge by anticipating what can be transposed into the food packaging.

4.3. Refrigerator

The intent behind this research was to explore the primary packaging trends of food products in order to analyse how they might impact the design and development of future refrigerators. In this chapter section. The answer to RQ.3 **How might all of the factors, in packaging development and consumer behaviour, affect the design and development of future refrigerators**, is provided.

4.3.1. Interaction packaging - refrigerator

In relation to how the refrigerator interacts with the primary food packaging, several questions were asked during the interviews. One of those was how do the companies consider the **refrigerator** in the **packaging development**. *M-UK* answered “*It probably isn't considered very much, to be fair. We have been talking about how things will be displayed on the supermarket shelves”, but no one really thinks what happens back at home, with the consumers*”.

D-UK also said that it is not a main driver. The refrigerator design does not have a major influence on their products conception, although in the future that might change. Ordering new items or being alerted to the ones that are expiring were pointed as interactions which could happen between packaging and the refrigerator.

For *F-Swe*, the same thought applies. Part of their development is focused on packaging that can communicate with the consumer, not necessarily the refrigerator. Currently, the refrigerator is not considered in the packaging development because other important elements, such as pallet fit, production equipment, distribution, and place on the retail store are prioritized (*PN-Swe*).

When asked if they believed food packaging and the refrigerator could become competitors, the experts answered that this is unlikely. For that to happen, packaging would have to become self-refrigerated or self-heated, or the fridge would have to become truly portable. Further, the fridge is not just an appliance that preserves and protects the food it contains.

MS-UK emphasized that the refrigerator is also a holding area for the food and the packaging, before it actually goes to the table, is eaten or wasted. For *D-UK* both could, in theory, become either competitors or allies, although in the future, the way to benefit both would be through collaboration.

This collaborative process was previously presented as a way towards packaging evolution. A holistic approach which nowadays does not consider all of the packaging chain participants, even though they share the same priority: consumer satisfaction.

4.3.2. The future refrigerator

All of the packaging experts had a refrigerator at home, which means they are all users of the appliance; thus, all can be considered as potential Electrolux consumers. They feel, first hand, the pains and needs of a consumer who uses food packaging on a daily basis while also interacting with the refrigerator.

A-Swe mentions how the refrigerator looked the same for 40, 50 years with little development.

Examples of the future, provided by the interviewees, include the purchase of a food subscription and not only of a refrigerator. Therefore, when buying the delivery would include the food products, already in the refrigerator and its replenishment when needed. The consumer would then choose the type of refrigerator on the basis of a premium or basic food subscription, personalized to him/her. The challenge here, as pointed by *PN-Swe*, would be the consumer acceptance as he/she is used to do the shopping for their own products.

Other visions included an interaction between packaging and the refrigerator which would allow the consumer to know when the food is close to expiring, by monitoring its freshness, instead of the stamped expiry date. Moreover, it would suggest what to cook with basis on the ingredients already in the shelves, where to place the food items or how to automatically create and order the grocery list.

O-Swe says “*I do not understand why I'm still going to the shop. All of the basic things like milk and cheese, I would like to have them in my fridge. It should understand that it is in a low level and just send a mail to my store and they would just send it home and fill it. Then, the fridge must be on an outside wall, with a back opening so they could just fill in it*”.

F-Swe, *TP-Swe* and *A-Swe* all mentioned that a milk dispenser would be a feature to have in the future refrigerator. A “bag-in-box” approach to milk that would allow the consumer to serve the desired amount of milk without having to open the refrigerator door. Consumers also desire this feature alongside the previously stated, freshness monitors and stock control systems (Westgarth, 2014). In future scenario made in collaboration with the largest UK retailer Tesco, dispensers were also envisioned to be available in retail stores in 2022.

A-Swe would also like to have a transparent fridge. The door would not only allow seeing through, but it would open and close automatically. No more standing at the fridge, with the door open while searching the shelves and trying to select what to eat.

Inside the fridge there could be a hangers for yogurts and for bags. As *A-Swe* mentions, yogurt cups have the same diameter, despite having different shapes, making it easier to hanging the pot in between two sides. This would help solve a problem mentioned by several participants: limited storing capability with no stacking system. *M-UK* adds that the fridge should have more space for fresh products such as vegetables. Nowadays, *M-UK* feels “*like everything that you buy in the supermarket goes into the fridge so it needs to be bigger to take it all*”.

F-Swe points out how packaging is becoming easier to use with re-closable options, therefore the need to transfer the food into another container should decrease and more packaging should be stored in the refrigerator. At the same time, that goes against the intention of the food companies, as the communication is lost if the consumer discards the original package. A challenge could be the fact that products are stored on top of each other, reducing branding visibility.

The fridge door was referred to as “*not holding the products steady enough*” and a suggestion was made regarding an attachable cage facility to the top (*M-UK*).

A highly efficient refrigerator with sections for different temperatures was another suggestion. As well as a refrigerator that is able to communicate and control itself and its content, independently from its user. It would even clean itself (*D-UK*).

D-UK would like a refrigerator that has an oven connected to it; “*a section of your fridge where you can have your meal, but at a certain time you can connect and say that I want to have that [cooked or heated] because you'll be in the house in 20 minutes*”.

Another perspective was of a modular fridge. One that may start as a cubic meter and expand to two cubic meters and back to one cubic meter. The intent would be to buy products that need maintenance as an update, instead of purchasing a completely new product. Therefore, “*people would come in to our homes to add new parts to the basic module, a core piece that would continue to run for decades*”. For *MS-UK* this is the characterization of true sustainability.

4.3.2.1. The personalized refrigerator

The results and discussion were important to provide the answers to the research questions and the specific problems derived from them (Figure 13).

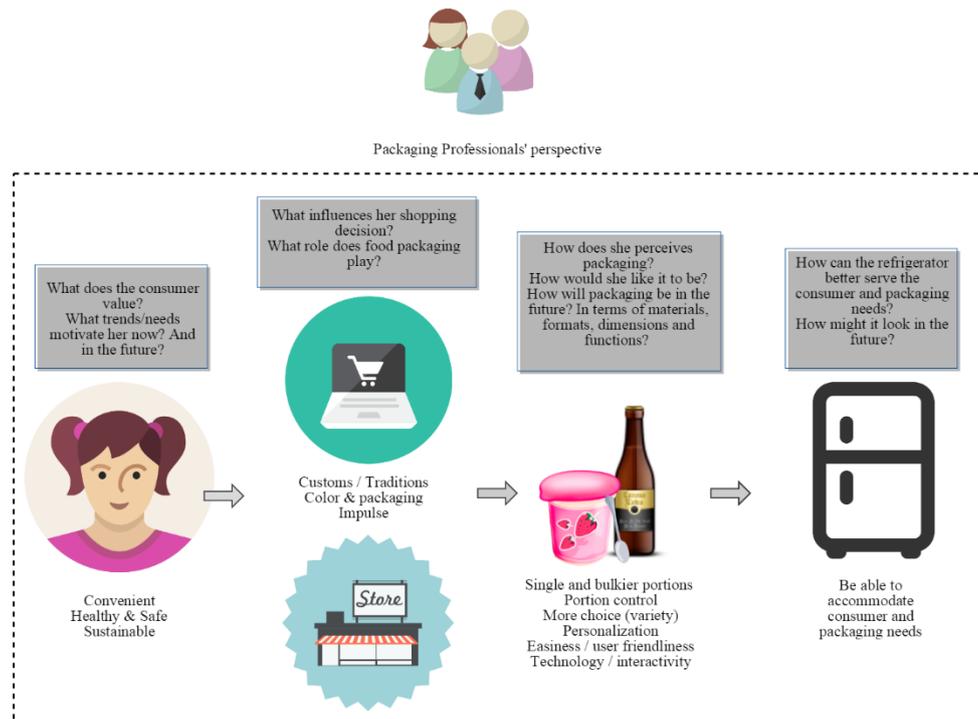


Figure 13. Questions raised in the beginning of this research (top) and main findings (bottom)

With the collected data, features that could be seen in future refrigerators were joint in a concept of a personalized appliance. Although, attention should be given to the fact that they do not represent Electrolux's developments or viewpoint. They were only based on the results of the study and the authors' interpretation of the future refrigerator.

Thus, the future refrigerator could be a structure with no interior. A base module which serves as the backbone to all the shelves and compartments its owner could purchase.

In this scenario, Electrolux adopts the trend "from products to services". It changes its business model from selling refrigerators to selling the service of organizing and making the kitchen the easiest, most consumer-friendly place. With connection to online shopping, this service is responsible to know everything that is in the refrigerator, and everything that is arriving with the food delivery system.

Considering that each consumer is singular, with individual preferences regarding taste, appearance, organization etc., the service would recognize these characteristics and the purchasing habits, in order to suggest modifications to the core module.

It would be like an extension, an add-in, add-out service, adaptable to all the changes consumers go through in life. From getting married to having children going around in the house; from seeing their young adults leaving the nest, to becoming seniors treasuring their home memories; this would be a lifecycle service.

An analogy can be made with a specific product /service: SolarCity®. The American energy company designs, installs and repairs customized solar panels to fit the consumer home's dimensions and energy needs, in a up to thirty year service where the user chooses from different payment methods, based on much of the solar panel he/she wants to own, and the provided energy he/she wants sell. This product to service approach benefits the consumer as a shift occurs, from an un-personalized product to a customized service, fit to the fluctuating consumer needs.

A simple example can be given using the collected information on packaging for milk and yogurt, in the analysed countries, UK and Sweden (shown in the theoretical framework). Two consumers with the same needs, would buy a 1L bottle of regular milk and a regular flavoured yogurt. Despite having looked for the same thing, the products would have different packages (Figure 14). In the UK, the bottle of milk would be made of plastic and not in the rectangular Gable top package found in Sweden. The yogurts would differ in height and shape, thus also requiring a distinct storage.

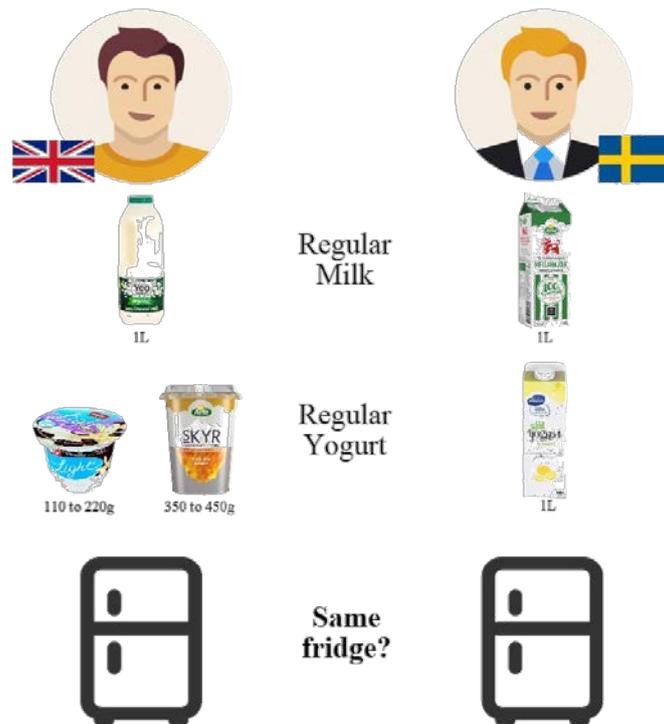


Figure 14. Example of two consumers whose packaging differs; English on the left and Swedish on the right.

Other examples such as vegan consumers, that do not require meat and fish fridge space, or consumers whose eating habits very much rely on frozen ready meals, or even single portions, show how much a “personalized fridge” would be beneficial. Furthermore, future packaging will be developed towards both smaller and bulkier packages. The refrigerator should be flexible enough to consider both dimensions in the given context.

By knowing what the consumers buy, and the packaging those items come in (which, nowadays is becoming increasingly easy to recognise because the products are displayed online, and the consumer will shop online), the “Electrolux service” would suggest which compartments and shelves that particular consumer should acquire. The kitchen could even be updated independently if the consumer would have purchased that service.

Personalization would then be an important feature of this concept. The consumer could also choose different colours and textures. Even limited editions could be available and brand partnerships established.

For example, if a consumer is a Guinness beer fan, its interactive packaging could inform him about the best way to store the cans he bought by purchasing the new “Guinness hanger for the fridge door”.

Such liberty would still have to allow some boundaries. Although most consumers buy the same products, quick suggestions on how to organize the products to fit the newcomers would have to be provided. If those changes were to become permanent, then the service would fulfil the shelves and compartments modifications.

This concept would imply a more “on-demand” and sustainable production from Electrolux. Nevertheless, because the future consumer rents and lends easily, a second hand marketplace would also be available to exchange compartments and shelves. In this circular economy, true sustainability could be achieved.

Two of the main drawbacks to innovation mentioned throughout this research were costs and established conventions (either in relation to packaging or manufacturing and supply chain). Therefore, changes would have to occur incrementally, and this concept would come alive by firstly creating solutions for the most common products an average consumer stores in the refrigerator. A process that would imply to consider the packaging format, shape and volume of their purchase products.

Further features of personalization could include a drink dispenser. The refrigerator would have a water, milk and juice dispenser. In order to provide it safely and without food waste, a personal database with an estimative of the amount of drink consumed in a week would be provided, therefore the delivery company with re-fill the storage in proportion to the household needs. Nanotechnology would allow an easy maintenance with all of the contents easily being ejected.

Another alternative uses plastic bags/pouches (as the ones used in the JUGIT example) which could be available in the “fridge hidden storage” in two or three volumes. Then the consumer could choose from the size he/she desires in the moment. The plastic bags would be popped, squeezed and discarded.

Lastly, the personalization could be facilitated by the use of 3D printing. In the future, consumers would be able to easily print their refrigerators shelves and compartments using Electrolux database. Different files, with suitable models, would be available for download according to the subscribed payment. Then, the consumer would print it at home or in the nearest 3D printer.

Any of these concepts would require several years of development, but would allow to be in alignment with consumer expectations and needs.

5. Conclusions and further research

Food packaging and refrigerators are both in our daily lives, evolving to a set of **consumer** demands. **Convenience** is one of the most important **drivers** of packaging change. It has been, at least since the sixties, and it will continue in the years to come. Other **trends** which will also remain important are sustainability, health and safety, while incorporation of **technology** and package / product **personalization** are likely to grow in importance.

These trends, applicable not only to consumers but also to the packaging industry, will be reflected mainly on the type of **materials**, packaging **dimensions** and functions. Primary food packaging will likely become more environmental friendly, with the use of bioplastics in detriment of glass in formats such as flexible pouches. The future will potentially have smaller and bulkier packages, portion control and multipacks.

When it comes to **functions**, food packaging will likely have a more active role in interactive communication and branding of the food product, through the use of technologies such as printed electronics, thermochromic ink, as well as active and intelligent packaging,

In the next five to ten years, the future of packaging is not likely to be focused on the older population, new formats, incorporation of RFID, edible packaging and nanotechnology.

Currently, **differences** between the English and the Swedish **market** are noticeable for, at least four food categories: milk, yogurt, chilled fruit juice and frozen ready meals, being mostly in the type of materials used, format and number of available products. Such differences are expected to continue in the future due to established traditions and habits. Therefore, packaging standardization will likely be a challenge even when it comes to e-commerce.

In the future, the **refrigerator** development is likely to respond to personalization by exploring a new feature: detachable compartments. Motivations to this projection are health, online communications and the shift of business models, from products to services. However, such evolution will happen gradually in a process that requires **collaboration** across the supply chain.

In order to start this process, **further research** should consider the in-depth study of the most frequent type of products stored in the refrigerator, of others food categories besides the four investigated in this study. As an option, the establishment of a **partnership** between the refrigerator manufacturer and a food company / retailer should be considered.

Future studies should also focus on the consumer perception of packaging in relation to the refrigerator and on the perspective of **packaging professionals**. As far as the author is aware, this group of professionals are not as accounted for, in the literature, as other experts in the supply chain, although their contribution in linking industry and consumer related subjects can be very valuable.

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7. Appendices

Appendix I. Consent form

Consent to participate in interview

Packaging trends of chilled and frozen products in the refrigerator

You have been asked to participate in an interview conducted by *Elisabete Oliveira*, student of the Erasmus Mundus Master *Food Innovation and Product Design*, at *Lund University*.

The purpose of the study is to explore and organize the packaging trends of chilled and frozen foods in the refrigerator, in the near future, to analyze how they might impact the design and development of new refrigerators, at the powered appliances company Electrolux. The results of this study will be made public in *Elisabete Oliveira's* Master thesis.

You were selected as a participant in this study due to your expertise in food packaging. You should read the information below and ask questions about anything you do not understand, before deciding whether or not to participate.

- This interview is voluntary. You have the right not to answer any question, and to stop the interview at any time or for any reason.
- Unless you do not give permission to use your name, job title, years of experience and / or quote you in any publications that may result from this research, the information you provide will be made public, as content of the Master thesis.
- This interview will be recorded for reference while proceeding with this research. I will not record this interview without your permission. If you do grant permission for this conversation to be recorded, you have the right to revoke recording permission and/or end the interview at any time.
- After the interview, you can expect to receive the transcript within a week and to be able to amend or withdraw content as you wish.
- The transcript will not be published.

I understand the procedures described above. My questions have been answered to my satisfaction, and I agree to participate in this study. I have been given a copy of this form.

(Please check all that apply)

I give permission for this interview to be recorded.

I give permission for the following information to be included in publications resulting from this study:

my name my job title years of experience direct quotes from this interview

Name of Interviewee: _____

Signature of the Interviewee _____ Date _____

Signature of the Student _____ Date _____

Please contact *Elisabete Oliveira* with any questions or concerns at *elisabete.oliveira.640@student.lu.se* and *0725349119*.

Appendix II. Interview guide

Interviewee data

Where do you work?
What is your job title?
How many years of experience do you have?
Could you briefly describe your daily work responsibilities / functions?

Packaging: How will packaging for chilled and frozen foods evolve in the near future?

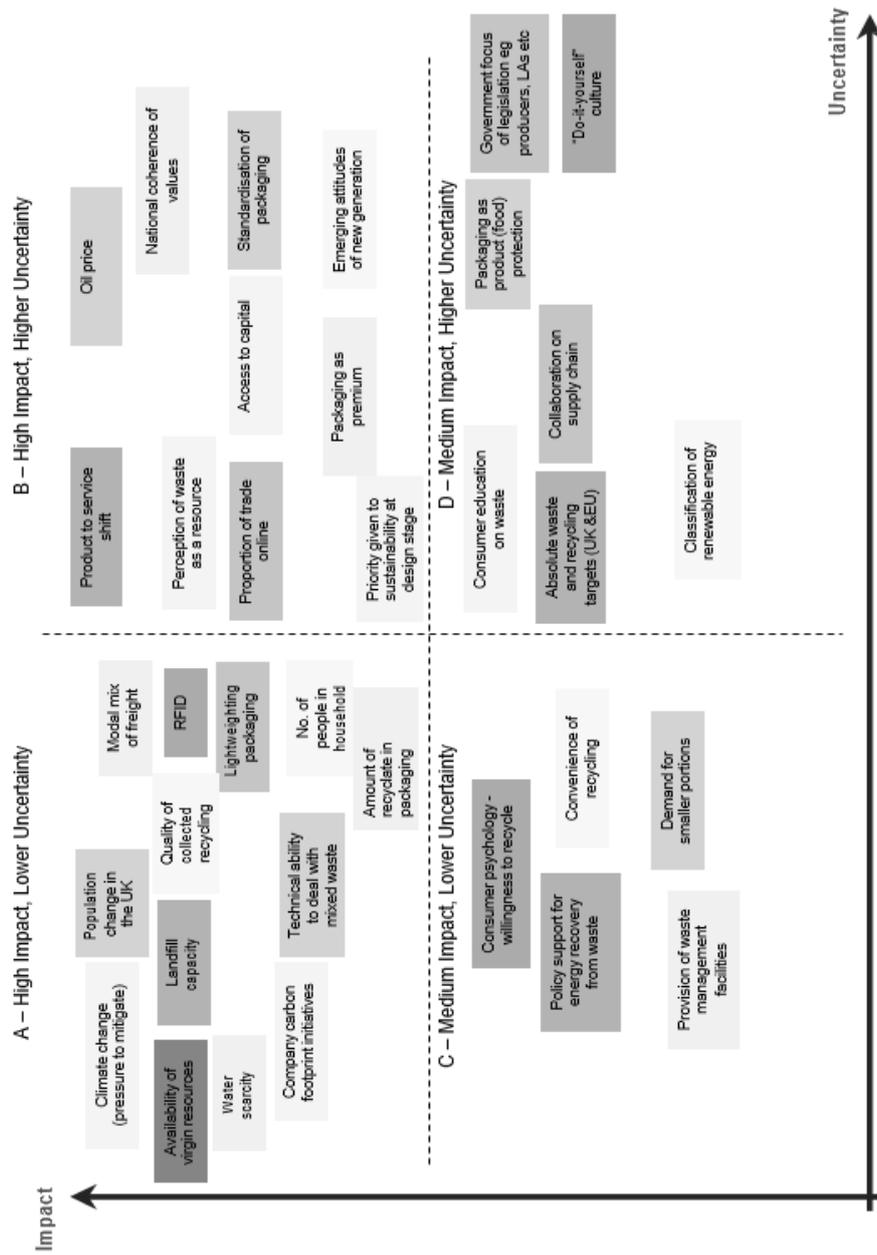
External characteristics	
Format	What will be the top 3 packaging formats most common in the future? Why?
Material	What will be the top 3 packaging materials most common in the future? Why?
Dimensions / size	When it comes to dimensions, what will the trend be for most products? Smaller, bigger or remain the same? What food products will change the most? Why?
Mix	a. What will be the most common packaging for chilled and frozen foods? b. Do you believe we will have any dramatic changes when it comes to the physical appearance of packaging? Which type of packaging will be outdated?
Functions	
Active and intelligent packaging	Which one do you believe will have the biggest share in the market? Which type of products will they protect? To your knowledge, are there new food products being developed because of the benefits active and intelligent packaging bring?
Edible packaging	What role will edible packaging have in the future? In which type of products will be most used?
Nanotechnology	What applications and changes will nanotechnology bring? Which products will be most affected?
Interactions	
Refrigerator	Right now, what factors are considered when developing a packaging? Do you focus mainly on the supply chain? Do you

	<p>consider the refrigerator? Do you consider the refrigerator as part of the product protection?</p> <p>Both packaging and the refrigerator serve similar functions when it comes to food products. Protect and preserve it in the best of conditions. What is your opinion in this relation? How well is the dynamics taken into consideration? Do you see them as competitors in the future?</p> <p>As a packaging expert and consumer with a fridge at home, how would do you imagine your future fridge?</p>
Technology / Connectivity	<p>What changes will connectivity between the supply chain, packaging and home appliances bring to the consumer?</p> <p>Which type of technologies do you believe will most used in the future?</p>
Other	<p>What main challenges will packaging have to solve in the future?</p> <p>What are the main constrains to packaging innovation, to new developments?</p>
Retail	
Online	<p>How will online shopping affect the packaging, its storage and branding?</p> <p>Will the packaging become more standardized or customizable due to e-commerce?</p> <p>How to be sustainable in an e-commerce world?</p>
Retail stores	<p>How do you see the future of packaging in terms of retail without packaging? For instance using bulk sale as an alternative.</p>

Drivers: What are the drivers behind these packaging changes?

Products / Retail	
Frozen	How do you see the future of frozen products?
Consumer	
Standardization / Customization	How do you see standardization and personalization in the future?
Demographics	How will the demographic changes towards an older population impact packaging?
Differences between markets	Which are the main differences in packaging between UK and Sweden?
Food waste	How do you see the concern for food waste affecting packaging?

Appendix III. Factors affecting packaging in the future



Source: Brawn et al., 2014