Packaging and E-Commerce

An exploration of needs and potential innovations

Maria Fransisca Njoman

DIVISION OF PACKAGING LOGISTICS | DEPARTMENT OF DESIGN SCIENCES
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MASTER THESIS

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Abstract

Issue of study : The difference in supply chain characteristics between brick and mortar and E-commerce has triggered the potential need of new packaging requirements for E-commerce.

Purpose : The purpose of this study is to understand why there might be specific packaging requisites in the online channels and what the requirements are. The thesis aims to explore the product and the logistics requirements of packaging from different perspectives, including the producers, the E-commerce players, and the consumers. Collaborating with Tetra Pak, this thesis also aims at analysing the gap between Tetra Pak's current portfolio and the expected packaging requirements in E-commerce.

Method : In order to answer the research questions, a literature study and semi-structured interviews have been carried out. The interviewees include people from Tetra Pak, an E-commerce player in Indonesia, an E-grocer in Sweden, as well as a producer which owns its internal E-commerce.

Conclusions :1) The need for more robust packaging is identified in E-commerce, especially in the pure players, due to the higher number of touch points, the early package breakdown, and the unstandardized package configuration throughout the supply chain. However, this need might not be applicable to the omnichannel players which have almost similar supply chains with brick and mortar.

2) The new solution should maintain the product protection feature, while being low cost and sustainable. The package no longer needs the promotional attributes to enhance the first purchase decision, but it may promote the repurchase decision through great after-purchase experiences.

3) Tetra Pak has already had some potential building blocks, including the brick packaging shape, the paper-based packaging materials, the aseptic packaging, the packages for chilled products, as well as the technology of track and trace and digital printing in its packing solution. For the future innovation, it would be interesting to evaluate the pros and cons of innovating the primary or secondary packages, redefining the concept of group packs, as well as including the geographical insights.

Keywords : E-commerce, packaging, logistics, supply chain, sustainability

Sammanfattning

Utfärdande :De olika egenskaperna i distributionskedjan mellan fysiska affärer och E-handel har skapat ett potentiellt behov för en ny sorts paketering inom E-handel.

Syfte : Syftet med studien är förstå varför det finns ett ökat behov av olika förpackningsalternativ på marknaden utifrån konsument, producent och online handelens perspektiv. Samarbetet med Tetra Pak syftar också till att analysera klyftan mellan Tetra Paks nuvarande portfölj och de förväntade förpackningskraven inom E-handel.

Metod : För att kunna besvara forskningsfrågorna har en litteraturstudie och halvstrukturerad intervjuer genomförts. I studien intervjuades personal från Tetra Pak, ett E-handelsföretag i Indonesien, en E-livsmedelsbutik i Sverige, samt en producent som äger en E-handel

Slutsatser :1) Behovet av robustare förpackningar identifieras i E-handel, särskilt i de rena aktörerna, på grund av mer beröringspunkter, den tidiga paketfördelningen och den icke-standardiserade paketkonfigurationen i hela distributionskedjan. Detta behov kanske inte är tillämpligt på de omnichannel-spelare som har nästan samma distributionskedjor som fysiska affärer.
2) Den nya förpackningslösningen bör bibehålla produktskyddsfunktionen, samtidigt som den bör vara prisvärd och miljösynpunkt. Marknadsföringsattributer är mindre viktiga för att förbättra det första köpbeslutet, men det kan främja återköpsbeslutet genom bra upplevelser efter köpet.
3) Tetra Pak har redan haft några potentiella byggstenar, inklusive fyrkantig förpackningsform, pappersbaserade förpackningsmaterial, aseptisk förpackning, förpackningar för kylda produkter, samt teknik för spårning och digital tryckning i förpackningslösningen. För framtida innovation skulle det vara intressant att utvärdera fördelarna och nackdelarna med att förnya de primära eller sekundära förpackningen, omdefiniera konceptet med grupppaket, samt inkludera den geografiska aspekten.

Nyckelord : E-handel, förpackning, logistik, försörjningskedja, hållbarhet

Executive Summary

Introduction

E-commerce has been growing in the past decade. Globally, the value is predicted to rise from $2.3 trillion in 2017 to $4.9 trillion in 2021 (Sabanoglu, 2020). Although increase the consumer's convenience, compared to the traditional in-store shopping, E-commerce produces 70-85% more CO_2 emission (Escursell, et.al., 2020). The adverse environmental impacts of E-commerce are mainly due to the extra packaging use and the last-mile delivery service (Manerba, et al., 2018).

This thesis project was initiated to respond to the emerging trend of E-commerce, along with the potential environmental impacts from its packaging. As a collaboration project between LU and Tetra Pak, this thesis project addressed three research questions:

1. What are the factors that trigger specific packaging requisites in E-commerce which are different from the current packaging solutions?
2. How should the packaging for liquid products be designed to fulfil the product, the logistics, and the consumer requirements in E-commerce channels?
3. For Tetra Pak, what should be considered to fulfil the gaps between the current portfolio and the expected packaging requirements in E-commerce?

As delimitations; 1) only three categories of products were evaluated for the product requirements analysis (fruit juices, dairy milk, and plant-based dairy alternatives (PBDA)), and 2) although the basic packaging requirements in E-commerce summarised in this thesis might potentially be generally applicable, it is worth to note that the information sources were mainly from the European Union (EU), America, and Asia Pacific (APAC), with majority from Sweden and Indonesia.

Methodology

In order to answer the research questions, literature review and semi-structured interviews were conducted; followed by data analysis using open coding, axial coding, and selective coding.

The sixteen interviewees were divided into three categories; 1) Tetra Pak's employees, 2) E-commerce players, and 3) producer which owns its internal E-commerce. Tetra Pak's employees were interviewed to understand the current state of E-commerce packaging development, the customers' expectations of the packaging performance, and how this research could contribute to the on-going

development projects. E-commerce players both from Indonesia and Sweden were interviewed to understand their supply chain models, the challenges within food and beverage products, the current packaging specification, and how packaging could further support their online businesses. Finally, the interviews with a food and beverage manufacturer in Indonesia, which also owns its internal E-commerce, were aimed to understand the supply chain, the challenges, the current packaging specification, and the products differentiation in different channels. The interviewees were also asked how they foresee the possibility of having different packaging types for online and offline channels.

Findings

From the studies, factors that trigger specific packaging requisites in E-commerce are 1) the higher number of handling and touch points in the online channels compared to brick and mortar (B&M), 2) the package breakdown that could happen in the intermediate point of the supply chain, leaving the products free from the original transport packaging, thus transported as individual packs, 3) unstandardized packaging configuration during transport (e.g. horizontal, diagonal, etc.). Currently, most packaging is developed for B&M and therefore might not be strong enough to endure the rough distribution scheme of E-commerce. Nevertheless, these needs are predicted to be only applicable for the pure players with centralised fulfilment centres, not for the E-grocers or omnichannel players with micro-fulfilment centres which have almost similar supply chain with B&M.

Combining the results of the literature reviews and the interviews, the summary of packaging requirements in E-commerce is depicted in Figure 0.1.

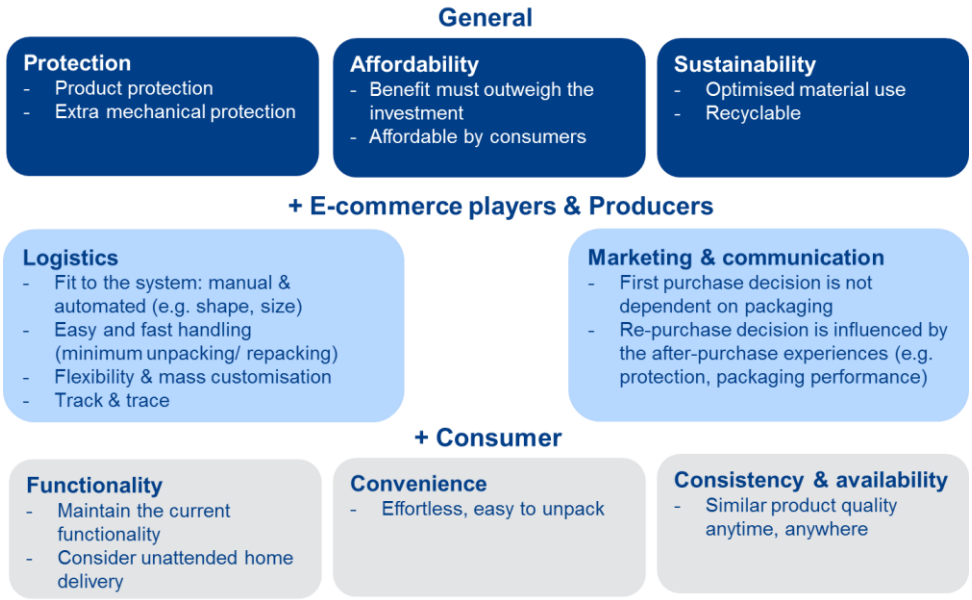

Figure 0.1 Summary of packaging requirements in E-commerce.

Tetra Pak has already had strong building blocks to fulfil the packaging requirements in E-commerce, particularly 1) the brick shape which supports logistics efficiency, 2) the wide range of portfolio that supports both ambient and cold distribution, and 3) the use of sustainable materials. Nevertheless, the protruding features, such as caps, may reduce the mechanical properties of packaging, and thus might be a challenge to survive in E-commerce distribution scheme.

There are several ideas that might be interesting to explore. The first idea is designing sustainable packaging for E-commerce by replacing the aluminium foil layer and removing the promotional attributes from the packaging. The second idea is to modify the mechanical properties of either primary or secondary packaging to promote packaging survival in the rough distribution scheme. The third idea is to redefine the group packs in E-commerce. For instance, instead of having a bulky box with 24 portion packs inside, it might be interesting to have 4-6 portion packs per box, excluding the needs of unpacking and repacking in the fulfilment centres.

When designing the packaging for E-commerce, it is essential to take into account the system in the E-commerce players as well as the geographical insights. This is due to the fact that different players and different regions might apply different ways of packing and handling goods. The success of defining just the right packaging solution for E-commerce might contribute to the actualisation of the 12th United Nations-Sustainable Development Goal, Responsible Consumption and Production.

Recommendations and Future Research

In order to develop an effective packaging solution for E-commerce, there are several recommendations that might be worth to consider. Firstly, since there is no one solution that fits for all, it is important to focus on a potential target market by analysing the consumer's choice of purchasing channels. Offering a breakthrough innovation to a new market area, such as meal subscription model, could also be a point of interest. Secondly, it is also important to consider the geographical insights to understand the drivers of purchase and re-purchase. Thirdly, understanding the needs is mandatory to define the right solution. In this case, the packaging manufacturer shall carefully select what properties shall be kept and which properties must be changed. The decision shall take into account not only the current system in the E-commerce players, but also the future development strategy, especially related to the last-mile logistics.

For further research, more literature reviews, especially in last-mile logistics, and interviews are highly suggested to capture different point of views and project the suitable solution. It is recommended to include more actors in the supply chain, for instance the end consumers, the packaging suppliers, and the transport providers.

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Lund, June 2021

Maria Fransisca Njoman

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List of acronyms and abbreviations

A list of the used acronyms and abbreviations used in this master thesis is provided, in order to simplify the reading

APAC	Asia Pacific
B&M	brick and mortar
B2C	business to consumer
BO	Brand Operation
CSCMP	Council of Supply Chain Management Professionals
D2C	direct to consumers
DO	dissolved oxygen
E&CA	Europe and Central Asia
EU	European Union
EVOH	ethylene vinyl alcohol
FFP	frustration-free packaging
FMOT	first moment of truth
HDPE	high-density polyethylene
HMF	hydroxymethylfurfural
HTST	high temperature-short time
ISTA	International Safe Transit Association
LDPE	low-density polyethylene
LML	last-mile logistics
LTLT	low temperature-long time
OTR	oxygen transmission rate
PBDA	plant-based dairy alternatives
PC	polycarbonates
PEN	polyethylene naphthalate
PET	Polyethylene terephthalate
PFP	prep-free packaging
PME	pectinmethylesterase
PPIC	production planning and the inventory control

Q&A	question and answer
RFID	Radio Frequency Identification
RQ	research question
RTD	ready-to-drink
SDG	Sustainable Development Goal
SIOC	ships-in-own-container
SKU	stock keeping unit
TTI	time and temperature indicator
UHT	ultra-high-temperature
UK	United Kingdom
UN	United Nations
UP	ultrapasteurised
US	United States
WH	warehouse

Initials used for the companies and interviewees

E-NX	NX's internal E-commerce platform
GT	An ex-employee of NX
MH	An employee of ICA
MY	An employee of NX
NX	A food and beverage manufacturer in Indonesia which has its own E-commerce platform
SH	An employee of TK
TK	An E-commerce pure player in Indonesia
TK-CB	TK's consignment service

1 Introduction

The following chapter describes a brief introduction of the master thesis project, including the background, the objectives, the research questions and the delimitations of the project. At the final section, there is a report outline to familiarise the contents of the report.

1.1 Background

E-commerce has been growing in the past decade. Globally, the value is predicted to rise from $2.3 trillion in 2017 to $4.9 trillion in 2021 (Sabanoglu, 2020). Although increase the consumer's convenience, compared to the traditional in-store shopping, E-commerce produces 70-85% more CO_2 emission (Escursell, et.al., 2020). The adverse environmental impacts of E-commerce are mainly due to the extra packaging use and the last-mile delivery service (Manerba, et al., 2018). The extra material use was aimed for a good product protection throughout the distribution channels. Nevertheless, some studies revealed that overpackaging remains a major issue in most E-commerce businesses (Monnot, et.al., 2019). A study from Amazon showed that in 2018 Amazon has dispatched more than 10 billion packages per year, resulting in 44.40 million tonnes carbon footprint (Amazon, 2020; Escursell, et.al., 2020). This fact was complemented by its recent study which revealed that 22% rise of its net sales in 2019 has led to 15% more CO_2 emission compared to the previous year (Amazon, 2020).

Responding to the new market direction, along with the potential environmental impacts from E-commerce packaging, this thesis project was initiated as a collaboration between LU and Tetra Pak. Tetra Pak is a world leading company in the field of food processing and packaging solutions. Operating since 1943, Tetra Pak commits to its vision of making food safe and available, everywhere. Serving the customers in 160 countries, Tetra Pak puts sustainability as the core of its business by designing effective solutions with minimal use of materials and energy (Tetra Pak, 2021b).

1.2 Objectives

The objectives of this project are to understand the nature of E-commerce and the online grocery distribution channels and to define the packaging requirements related to it. Taking both product, logistics, and consumers requirements into consideration, the gathered insights would be utilised to measure the gaps between the current product portfolio of Tetra Pak and the expected packaging characteristics for E-commerce. Looking packaging as an integrated system which highly corresponds to the need of product, logistics, and consumers may result in better-fit packaging design with just the right amount of material use. Thus, this research is expected to positively contribute to the 12th Sustainable Development Goal (SDG) of the United Nations (UN), Responsible Consumption and Production.

1.3 Research questions

In order to fulfil the purposes of this thesis within the pre-determined scope, the objectives were then formulated into appropriate research questions (RQs);

1. What are the factors that trigger specific packaging requisites in E-commerce which are different from the current packaging solutions?
2. How should the packaging for liquid products be designed to fulfil the product, the logistics, and the consumer requirements in E-commerce channels?
3. For Tetra Pak, what should be considered to fulfil the gaps between the current portfolio and the expected packaging requirements in E-commerce?

1.4 Delimitations

The focus of the research is directed to understand the key product requirements as well as the basic packaging requirements in E-commerce based on the literature reviews and the semi-structured interviews with relevant actors. For the product requirements, only three categories of products are evaluated in this thesis; fruit juices, dairy milk, and plant-based dairy alternatives (PBDA). For the basic packaging requirements in E-commerce, although the enlisted requirements in this thesis might be generally applicable, it is worth to note that the information sources are mainly from the European Union (EU), America, and Asia Pacific (APAC), with majority from Sweden and Indonesia. Finally, as the information gathered for this thesis came from the literature reviews and the interviews, in order to distinguish the resources, the information that came from the interviewees will be referred to: “IE-interviewee last name”.

1.5 Report outline

This section provides a short summary of the following chapters in the report.

Chapter 1 Introduction

This chapter describes a brief introduction of the master thesis project, including the background, the objectives, the research questions and the delimitations of the project. At the final section, there is a report outline to familiarise the contents of the report.

Chapter 2 Theoretical Framework

This chapter presents the previous studies within the relevant subjects to get a better understanding of the research field and build a strong project framework. Reflecting upon the thesis objectives at defining E-commerce packaging requirements from product and logistics perspectives, this chapter is divided into four subsections, 1) packaging roles, 2) product characteristics, 3) packaging logistics and product packaging system, 4) E-commerce, packaging, and logistics.

Chapter 3 Methodology

This chapter discusses the methodological approach of this master thesis, including the details of data collection and data analysis, as well as the credibility assessment.

Chapter 4 Results

This chapter is divided into two sections. The first section presents the key takeaways of the literature reviews related to the product requirements and some potential packaging solutions. Meanwhile, the second section presents the key takeaways from the interviews with different actors in the supply chain.

Chapter 5 Discussion

This chapter presents the elaboration of the results both from the literature reviews and the interviews. The four sections presented in the chapter discuss about 1) E-commerce and packaging, 2) packaging requirements in E-commerce, 3) Tetra Pak and packaging for E-commerce, and 4) packaging innovation direction. The discussion also includes the author perspectives of the findings.

Chapter 6 Conclusions and Final Remarks

This final chapter presents the answers to the RQs presented in Chapter 1, the concluding recommendations for Tetra Pak, as well as the personal reflection to give some insights of the possible future development of this project. The contribution to the 12th UN SDG is also discussed at the end of the chapter.

2 Theoretical Framework

To get a better understanding of the research field and build a strong project framework, this chapter presents the previous studies within the relevant subjects. Reflecting upon the thesis objectives at defining E-commerce packaging requirements from product and logistics perspectives, this chapter is divided into four subsections, 1) packaging roles, 2) product characteristics, 3) packaging logistics and product packaging system, 4) E-commerce, packaging, and logistics. To maintain the relevancy, the product categories were selected from the existing Tetra Pak's products portfolio which are packed in the laminated paper packaging. The discussion is focused on the indices of failures and the deterioration factors. Meanwhile, the theory of packaging logistics and E-Commerce business models are discussed in general, as the thorough analysis is elaborated in the next chapters.

2.1 Packaging roles

According to Lockamy III (1995), there are six main functions of packaging; containment, protection, apportionment, unitization, convenience, and communication. In order to obtain the optimum benefit, the packaging design shall take into account the needs of products, logistics, consumers, and environment.

Related to product, the packaging shall deliver an adequate product protection, considering its characteristics and deterioration factors, including the physical, the chemical, and the biological factors (Marsh and Bugusu, 2007). Some parameters that are considered are; 1) product characteristics and potential deterioration factors, 2) desired shelf-life, 3) transportation hazards, 4) properties of available packaging materials and machinery (Kontominas, 2010). Regarding the safety aspect, the packaging materials shall also be food-grade, not containing any dangerous substances.

Related to logistics, similar to the traditional supply chain, the packaging shall promote transport efficiency, security, track and trace, and easy material handling to reduce the seven types of waste (Pålsson, 2018; Jaffar, et.al., 2015). Specifically, for E-commerce, with a high variation in the shipment size, flexibility is demanded. Thereby, modular and customizable packaging would be preferable. Some companies have opted for 3D packaging printers to address this issue (Escursell, et.al., 2020).

On the consumer side, convenience and adequate information are the most important features to deliver (Pålsson, 2018). In addition, due to the growth of the environmental concern in the past couple of years, consumers demand more sustainable packaging (Monnot, et al., 2019). Not only related to the ease to open, use, and store, the convenience for E-commerce consumers also includes the ease to pick up. The last-mile delivery service gives the highest convenient level to the consumers. Nevertheless, it leads to a longer distribution chain, resulting in higher CO_2 emission (Van Loon, et al., 2015). Some companies have introduced drones, electric cars and pick-up points as new logistic strategies to address this issue (Escursell, et al., 2020; Mercedez-Benz, 2020).

Environmental sustainability has become a major concern in the past decade. Packaging is one of the strategic fields to address the environmental issues. Not only reducing food waste, good packaging can also increase the transport efficiency, resulting in a lower CO_2 emission level (Molina-Besch and Pålsson, 2016). The optimisation of the packaging design could be done by implementing 3R principles, reduce, reuse and recycle. Applying the first R principle, a study in E-commerce shows that the use of drone and robots for transporting goods could lead to a possibility of packaging material reduction due to the less mechanical shock during transport and the less distribution time (Escursell, et al., 2020).

In overall, a good packaging design shall neither be overpackage nor underpackage. Utilising just the right type and the right amount of materials to protect the products as well as defining the optimum packaging size to avoid the transport of air are the main goals of packaging development. Specifically, for E-commerce, modular and customizable design might be preferable to facilitate the high variation of the shipment size.

2.2 Products characteristics

2.2.1 Fruit juices

In 2018, almost 36 billion litres of fruit juice and nectar were consumed worldwide. Among all regions, EU-28 countries had the highest number with almost 9.1 billion litres in total consumption (Koptyug, 2019). Both product safety and quality must be maintained in order to assure the consumers satisfaction.

Related to the product safety, generally, pathogenic bacteria are not fond of acidic environments (e.g. pH<4 for citrus juices). However, a study from Caggia et.al., (2009) found that cells of *Listeria monocytogenes* are resistant to acidic environments and can grow in orange juices. Therefore, an additional heat treatment, such as pasteurisation, is commonly applied to inactivate enzymes and

pathogenic bacteria, resulting in an extended product's shelf-life (López-Gómez, et.al., 2010).

Pasteurisation has a significant impact on fruit juices shelf-life. For instance, with the same storage condition at 4^{o}C, freshly squeezed orange juices have 14 days of shelf-life (López-Gómez, et.al., 2010), much shorter compared to the pasteurised juice with 105 days of shelf-life (Leizerson and Shimoni, 2005). Furthermore, pasteurisation combined with hot-filling is proven to ensure the shelf stability of orange juice at ambient temperature for more than 180 days (López-Gómez, et.al., 2010; Anon, 2004; Tekkanat, 2002). The suitable combination of time and temperature in thermal processing is important, because although thermal processing promotes a better product safety through inactivation of microorganisms and enzymes, the excessive heat treatment often leads to counterproductive effects, such as changes in sensory quality of fruit juices and degradation of ascorbic acid or vitamin C (López-Gómez, et.al., 2010).

In terms of quality, there are five deteriorative reactions that can lead to quality losses of fruit juices during processing, packaging, and storage, which are microbial spoilage, oxidation, nonenzymic browning, cloud loss, and scalping (i.e. absorption of flavour compounds by the package) (Ayhan, et al., 2001; Polydera, et al., 2003; Torregrosa, et al., 2006; López-Gómez, et al., 2010).

Unpasteurised fruit juices are prone to the microbial spoilage caused by acid tolerant microorganisms, such as lactic acid bacteria (*Lactobacillus* spp. and *Leuconostoc* spp.), moulds, yeasts (*Saccharomyces cerevisiae*), and *Alicyclobacillus acidoterrestris* (López-Gómez, et.al., 2010). Meanwhile, the non-enzymic browning of fruit juices is related to the presence of furfural and 5-hydroxymethylfurfural (HMF) due to the excess thermal treatments and the lengthy storage times. The carbonyl compounds from the L-ascorbic acid degradation are also reported responsible for this type of browning (Roig, et al., 1999).

Cloud is a complex mixture of proteins, pectin, lipids, hemicellulose, cellulose and other minor components, which significantly affects the flavour, the colour, and the mouthfeel of fruit juices (Baker and Cameron, 1999; Klavons, et al., 1991). Pectinmethylesterase (PME) is responsible for the cloud loss as this enzyme hydrolyses the pectin in the fruit juices (Basak and Ramaswamy, 1996). The inactivation of PME through pasteurisation is important to avoid cloud loss phenomenon. Furthermore, as PME is more heat resistant compared to pathogenic and spoilage microorganisms, its inactivation is an indicator of the pasteurisation process adequacy (López-Gómez, et al., 2010).

The degradation of ascorbic acid due to oxidation is a major problem in fruit juices. Not only reducing the nutritional impact, the degradation of ascorbic acid also imparts in the non-enzymic browning and the flavour change. Specifically, for orange juice, the Association of Industries of Juices and Nectars from Fruits and Vegetables of the European Union sets the minimum ascorbic acid content in orange juice at 20mg/100ml. As the most limiting deteriorative factor, the concentration of

ascorbic acid is used to determine the orange juice shelf-life (Lee and Coates, 1999; López-Gómez, et.al., 2010). Induced by the O_2 presence, the rate of ascorbic acid oxidation during storage is dependent on the amount of O_2 in the headspace, the O_2 permeability of the package, and the storage temperature (Kabasakalis, et.al., 2000). On the other hand, studies from Solomon, et al. (1995) and Berlinet, et al. (2008) showed that ascorbic acid stability is not affected by light exposure. Oil-based volatiles compounds in fruit juices are also prone to oxidation, leading to the development of undesirable, terpene-like off-flavours (López-Gómez, et al., 2010).

Finally, fruit juices could also deteriorate due to scalping phenomenon. The use of nonpolar packaging materials might induce the occurrence of scalping, where the oil-based aroma and flavour compounds of fruit juices are diffused into the packaging polymers (Nielsen, 1994; Moshonas and Shaw, 1997).

There is a wide range of packaging materials used for fruit juices, i.e. plastic bottles, metal cans, glass bottles, plastic/alufoil/paperboard laminate cartons, and flexible packages. Understanding the product characteristics, the deteriorative factors, as well as the expected shelf-life is the first step to select the most suitable packaging material for the product.

2.2.2 Dairy milk

In 2020, the cow milk production has reached 500 million metric tons worldwide. The EU-28, the United States (US), and India are the leading producers, covering more than two-third of the global production (Shahbandeh, 2021a; Shahbandeh, 2021b). In the same year India consumed the most cow milk with a consumption volume of around 81 million metric tons (Shahbandeh 2021a).

In the EU, the US, and Australia, a third of the milk produced is consumed as fluid milk, with pasteurised milk as the leading category, followed by ultra-high-temperature (UHT) treated milk and ultra-pasteurised (UP) milk (Kontominas, 2010). With pH around 6.5-6.7, rich nutrients content, and high-water activity, milk is an excellent medium for microorganism's growth (Hill and Ferrer, 2021). Furthermore, the presence of enzymes (proteases, lipases) make it vulnerable to the chemical deterioration, such as oxidative rancidity. Heat treatments, such as pasteurisation, ultra-pasteurisation, and UHT are effective to inactivate both the microorganisms and the enzymes in milk, extending its shelf-life. Different heat treatments result in different characteristics of products, including the microbiological and the sensory properties, which affect their shelf-life and storage condition requirements.

Pasteurisation aims to destroy all vegetative and pathogenic microorganisms, without altering the flavour and composition of the product. There are two ways of conducting pasteurisation; low temperature-long time (LTLT; 63°C for 30 min) and high temperature-short time (HTST; at least 72°C for at least 15 sec, followed by

immediate cooling to 4°C). LTLT is suitable for the small-scale production with batch system, while HTST is fit for the large-scale production with continuous system. As a result, pasteurised milk can have 5 to >15 days of shelf-life at 4°C in the low-density polyethylene (LDPE)-coated paperboard cartons, the high-density polyethylene (HDPE) packages, or polyethylene terephthalate (PET) bottles (Kontominas, 2010). Due to its limited thermal exposure, the temperature of storage and distribution is critical to maintain the pasteurised milk quality. For every 2°C increase in the storage temperature, the keeping ability is decreased by 50% (Rysstad and Kolstad, 2006).

Ultra-pasteurisation aims to obtain a product with a longer shelf-life than pasteurised milk, but with fewer flavour defects than the UHT-treated milk (Simon and Hansen, 2001). It is conducted by heating milk at 115-138°C for 2-4s (usually 138°C for 2s), followed by immediate cooling below 4°C. UP milk has 30-35 days of shelf-life at 4°C in pre-sterilised containers.

Aiming at producing a commercially sterile product, UHT treatment is conducted at 139-150°C for 3-6s for a complete inactivation of microorganisms and enzymes. UHT-treated milk has up to 9 months of shelf-life in pre-sterilised containers at ambient temperature (Kontominas, 2010). Although pasteurised milk still dominates the European market, some countries, such as Germany, Spain, France, Portugal, and Switzerland opt for UHT-treated milk for its convenience of longer shelf-life and less refrigeration requirements (Rysstad and Kolstad, 2006).

Besides the desirable effect of microorganisms and enzymes inactivation, the thermal processing also alters the sensory and the nutritional properties of milk. Heat causes denaturation of whey proteins. Varnam and Sutherland (1996) reported that loss of available lysine is approximately 1-2% in the pasteurised milk and 4-5.5% in the UHT-treated milk. Meanwhile, changes in sensory, such as the development of cooked flavour and the non-enzymic browning, are not detectable in the pasteurised milk, slightly detectable in the UP milk, and more intense in the UHT-treated milk. Heat also causes the degradation of ascorbic acid where 10-25% of ascorbic acid is lost during pasteurisation, while ultra-pasteurisation and UHT causes more than 25% of loss (Kontominas, 2010). Different attributes of each type of milk leads to different deterioration factors. Thus, they would be discussed separately in the following sections.

2.2.2.1 Pasteurised milk

The pasteurised milk deterioration is caused by microbial spoilage, lipid oxidation, and vitamins degradation (Valero, et al., 2000; Zygoura, et al., 2004). Between those phenomena, lipid oxidation is considered as the limiting factor because it leads to the development of unacceptable sensory quality (off-flavour), before the microbes reach the critical safety limit. The light-induced lipid oxidation imparts in the development of the cardboardy and the sunlight burnt off-flavour due to the degradation of the methionine of the whey proteins (Marsili, 1999; Barnard,

1972). The light exposure, especially with wavelength <500nm, also induces the degradation of the light-sensitive vitamins, particularly riboflavin and vitamin A (Fanelli, et al., 1985; Moyssiadi, et al., 2004; Zygoura, et al., 2004). The shelf-life of pasteurised milk stored in paperboard cartons at 2°C, 5°C, 7°C, 12°C, and 14°C was 15.8, 13.7, 12.3, 4.6, and 3.9 days, respectively (Kontominas, 2010).

Understanding the deterioration mechanisms, the pasteurised milk shall be protected from light and kept at stable refrigerator temperature to maintain its quality.

2.2.2.2 Ultrapasteurised (UP) and Ultra High Temperature (UHT)-Treated Milk

The UP-milk deterioration is caused by both microbial and chemical hazards. The spoilage microbes include *Pseudomonas* spp., *Alcaligenes* spp., *Flavobacterium* spp., *Bacillus coagulans*, *B. subtilis*, and *B. licheniformis*. The psychrotrophs produce proteolytic and lipolytic enzymes, leading to chemical deteriorations. The protein hydrolysis by the proteolytic enzymes results in gelation and bitter flavours, while the lipolytic enzymes' activities lead to rancidity (Kontominas, 2010).

As a commercially sterile product, UHT-treated milk is microbiologically stable. The most important index of failure of the UHT-treated milk is age gelation and sedimentation. Karlsson, et.al. (2019) reported that UHT-treated milk stored at 4 and 20^{o}C had shelf-life between 34-36 weeks, limited by the sediment formation, meanwhile, the UHT-treated milk stored at 30 and 37^{o}C had 16-20 weeks of shelf-life, with the sediment formation and the changes in taste and colour as the limiting factors. The taste and colour changes are mainly caused by the lipid oxidation due to the long-term storage (Walstra, et al., 2006). Although the activities of proteases and lipases are always zero after sterilisation, these enzymes might be reactivated during storage. The rate of reactivation increases with storage time and temperature (Robertson, 2006), and is induced by the light exposure and the O_2 penetration through packaging (Kontominas, 2010).

There are two mechanisms which lead to gelation and sedimentation. The first one involves the activities of the heat-stable proteolytic enzymes which degrade the proteins, leading to gel forming. The second mechanism is known as the physico-chemical mechanism, which is affected by the milk composition and the heat-load during processing (Anema, 2018). The milk treated by the direct UHT is more prone to gelation than that prepared using the indirect method. This is due to the fact that the indirect UHT has a better heat control (Rosenberg, 2002). A study from Topçu, et.al. (2006) revealed that the UHT-treated milk, produced with a direct steam-injection system from low-quality raw milk with high initial microbial loads, including the psychrotrophs, showed high levels of proteolysis during storage at 25^{o}C for 180 days. This caused bitterness, gelation, and sedimentation. The inadequate heat treatment was suggested as the reason of the remaining proteolytic activities from the psychrotrophs.

Understanding the indices of failures, the UP and the UHT-treated milk shall be protected from light and O_2 which induce the oxidative reactions. For storage conditions, the UP milk shall be kept at refrigerator temperature, while the UHT-treated milk can reach its optimum shelf-life when kept below 30ºC. Furthermore, an adequate thermal processing is highly important to avoid the gelation and the sedimentation in the UHT-treated milk.

2.2.3 Plant-based dairy alternatives (PBDA)

Despite the fact that 75% of the global population is lactose intolerant, the sustainability issue has induced the growth of plant-based alternatives. More people opt for reducing the consumption of animal-based products as the livestock sector is responsible for approximately 16% of the anthropogenic greenhouse gas emissions (ProVeg, 2019). For instance, in terms of water use, producing 1L of milk requires 628L of water, significantly higher compared to the soya drink which requires 28L of water/L product (Poore and Nemecek, 2018).

Plant milks or plant-based dairy alternatives are one of the most growing plant-based products worldwide. Generally, they are an extract of legumes, cereals, nuts, and/or seeds, diluted in water (ProVeg, 2019). The use of "milk" term is controversial as some countries restrict the milk definition to the lacteal secretion from mammals. For instance, the Regulation (EU) 1308/2013, Annex VII, part III, defines 'milk' as "the normal mammary secretion obtained from one or more milkings without either addition thereto or extraction therefrom". Therefore, in order to avoid confusion, the report would use the term of "plant-based dairy alternatives (PBDA)".

The rise of the environmental concerns is reflected on the sales trend of the PBDA and the cow's milk. In 2018, the sales of PBDA in the US rose by 9%, while the sales of cow's milk decreased by 6% (Fields, 2018). A similar pattern is found in Germany, the United Kingdom (UK), and the Netherlands. Globally, PBDA is expected to reach more than $38 billion by 2024, with 14% growth rate between 2018 and 2024 (ProVeg, 2019). Surveys from Cargill in 2018 concluded that 54% of the respondents in the US and Europe, 69% of the respondents in APAC, and 71% of the respondents in Latin America consume PBDA, either by itself or in addition to cow's milk. Besides the nutritional and the environmental benefits, Danone confirmed that plant-based proteins are on average 30% cheaper than dairy proteins. Due to the multi-dimensional benefits, Danone planned to triple its plant-based output by 2025 (Fields, 2018).

The common processing steps of PBDA production are depicted in Figure 2.1 (McHugh, 2018; McClements, et al., 2019).

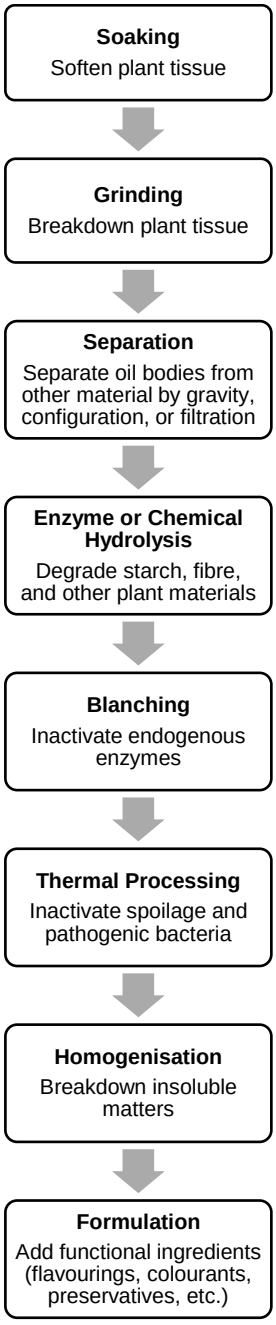


Figure 2.1 Common processing methods of PBDA (McHugh, 2018; McClements, et al., 2019).

Considered as a simple process, the challenges lie in how to make the final products resemble the dairy version. The first issue is the presence of the unsaturated fatty acids and the lipoxygenases in legumes that are responsible for their distinctive

flavours which are less favoured by the consumers (Maestri, et al. 2000). The second issue is the consumers expectation of having the desirable creamy appearance, texture, and mouthfeel of dairy products in PBDA. The first issue is solved by the inactivation of enzymes through the heat treatment, the deodorisation, and the addition of flavourings (Maestri, et al. 2000). Meanwhile, the second issue is addressed by mimicking the milk fat globules through the isolation of natural oil bodies (Sethi, et al., 2016) or the construction of the artificial fat globules from the other plant-based materials (Do, et al., 2018).

There are three indices of failures of PBDA, 1) microbial spoilage, 2) oxidation, 3) sedimentation. Generally, PBDA is an ideal medium for microorganisms' growth due to its neutral pH and high nutrient contents. Furthermore, it is also susceptible to the development of rancid off-flavour due to the oxidation of its unsaturated fatty acids by lipoxygenase (Maestri, et al. 2000). Therefore, inactivation of microbes and enzymes by heat treatment is beneficial to prolong its shelf-life. The most commonly used methods are pasteurisation (<100^{o}C), in-container sterilisation (121^{o}C, 15-20 min), and UHT (135-150^{o}C, few seconds) (Sizer, 1989). As a colloid, the stability of PBDA is dependent on the stability of its colloidal structure. The smaller the size of the dispersed particles, the more stable the structure, thus the sedimentation could be avoided for a longer time. The effective homogenisation as well as the use of emulsifiers and stabilisers could positively impact the stability of PBDA (Valencia-Flores, et al., 2013).

The heat treatment in PBDA production is highly important as it contributes to the inactivation of the microorganisms and the oxidative enzymes, as well as the destruction of the trypsin inhibitors, leading to better product safety, the removal of off-flavours, and the higher protein bioavailability. Trypsin inhibitor reduces the protein absorption which adversely affects the nutritional impact of PBDA (Sethi, et al., 2016).

UHT treatment is the most common method used for PBDA, as pasteurisation could not reach the desirable deactivation level of microorganism, enzymes, and trypsin inhibitors. Furthermore, there is a huge gap of shelf-life between pasteurised and sterilised products. Pasteurised soy drink (60°C, 30 min) has only 3 days of shelf-life in the refrigerator, while sterilised soy drink (120°C, 5 min) could be safely kept for 1 year at room temperature (Sethi, et al., 2016). Kwok and Niranjan (1995) further explained that the combinations of time–temperature in the thermal processing is critical, as an excessive heating leads to nutrient degradations, particularly vitamins and amino acids, non-enzymic browning, and development of cooked flavour.

2.3 Packaging logistics and product packaging system

Packaging is defined as 'a coordinated system of preparing goods for transport, distribution, storage, retailing, and end use'. It is also described as 'the means of ensuring safe delivery to the ultimate consumer in sound condition at minimum cost and at minimum environmental impact' (Paine, 1981; Pålsson, 2018). Packaging as a system includes the interrelated functions of primary, secondary, and tertiary packages. Packaging system is further expanded into product packaging system which highlights the interdependence between the three levels of packaging and the product it contains (Sohrabpour, 2014).

Primary packaging, commonly called as a consumer package, is the package that comes in direct contact with the product (Krochta, 2007; Pålsson, 2018). Secondary packaging, known as retail packaging, contains several primary packages and has a role of facilitating packages handling in the retail level (Hellström and Saghir, 2007; Krochta, 2007). Finally, tertiary packaging, such as pallet or roll container, contains a certain number of secondary packages and is usually called transport packaging (Hellström, 2007; Hellström and Saghir, 2007).

Council of Supply Chain Management Professionals (CSCMP) defines logistics management as the part of supply chain management that plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services, and related information between the point of origin and the point of consumption in order to meet customers' requirements' (CSCMP, 2018). Combining the two definitions of packaging and logistics, Pålsson (2018) refers packaging logistics as 'the interface between packaging and logistics throughout supply chains, which demonstrates and supports the importance of viewing the physical flow of goods and its related information flow as one integrated system'.

An illustration of a producer and simplified supply chain for a packed product is depicted in Figure 2.2 (Pålsson, 2018).

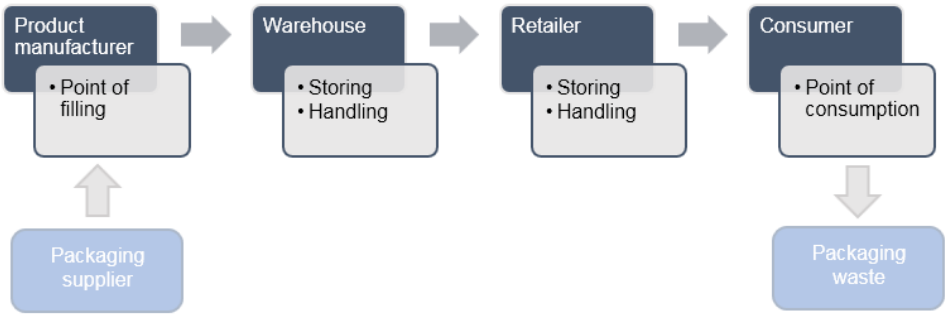


Figure 2.2 A producer and simplified supply chain for a packed product (Pålsson, 2018).

Although acts together as a system, Hellström (2007) highlights that, along the supply chain, the roles of each packaging level might be seen differently by different actors depending on their degree of interaction. The illustration is depicted in Table 2.1, while the code description could be observed in Table 2.2.

Table 2.1 The interacting packaging levels in the retail supply chain (adapted from Hellström, 2007).

Supply chain members	***Manufacturer***			***Distribution centre***					***Retail outlet***		
Logistics processes ***Packaging system***	Filling process	Warehousing process	Transport	Receiving process	Storing process	Picking process	Shipping process	Transport	Receiving and shipping	Replenishing process	Reuse and recycle
Primary	PE									HE PM SH ID	HE MT
Secondary	HE PE					HE ID ER PT SY			HE ID	HE ID PT SH ER	HE MT
Tertiary	HE ST	HE ST PT SY	CU ST HW SY	HE SY ID	CU HW	HE MT	HE HW SY	CU HW SY ST	HE MT SY	HE ID PM	HE MT

Table 2.2 Code description.

Code	***Description***
PE	Production efficiency (including packing line efficiency, filling speed, label application, sealing, technology, flexibility)
HE	Handling efficiency
ST	Stackability
SY	Stability
CU	Cube utilisation
HW	Height and weight
MT	Material
ID	Identification
PT	Protection
ER	Ergonomics
PM	Promotion
SH	Shelf adaptation

2.4 E-commerce, packaging, and logistics

2.4.1 E-Commerce

"E-commerce is defined as the sale or purchase of goods or services, whether between businesses, households, individuals or private organisations, through electronic transactions conducted via the internet or other computer-mediated (online communication) networks. The term covers the ordering of goods and services which are sent over computer networks, but the payment and the ultimate delivery of the goods or service may be conducted either on- or off-line" (Eurostat, 2019).

This online market channel has grown fast in the past decade. The growing scheme from 2014-2021 is captured in Figure 2.3 (Orendorff, 2019). In 2021, E-commerce sales are expected to reach $4.891 trillion, which equals to 19.5% growth from the previous year (Oberlo, 2021a).

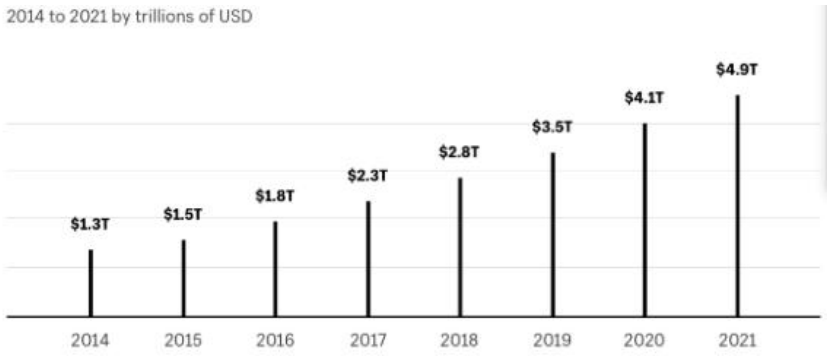


Figure 2.3 Retail E-commerce sales worldwide (Orendorff, 2019).

Since corona pandemic hit the world in 2019, more vendors have extended their traditional brick and mortar (B&M) stores to the online channels. The growth is predicted to continue in the future. Figure 2.4 shows the expected growth of E-commerce share of the retail sales from 13.6% in 2019 to 21.8% in 2024 (Oberlo, 2021b). Looking at the promising growth trend, many business fields have adapted to fit into this channel. Tetra Pak, as one of the global packaging suppliers, also has started observing whether there is a need of adaptation in their packaging portfolio to fit into this channel.

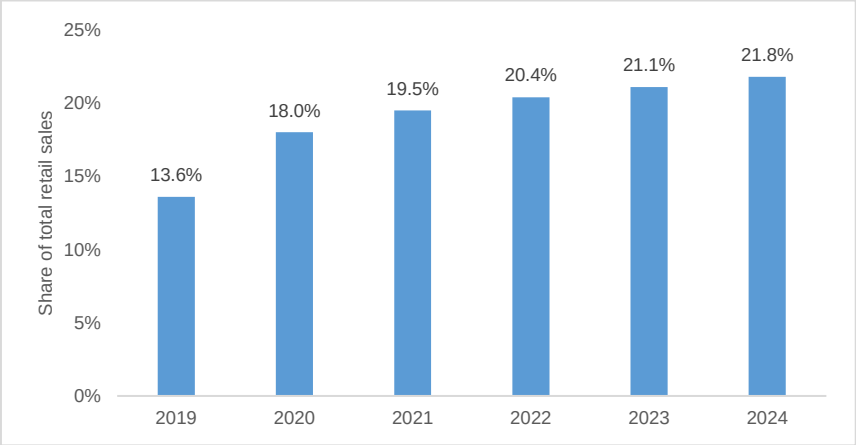
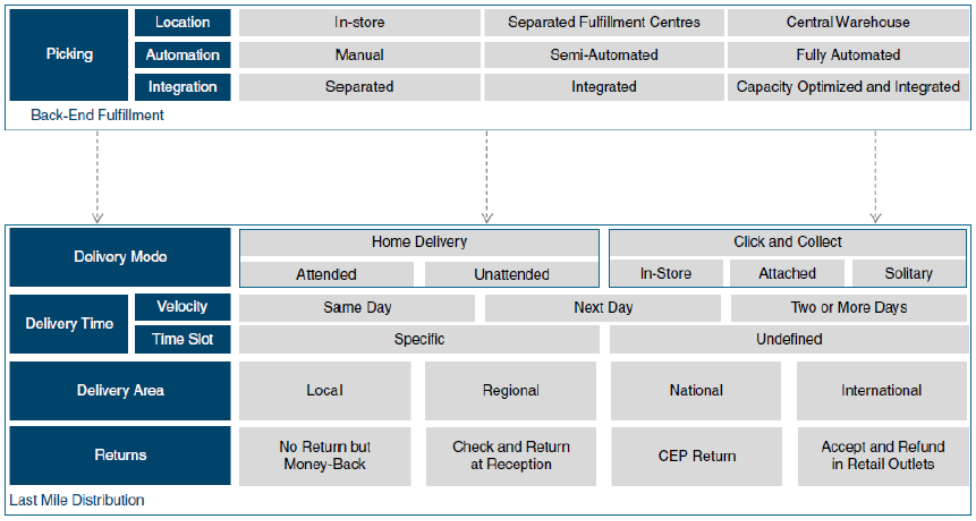


Figure 2.4 E-commerce share of retail sales (2019-2024) (Oberlo, 2021b).

2.4.2 Distribution and last-mile logistics

According to Lim, et.al. (2015), last-mile logistics (LML) is defined as the last stretch of a business-to-consumer (B2C) parcel, taking place from the order penetration point (i.e., fulfilment centre) to the final consignee's preferred destination point (e.g., home or cluster/collection point), for reception of goods. Hübner, et al. (2016) illustrated a strategic planning framework for the last mile order fulfilment and delivery, as depicted in Figure 2.5.



*CEP: Courier, Express and Parcel Services

Figure 2.5 A strategic planning framework for last mile order fulfilment (Hübner, et al., 2016, p. 234).

LML is a big challenge in E-commerce. It is one of the most expensive, the least efficient, and the most polluting parts of the supply chain (Gevaers, et al., 2011). Some issues related to the LML are the small delivery time windows, the troubles in preserving temperature regulations (e.g. chilled distribution), and the small quantity of orders (Punakivi, et al., 2001).

In E-commerce, back-end fulfilment is the means to pick, pack, and fulfil the consumer order. Different players use different types of fulfilment centres, depending on their business models. For instance, E-grocers and omnichannel players usually fulfil the orders from the dark stores or their retail stores (e.g. ICA, Willys), meanwhile the pure players (e.g. Amazon) mostly have dedicated customer fulfilment centres.

For the last mile distribution, usually there are two alternatives provided; the home delivery, and the click-and-collect. The home delivery is divided into two types; the attended home delivery, when the consumers must directly receive the package, and the unattended home delivery, when the packs could be dropped at the assigned place, without the consumers' attendance. Unlike the home delivery in which the order is sent to the consumers' place, the click-and-collect model requires the consumers to pick the orders at the collection point (Hübner, et al., 2016).

2.4.3 Pure players, multichannel and omnichannel players

Depending on how many channels used to sell the products, there are two big types of E-commerce players; the pure players and the multi/omnichannel players. The pure players primarily sell the products via their online storefronts, while the multi/omnichannel players sell the products in several channels, usually by operating both offline and online storefronts (Ritchie, 2020). The examples of pure players are Amazon, Alibaba, Pinduoduo, Tokopedia, Shopee, and Ocado; whereas, Walmart, ICA, Willys, and IKEA are the examples of the multi/omnichannel players. Analysing the considerable growth of E-commerce in the recent years, many local B&M stores have launched their online services and become the multi/omnichannel players to expand their business and boost their sales.

Even though using multiple channels to sell the products, there are some key differences between multichannel and omnichannel players, which are depicted in Table 2.3 (Verhoef, et al., 2015).

Table 2.3 Multichannel vs omnichannel management (Verhoef, et al., 2015).

Aspect	*Multichannel management*	*Omnichannel management*
Channel focus	Interactive channels only	Interactive and mass-communication channels
Channel scope	Retail channels: store, online website, direct marketing	Retail channels: store, online website, direct marketing, mobile channels, social media, customer touchpoints (incl. mass communication channels: TV, radio, etc.)
Separation of channels	Separate channels with no overlap	Integrated channels providing seamless retail experiences
Brand vs channel customer relationship focus	Customer-Retail channel focus	Customer-Retail Channel-Brand focus
Channel management	Per channel objectives (i.e. sales per channel, experience per channel)	Cross-channel objectives (i.e. overall retail customer experience, total sales over channels)

2.4.4 Packaging in E-commerce

A study from Regattieri and Santarelli (2013) revealed that E-commerce business model has affected three dimensions of packaging roles, as captured in Table 2.4. The study concludes that in E-commerce the role of packaging will be less about the shelf display, but more about information and products containment. A higher concern in the protection feature is also identified in the E-commerce packaging (Regattieri and Santarelli, 2013). More detailed findings are discussed in the Result and Discussion chapters.

Table 2.4 Packaging roles in offline and online channels (Regattieri and Santarelli, 2013).

Dimension	*Offline channels*	*Online channels*
Marketing	Sell, differentiate, promote, value, inform, shelf presentation, visual communication	Brand identity, means of disseminating information, product promotion
Logistics	Handle, transport, store, distribute	Protection and covering the product, transport, reverse logistics, security
Environment	Reduction of materials, re-use, recover, disposal	Reduction of materials, recyclable materials, re-use, disposal

3 Methodology

The following chapter discusses the methodological approach of this master thesis, including the details of data collection and data analysis, as well as the credibility assessment.

3.1 Data collection

Aiming for a comprehensive qualitative study, this master thesis uses both primary and secondary research for data collection purposes. The secondary research consists of a literature review, with the usage of internal data sources from Tetra Pak and LU, as well as external data sources, such as E-commerce platforms' websites, scientific journals, research articles, and books. On the other hand, the primary research was conducted through semi-structured interviews with Tetra Pak's employees and the relevant actors in several E-commerce's platforms.

3.1.1 Literature review

As a direct access to the company's database was prohibited, the relevant studies from Tetra Pak were shared by the supervisors and the interviewees. The materials include the business models and the supply chain of several E-commerce players, as well as the progress of recent packaging development projects. On the other hand, the materials from LU were gathered through LUBsearch (an electronic search tool for scientific literature), which include the previous students' theses and scientific databases. Aiming for a high relevancy with the thesis objectives, some keywords were used for both searches in LUBsearch and the other external sources, as depicted in Table 3.1.

Table 3.1 Keywords used in the literature search.

Main topics	*Keywords*
Product requirements	Consumption trend;
(fruit juices, milk, and plant-based milk)	Deterioration factors;
	Packaging requirements;
	Shelf-life in different packaging;
E-Commerce and packaging	E-commerce growth;
	E-commerce and E-grocery supply chain;
	Packaging for E-Commerce;
	Packaging logistics in E-Commerce;
	Last-mile logistics;
	Amazon packaging certification

3.1.2 Semi-structured interviews

Research interviews could be either structured, unstructured, or semi-structured. The structured interviews follow a strict order of pre-defined questions, whereas the unstructured interviews aim for impromptu and spontaneous conversations with the highest degree of exploration. For this thesis project, semi-structured interview model was selected to assure the interviews' objectives were achieved, without forfeiting the flexibility of exploration during the process. In semi-structured interviews, a set of open-ended questions is prepared before the interviews, but dialogue can meander around the topics, depending on how the conversation evolves (Adams, 2015).

In order to gather comprehensive data, a multi-perspectives approach was employed. The interviewees were divided into three different groups, A) Tetra Pak's employees, B) E-commerce and E-grocer, and C) producer with internal E-commerce platform. The details of the interviews are depicted in Table 3.2, and the interview guides can be viewed in Appendix A.

Table 3.2 Interviews groups and their specific purposes.

Group	*Number of interviewees*	*Interviewee groups*	*Purposes*
A	12	Tetra Pak employees	To understand the current state of E-commerce packaging development, and the customers' expectations of the packaging performance. To get insights how this research could contribute to the on-going projects in E-commerce.
B	2	E-commerce, E-grocers	To understand their supply chain models and the challenges within food and beverage products. To know the current packaging specification, and how packaging could further support their online businesses.
C	2	Producer with internal E-commerce platform	To understand the supply chain, the challenges, the current packaging specification, and the products differentiation in different channels. To get insights how they foresee the possibility of having different packaging types for online and offline channels.

The interviews with Tetra Pak employees were aimed at getting insights from their current projects and research on the packaging solutions for the online channels, including their views of the market's trend, as well as the challenges and the expectation of the packaging performance. During interviews, the interviewees were also asked about how this thesis project could positively contribute to the on-going projects.

On the other hand, the interviews with the external parties in category B and C were aimed at understanding their supply chain models, the challenges, as well as the specific packaging and products requisites for the online channels. Furthermore, as the decision-makers of the primary packages, the producer's representatives were also asked how they foresee the possibility of having different packaging types for the online and the offline channels.

A summary of the conducted interviews, including the interviewees profiles as well as dates and lengths of the interviews, is provided in Table 3.3.

Table 3.3 Interviews summary.

Group	***Company***	***Name***	***Position***	***Team/ Department***	***Date***	***Length***	***Format***
A	Tetra Pak	Nils Toft	Company Specialist	Packaging Material Design Dept: D&E Materials & Package	26 Jan 2021	60’	Presentation
A	Tetra Pak	Patricia Civa	Package Expert	Market Support Dept: D&E Materials & Package	3 Feb 2021	40’	Presentation, Q&A
A	Tetra Pak	Hemant Krashak	Senior Product Manager	Ambient Packaging Solution Dept: PSCO Packaging Solutions	4 Feb 2021	60’	Presentation, Q&A
A	Tetra Pak	Philip Wirsen	Strategy & Channel Leader	Growing with New Channels Dept: PSCO Marketing	5 Feb 2021	45’	Q&A
A	Tetra Pak	Erica Lundström	Package Designer	New Solution Scouting and Pre-Studies Dept: D&E Materials & Package	8 Feb 2021	60’	Presentation, Q&A
A	Tetra Pak	Jala Omar	Business Analyst	PSE Projects, Engineering & Plant Automation	5 Feb 2021	60’	Presentation, Q&A
A	Tetra Pak	Debora Parreira	Sales and Distribution Solutions Manager (America)	AMER Marketing	1 and 4 Mar 2021	80’&70’	Presentation, Q&A
A	Tetra Pak	Lars Henriksson	Innovation Study Leader	D&E Systems Engineering & Quality	10 Mar 2021	50’	Q&A
A	Tetra Pak	Karin Marcovecchio	Lead User Experience Researcher	D&E Automation & Digital	16 Mar 2021	60’	Presentation, Q&A

Group	***Company***	***Name***	***Position***	***Team/ Department***	***Date***	***Length***	***Format***
A	Tetra Pak	Ezequiel Fourcade	Cluster Marketing Services Manager	E&CA Marketing	17 & 25 Mar 2021	30' & 60'	Q&A
A	Tetra Pak	Zhang Ami	Operational Marketing Director	APAC Market Greater China	23 Mar 2021	60'	Q&A
A	Tetra Pak	Ishikawa Toru	Cluster DE/SDS (Downstream Equipment/ Sales & Distribution Solution) Specialist	APAC Marketing			
B	TK	SH	Senior Lead	Category Development: Mom and Baby	6 Feb 2021	80'	Q&A
B	ICA	MH	Head of Packaging & Traceability	Logistics/ replenishment	2 Mar 2021	30'	Q&A
C	NX	GT	Ex-Associate	Production Planning and Inventory Control	7 Feb 2021	60'	Q&A
C	NX	MY	Manager	E-Commerce: Supply Chain Management	11 Feb 2021	40'	Q&A

3.2 Data analysis

Opting for an iterative-qualitative research model, Grounded Theory was selected for data analysis purposes. Strauss and Corbin 1998 (see Bryman and Bell, 2003) defined Grounded Theory as a theory derived from data that systematically have been collected and analysed during the research process. In this theory, there is a close linkage between the data collection, the analysis, and the resulting theory.

3.2.1 Qualitative data analysis

There are three types of activities incorporated in the qualitative data analysis; data condensation, data display, and conclusions drawing and verification. As an iterative process, these interwoven activities occur simultaneously before, during, and after the data collection (Miles, et al., 2013).

Data condensation aims at transforming the raw data into the more focused and organised data. This process includes writing summaries and analytical memos, coding, and developing themes or categories to focus, sort, organise, and discard irrelevant data (Miles, et al., 2013). Data display is a process of creating a compact presentation of the obtained information (e.g. tables, matrices, graphs, charts) which enables easy interpretation, and thus help the analyst to elaborate the results and suggest the next steps (Miles, et al., 2013). Both the data condensation and the data display shall support the processes of conclusions drawing and verification, where the perceived meanings must be tested for their validity (Miles, et al., 2013).

3.2.2 Coding

Coding is performed to identify keywords, concepts, or categories. For this thesis project, the result of coding shall be able to reach the theoretical conclusions where all the RQs are answered thoroughly. There are three steps of coding; open coding, axial coding, and selective coding (Bryman and Bell, 2003).

In the open coding, the data were broken down, compared, and categorised into sub-concepts (Bryman and Bell, 2003). For this study, this step was conducted by transcribing the interviews and listing the key takeaways both from the interviews and the literature review. Reflecting upon the objectives of the studies, the selection of the key takeaways focused on the products requirements, the products deterioration factors, the supply chain models, the logistics challenges, and the packaging specification. The responses from different interviewees were analysed and compared, in which the key takeaways were withdrawn based on the occurrence frequency. Then, the axial coding was performed by analysing the sub-concepts and finding links among them, for instance based on contexts, consequences, and/or interaction patterns (Bryman and Bell, 2003). For this study, this step was carried out by grouping the key takeaways based on their contents, followed by specifying the suitable themes. Four themes were concluded from this step which became the titles of section 5.1 to 5.4. Then, the selective coding was conducted to select the core categories, which are discussed in each subsection in section 5.1 to 5.4.

3.3 Credibility

The credibility of the qualitative study was assessed by evaluating the validity and the reliability of the research (Yin, 2009).

3.3.1 Validity

There are two types of validity being assessed; internal and external validity. The internal validity could be achieved by having a well-defined research framework, adequate quality control and implementation strategies, including adequate recruitment strategies, data collection, data analysis, and sample size (Gibbert, et.al., 2008; Patino and Ferreira, 2018). On the other hand, the external validity refers to whether the research findings are generalisable. This could be increased by using a broad inclusion of the research criteria which results in a sufficient population size that resembles the targeted population (Patino and Ferreira, 2018).

Both the internal and the external validity of this project were induced by utilising multi-approaches data collection through literature review and interviews. To avoid the risk of having narrow mindset and making premature conclusions, the literature review was conducted by using various sources and the interviews were held with different groups of people with a broad set of positions, backgrounds, and experiences (Simundic, 2013; Yin, 2009). The external respondents were also selected from different types of E-commerce players to increase the generalisation potency of the research result.

In relation with the practical implementation of the chosen methods, the internal validity was increased by the use of open-ended questions in the semi-structured interviews. This was aimed to avoid the risk of alluding the interviewees' responses. The interviews were also recorded and the results were transcribed to enable revisit, and thereby memory bias could be averted (Tryon, 2014).

3.3.2 Reliability

Reliability represents the trustworthiness and the consistency of the study, whether it is stable over time and across researchers and methods (Miles and Huberman, 1994). According to Miles, et.al. (2013), a team coding is one of the good ways to check the research reliability, as analysis of two or more coders are considered less subjective compared to individual analysis. Since this thesis project was conducted individually, the internal consistency was insured by doing the same coding twice with a few days or weeks in between. In addition, the peer reviews and the continuous feedback sessions with the supervisors were also held to include different perspectives that increase the objectivity of the analysis result. The reliability of the interviews data was also assured by asking the confirmation of the respondents towards the written draft of the interviews results.

4 Results

This chapter is divided into two sections. The first section presents the key takeaways of the literature reviews related to the product requirements and some potential packaging solutions. Meanwhile, the second section presents the key takeaways from the interviews with different actors in the supply chain, comprising the market insights, the supply chain, the technical aspects of packaging, as well as the challenges and opportunities for packaging development in E-commerce.

4.1 Analysis of product requirements and different packaging solutions

The product requirements are discussed in this thesis because every product has different characteristics and deterioration factors that must be considered for designing the suitable packaging. These factors remain regardless of which channels are used to sell the products. Thus, no matter what the modifications would be applied to the packaging for E-commerce, the packaging protection feature against the deteriorative hazards shall remain.

4.1.1 Fruit juices

Based on the identified risks and hazards, a fully-covered package with suitable polarity and good O_2 and microbial barriers is essential to promote an extended shelf-life of fruit juices. Among those properties, O_2 barrier is the most critical attribute. The summary of the potential deterioration factors and the packaging roles is depicted in Table 4.1.

Table 4.1 Potential deterioration and packaging requirements of fruit juices.

Potential deterioration	*Hazards*	*Packaging requirements*
Microbial spoilage	O_2 Cross-contamination	O_2 and microbial barriers
Oxidation, Off flavour, Degradation of ascorbic acid, Non-enzymic browning	O_2	O_2 barrier
Cloud loss	PME	Fully-covered package; A package could not eliminate the hazards, but a fully-covered package could help to reduce the visibility of cloud.
Scalping	Affinity between non-polar packaging materials and oil-based aroma and flavour compounds	Suitable polarity of packaging materials.

With good O_2 barrier properties, a package could inhibit the aerobic microbial growth, particularly moulds, yeasts, and the pathogenic bacteria, such as *Salmonella* spp. and *E-coli* O157: H7. Meanwhile, the inhibition of microaerophilic and anaerobic bacteria, such as Lactobacillus spp., is more dependent on the thermal processing (López-Gómez, et.al., 2010).

Oxidation contributes to the off-flavour development, ascorbic acid degradation, as well as non-enzymic browning. Specifically, for orange juice, the degradation of ascorbic acid is the limiting factor of its shelf-life (López-Gómez, et.al., 2010). The oxidation in fruit juices is mainly induced by O_2 and high storage temperature. The amount of O_2 in the package is dependent on the efficiency of deaeration during filling process, the amount of O_2 in the headspace, and the permeation of O_2 through the package into the juice (Kabasakalis, et al., 2000). A study from Soares and Hotchkiss (1999) described that juices in high-O_2-permeability containers showed a faster decrease in ascorbic acid content, independent of the initial dissolved oxygen (DO) content (Soares and Hotchkiss, 1999). Therefore, a package with good O_2 barrier properties is necessary to slow down the rate of ascorbic acid degradation in fruit juices, thus prolong their shelf-life.

Some studies show that oxidation in fruit juices is not affected by light exposure. Solomon, et.al. (1995) concluded that light has no effect on the stability of ascorbic acid in orange juice, as there is no difference in ascorbic acid contents between the orange juice stored in glass at 8^{o}C under artificial light (200 lux) and the juice stored in darkness. Berlinet, et al. (2008) confirmed the same thing from their findings of no difference between the ascorbic acid contents between the ascorbic acid contents of juices stored under artificial light (750 lux, which is typical of lighting in supermarkets) and in darkness after both 3 and 9 months of storage.

A package could not eliminate the hazard of cloud loss phenomenon, which is attributed to the presence of PME. However, considering that it is not related to the product safety and more into visual perception, a fully covered package could help to reduce its visibility to the consumer (López-Gómez, et.al., 2010).

Scalping is caused by the high affinity between non-polar packaging materials and oil-based aroma and flavour compounds of fruit juices. A study from Mannheim, et al. (1988) revealed that citrus juices aseptically packaged in laminated cartons had 25% reduction of D-limonene content within 14 days of storage at ambient temperature, due to the absorption by the polyethylene. The sensory evaluations show that juices packaged in laminated cartons and glass are significantly different after 10-12 weeks. On the other hand, a study from Pieper, et al. (1992) concluded that absorption of up to 50% limonene had no significant effect in the sensory quality of juice stored at 4ºC. The two studies at different storage temperature implied that low storage temperature, and cold serving, which are mostly applied in the households, might reduce the sensory impact from D-limonene's adsorption. Aligned with Pieper, et.al. (1992), a recent review from Linssen, et al. (2003) described that the interactions between packaging and flavour do not influence the acceptability of fruit juices. Nevertheless, if the producers aim to reduce the flavour diffusion into the packaging polymers, they could opt for more polar packaging materials, such as PET, polyethylene naphthalate (PEN), and polycarbonates (PC) (López-Gómez, et al., 2010).

Packaging selection is important to obtain an optimum shelf-life of fruit juices, as different materials has different barrier properties which affect the stability of fruit juices' during storage (Beltrán-González, et al.; 2008; López-Gómez, et al., 2010). Beltrán-González, et al. (2008) evaluated the shelf-life of aseptically packaged pasteurised orange juice (86ºC/20s) in different containers at 4ºC storage temperature. The changes of ascorbic acid content, colour, as well as the consumer perceptions of sensory attributes were observed during 90 days of storage time. The analysis concluded that the juice packed in multilayer carton package with aluminium foil as O_2 barrier has the longest shelf-life with over 90 days of shelf-life, where all quality attributes have not reached the critical acceptance limit until the end of the observation period. On the other hand, the shelf-life of samples packed in the multilayer carton packages with ethylene vinyl alcohol (EVOH) as O_2 barrier and in the transparent PET bottles were 54 and 36 days, respectively.

A review from López-Gómez, et al. (2010) stated that pasteurised juices aseptically packed in laminated cartons with aluminium foil barrier has approximately four to six months at ambient temperature. Furthermore, despite the packaging materials, Graumlich, et al. (1986) suggested that the most important factor in determining the shelf-life of aseptic orange juice is the storage temperature, as high storage temperature accelerates the rate of oxidation, leading to ascorbic acid destruction and non-enzymic browning.

4.1.2 Dairy milk

As described in section 2, the main deterioration mechanisms of milk include oxidation, microbial spoilage and sedimentation. Thus, packaging roles of protecting the product from light, O_2, and microbial cross-contamination are essential to extend the product's shelf-life (Borle, et al., 2001; Vassila, et al., 2002).

Generally, photo-oxidation is the limiting factor of milk shelf-life. In order to adequately protect milk against photo-oxidation, it is recommended to have packaging material with low permeability of O_2 and maximum permissible light transmission of 8% at 500nm and 2% at 400nm (Rysstad and Kolstad, 2006). Using this standard, transparent packaging materials offer minimal protection against harmful light; paperboard gives a very good light protection; while aluminium foil with 0% light transmission provides the best protection against light (Rysstad and Kolstad, 2006).

Unlike UP and UHT-treated milk which shall be protected from both O_2 and light-induced oxidations, pasteurised milk packaging focuses its protection feature only on the light barrier properties. This is due to the fact that with a relatively short shelf-life (5-15 days), the permeability of O_2 through packaging has a negligible impact to oxidative reactions compared to the light-induced oxidation (Kontominas, 2010).

Specifically, for UHT-treated milk, in addition to oxidation, sedimentation is one of the most common deterioration factors which limits its shelf-life. Caused by the remaining proteolytic activities from the psychrotrophs, the hazards elimination is dependent on the effectiveness of the thermal processing. Packaging could not eliminate the hazards, but can reduce the visibility of sedimentation to the consumers.

Different thermal processing also results in different storage condition requirements, where both pasteurised and UP milk shall be kept under refrigerator temperature, while UHT-treated milk can be stored at ambient temperature. The summary of the potential deteriorations as well as packaging and storage requirements of milk products is depicted in Table 4.2.

Table 4.2 Potential deteriorations and packaging requirements of milk products.

Potential deterioration	*Hazards*	*Packaging requirements*	*Storage requirements*
Microbial spoilage	O_2 * Cross-contamination	O_2* and microbial barriers	Pasteurised and UP: refrigerator UHT: ambient
Oxidation Off flavour Non-enzymic browning Vitamins degradation	O_2*, light	O_2* and light barriers	
Gelation and sedimentation**	Proteolytic activities from the psychrotrophs	Fully-covered package; A package could not eliminate the hazards, but a fully-covered package could help to reduce the visibility of sedimentation.	

*only applicable for UP and UHT-treated milk
**only applicable for UHT-treated milk

Several studies have confirmed the impacts of different packaging to milk shelf-life. Comparing UHT-treated milk packed in LDPE-coated paperboard cartons with and without aluminium foil layer, Farrer (1983) found that O_2 content in the milk packed in the carton containing aluminium foil remained almost unchanged after 33 days, while in the other package, the O_2 content increased to 8-9ppm only after a few days. The sensory evaluation showed that even under extreme storage condition (38^{o}C) milk in the container with aluminium foil was organoleptically acceptable for up to 2 months, whereas in the other package, the milk was acceptable only for 3 weeks when stored at 15^{o}C (Farrer, 1983).

Another study from Rysstad, et al. (1998) analysed the impact of different O_2 permeability of packaging, expressed as oxygen transmission rate (OTR), to the sensory and chemical shelf-life of UHT-treated milk. The samples were evaluated in 1-L gable-top cartons with three structures: an aluminium foil barrier (OTR: 0ml O_2/m^2/day); a non-foil, paper-based barrier (X-board; OTR: 2-4ml O_2/m^2/day); and LDPE-coated paperboard (>200 ml O_2/m^2/day). When stored in the dark place, UHT-treated milk in cartons with aluminium foil had 6 months of shelf-life, whereas in the other packages, the milk had 4-5 months of shelf-life. When exposed to direct light at 6^{o}C, a light-induced off-flavour was detected from the milk with LDPE-coated package and X-board cartons after 2 weeks and 8 weeks, respectively.

4.1.3 Plant-based dairy alternatives

To-date, UHT-treated PBDA is the most common form of PBDA found in the market. This is due to the fact that other thermal processing, e.g., pasteurisation, could not reach the desirable deactivation levels of microorganism and enzymes,

leading to products with not only a short shelf-life, but also unacceptable off-flavours (Sethi, et al., 2016). The summary of potential deteriorations, hazards, and packaging requirements of UHT-treated PBDA is presented in Table 4.3.

Table 4.3 Potential deteriorations and packaging requirements of PBDA.

Potential deterioration	***Hazards***	***Packaging requirements***
Microbial spoilage	O_2 Cross-contamination	O_2 and microbial barriers
Oxidation, Off flavour, Non-enzymic browning, Vitamins degradation	O_2, light	O_2 and light barriers
Sedimentation	Instable colloidal structure	Fully-covered package; A package could not eliminate the hazards, but a fully-covered package could help to reduce the visibility of sedimentation.

Some studies show that sedimentation is the limiting factor of PBDA's shelf-life, while some other show that oxidation is. Therefore, to maintain its stability, effective homogenisation and heat treatment during processing as well as a package with good O_2 barrier properties are pivotal.

Similar to the UHT-treated dairy milk, the most common packaging used for UHT-treated PBDA is a coated paperboard carton with aluminium foil as a barrier against O_2, light, and microbial contamination. Unfortunately, the previous studies related to the impacts of different packaging to PBDA's shelf-life were not found.

4.2 Interview results

This section presents the key takeaways of the interviews with three different categories of interviewees, the Tetra Pak employees (A), the E-commerce and E-grocers (B), and the producer with online market channel (C).

Not only having different expertise, each interviewee also had different preference on the way of sharing knowledge. Some of them preferred to share their packaging development projects, while the others were more comfortable with the pure question and answer (Q&A) format during the interviews. Therefore, in order to leverage the optimal values of discussions, different formats of discussions were employed; 1) a pure Q&A, and 2) the project presentation from the interviewee with Q&A session during the presentation. The second type was only applicable to some interviewees in category A. Meanwhile, the interviews with B and C categories were fully conducted using the Q&A format, aiming at gathering insights of the supply chain model, the experiences and challenges with beverage products and packaging,

as well as the packaging requirements and/or expectations. More details can be found in the interview summary, Chapter 3, Table 3.3.

Regardless of how the discussions were conducted, all the interviews results were summarised and then verified by the interviewees before being used for the final analysis. The key-takeaways of the interviews are discussed in the following sections. In order to differentiate the sources of the information, when the information was leveraged from the interviews, the source would be cited as "IE-last name of the interviewee".

4.2.1 Category A-Tetra Pak

Within Tetra Pak employees, twelve people from different departments were interviewed to capture different aspects of E-commerce packaging development. Generally, the interviews with Tetra Pak's employees were aimed to gather the insights of E-commerce packaging requirements as well as the opportunity to seize the online market channel. Specifically, the interviews with the marketing team were aimed to capture the market trends, the market demands, and the geographical insights from different marketing regions. Whereas, the interviews with the technical experts were aimed to gather the technical aspects of packaging and the building blocks to seize the market.

4.2.1.1 Market insights

Currently, E-commerce is growing worldwide. Some well-known market leaders are Amazon, Ocado, Alibaba, JD, Pinduoduo (IE-Wirsen, 2021). Compared to the traditional B&M, this new market channel has a different characteristic of supply chain. Some key differences were captured in Table 4.4.

Table 4.4 Key differences between traditional B&M and E-commerce.

No	*Aspects*	*Traditional B&M*	*E-commerce*
1	How the products are packed and transported	On the pallets. Products and packaging's configurations are standardised and optimised (e.g. carton packages would be transported in vertical position, as suggested).	Movement of an individual stock keeping unit (SKU). Products are packed in bag/box with varied configuration (can be vertical, horizontal, etc.).
2	How the products are grouped	By category.	Not organised by category, but depending on the consumers' order (i.e. different products can be packed in a single bag).
3	Touch-points	Low.	High.
4	Risk of damages and leakages	Low.	High, due to point 1-3.
5	Packaging system and risk of waste	Standard protection properties. Minimum risk of packaging waste.	More layers to protect the products in the last-mile delivery. Higher risk of packaging waste.
6	Forecast system	Procure to stock.	Procure to order. As little inventory as possible. High fluctuation of the supply forecast.

Point 1-3 from Table 4.4 highlight the differences in packaging configuration and number of touch points between offline and online channels. The high number of touch points and the unstandardized packaging configuration in E-commerce affect the risk of damages and leakages in point 4. Addressing this issue, many producers apply more packaging layers to protect the product, leading to higher risk of packaging waste, as described in point 5. Finally point 6 mentions the different forecast system between B&M and E-commerce which highlights the preference of E-commerce to maintain minimum number of stocks, supplying only what is necessary to fulfil the demands. Aiming at minimum risk of forecast error, E-commerce is exposed to more fluctuation in the supply forecast (IE-Wirsen, 2021).

From the packaging suppliers' point of view, including Tetra Pak, the current packaging that exists in the market is designed for B&M, and thereby might not fit for E-commerce. Through some preliminary studies, Tetra Pak has gathered some insights of what properties shall be focused on to fulfil the specific needs of E-commerce. Some key requirements are captured in Table 4.5.

Table 4.5 Key packaging requirements for E-commerce.

No	*Needs*	*Description*
1	Protection and sustainability	How to protect more while using less materials.
2	Feasible implementation in the production site	Package shall be able to enter the E-commerce supply chain, with no/low needs of manipulating the current process. Allow flexibility, for instance supporting different order quantity. Allow automation (e.g. with robots).
3	Effective & efficient logistics	Easy handling; Less handling (e.g. less needs of package breakdown); Less waste generation.
4	Maintain consumer's satisfaction	Remain consumer-friendly, e.g. easy-to-open.

4.2.1.2 Technical aspects of packaging

Other studies at Tetra Pak also revealed that there are some factors which increase the package's vulnerability to damages (see Table 4.6).

Table 4.6 Factors affecting the packages' vulnerability to damages.

Aspect	*Detailed points*	*Description*
Packaging properties	Packaging materials	The stronger the materials, the less susceptible the packages to damages.
	Accessories (e.g. caps, straws)	Protruding features increase the susceptibility of packages to damages.
	Package size	The bigger the size, the more vulnerable the packages to damages.
	Grouping size	The larger the grouping size, the more vulnerable the packages to damages.
External factors	Touch points	The more the touch points, the more vulnerable the packages to damages.
	Road condition	Bad road condition causes more shaking and pressures towards packages, leading to a higher risk of damages.

In E-commerce, the selection of packaging materials is crucial to define not only the product protection properties, but also the protection against pressure and mechanical shocks throughout the product's life cycle (IE-Parreira, 2021). In his interview, IE-Henriksson (2021) stated that the brick-shape of Tetra Pak's packaging has been optimised to support the logistics needs, including the mechanical protection, nevertheless additional accessories, such as caps and straws, were added to fulfil the consumers' requirements. These accessories create holes and protruding features on the packages, and thus reduce their robustness against the mechanical pressure (IE-Parreira, 2021; IE-Fourcade, 2021; IE-Omar, 2021; IE-Krashak, 2021; IE-Lundström, 2021).

Related to the packaging's individual and grouping size; the bigger the size, the more vulnerable the packages to damages. This is due to the facts that 1) the smaller the package, the larger the surface area of products which is protected by

the packaging materials, 2) the bigger the package, the heavier the product it contains, and thus when it falls, it creates a higher force which increases the risk of damages (IE-Fourcade, 2021).

The external factors, such as the number of touch-points as well as the road condition, also affect the risk of damages. These factors are mainly related to the shaking phenomenon during transportation or handling which increases the pressures towards the packages (IE-Ishikawa, 2021). In order to minimise the shaking effect on the packages, E-commerce players often try to reduce the unoccupied space inside the secondary package, for instance by adding cushion (IE-Parreira, 2021; IE-Lundström, 2021).

4.2.1.3 E-commerce packaging development projects

Tetra Pak mainly produces the primary packaging materials, but it also produces the equipment that can pack both the primary and the secondary packages (IE-Henriksson, 2021). Taking all the gathered insights into account, Tetra Pak has initiated several E-commerce packaging development projects. Aiming at securing the E-commerce channel and grabbing all the potential opportunities, the development projects have considered both innovation in the primary and the secondary packages.

Within its primary packaging's portfolio, there are two big categories of packaging; the aseptic and the non-aseptic packaging (IE-Civa, 2021). The aseptic packaging is designed for products with long-shelf-life and ambient distribution, whereas the non-aseptic packaging is mainly used for the short-shelf-life products with chilled distribution. For E-commerce packaging innovation, Tetra Pak focuses its studies within its aseptic packaging as it observes that ambient products are more common in E-commerce. Online grocery channels that sell both ambient and chilled products usually have had established their cold distribution chain which is compatible to the current packaging portfolio.

There are also projects of secondary packages development for E-commerce. One of them was a project in America lead by Parreira. This project studied the performance of Tetra Pak's primary packaging series in different types of secondary packaging. The whole packaging system was then assessed using Amazon's standard method of packaging assessment; i.e. International Safe Transit Association (ISTA)-6 AMAZON.COM test. The ultimate goal of this project was to retain the diversity as well as the properties of each type of the primary package at Tetra Pak, while fulfilling the extra protection requirement against the rough distribution in E-commerce channels. (IE-Parreira, 2021).

Most of Tetra Pak's development projects are oriented to the Amazon packaging certification standard, i.e. ISTA-6 AMAZON.COM. IE-Fourcade (2021) and IE-Parreira (2021) described that Amazon has one of the roughest distribution chains among the E-commerce players. IE-Parreira (2021) added that although Tetra Pak uses Amazon's packaging certification standard, it does not mean that Tetra Pak

only targets Amazon market. It is mainly due to the fact that Amazon has the most standardised packaging certification model, with detailed methods and requirements. Details of Amazon's packaging certification standard would be discussed in section 5.2.1.

According to IE-Wirsen (2021), there are three main points that Tetra Pak must address to develop an effective packaging solution for E-commerce; 1) to create a robust packaging system (i.e. primary and/or secondary packaging) with as little material as possible, 2) to design a package with minimum waste and handling time at the E-commerce site, and 3) to enable the implementation of solution at the manufacturer site, using the current facility, without negatively affecting the process efficiency. For the second point, some Tetra Pak's customers have mentioned a need of less package breakdown in the middle of the supply chain. They expected "what comes in, comes out" (IE-Wirsen, 2021; IE-Marcovecchio, 2021). Meanwhile, for the last point, some producers stated that at the moment it is not possible to build a separate line for E-commerce. This is due to the fact that it is a high investment and the market shares of the online channels are still small compared to the traditional stores (IE-Fourcade, 2021). Furthermore, specific SKUs for the online channels will reduce the flexibility to sell products across-channels (IE-MY, 2021). Nevertheless, IE-Wirsen (2021) argued that this might be the case in the long term as it is more likely that the packaging built for B&M would not be as efficient for E-commerce, and vice versa.

4.2.1.4 Geographical insights

In addition to the technical aspects and the market insights, there are geographical insights captured from the interviews. These insights are mainly gathered from the interviews with Parreira, Fourcade, as well as Zhang Ami and Ishikawa Toru, who are handling different regions; i.e. America, Europe and Central Asia (E&CA), and APAC, respectively.

From the interviews, it was captured that different regions are in the different stages of E-commerce packaging development. For instance, in America the packaging development has arrived in the packaging performance validation with Amazon and the associated clients, meanwhile in APAC, the team is still discussing which player shall be the main target of the study. Another interesting point is that there is a high probability that a particular E-commerce packaging solution will be applicable in one region, but not necessarily in other regions. This is due to the fact that each region has different characteristics of E-commerce. As the analysis of geographical insights will be combined with some external information sources, this topic would be further discussed in Chapter 5.

4.2.2 Category B-TK

There were two people interviewed from B category. The first one was an employee of one of the biggest E-commerce platforms in Indonesia. Respecting the identities of the interviewee and the company, this interviewee will be identified as SH from TK. By the time the interview was held, SH was the senior lead of category development at TK, but he no longer worked there by the time this thesis was finalised.

TK is one of the biggest E-commerce pure players in Indonesia. Like other platforms, TK sells products from various categories. As TK's customers, the merchants or sellers could choose two types of order fulfilment; 1) fulfilment by sellers, or 2) fulfilment by TK. For the second category, TK provides a consignment service. In this thesis, this consignment service would be called TK-CB.

For the first type of fulfilment, the sellers can decide how they would like to pack and fulfil the orders, TK only regulates the maximum time of fulfilment. As different mechanisms are applied for the first type of fulfilment, the focus of discussion was mainly for the latter type. At TK, SH did not handle the beverage products, but he explained the general flow of order fulfilment which is applicable for all products sold via TK-CB. Some reading materials related to the packaging policy were also shared to give more technical insights.

4.2.2.1 TK-CB

Understanding that Indonesia is an archipelago with a huge challenge of distribution, TK launched its consignment programme in 2019, i.e. TK-CB. With its TK-CB, TK is the first E-commerce in Indonesia that initiated the establishment of warehouse (WH) facilities in different areas in Indonesia with the ultimate goals of increasing the products accessibility, reducing the shipping cost, and facilitating the efficient logistics across islands in Indonesia.

Most brands have their manufacturing sites in Jakarta, the capital city of Indonesia, and within the West Java region, but they sell the products nationwide. When sellers decide to join TK-CB, they can deliver their products to TK's WH in Jakarta and TK will ship the products to the other WHs based on the customers' requests. This bulk shipment could significantly reduce the shipping cost, benefitting not only the producers, but also the consumers who basically pay all the cost.

At TK-CB, the consignment fee is charged per unit product being sold. This fee, so called fulfilment fee, includes the services of products storage, packing, labelling, delivery, and customer's complaint handling. An additional fee, called aging fee, is applied for products stored more than 60 days. At TK, this aging fee is two third of the fulfilment fee and is charged for every additional month of storage at TK-CB WH. According to SH (2021), this aging fee is typically applied in the E-

commerce platforms, because dead stocks significantly reduce the profitability of E-commerce platforms by taking space in their limited capacity of WH.

4.2.2.2 Fulfilment process

TK has an organised system to control its inbound and outbound delivery. In the inbound process, the seller must send the advanced shipping notice at least two days before the expected delivery date. The seller will receive a confirmation mail from TK, stating the schedule for inbound. On the assigned date, the seller delivers the goods to TK-CB's WH. Upon arrival, there would be mandatory quantity and quality checks. For the quality control, there are two types of inspection; 1) the general inspection based the physical condition and the product description, as well as 2) the specific inspection based on the seller's criteria. Products which pass both the quantity and quality inspections would be transferred into the storage area. The stock would also then be updated in TK's Warehouse Management System which is linked to TK's application. This process could take up to 3x24 hours (TK, 2021).

For the outbound process, the orders fulfilled by TK-CB are always repacked by TK-CB, and the fee has been included in the fulfilment fee. Bubble wrap is the standard packaging that would be provided. TK-CB also provides boxes using corrugated paperboard C-flute. The standard sizes of the boxes are depicted in Table 4.7. The largest box is designed to fit the maximum product size (including the original packaging, if any) allowed by TK-CB, i.e. 40x28x28 cm (TK, 2021).

Table 4.7 TK-CB standard box sizes (TK, 2021).

Size	***Dimension (cm)***		
	Length	***Width***	***Height***
XS	17	10	8.5
S	20	17.5	9.5
M	28	21	10
L	37	29	14.5
XL	30	27	25
XXL	42	30	30

When asked about the opportunity of using the original packaging from the sellers or the producers for the last mile delivery, SH stated that there are some issues associated to that; 1) currently the packaging for B&M is mostly not sturdy enough for the last-mile delivery, 2) the producers send the products in bulk using their secondary packages, while the consumers order the products in the smaller units, 3) the repacking is already included in the fulfilment fee, and therefore no added benefits for the producers to keep their original packaging.

4.2.2.3 Product and packaging specifications

At TK-CB, there are some products which are categorised in the red zone. This zone is divided into two sub-categories, the conditional products and the

prohibited products. Details of products classified in these categories are provided in Table 4.8.

Table 4.8 Red zone category at TK-CB (adapted from TK, 2021).

Categories	*Description*
Conditional products	Perishable products (e.g. liquid, gel, powder, sharp thing, fragile/brittle product)
	Products containing liquid (e.g. shampoo, perfume, beverage)*
Prohibited products	Products that are sensitive to temperature (i.e. max T storage: 25^{o}C)
	Perishable products (i.e. related to shelf-life)**
	Pharmaceutical products
	Products with strong fragrant
	Products that are prohibited in the existing TK platform
	Products that are poisonous, having high pressure, aerosol, corrosive, dangerous when wet, containing radioactive compounds
	Products with high value: • have high price per dimension • are prone to theft • jewelries • artworks • antiques • tobaccos
	Products with strong magnetic power
	Products that can incite controversies
	Plants and seeds

*Tetra Pak's product falls in this category

**TK-CB only accepts products with minimum total shelf-life of 12 months.

Unlike the prohibited products that are not allowed to be marketed at all at TK-CB, the conditional products can still be sold at TK-CB, with additional rules to follow. The requirements for the conditional products are; 1) the products must be packed in sturdy packaging to protect them from all types of damages, 2) the products containing liquid must be double-sealed, or sealed inside the polybag that has a warning label, 3) the liquid product's packaging which is equipped with an opening must have a safety seal inside the lid, 4) if the liquid is flammable, it must be stated on the label (TK, 2021).

The first point was further explained in TK-CB's special packing policy. It is stated that the products shall be packed properly to ensure the products' safety during handling, avoiding any potency of damages, spillages, and leakages (including the aroma leaking). The products' packaging must also be able to withstand the rigors of shipping without any special handling. TK-CB will not accept any products that are only packed in plastic bags, without boxes. TK-CB WH will return the products that do not follow the packaging policy (TK, 2021). According to TK policy, Tetra Pak's products (i.e. packed beverages), were categorised as conditional products, and thereby must follow the above requirements.

TK-CB also applies a strict shelf-life policy; 1) the minimum total shelf-life of the products is 12 months, 2) the minimum shelf-life of products when entering TK-CB WH is 6 months, 3) once the products enter the critical shelf-life ($\leq$3 months), the products will be automatically quarantined and shall be picked up by the seller as soon as possible. TK-CB's policies of shelf-life and aging fee show that despite the high-speed fulfilment service, TK-CB prefers to sell non-perishable and high-turnover products to maintain its logistics efficiency.

4.2.2.4 Challenges of handling beverage products

When asked what the biggest challenges of handling beverage products at TK-CB were, SH mentioned the two most common issues. The first one was related to the damaged packaging. Consumers tend to be more critical on food products, even only with small scratch or dents on the package. The second one was related to the high specification of storage facility for food and beverage products. "For instance, a beverage manufacturer wants to register one of their ready-to-drink (RTD) products at TK-CB. Before signing the agreement, the manufacturer would inspect the WH, including the temperature, the storage place, etc. This is a challenge to fulfil many checklists for beverage products" (IE-SH, 2021).

4.2.2.5 Additional insights

There are some additional insights that are captured from the interview. Firstly, related to the effectiveness of the promotional measure at TK, SH mentioned that up to date, the most favourite promotional feature at TK is the "free delivery fee". Consumers tend to be most satisfied while shopping with no charge of delivery fee. Secondly, related to the speed of products' absorption, in a special case, the sellers can use the online channel for flashing out their products which are already closed to the expiry date. This can be done by using a promotional measure. Nevertheless, in order to maintain the ethical business practice, this expiry date shall be described clearly, assuring that it is noticeable by the consumers.

4.2.3 Category B-ICA

The second interviewee from category B was the Head of Packaging and Traceability of ICA, a retailer in Sweden which occupies omnichannel marketing strategy. Respecting the interviewee's choice to be anonymous, the second interviewee is called MH from ICA.

MH handles packaging and traceability at ICA, but he does not specialise in E-commerce; thus, some technical aspects of E-commerce could not be leveraged from the interview. Nevertheless, he explained the general supply chain from the supplier or producer until the retail store as well as the mechanism of online order fulfilment.

ICA is a franchise business, applying a decentralized decision-making policy. With over a thousand stores throughout Sweden, every ICA store can choose to sell goods online or not. If a store decides to have an online market channel, it can choose either to be connected to the central E-commerce WH or to have its own solution for the online service. The small stores, such as ICA Nära, usually prefer the first option as it solves the problem of space limitation and promotes cost efficiency. When they are connected to the central E-commerce WH, they can sell a larger range of products. Some goods that are not available at the offline stores can be ordered from the online channels. Furthermore, the cost-efficiency could be achieved by utilising the shared-facility to store the goods that are aimed for the online orders. On the other hand, beside this option, the bigger stores, such as ICA Kvantum and ICA Maxi, could also choose to independently fulfil their online orders.

The flow of products in ICA supply chain is illustrated in Figure 4.1. As a retailer with omnichannel marketing strategy, there is no big difference between supply chain for the offline and the online channels. The original supply chain for the offline channels is marked with white colour. This flow is also applicable for the second option mentioned above. On the other hand, if the store chooses to be connected to the central E-commerce WH, there would be an additional touch-point at ICA E-commerce WHs which are located in Stockholm and Gothenburg.

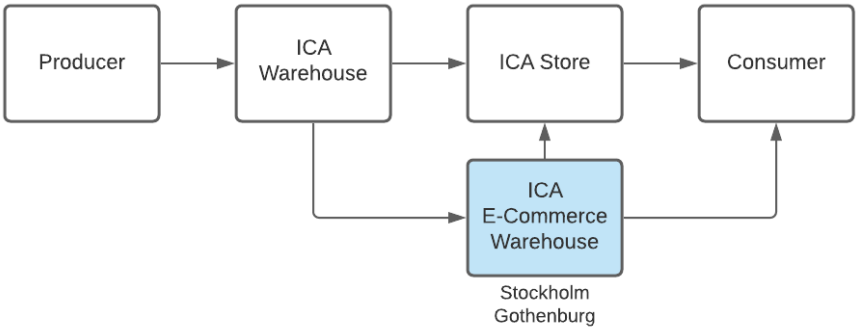


Figure 4.1 Flow of products in ICA supply chain.

MH also stated that the point of package breakdown is quite similar between the offline and the online channels. For instance, the smallest unit that ICA stores and ICA central E-commerce WHs could order from ICA WH is one secondary package. The order fulfilment procedures are also the same; i.e. ICA WH sends the products either in pallets, for a large quantity of a single SKU, or roller containers, for a small quantity order containing several SKUs. MH also noted that the cold chain distribution is available along the supply chain, regardless of where the order comes from.

From the consumers' site, the process flow of ordering online is illustrated in Figure 4.2. The smallest unit that the consumers can order is similar to the one they

could get in the offline stores. For instance, if they could buy a single pack of milk in the offline stores, they could also order the same unit in the online stores. Consumers can choose either to pick up the order at the retail store or to get it delivered to their houses. If they choose to pick up at the physical store, the difference between buying the products online and offline would be just who pick the goods from the shelves. Whereas, if they choose a home-delivery service, there would be an additional step in which the products would be transported using ICA's vehicles. This is usually a short-distance transportation.

Figure 4.2 Process flow of ordering online from the consumers' site.

When asked about the specific packaging issue, due to confidentiality, MH could not share the common quality problems, but he implied that as far as he knew, there was no specific issue due to the online distribution model. Meanwhile, related to the online sales growth, he said that it has increased quite fast in the past couple of years, especially after the COVID-19 pandemic hit Sweden.

4.2.4 Category C-NX

From category C, there were two people from the same company in Indonesia being interviewed. The identities of the interviewees and the company are confidential, and therefore the interviewees would be called GT and MY, while the company and the internal E-commerce platform would be identified as NX and E-NX, respectively.

NX is a food and beverage manufacturer in Indonesia with four production branches in Java Island. Founded om 1979, NX has produced healthy foods and beverages for 42 years. Distributing its products to more than 30 countries, NX commits to its vision of "Be leading brands to make a healthier society by managing salt, sugar, and fat." The product portfolio includes powdered beverages, RTD, cookies, oil, snack bar, crisps, syrup, sweetener and jam.

NX sells its products both in the online and the offline channels. In the online channels, NX utilises the internal and the external E-commerce platforms. For this thesis the internal E-commerce platform is called E-NX. For the external platforms, NX uses the consignment service, in which the storage and the order fulfilments are handled by the E-commerce platforms (Tokopedia, Shopee, Blibli, JD.ID, etc). Applying the omnichannel business strategy, with a full control of manufacturing plan and even owning its internal E-commerce platform, the interviews with NX

leveraged many insights related to the supply chain, the products portfolio management, as well as the opportunities and the challenges in E-commerce.

GT was an ex-associate of the Production Planning and Inventory Control (PPIC) department and no longer working at NX by the time the interview was conducted, whereas, MY is currently handling E-commerce supply chain management at NX. The connection between the two departments is that the PPIC department will translate the demand forecast from both the offline and the online channels into the number of raw materials required and the production plans. After the production realisation, the final products would then be sent to the assigned channels to be marketed.

4.2.4.1 Supply chain management

The scope of the supply chain discussed during the interviews with GT and MY was from the demand forecasting until the order fulfilment. In the normal condition, E-commerce division could not directly submit its forecast to PPIC. Demand forecasting is the role of Brand Operation (BO) department at NX. Every year this department will pool the forecast demands of all NX's SKUs in a single annual forecast. In this case, MY will submit the forecast from the online channels to BO, thus PPIC only receives a single forecast document from BO to fulfil the needs of all channels. Applying omnichannel marketing strategy, almost all the products sold in the online channels are also available in the offline channels. Nevertheless, there are also some products that are only available in the online channels. These limited product editions are aimed to attract consumers by applying the scarcity strategy (IE-MY, 2021). Currently, this type of products is not the main revenue puller for NX, but it is expected to be the source of company revenue from a different channel. IE-MY (2021) further described that the total online sales are still not significant compared to the conventional stores, nevertheless the growth is fast for the last couple of years.

For its online order fulfilment, NX has two mechanisms, 1) fulfilment by the internal E-NX WH, and 2) fulfilment by the external E-commerce platforms using the consignment service (Tokopedia, Shopee, Blibli, JD.ID, etc). The majority of sales come from the external platforms, because compared to E-NX which only sells the NX products, the external platforms have much higher market traffic due to the high variations of products sold through the platforms (IE-MY, 2021).

In order to maintain the smooth online order fulfilment, MY always maintains stocks availability in the internal and the external WHs. Regularly, E-NX orders stocks from the NX factory (i.e. where the goods are manufactured and stored before distributed). The factory will prepare the order and send the goods to both the external and the internal WHs, as requested. The goods would then be stored until the consumers' orders arrive. When the orders arrive, the E-commerce WHs (both

internal and external) will repack the products and deliver them to the consumers. Internally, E-NX uses third party couriers for its delivery service.

4.2.4.2 Products portfolio and packaging policy in the online channels

Not all products marketed in the offline channels are available in the online channels. According to IE-MY (2021), there are some considerations to place particular SKUs in the online channels, such as; 1) the placement has a special intention, e.g. product launching, sales push, etc., 2) the product must fit to the channels; i.e. consumers are willing to buy it online. According to IE-MY (2021), NX likes to use the online channels for launching the new products as the market penetration is much faster in this channel. The consumers are exposed to the products from the first day they are launched.

Typical orders in the online channels are mixed products, therefore both E-NX internal WH and external WHs always do repacking for each order. For liquid products, E-NX applies a specific packing policy, which is depicted in Table 4.9.

Table 4.9 E-NX packing policy for the liquid products.

Product categories	***Main material of the primary packaging***	***Destination***	***Packing policy***
Single packs RTD-full box	Beverage carton*	Jakarta	No bubble wrap
Single packs RTD-full box	Beverage carton*	Non-Jakarta	With bubble wrap
Single packs RTD-not full box	Beverage carton*	All	With bubble wrap
Oil	Glass	All	With bubble wrap

*Tetra Pak's packaging

At the moment, E-NX does not standardise the materials nor the size of its secondary packaging. For its online channel, NX uses the same packaging materials with the ones in the offline channel, but with additional bubble wrap for extra protection.

4.2.4.3 Challenges and opportunities in E-commerce

During the interview, MY was asked about the opinion of having different RTD packaging between the online and the offline channels. She replied that it might not be the best solution for now due to some reasons. Firstly, different packaging equals new investment. At the moment, the online market size is still small, and therefore the investment will outweigh the benefits. Furthermore, the demands of RTD in the online channels are relatively low compared to the powder products. This is due to the fact that RTD is heavy. This leads to a high delivery fee compared to the product value. The consumers find that it is cheaper to buy RTD in the conventional stores rather than buying it online. According to the sales report, RTD demand is still highly dependent on the promotional measures (e.g. discount, bundling, etc.). According to IE-MY (2021), this is one of the biggest challenges to sell liquid products online. Secondly, different SKU means less flexibility. At the moment, NX could use both channels to absorb the products. It would no longer be

possible when a specific SKU is assigned to only a specific channel. Thirdly, a need of specific packaging has not been observed. Up-to-date, in the online channels, the consumers complaints related to damaged packaging is less than 1% of the total complaints (IE-MY, 2021).

When asked about the difference of the process lead time between the online and the offline channels, MY stated that the online channels have much shorter lead time compared to the offline channels. Utilising the short process lead time as well as the high products exposure through consumers' mobile devices, in special cases this channel could be used for flashing out the products which are not well absorbed in the offline channels (IE-MY, 2021; IE-GT, 2021).

5 Discussion

This chapter presents the elaboration of the results both from the literature reviews and the interviews. The four sections presented in the chapter will discuss about 1) E-commerce and packaging, 2) packaging requirements in E-commerce, 3) Tetra Pak and packaging for E-commerce, and 4) packaging innovation direction. The discussion also includes the author perspectives of the findings.

5.1 E-commerce and packaging

As discussed in Chapter 2, E-commerce is continuously growing, expanding its share of the total retail sales from 13.6% in 2019 to 21.8% in 2024 (Oberlo, 2021b). Nevertheless, a discussion about E-commerce is not only about the number of sales. This section will discuss several dimensions of E-commerce that might be worth to consider, especially to define the direction of the packaging innovation.

5.1.1 The impacts of COVID-19 on the online grocery channels

The COVID-19 pandemic has significantly increased the demand of online grocery service which induces the growth of this segment in a very short time. The online grocers (E-grocers or E-retails) usually provide two options of online order fulfilment; 1) click-and-collect, and 2) home delivery. Nevertheless, the first option is growing a lot faster compared to the latter option. For instance, according to a survey report from Edge by Ascential (2020), between March and May 2020; 1) 43% of the surveyed US retailers expanded the home delivery, while 67% enhanced the click-and-collect, 2) No retailer launched the home delivery service, but 5% launched the click-and-collect service.

The report shows that click-and-collect option is more preferable in a short time development. This is due to the fact that the last mile option includes medium to high degree of complexity, especially for those who originally did not have the last mile delivery service. Some areas to invest in include the transportation mode, facilitating both the ambient and the cold distribution, the track and trace system, as

well as the human resources to deliver. All of these require high investment and long-term development process.

COVID-19 pandemic seems to not only urge the quick adaptation measures from all actors, but also may cause long-term effects. According to the report from Edge by Ascential (2020), COVID-19 will influence the improvement directions of E-retailers. Focusing on the four main themes, the short and long terms impacts are depicted in Table 5.1 (Edge by Ascential, 2020).

Table 5.1 E-retailers' improvements points in the short and long terms (adapted from Edge by Ascential, 2020).

No	*Points of improvements*	*Short term*	*Long term*
1	Ensuring safety of consumers and associates	Enabling contactless delivery and pickup.	Contactless trends accelerate. Increased use of robotics in the warehouses.
2	Increasing capacity	Scaling delivery, pickup, as well as click-and-collect services. Partnering with delivery intermediaries to meet demand.	Stores at centre of fulfilment strategies. Intermediaries become a new retail channel.
3	Improving delivery speed	Prioritising click-and-collect services.	Same-day fulfilment becomes highly important. Micro fulfilment centres become a pillar of rapid delivery. Stores become central to supporting rapid delivery.
4	Availability and sourcing	Focus on the availability of essential products. Stores used as temporary fulfilment centres. Suppliers launch Direct to Consumers (D2C) websites.	Leveraging data insights to monitor demand fluctuations. Production will be expanded both for essential and non-essential products. COVID-19 will further drive supply network mapping.

The prediction shows that the fast delivery, the use of stores as micro fulfilment centres, as well as the more advanced automated system would be the future of E-retailers. Analysing these points, it is worth to consider whether there is a need of new packaging solution for the E-retailers, or mainly only for the pure players.

5.1.2 Offline vs online channels

5.1.2.1 Different characteristics between offline and online market channels

The first RQ of this thesis is why the online market channels might require a different packaging format with what has been available in the market. Table 5.2 summarises the different characteristics between the offline (i.e. traditional B&M),

and the online (i.e. E-commerce) channels that might elicit the need of different packaging solutions between channels.

Table 5.2 Different characteristics between offline and online market channels.

No	*Aspects*	*Offline*	*Online*
1	Touch points and number of handlings (≈potential damages)	Low.	High.
2	Package format and configuration	Group packs; Products are transported in bulk in the original transport packaging system (e.g. pallets) throughout the supply chain. Products and packaging's configurations are standardised and optimised.	Individual packs; Package breakdown could happen in the intermediate point of the supply chain, leaving the products free from the original transport packaging. Products are packed in bag/box with varied configuration. When repacked, the products might be combined with different products in the new box.
3	Promotional graphics on the package	Highly important.	Less important.

In E-commerce, the packages are handled differently and much more than in the traditional B&M (IE-Lundström, 2021). To date, Amazon has one of the roughest distribution chains in the E-commerce field (IE-Fourcade, 2021). Figure 5.1 illustrates the comparison of Amazon supply chain and the traditional B&M (IE-Krashak, 2021). The figure shows that besides having a lot more touch points, in E-commerce the breakdown of packages might happen in the very early stage, leaving the individual packs travel without their original transport packaging. Being exposed to more handlings, both the manual and the automated handlings, the packages are expected to withstand a lot more pressures and mechanical shocks in the online channels than in the traditional B&M.

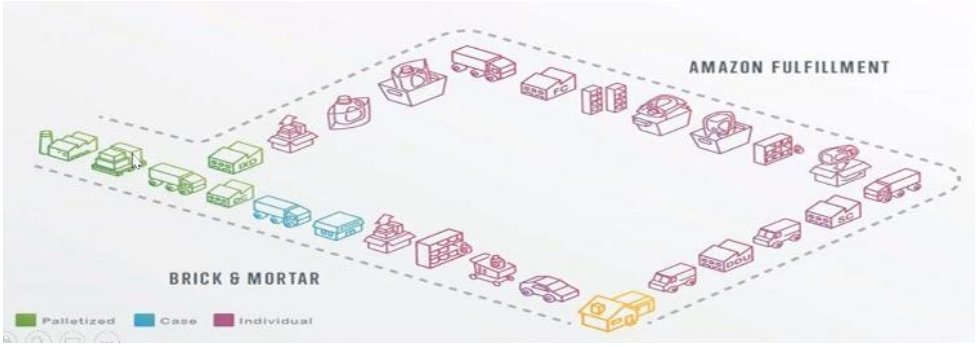


Figure 5.1 Supply chain comparison between B&M and Amazon.

Furthermore, unlike the B&M which handles the packages in a standardised and optimised way (see Figure 5.2), in Amazon the packages could have various

configuration throughout the supply chain (see Figure 5.3). At Tetra Pak, the packages are designed to be placed in a vertical position. The B&M easily follows this recommendation because the products are transported in bulk. Meanwhile, Amazon has difficulties to follow the recommendation due to the high variation of products it serves in the fulfilment centres which are mostly ordered in a small quantity.

Source: https://123trainingsolutions.com.au/calc/boxes

Figure 5.2 Standardised and optimised packaging configuration at B&M.

Figure 5.3 Unstandardized packaging configuration at Amazon (Lundström, 2017).

In E-commerce, although mostly orders come in a small quantity, a single order may consist of several different products. These products could be mixed and repacked in a new box in the E-commerce fulfilment centre. The mix of products with different shapes and sizes leaves some empty space inside the box, increasing the risk of damages due to the higher shaking effects.

Due to these factors above, the current packages which are designed for B&M are possibly not robust enough to withstand the rough handling in E-commerce. This hypothesis was also confirmed by some studies at Tetra Pak which showed that some ranges of portfolio with no issue in the B&M, suddenly have problems in the online channels. Adding cushions and applying more layers in the secondary packages are the most common ways of solving the problems today. Nevertheless, these options rise another issue of packaging waste.

Revealing the visual and promotional aspects of packaging, the last point in the table shows that E-commerce packaging might need less promotional aspects since the purchase decision is taken before the consumers even touch the products. The motivation is more likely to be influenced by digital promotion, product description, and reviews/ratings (IE-Henriksson, 2021).

5.1.2.1.1 Lead time

There is one characteristic which might be different between channels, but is not stated in the table; the lead time. It is not written in the table, because different interviewees have different arguments on it. Therefore, this aspect will be specifically discussed in this subsection.

Giving a contextual definition, lead time in this thesis is defined as the amount of time between the product is produced in the factory and the product is received by the end consumers. Some argued that there is no significant to slightly different lead time between the online and the offline channels, while some others argued that the online channels have much shorter lead time compared to the offline channels.

The ones who argued that the lead time is similar explained that the amount of time for producing and transporting the goods from the manufacturing site to the distribution centres is similar. The only different is the length of time the products are stored on the stores' shelf (IE-Henriksson, 2021; IE-Marcovecchio, 2021). This statement represents the omnichannel players that use their stores as the micro fulfilment centres. In this case, the products go through the same chain between their online and offline channels. The only difference is whether the consumer purchase it directly in the store or purchase it through the online platforms (IE-Fourcade, 2021; IE-Henriksson, 2021).

On the other hand, the ones who had a contrast argument described that the online channels have different ways of fulfilling the orders, and thus significantly shorten their lead time. MY from NX argued that the online channels have much shorter lead time compared to the offline stores. MY explained that in the B&M, in order to sell the products in the retail stores, the products must go through a lot of stages in the supply chain. First, the products must be transported from the factory to the distributor. Then the distributor will wait for the purchase order from the retail stores. Some uncertainties may delay the purchase order, and prolong the storage time in the distributor's WH. For the new launched products, especially, this is a problem since the products might take some time before they are exposed to the targeted market, delaying the process of market penetration (IE-MY, 2021).

On the other hand, using a B2C model, the online channels exclude many stages that exist in the offline channels. E-commerce is also an ideal platform for product launching as the product could be exposed to the targeted consumers since the first day it is launched. Further advantage is gained by NX that has a full control of the production plan and even owns its internal E-commerce. Most of the time, NX fulfils its online orders through the available stocks in the internal and the external E-commerce Whosoever, in some cases, the product can be produced today, delivered to the E-NX WH on the next day, and then shipped to the end consumer on the same day or the day after. Other reasons why online channels have possibilities to shorten the lead time are; 1) the algorithm of products exposure could be modified to fit the consumers behaviour, 2) the promotional measures, such as

discounts or special product edition might escalate the sales significantly (IE-MY, 2021).

IE-Wirsen (2021), a Strategy & Channel Leader at Tetra Pak, stated that, even within E-commerce, different players have different lead time. Ocado, an online grocery in the UK, has a much faster operation compared to the B&M, while in Amazon the lead time varies among product categories. IE-Fourcade (2021) added that in Amazon, the lead time is highly affected by the products' turnover rate, i.e. how long the products stay in the Amazon WH, and not by the speed of order fulfilment. For logistics efficiency, E-commerce usually prefers products with high turnover for their consignment service, thus extra fee would be charged if the product stays longer than a specified period of time (IE-Parreira, 2021; IE-SH, 2021). Due to this policy, it seems that the online channels have much shorter lead time compared to the offline channels.

As IE-Fourcade (2021) mentioned, the speed of order fulfilment does not significantly affect the total lead time. In the online channels, the order fulfilment itself usually has a time limit from the time the order is received until the product is delivered to the consumers. Generally, E-commerce puts speed as one of the competitive advantages, and therefore they compete on giving the service as fast as possible to win the market (IE-SH, 2021). A study in Brazil even revealed that distance does not affect the time to deliver (IE-Krashak, 2021).

From all the interviews, it is concluded that the lead time is mostly determined by the length of storage time, whereas the speed of order fulfilment is usually already short and stable through time. The alignment between the production planning, the supply chain management, and the marketing strategy is the key to shorten the lead time, regardless of the channels used. Thereby, a producer with an internal E-commerce platform has a huge benefit on this point.

5.1.2.2 Pros and cons of having different packaging in online and offline channels

Besides identifying the potential needs of specific packaging format for E-commerce, the interviews results also revealed some pros/enablers and cons/disablers of having different packaging in online and offline channels, which are summarised in Table 5.3.

Table 5.3 Pros and cons of having different packaging in online and offline channels.

Actors	*Pros/ Enablers*	*Cons/ Disablers*
E-commerce	Different packaging specification to fit the different nature of value chain. Most packaging is built for B&M, and therefore might not be suitable for E-commerce.	There are many variations of E-commerce supply chain models. How many variations should be accommodated?
	Non-fundamental modifications to induce logistics efficiency (e.g. grouping, sizing, shaping, etc.) are more preferable than fundamental modifications, such as barrier properties.	
	There is an emerging business model in the online channels which allows more accurate demand prediction, e.g. meal subscription.	
Producers	Collaboration with co-packers may allow more packaging variations.	Producers which own their packing facilities might be reluctant to invest on two different packing lines.
	At the moment, many brands have had wide range of the packaging solutions in different channels.	The more SKUs to handle, the higher the complexity and the lower the flexibility.
	Limited-edition products in E-commerce channel might be an effective marketing strategy.	
Consumers	All packaging formats might work as long as they work for the consumers and they are fit for purpose.	Consumers with brand loyalty might require consistency among channels.
	No need of shelf display properties to induce the purchase decision.	
Tetra Pak	A competitive advantage to secure the channel.	Might require time and effort to introduce the new type of packaging and gain the market interest.

As an innovation enabler from the E-commerce side, using a package that is designed for B&M is not ideal for E-commerce with rough distribution. On the other hand, there is a high range of spectrum within the E-commerce players, with mild to very rough distribution. Taking this fact into account, there comes another question, ”How many variations should be accommodated to provide the best solution for each player, without being under spec and over spec?” Some suggestions from the interviewees mentioned that non-fundamental changes, such as packaging’s shape, size, or grouping method might be sufficient to solve the logistics issue, while changing the materials or barrier properties will be more challenging (IE-Henriksson, 2021; IE-Fourcade, 2021). Another enabler comes from an emerging trend in E-commerce, the meal subscription model. Meal subscription allows E-commerce to accurately predict the demand, and therefore could anticipate the packaging supplies. This will eliminate the risk of over

packaging supplies, which is one of the biggest challenges in having specific SKUs for online channels.

The producers gain profit by inducing the process efficiency and maximizing the economies of scale. Having more SKUs to accommodate different channels means going in the reverse direction; increasing the complexity and reducing the flexibility. Although growing fast, in terms of sales, the size of online sales is much less compared to the offline sales. Thus, currently an investment for a specific packing line is not preferable (IE-Krashak, 2021; IE-Parreira, 2021; IE-Lundström, 2021; IE-MY, 2021; IE-Wirsen, 2021; IE-Fourcade, 2021). A study in a Korean E-commerce three years back showed that the producer did not expect any change in the primary package, as they have developed their system to fit the current packaging (IE-Zhang, 2021). Different SKUs in different channels also limit the flexibility of doing cross-sales absorption among channels which is one of the most effective strategies used by omni/multichannel players for addressing the forecast error in a specific channel (IE-MY, 2021; IE-GT, 2021; IE-MH, 2021; IE-Fourcade, 2021; IE-Wirsen, 2021).

On the bright side, IE-Marcovecchio (2021) argued that instead of having a specific line for each new packaging type, the producers can collaborate with co-packers. This strategy increases the flexibility while decreasing the risk of huge investment. IE-Henriksson (2021) also mentioned that at the moment many brands have had a wide range of packaging solutions in different channels; for instance, the large size with basic graphics for the discount stores, and the small size with a more exclusive design for the convenient stores. This shows the possibility of having another branch for the online channels. Some interviewees also mentioned that having limited-edition products in the online channels can be one of the good marketing strategies; for instance, World-Cup edition, Christmas edition, etc. (IE-Ishikawa, 2021; IE-Marcovecchio, 2021). The scarcity strategy attracts consumers to buy the products online (IE-MY, 2021; IE-Lundström, 2021). Furthermore, an omnichannel player with a limited space in the offline store could also sell more products by having some SKUs only available online (IE-MH, 2021).

From the consumers side, there are two perspectives captured from the interviews. On the bright side, IE-Marcovecchio (2021) and IE-Henriksson (2021) argued that there is no need of shelf-display properties for the E-commerce packaging and the consumers will gladly accept any packaging format as long as it fits for purpose. On the other hand, IE-Omar (2021) and IE-Krashak (2021) are concerned about the loyal consumers acceptance of different packaging in different channels. A consumer who has been used to a specific package in the offline channels might require some consistency among channels.

For Tetra Pak, providing the right solution for E-commerce will give a competitive advantage to secure the channel. Nevertheless, the benefits of the solution must outweigh the cost in order to win the customers (e.g. producers, E-

commerce players). The success of the solution depends on the promoted benefits, the degree of modifications and the efforts required by the customers to adopt.

5.1.2.3 Pure players vs omnichannel players

There is no perfect solution that fits for all. As mentioned in the previous section, one of the cons for having a specific packaging for E-commerce was there are many variations in the E-commerce supply chain models. For instance, there are pure players, like Amazon.com and TK, and also multi/omnichannel players, such as Willys, ICA, and NX. A further categorisation of the E-commerce players plays an important role to define which players require packaging modifications, what modifications are required, and how profitable it is going to be for the packaging suppliers, the producers and the E-commerce players to adopt the packaging modifications.

The pure players and the omnichannel players have different supply chain models and shipment methods. They also specialise in different categories of products. These factors lead to different packaging requirements. Table 5.4 shows the different characteristics of the pure players and the omnichannel players.

Table 5.4 Different characteristics of pure players and omnichannel players.

Aspects	***Pure players***	***Multi/omnichannel players***
Supply chain models	Long distance, many touch points, products might travel in individual packs.	Almost mimicking the B&M supply chain. The only difference is when the consumers choose a home delivery service with a short distance area coverage.
Shipment methods	Shipped by mail	Shipped by their own transportation modes which are adapted to their products' needs. For instance, these players usually have the transportation with chiller/ freezer for their chilled products.
Products being sold	High variation, with very limited amount of perishable foods and beverages (i.e. liquid product is categorised as perishable).	Mostly similar to what are available in the offline retail stores.

Analysing the differences in the supply chain models, a good solution for the pure players might be over spec and over cost for the omnichannel players, and vice versa (IE-Fourcade, 2021). This would be the big limitation of the general standardisation of the packaging properties in E-commerce. Tetra Pak's previous studies on the packaging performance in the pure players and the omnichannel players, showed that the pure players had more urgent needs of a specific packaging format, while omnichannel players found that the current packaging format was sufficient for their online and offline channels. Debora Parreira, handling the marketing in the American regions, stated that most complaints of the damaged packaging came from Amazon (re: the pure player), while Walmart, the biggest E-grocer in the US had no complaint on the package integrity ever since it started its

online grocery channel (IE-Parreira, 2021). The main reason of this was that its online channel had almost similar value chain with its offline channels. It had the same packaging breakdown point (at store) with a potential addition of a short distance delivery. The additional steps are picking from the store and delivering to the consumer's house which are almost mimicking the traditional way of shopping (IE-Henriksson, 2021; IE-Parreira, 2021; IE-Fourcade, 2021; IE-Krashak, 2021; IE-Lundström, 2021; IE-MH, 2021).

Another interesting note for Tetra Pak to consider is that the total sales growth of a particular E-commerce platform might not necessarily reflect the growth of the beverage products in it. The storage facilities and the shipment methods define which types of products could be sold in a particular channel. For instance, unlike the E-grocers or the omnichannel players which already have a settled distribution system for chilled products, TK and many other E-commerce platforms are not equipped with chilling facilities in their storage and transportation system (IE-SH, 2021). A lot of E-commerce players even use third party mail delivery or transport providers. For these reasons, ambient products are more commonly found in E-commerce, especially in the pure players.

There are two characteristics that support the preference of ambient products in E-commerce, see Table 5.5.

Table 5.5 Characteristics of ambient products.

No	*Characteristics*	*Actors*	*Description*
1	Ambient distribution	E-commerce players and producers	- Exclude the need of chilling facilities throughout the supply chain, resulting in: - Cost efficiency. - Logistics efficiency; could be mixed with other categories of products. - Less complexity, especially with a lot of touch points in the supply chain.
2	Long shelf-life	E-commerce players	- Some pure players have minimum shelf-life requirements for their consignment service. - Less risk of product waste due to over-supplies.
		Producers	- Increase production efficiency; the producers can do a big volume of production for a long-term supply. - Can do an over-supply and thus allows a bulk shipment, further reducing the distribution cost. - Provide flexibility.

Considering the two premises, 1) the current packaging properties are sufficient for the omnichannel players, and 2) chilled products are mainly sold in the omnichannel players; the need of specific packaging requirements might come from the ambient products in the pure players' platforms. Tetra Pak has adopted these premises, and thereby has been focusing the E-commerce packaging development projects in the aseptic packaging.

At Tetra Pak, the aseptic packaging was initially designed to remove the time and temperature constraints in the distribution process, and thus is typically used for the ambient products with a long shelf-life (IE-Henriksson, 2021). In general, both the aseptic and the non-aseptic packaging has already had a good protection against moisture and light barriers through its LDPE and paper layers. Nevertheless, a product with a long shelf-life needs an extra protection against O_2. For this reason, the aseptic packaging has an additional aluminium foil layer as an absolute barrier. As described in section 4.1, a product with a short shelf-life does not require an O_2 barrier as its shelf-life is more determined by the storage temperature, and not by the rate of O_2 penetration.

Another aspect that Tetra Pak must take into consideration is the future market growth in a specific channel. This can be observed by learning the current pattern of how Tetra Pak's customers respond to damaged packaging issues in a particular channel; whether they withdraw the products from that channel and focus more on the other channels, or they try to fix the issues in that channel. This is important because this will determine the future products sales growth in a specific channel and whether it is worth to invest a new packaging solution to secure that channel. Fourcade (2021) also suggested to give an attention to the regional market demands for further segmenting the potential current and future target markets. For instance, Northern Europe prefers fresh milk, while consumers in Southern Europe are used to ambient distribution milk (IE-Fourcade, 2021).

Targeting the right market and understanding the needs will be the two most important factors to define what needs to be done next. The current hypothesis suggests that it might be more relevant to focus on the aseptic packaging and the ambient distribution, targeting the pure players with rough distribution. Nevertheless, the market share of the beverage products in this channel as well as the potential growth in the future must be further analysed to assure the profitability of the innovation investment.

5.1.3 The big three

While the previous studies differentiate the strategy of pure players and omnichannel players, the three biggest E-commerce players worldwide, Amazon, Alibaba, and Walmart have shown revolution in their business strategy (Oberlo, 2021c). Well-known as the pioneers of pure players in E-commerce, Amazon and Alibaba have expanded the business area, mimicking the omni channel players. In contrast, Walmart which started with B&M business model, now has been the biggest omnichannel player worldwide. Comprising more than 70% of the total market value of the top ten E-commerce companies worldwide, understanding their packaging policies and fulfilment strategy is profoundly important to define the appropriate future packaging development strategy (Oberlo, 2021c). Some key developments in these three giants are discussed in the following sections.

5.1.3.1 Amazon

There are two points within its business strategy which are likely to be the game changers and heat up the competition in E-commerce. Firstly, Amazon continues to open physical stores to complement its online channel. In the upcoming years, Amazon will continue to invest on micro-fulfilment centres to increase the efficiency and speed up the delivery time. Secondly, its grocery channels, i.e. Go Grocery and Amazon Fresh, have been growing fast in the past couple of years (Edge by Ascential, 2020; see Tetra Pak, 2021a). Unlike Amazon.com, this grocery channel mimics the omnichannel players, such as Walmart and ICA. Its service even goes beyond the standard E-grocers, by providing free 2-hour grocery delivery for its Prime members. IE-Parreira (2021) stated that while Amazon.com has a rough distribution scheme, Amazon Fresh has mild distribution scheme and therefore has no big packaging issues.

In terms of sustainability, Amazon strives to reduce packaging waste by reinventing the sustainable packaging solutions using a science-based approach. For instance, in order to serve the right sized packaging, Amazon utilises automated packing technology which evaluates the product size and then packs the product with a customized box, leaving as little space as possible inside the box (Levy, 2019). Amazon shows its commitment to optimise the packaging material use not only internally, but also externally. To promote this means to the sellers, it has set packaging certification standards, called Ship in Own Container (SIOC) and Frustration Free Packaging (FFP). More details on the Amazon packaging certification will be presented in section 5.2.1.

5.1.3.2 Alibaba

Similar to Amazon, realising its "New Retail" strategy to blend the online and offline market channels, Alibaba has built strategic partnerships with leading Chinese physical retailers. Through Tmall Global and AliExpress platforms, Alibaba aims to serve 2 billion global shoppers by 2036. Aligning with this mission, Alibaba plans to reduce cross border shipping time to 72h and build a virtual, borderless commerce platform, called World Trade Platform or eWTP (Edge by Ascential, 2019; see Tetra Pak, 2021a). This cross-border shipping is currently the biggest hurdle for packaging, as the intensity of the mechanical shock is a lot higher than the B&M.

In terms of sustainability, Alibaba's logistics arm, Cainiao, has put a large investment in the packaging innovation and reduction . Their commitments include 1) reducing 15% of secondary packaging in the fulfilment centres, 2) replacing 50% of packaging with 100% eco-friendly or biodegradable materials. In 2019 Alibaba also introduced 40 000 recycling stations across China. This was aimed to alleviate the impact of secondary packaging linked to E-commerce delivery (Edge by Ascential, 2019; see Tetra Pak, 2021a).

5.1.3.3 Walmart

Going from B&M business model, Walmart is expanding its omnichannel strategy by increasing its marketplace assortment and increasing delivery capacity. Walmart has partnered with E-commerce platform in the US, Shopify to enable Shopify sellers to sell on Walmart.com. It is predicted that 48.8% of Walmart's growth will come from e-retail in the next five years (Edge by Ascential, 2020; see Tetra Pak, 2021a).

In terms of sustainability, Walmart aims to achieve zero waste from operations by 2024 in Canada, Japan, the UK and the US. Its Gigaton Project also intends to avoid one billion metric tons of greenhouse gases from the value chain by 2030. Specifically, for packaging, Walmart established a goal for North American private brands to achieve 100% recyclable, reusable, and industrially compostable and to use 20% post-consumer recycled content by 2025. Walmart also strives in recyclability by recycling more than 330 million pounds of plastic film and rigid plastics worldwide (Edge by Ascential, 2020; see Tetra Pak, 2021a).

Key takeaways:

The main key takeaway from section 5.1 is that market channels were originally categorised into B&M and online channels, leading to potential different packaging requirements. But then within the online channels there are pure players and omnichannel players, with different supply chain characteristics as well as different methods of fulfilment. This results in gradual range of packaging needs. Finally, now the three biggest E-commerce players, Amazon, Alibaba, and Walmart have broken the wall of categorisation, blending all the possible methods to reach and satisfy the consumers. Trends have shown that omnichannel strategy with more micro-fulfilment centres will continuously grow in the future. This most likely will result in similar product ranges among channels. Thus, Tetra Pak must carefully decide what to change and what to keep in its packaging portfolio to secure the channel.

5.2 Packaging requirements in E-commerce

Based on the interview results, it was decided to discuss the packaging requirements divided in two parts. The first one is the general packaging requirements which are needed by all actors in the supply chain, while the second part discusses the specific requirements that are only applicable for particular actors. In this thesis, the discussion focuses on three different actors; the E-commerce players, the producers, and the consumers.

5.2.1 General packaging requirements in E-commerce

The summary of general packaging requirements in E-commerce is depicted in Table 5.6. Although the discussion mainly focuses in E-commerce, these three aspects are also considered basic packaging requirements in the offline channels.

Table 5.6 General packaging requirements.

Needs	***Details***
Protection	The packaging must be able to protect the product until it arrives at the consumers site. The barrier properties must be able to protect the product until the end of its intended shelf-life.
Sustainability	The packaging must have an optimised material use (i.e. weight, dimension, barrier properties), preferably is recyclable and generates as little waste as possible.
Low cost	The investment should not outweigh the benefits. The price shall remain affordable by the consumers.

All the interviewees agreed that protection is the ultimate function of packaging. This protection aspect covers both the mechanical protection that assures the product safely arrives at the consumer site as well as the sufficient barrier properties to protect the content until the end of its intended shelf-life. The acceptable level of damage is varied among consumers and among product categories. For instance, the higher the product value, the more critical the consumers, even until the scrutiny. But in general, there should be no leakage and the packaging shall be fully functional. One of the interviewees also mentioned that packaging shall be able to protect the products from theft.

While assuring the protection feature, the packaging should also fulfil the sustainability aspect by having an optimised material use that generates as little waste as possible. It is also preferable to have packaging from recyclable materials. The sustainability issue is getting more attention in the past few years. Even though the degree of concern as well as the adoption level of sustainable practices are diverse among regions, all are going to the same direction, towards a more sustainable earth.

The importance of protection and sustainability properties of packaging can be explained by Amazon packaging certification standard. Amazon is currently the number one E-commerce worldwide. Its policies and technology innovation have been recognised as the most advanced and therefore often being adopted by the other E-commerce platforms (IE-SH, 2021). At the moment, only Amazon has a standardised packaging assessment method, but maybe in the future it would be adopted widely.

Within its standard, Amazon has three tiers of packaging certification, as captured in Figure 5.4 (Pollock Orora, 2021). On the third tier, there is prep-free packaging (PFP) which requires Amazon overbox for shipment. On the second and

third tiers, there are SIOC and FFP which allow the shipment using the original packaging from the sellers. Both SIOC and FFP-certified packaging must pass ISTA-6 AMAZON.COM test. The difference between the two is that FFP has additional features, such as easy-to-open, minimal packaging, and 100% recyclable.

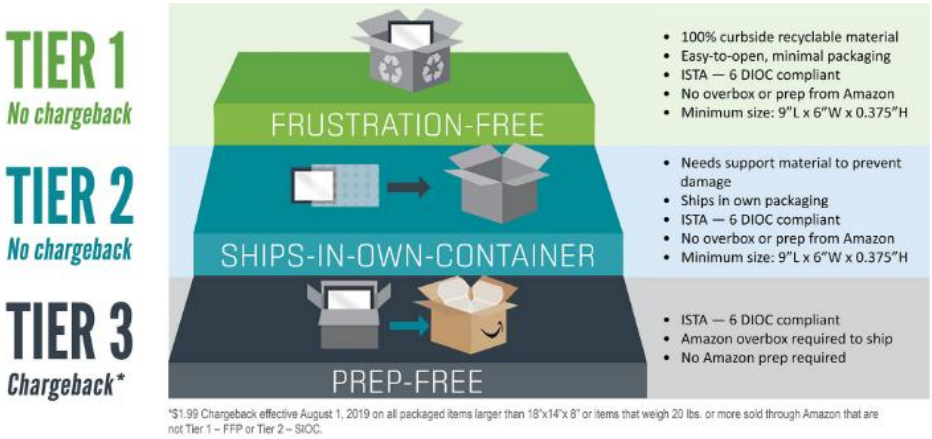


Figure 5.4 Three tiers of the packaging certification at Amazon (Pollock Orora, 2021).

ISTA-6 AMAZON.COM test is a general simulation test for packaged-products shipped through Amazon's distribution system to final customer destinations (ISTA, 2016). Considering the varied distribution field of different regions, ISTA 6-AMAZON.COM covers the testing of packaged-products prepared for shipment to North America destinations (ISTA, 2016). In this test, the package and product are considered together and not as separate entities. The test simulates the handling inside the Amazon fulfilment centre, the transportation outside the fulfilment centre, and the last-mile delivery (IE-Parreira, 2021).

ISTA-6 AMAZON.COM test can be used to evaluate the protective performance of a packaged-product related to vibrations, shocks and other stresses normally encountered during handling and transportation in the Amazon.com distribution system, but might not cover some conditions of transit, such as moisture, pressure, or unusual handling. The passing grade of each category of product might differ, therefore in the test document, it is stated that the shipper, the manufacturer, Amazon.com and/or other stakeholders shall determine the damage tolerance prior to testing, to permit the determination of pass or fail at the conclusion of the tests (ISTA, 2016). For Tetra Pak's packaging, the success criteria are the packages should have no leakages and remain fully functional at the end of the test (IE-Civa, 2021).

Last, but not least, any given solution shall be cost efficient. The E-commerce players and the producers prefer to be able to use the existing facilities they have and even if an investment is necessary, it shall not outweigh the benefits. Likewise, Tetra Pak also aims to leverage the current product strength to secure the channel.

All actors are aware that the additional costs would be imposed to the product price, meanwhile the consumers expect an affordable price.

5.2.2 Specific requirements by actors

5.2.2.1 E-commerce players and producers

From the perspective of the E-commerce players and the producers, in general, packaging functions could be divided into two; the logistics and the communication roles.

5.2.2.1.1 Logistics

Table 5.7 presents some points that were leveraged from the interviews related to the expected packaging performance from the logistics point of view.

Table 5.7 Logistics requirements.

Aspects	***Points to address***
Optimised shape and size	Support transport efficiency.
	Storage-friendly.
	Right sizing for the individual packs and the group packs.
Fitness to the system	Fit for the manual handling (e.g. ergonomics, easy to handle).
	Fit for the automated handling (e.g. work in the current automated cardboard packer, fit for robot handling).
Fast and efficient handling	Require less thinking process to avoid mishandling/ unconformities.
	Require minimum handling.
	Easy to unpack (when applicable).
Flexibility	Easily switch between the online & offline SKUs with the existing machine.
	Allow mass customisation.
	Prefer to be able to sell the products in the multi-channels.
Track and trace	Enable easy tracing and tracking of products.

Packaging with optimised shape and size is important to support logistics efficiency as it can optimise the space utilisation in the transportation and the storage facilities. A package that could stand by its own without any support is also highly preferable. Regarding size, as mentioned in the previous part, the bigger the size, the more vulnerable the package towards damages. Thus, the right sizing could induce a stronger packaging configuration. This size factor is not only applicable to the size of the individual packs, but also the size of the group packs (IE-Fourcade, 2021; IE-Parreira, 2021). It is also highly preferable if the group sizing has matched the consumers purchase behaviour, as it may reduce the need of handling in the E-commerce fulfilment centres.

The E-commerce players with a standardised system also expect the package to fit their current setup. In terms of package size, Amazon and Ocado expect the selling unit of the products to fit in their existing trays (IE-Wirsen, 2021). In terms

of facilitating the automated handling, the producers expect the package to work in the current automated cardboard packer (IE-Parreira, 2021), while in Amazon, the packages are expected to fit the existing robot handling (IE-Wirsen, 2021). Although most industries have tried to automate most parts of the processing, some manual handlings remain. Thus, it is also highly preferable if the package is easy to handle, promoting the ergonomic design. An anti-slippery surface might be an example of design that supports both the manual and the automated handling in E-commerce.

A package design must also promote fast and efficient handling throughout the supply chain. Related to this, a good package must facilitate less thinking process, require minimum handling, and be easy to unpack if the package must be broken down at some point in the supply chain. In her interview, IE-Marcovecchio (2021) gave an example of how a package affects thinking process; "For instance, glass, which is heavy, is not preferable as it must not be packed on the top of soft products, and therefore requires more thinking process and consideration during packing. If they could pack without thinking, it could be faster and cheaper for them." Related to the minimum handling expectation, some actors describe it as minimum secondary and tertiary packaging, while others state it as "what goes in, goes out" (IE-Marcovecchio, 2021). Both indicate the preference of less process of unpacking and repacking.

Flexibility is also an important aspect in logistics. From the marketing perspective, at the moment the size of online market is much smaller compared to the offline stores, and thereby any solution provided shall not require a huge investment (IE-Fourcade, 2021) and maintain the flexibility of sales absorption among channels (IE-MY, 2021). In the manufacturing site, since a specific packing line for E-commerce is not preferable, the producers expect a solution that could work in the existing packing line. Setting adjustment is acceptable, but shall not take long time that would sacrifice the overall process efficiency (IE-Fourcade, 2021).

On the other hand, in order to attract more consumers, the online channels must be able to show some competitiveness compared to the B&M (IE-Henriksson, 2021). This could be supported by selling limited-edition products that are only available in the online channels (IE-Ishikawa, 2021; IE-Marcovecchio, 2021; IE-MY, 2021). Facilitating these features, the solution offered shall allow mass customisation in a relatively small quantity, without sacrificing the process efficiency and the profitability. Last-mile printing is one of the promising solutions (IE-Marcovecchio, 2021).

The need of a good track and trace also has been identified from some studies (IE-Krashak, 2021; IE-Marcovecchio, 2021). Examples of applicable technology are barcodes and RFID. Nevertheless, there are some points that challenge this idea; to what extend the system shall enable the track and trace? Is it enough to track until the batch level, like what is applicable now or is it necessary to track until the individual level? If tracking individual pack is required, is it more relevant to attach

it to the order system in the E-commerce or to the packaging itself, considering a single order might contain mixed products?

5.2.2.1.2 Communication

Packaging employs important communication roles which connect the producers, the E-commerce players and the consumers. Generally, packaging is used by the producers to deliver the product information, visualise the brand image and convey the brand values. For instance, a brand uses green colour to show the environmental value or black colour to show the mysterious and elegant sides of its brand. Through packaging, the producer also communicates the products properties, such as the nutritional values, the nutritional claims, the health claims, etc.

As part of the communication properties, packaging is also used as a promotional tool (Agariya, et al., 2012). In the offline channels, packaging acts as a silent salesman. This term is related to the first moment of truth (FMOT) where the consumers see the product on the store's shelf. Packaging plays an important role to attract and convince the consumers to buy, especially for the ones who never buy the product before.

According to some interviewees, this promotional function of packaging might be no longer relevant in the online channels. Consumers' purchase decisions are more dependent on digital promotion; e.g. picture on the website, product description, and reviews/ratings (IE-Henriksson, 2021). Nevertheless, packaging in the online channels shall convince the consumers to re-buy the products by promoting the consumers satisfaction through the after-purchase experience (IE-Omar, 2021). This can be associated to the undamaged packaging, the fully protected product, the good visual appearance of products, and the fully functional packaging. The protection properties remain highly important to induce the products repurchase. Furthermore, some consumer research shows that personalisation, storytelling, as well as touch of surprises might increase the level of consumer engagement (IE-Marcovecchio, 2021).

Referring to the Amazon's packaging certification, up to date, there is no clear economic benefit gained when the original packaging is SIOC and FFP certified (IE-Parreira, 2021). Nevertheless, it might be a point of interest if the producers can maintain their own packaging until the end consumers, optimising the salesman role of a package until the final point.

5.2.2.2 Consumers

From the consumers perspective, it is all about how well the packaging engages the consumer to buy, re-buy, and then finally become loyal to the brand. As discussed in the previous section, in the online channels, the first purchase decision is induced mostly by the digital promotion, but the re-purchase decision, which potentially lead to brand loyalty in the long term, is mainly due to the after-

purchase perception. The consumers' after-purchase satisfaction is determined by how well the package fulfils the consumers expectation during usage.

The consumers expectations related to the packaging and the product performance in the online channels are summarised in Table 5.8.

Table 5.8 Consumers requirements.

Aspects	*Points to address*
Functionality	At least the offered solution has similar functionalities with the current packaging solution.
	Destination driven (door-friendly & work-friendly); especially for the unattended home delivery.
	Kitchen-ready size and shape for the meal subscription model.
Convenience	Effortless; easy to unpack/open.
Availability	Products are available anytime, anywhere.
Consistency	Same product quality with the one obtained from the B&M.

In terms of functionality, the offered packaging solution shall have at least similar level of functionalities with the current packaging, e.g. containment, protection, etc. For the home delivery service, especially the unattended type, the package must be designed to maintain products quality until the consumers pick up the products. The emerging trend of meal subscription has driven another opportunity of packaging innovation. IE-Omar (2021) mentioned that customisable size of package might be interesting for the food businesses with subscription model. For instance, rather than having a big package with re-closable feature, maybe the manufacturer could provide a single pack option for a single recipe.

The package should also promote convenience during usage and storage. This includes providing an easy access to the content, which can be supported by easy-to-open packaging. Highlighting the importance of this feature, in her interview, IE-Lundström (2021) mentioned that from consumers perspective too many packaging layers equal to more handlings (i.e. unpack, repack, recycle) and more waste. This not only affects the convenience aspect, but also negatively impacts the sustainability image of the products and the sellers. For multi-serving packs, a storage-friendly package with a re-closable feature is also preferable by the consumers (IE-Henriksson, 2021).

Observing that more players are expanding to multi and omnichannel services, Fourcade (2021) stated that this is a strategy to win the market. Fourcade (2021) shared an example of Tesco, a British multinational grocery and general merchandise retailer. Tesco provides different channels to sell their products; e.g. the physical stores, the click-and-collect, the dark stores, the home delivery, etc. Some of them are profitable, but some are not. Nevertheless, Tesco keeps all of them, because Tesco wants to fulfil the consumers' need of product availability. If one channel does not have the products, the consumers are still able to find them in the other channels. By having more options, the consumers can easily find the products they need anytime and anywhere (IE-Fourcade, 2021).

The multi/omnichannel marketing strategy triggers another expectation from the consumers, which is a consistency among channels. Consumers who have been loyal to a brand or a particular product must have known how the product looks like, how it tastes, and how long it shall last during storage. Therefore, either they buy it online or offline, they expect the same product quality (IE-Omar, 2021; IE-Krashak, 2021).

5.3 Tetra Pak and packaging for E-commerce

As a packaging supplier, Tetra Pak understands that E-commerce has a great future potential. In order to secure the channels, Tetra Pak must optimally leverage its value and products' strength. At the moment it takes all the necessary steps to understand the needs and carefully decide what solutions will fit best for this channel. Reflecting upon the E-commerce packaging requirements, Tetra Pak has already had some building blocks which potentially fulfil the needs. Some building blocks that were captured from the interviews and the reading materials are summarised in Table 5.9.

Table 5.9 Tetra Pak's building blocks.

No	*Needs*	*Building blocks*
1	Logistics-friendly design	Brick/square shape
2	Sustainability	Mainly paper-based
3	Fit for the products and the system	Ambient: Aseptic packaging Cold: Non-aseptic packaging
4	High mechanical protection (i.e. robust packaging)	Primary: Tetra Recart, portion packs. Secondary: cardboard boxes (on-going development projects)
6	Mass customisation via last-mile printing	Already started to explore digital printing
7	Track and trace	Time and temperature indicator (TTI), Radio Frequency Identification (RFID)

The brick shape of Tetra Pak's packaging has a high score from the logistics point of view, as it optimises the space utilisation during storage and transportation. It can stand by its own and has a good stackability, leaving almost no empty space between products. The brick shape along with the multi-layer packaging materials have induced the package strength, leading to a robust packaging solution. Tetra Recart, the strongest packaging type within Tetra Pak's portfolio, is even predicted to have no issue in the rough distribution of E-commerce (IE-Marcovecchio, 2021). Moreover, the on-going development projects of the secondary package are aimed to further strengthen the packaging system.

Facilitating different types of products, Tetra Pak also has series of packaging solutions; e.g. the aseptic packaging for ambient products and the non-aseptic packaging, mainly for the cold distribution. Furthermore, the packaging is mainly

composed of paper-based materials, inducing the environmentally-friendly value. Finally, some new technologies, such as the last-mile printing feature in the filling-packing line as well as the attached TTI and RFID to the package, correspond to the needs of mass customisation as well as the track and trace in the online channels (IE-Marcovecchio, 2021).

5.4 Packaging innovation direction

As discussed in Chapter 2, packaging is the means of ensuring safe delivery of products to the ultimate consumer. In order to achieve this purpose, packaging works as a system consisting of primary, secondary, and tertiary packages. The designated system for B&M might not fit for E-commerce due to two main reasons; 1) the packages breakdown occurs in much earlier stage, leading to an unoptimized packaging system 2) the environment is different with the one that the packages were initially designed for. In order to address these points, this section will discuss the potential direction of packaging innovation, including the pros and cons accounted for the selected options.

5.4.1 Different barrier properties for E-commerce packaging

There was a discussion about the possibilities of having different barrier properties between the packaging in the online and the offline channels. The main hypothesis was the shorter lead time of the online market channels might allow a shorter products' shelf-life, leading to a possibility of replacing the aluminium layer of Tetra Pak's aseptic packaging with a more environmentally-friendly material.

5.4.1.1 Different meanings of shelf-life

Shelf-life is the keyword of this innovation idea. Theoretically, shelf-life is defined as the length of time a food product can be stored and displayed whilst still maintaining an acceptable quality or specific functionality (Young and O'Sullivan, 2011). But practically, shelf-life has different meanings for different actors. Understanding the meanings of shelf-life is the key to comprehend the impacts of its modification.

5.4.1.1.1 For consumers

Talking about shelf-life from the consumers' point of view, the biggest question is whether the consumers use shelf-life for estimating until when they could consume the product, or for estimating how fresh the product is. In the offline channels, consumers go to the store, compare the expiry dates among products, and then choose the one with the latest expiry date. This decision is not merely due to

the fact that they need the product until the end of its shelf-life, but more into their preference of having the fresher product.

From the consumers' perspective, the strongest enablers of having different products' shelf-life among channels would be 1) in the online channels the consumers do not have any chance to compare different shelf-life of products like they usually do in the offline stores, 2) In the EU, there is no obligation to put the production date on the label. The key point of these enablers is no matter how long is the shelf-life, in fact the consumers never know the actual shelf-life of the products. The only thing that may affect their purchase decision related to the products' freshness is when they compare the different expiry dates of products on the shelf. They simply interpret that the one with a latter expiry date is the fresher one and they tend to choose a fresher product, despite their actual needs of shelf-life.

This key point might not be fully relevant for the other countries which oblige the producers to print the production date on the label; for instance, Indonesia. In these countries, the consumers know the actual product's shelf-life. Despite of the quality guarantee until the end of shelf-life, consumers always expect to buy fresh products either online or offline. In this case, the freshness perception plays an important role to drive the purchase decision. Therefore, in these countries it is more challenging to apply different shelf-life in different channels.

In some special cases, the omnichannel players might use the online channels to sell the closed-to-expiry-date products (IE-SH, 2021; IE-MY, 2021; IE-GT, 2021). They usually give a special discount for this type of products. The main drivers of this strategy are; 1) the easy algorithm alteration that allows higher exposure of products under promotion in the E-commerce platforms, and 2) the effortless order mechanism (i.e. the consumers do not have to go to the store to buy the products). This means is allowed under several conditions, 1) the company must guarantee the products quality until the end of shelf-life and, 2) the consumers are aware of the shelf-life difference, which becomes the reason of the discounted price. An inspiration from this practice for this project, for instance, other than discounted price, sustainability campaign could be the background of the special E-commerce packaging with more sustainable materials.

Another consideration is that consumers expect consistency; i.e. between channels, between purchases, etc (IE-Omar, 2021; IE-Zhang, 2021). "When it usually last five days in the fridge, it should not last only two days when you buy it from E-commerce" (IE-Krashak, 2021). The risk of mistrust might arise if the consumers do not have enough information related to the different product shelf-life among channels.

5.4.1.1.2 For producers and E-commerce players

For producers and E-commerce players, shelf-life is more than a number. Shelf-life provides flexibility; not necessarily about whether the product is

consumed in a long time or not (IE-Henriksson, 2021). Due to this reason, marketing, in general, likes a longer shelf-life (IE-MY, 2021). This flexibility is even more needed for seasonal products which can only be harvested in a specific time of the year. In this case, the products harvested in that specific time must be able to fulfil the needs throughout the year (IE-Henriksson, 2021).

E-commerce players usually have a limited space of storage, and therefore prefer high-turnover products to maintain their profitability. The maximum storage time policy is aimed to avoid dead stocks in their WHs (IE-SH, 2021). This policy is supposed to support the premise of allowing shorter shelf-life products in E-commerce. Nevertheless, due to the high range of products they must handle, E-commerce players opt for non-perishable and long shelf-life products. Some E-commerce applies minimum shelf-life policy and special requirements for perishable products. For instance, TK applies a maximum 60 days of storage period, but it also applies the minimum 12 months of shelf-life for products consigned to their WHs (TK, 2021).

As discussed in the previous section, the speed of sales highly depends on the length of storage time, which is more related to the products' turnover rate, rather than the order fulfilment speed. Even if some of the online platforms' lead time is significantly different from the offline channels, there is another question of whether the lead time difference can be standardised to design the new packaging solution.

In his interview, Fourcade (2021) explained his concern on this. For instance, a company produces several types of plant-based beverages; soy drink, rice drink, and oat drink. These products use the same packaging materials, the same packing line with the same equipment's setting. In order to maintain its economies of scale while implementing the sustainability practice, this company might be interested to adopt the new packaging solution which might slightly shorten the product's shelf-life, but the solution must be applicable to all of the products. The problem is that the soy drink has a much higher turnover rate compared to the rice and the oat drink. So, the shorter shelf-life is not a problem for the soy drink, but becomes a major problem for the others. Similarly, this might happen to a brand of juice with five different flavours, but only two of the five have high turnover rates, while the other three are less popular.

Another interesting point to discuss is the relation between packaging materials selection, the product requirements and the sustainability concern. It is known that aluminium is an excellent packaging material due to its absolute barrier properties against oxygen, moisture, and light. Nevertheless, it has high environmental impacts, and therefore Tetra Pak has initiated projects to find suitable substitute for aluminium foil (IE-Toft, 2021). The finding of this thesis shows two important insights for this topic, 1) different products have different deterioration factors (IE-Toft, 2021), and 2) even though two products have similar deterioration factors, such as oxygen and moisture, the replacement of the packaging barrier properties might have different impact to their shelf-life. For instance, taking out

oxygen barrier might give a bigger impact to the UHT-treated milk than to the PBDA.

Finally, the sustainability concern has been increasing worldwide. Nevertheless, the impacts towards the purchase decision are different in every region. For instance, in the US and the EU, the governments have pushed the sustainability movements through regional policies, such as via Paris Agreement, and through continuous environmental campaigns. Thus, the business practice as well as the purchase decision have been impacted significantly. On the other hand, in Asia the sustainability concern is still growing, and has not become a strong driver to buy products (IE-Ishikawa, 2021).

Asian countries have both national and regional agenda for the sustainability movement. Thus, they are going to the same direction with the Western countries. Nevertheless, the urgent issues, such as poverty, economy crisis, and food security, have driven most of the recent government policies. Furthermore, the huge gaps in the society (i.e. economy status, educational background, etc.) have become great challenges for industrial actors to standardize the sustainable business practice which mostly leads to a higher product price.

One thing that might be a point of interest for Tetra Pak and other packaging suppliers is that start-ups have been growing fast in Asia. With small to middle business scales, these emerging players are coming from young generation with a high sustainability concern. Most businesses are in the fields of food and dining as well as home delivery food service. During pandemic, the trend of home delivery is increasing, and thus if Tetra Pak could pioneer the use of sustainable packaging materials for ready meals and beverages, replacing the plastic-based packaging, it could be a revolutionary movement. An important point to note, the products in this business area do not require a long shelf-life nor the flexibility in the supply chain. More geographical insights would be discussed in section 5.4.4.

5.4.1.2 Opportunities for having different barrier properties in different channels

Taking all the above factors into account, the innovative idea of having environmentally-friendly barrier properties might be more relevant to be applied based on the product categories rather than the marketing channels. The product which is predicted to be suitable for this type of modification is the one with a high turnover rate, and which shelf-life is not highly impacted by the replacement of aluminium foil. While for the geographical consideration, it is important to align the sustainability mission of the package with the sustainability policies in the targeted countries. More efforts might be required in several countries, but Tetra Pak should be able to standardise its sustainable practices across countries. Some opportunities might also available in the new market field, such as ready meals, which fulfil the basic requirement above, high turnover rate with no need of long shelf-life.

5.4.2 Primary vs secondary

Understanding that packaging works as a system, the ultimate goal is not to innovate the primary or secondary packages as individual items, but as a unity. The aim is not to create a perfect primary or secondary package, but to create a system which perfectly fits for the designated environment.

Interviewing some package experts at Tetra Pak, there are some innovation ideas captured for fulfilling the needs of E-commerce; 1) modifying the primary packages, while keeping the current secondary package solutions, 2) modifying the secondary packages, while keeping the current primary package solutions, 3) modifying both primary and secondary packages, 4) merging the primary and secondary packages properties into a compact new solution.

According to the interviews results, there are positive and negative consequences attached to the modifications of either primary or secondary packages, which are summarised in Table 5.10.

Table 5.10 Consequences of modifying the primary and the secondary packages.

Packaging	**+**	**-**
Primary	Give value throughout the chain, even until the end of product use. Integrating the function of the secondary package into the primary package might enable the removal of the secondary package, which contributes to the reduction of handling cost. It is the core competence of Tetra Pak.	Require modification of the current portfolio. Require thicker and stiffer materials, leading to higher cost per pack of product. Might require modification in the processing line or even a specific line for E-commerce product. Parts of the machines might wear faster to handle a stiffer package. If the new solution is completely different with the current solutions, it might be a challenge for the packaging supplier to convince the customer and consumers for adopting the new solution.
Secondary	Requires a lower cost per pack of product. Could keep the current primary packaging solutions, including the processing line setups.	There is a high probability that the secondary package will be removed or overboxed when combined with other products. More layers lead to the impression of more waste, from the customers and the consumers. A complicated design might not fit for the automated system. It is not Tetra Pak's core competence.

5.4.2.1 Primary packaging

Modifying the primary packaging could be advantageous, because it stays intact with the product from the time the product is packed, until its end of use, and thus giving value throughout the chain (IE-Lundström, 2021). In other words, unlike the secondary package that loses its value when it reaches the consumers, the primary package is useful for the consumers until the product is finished.

Furthermore, having a robust primary package also means that even if the transport package must be broken down in the early stage, or even if it needs to be repacked due to mixed products in one order, the protection properties remain. In a more advanced level, integrating the function of the secondary package into the primary package might enable the removal of the secondary package, which contributes to the reduction of handling cost (IE-Marcovecchio, 2021). For Tetra Pak, its primary packaging portfolio is not only the core competence of the company, but also the strong competitive advantage of the business (IE-Marcovecchio, 2021; IE-Parreira, 2021).

On the other hand, modifying the primary package is not simple. As described in the previous section, the rough distribution in E-commerce demands a stronger mechanical protection. This means either the packaging materials or the materials composition must be altered to meet the requirements. In Tetra Pak case, for instance, the current packaging portfolio has been optimized to protect the products which the packages are intended for; thus, despite the additional mechanical properties, it is important to maintain the barrier properties to protect the products (IE-Parreira, 2021; IE-Zhang, 2021). In this case, it remains a question whether E-commerce packaging should be one type of package or another series of packages. Furthermore, if Tetra Pak decides to add thicker and stiffer materials, it must not only think about the materials cost, but also the modification required in the processing line as well as the higher risk of the machines' deterioration when handling stiffer packages (IE-Fourcade, 2021). Some pre-studies revealed that the most common problems of applying thicker materials are in the folding and sealing processes (IE-Fourcade, 2021). Due to these reasons, there is a high probability that modifying the primary package will significantly increase the cost per pack of product (IE-Fourcade, 2021). However, IE-Marcovecchio (2021) argued that although the production cost might increase, the handling cost could be decreased, thereby a thorough calculation must be conducted to reveal the total impact of the modification. Finally, how different is the new solution from the old ones and how much effort required to change will also determine how widely the new solutions would be adopted by both the customers and the consumers.

5.4.2.2 Secondary packaging

Compared to the former option, modifying the secondary package could be advantageous because it requires less effort and lower modification cost per pack of product. This type of modification enables both the packaging supplier and the food producer to maintain the product protection feature of the current primary packaging (IE-Fourcade, 2021). In the producers' site, some modifications in the packing line might be required, but the filling line could be kept as it is (IE-Parreira, 2021).

On the negative side, altering only the secondary package might not solve all the issues. Firstly, there is a high probability that the secondary package would be removed or overboxed when the order consists of mixed products (IE-Lundström, 2021; IE-SH, 2021; IE-MY, 2021). Secondly, Tetra Pak's customers (i.e. food

producers) and the final consumers tend to avoid many packaging layers. For the E-commerce players, specifically, if the selling units are not per secondary package, more layers equal to more handlings (i.e. unpack, repack) and more waste. These lead to less efficient and less sustainable business practices (IE-Marcovecchio, 2021). Similarly, in the consumer side, more layers of the secondary package equal to more efforts to unpack and recycle, while they are not really using the package. The higher-waste impression will also negatively impact the sustainability image of the seller and the E-commerce platform (IE-Lundström, 2021). Thirdly, some potential modifications require additional grids and inserts inside the box which cannot be supported by the current automated solution. Additional manual works will not only increase the labour cost, but also increase the probability of unconformities, and thus are not preferable by the customers (IE-Lundström, 2021; IE-Parreira, 2021). From Tetra Pak's side, although the company provides the packing solution for the secondary package, it does not develop the secondary package itself (IE-Henriksson, 2021). Meanwhile, there have been a lot of competitors focusing on the secondary package which makes the competition in this field more challenging for Tetra Pak (IE-Marcovecchio, 2021).

5.4.3 Group vs single packs

The E-commerce packaging innovation could also consider the potency of group sizing optimisation. An optimum group sizing could minimise the risk of package breakdown at some point in the supply chain, and therefore the packaging system could fully serve its ultimate purpose.

There is no such standard group sizing that works for all products. Consumers might have different purchase behaviour depending on the product categories, the market channels, the purchase missions, the household sizes, and the consumption patterns (IE-Fourcade, 2021; IE-Henriksson, 2021). Therefore, both the E-commerce players and the producers must carefully analyse all the corresponding factors to define the optimum group sizing for a particular product in a particular market channel. Some pros and cons of selling group packs and individual packs in the online channels are depicted in Table 5.11.

Table 5.11 Pros and cons of selling individual packs and group packs in E-commerce.

Category	**+**	**-**
Individual packs	High flexibility in order quantity.	High transport/distribution cost per pack. Need of package breakdown somewhere in the value chain.
Group packs	Possibility of using SIOC/FFP to avoid unpacking/repacking. Low transport/distribution cost per pack (i.e. bulk shipment).	Less flexibility in order quantity.

In his interview, Fourcade (2021) explained that in general there are two different purchase missions of consumers; 1) big replenishment and 2) small purchase for daily needs. The big replenishment is associated with the consumers need of bulk stocking. Usually this mission is applicable for long shelf-life products that are well-known and routinely consumed by the consumers, such as milk and canned foods (IE-Fourcade, 2021; IE-Henriksson, 2021). Due to the frequent consumption, the consumers can accurately predict the required stocks for a certain period of time, and thereby may confidently buy group packs without the fear of wasting. For this type of products consumers tend to use the online channels for avoiding hassles of going to the stores, picking, and carrying the heavy products (IE-Fourcade, 2021). On the other hand, buying goods or ingredients for today's dinner or tomorrow's lunch is an example of the second mission. For this mission, consumers tend to buy individual packs both in the offline and the online channels (IE-Fourcade, 2021). People also tend to buy individual packs for something they do not routinely consume (IE-Henriksson, 2021).

IE-Henriksson (2021) stated that household size might determine the purchase behaviour. For instance, there would be a huge difference in the purchase pattern between a big family with three children and a single student living in a student accommodation. In a larger extent, consumers might have different purchase behaviour in different channels. Some products are more popular in the online channels, while others are more popular in the offline channels (IE-MY, 2021). Taking into account all the factors above might be useful to define the right grouping size of certain products for the specified target market.

In their interviews, Marcovecchio (2021) and Fourcade (2021) challenged the current method of grouping packs. For instance, the producers tend to choose a secondary package containing big number of individual packs, e.g. 12-packs, 24-packs, 48-packs. Practically, the consumers need much less than that, but selling individual packs might lead to over transportation cost. This misalignment between the consumers order pattern and the initial packaging design cause more handlings at some points in the supply chain. When the producers and the E-commerce players could accurately analyse the consumers behaviours and translate them into a suitable packaging design, they could not only avoid the unnecessary handlings, but also optimise the material use and minimise the waste generation.

Analysing the problem, a new concept of single and group pack could be introduced to the market. For instance, instead of having 12-packs per box and selling them as individual packs, producers could make and sell a box containing 4 individual packs in the online channels (IE-Marcovecchio, 2021). Not only addressing the consumers preference, this sizing strategy could also solve the technical issues of damaged packaging. As mentioned above, the bigger the group size, the higher the risk of damages (IE-Parreira, 2021; IE-Fourcade, 2021). Another issue that could potentially be solved is the smaller group size of packages could fit better in the E-commerce trays. E-commerce players, such as Amazon and Ocado have their own trays to pull all products in one order together. Thus, the right sizing

would promote a better handling, avoiding repeated unpacking and repacking (IE-Wirsen, 2021). Assuring that the secondary package will stay intact until the products reach the consumers, the packaging supplier could choose to maximise the secondary package performance, without altering the primary package specification. In Amazon, this type of secondary package could be SIOC-certified.

5.4.4 Geographical insights

The discussion in this section will be limited to the regions of America, E&CA, and APAC. As mentioned in the previous chapter, different regions might have different packaging requirements for E-commerce. These are mainly affected by some factors; 1) market size, 2) top E-commerce players, 3) market characteristics and degree of sustainability concern, 4) infrastructure, 5) environment, 6) technology advancement, including the automation level.

Figure 5.5 shows the list of countries with the highest E-commerce sales worldwide, reported by Oberlo (2021a).

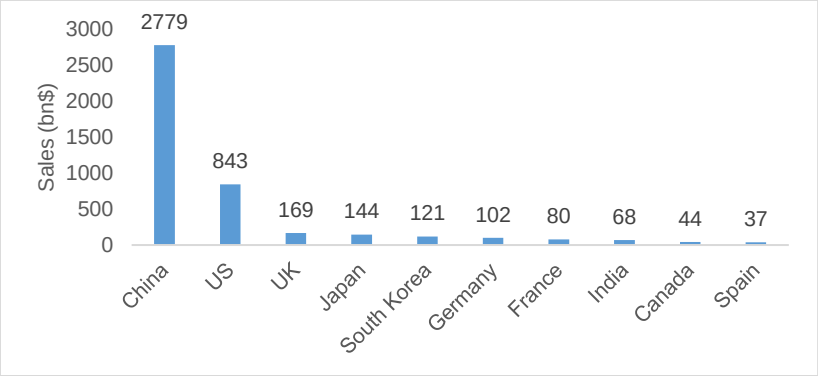


Figure 5.5 E-commerce sales by country in 2021 (Oberlo, 2021a)

The largest contributor of E-commerce sales is China with sales over $2.7 trillion. This number is equivalent to approximately 52.1% of the global E-commerce sales, which is also more than the total market size of the next nine on the list (see Figure 5.5). Even the US on the second place has less than a third of that of China's at $843.15 billion. Not only having the largest number of sales, China also has a strong 21.0% year-over-year growth, while the US E-commerce market is projected to grow by 6.1%. Following China and the US, there are the UK ($169.02, -6.3%), Japan ($144.08 billion, +2.0%), and South Korea ($120.56, +9%).

Three out of the five biggest E-commerce markets are in APAC region, making up 62.6% of the global E-commerce size. Top ten E-grocer players in APAC are presented in Figure 5.6 (Edge by Essential, 2020; see Tetra Pak, 2021a). For the product categories, drinking milk dominates the market with $6.343 million in E-

commerce sales in 2020, while yoghurt and pet food are the fastest growing categories (Global Data, 2020; see. Tetra Pak, 2021a).

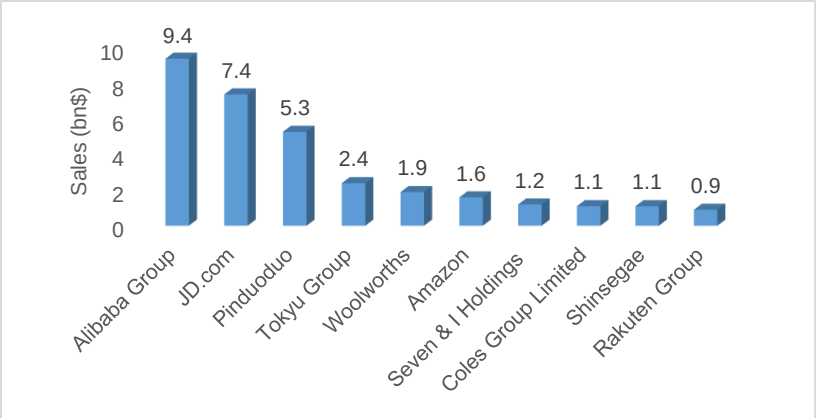


Figure 5.6 Top E-grocery players in APAC (Tetra Pak, 2021a)

Despite the total sales per country, there are some key E-commerce players which have a strong dominancy in this emerging market channel. Figure 5.7 shows the top E-commerce companies worldwide (Oberlo, 2021c). Among the ten companies, five are from the US, three are from Asia, and two are from Europe.

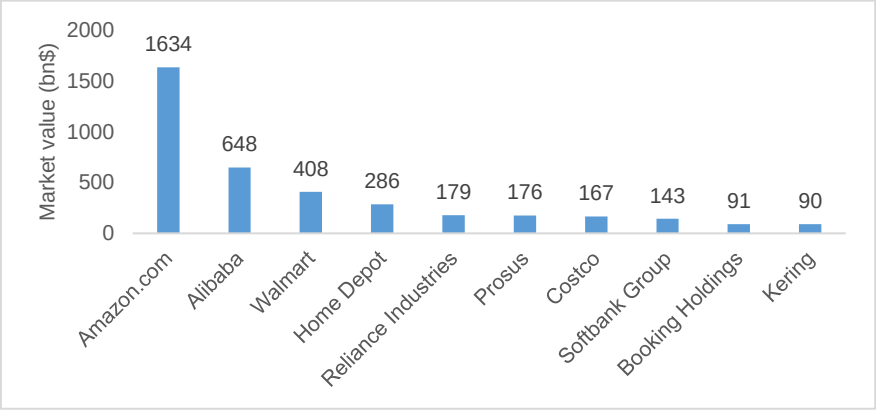


Figure 5.7 Top E-commerce companies by market value in 2021 (Oberlo, 2021c).

Amazon dominates the market with sales over $1.6 trillion per January 2021, more than doubled the market value of Alibaba in the second place with $648.32 billion. This number is also more than the combined total of the next four on the list. Amazon sales growth impressively grew by 73.6% from the previous year, which is attributed to the massive global lockdown phenomenon due to the coronavirus pandemic (Oberlo, 2021c). Similar trend is found in Alibaba in the second place which has more than doubled its net revenue from 2018 to 2020. The total market value of Amazon and Alibaba ($2.2 trillion) makes up more than 40% of the total market value of the top ten E-commerce companies in the world. In the third and

fourth ranks, there are Walmart ($407.84) and Home Depot ($285.97 billion) from the US, followed by India's Reliance Industry in the fifth rank with $178.95 billion market value.

Learning the facts that the top sales by country are not necessarily aligned with the E-commerce top companies has triggered more curiosity about how this happens. In their interview, IE-Zhang (2021) and IE-Ishikawa (2021) explained that unlike the western regions which are mainly dominated by Amazon, in APAC many countries have their local players which dominate their E-commerce markets. These companies might not be in the top ten E-commerce companies list, but they drive the E-commerce growth in their countries of origin. The variation among the E-commerce players across countries has been one of the biggest challenges to define the effective packaging solutions for APAC region (IE-Zhang, 2021; IE-Ishikawa, 2021).

Despite the sales numbers and the top E-commerce players, for Tetra Pak specifically, it is important to observe whether the growth of E-commerce sales align with the growth of its product categories, i.e. packed food and beverages. Figure 5.8 shows the online purchasing mapping by product categories per region (Orendorff, 2019). Using this figure, in order to select the right target market, it might be more interesting for Tetra Pak to focus on the market share and the growth trend of the packed grocery sales, rather than the total E-commerce sales.

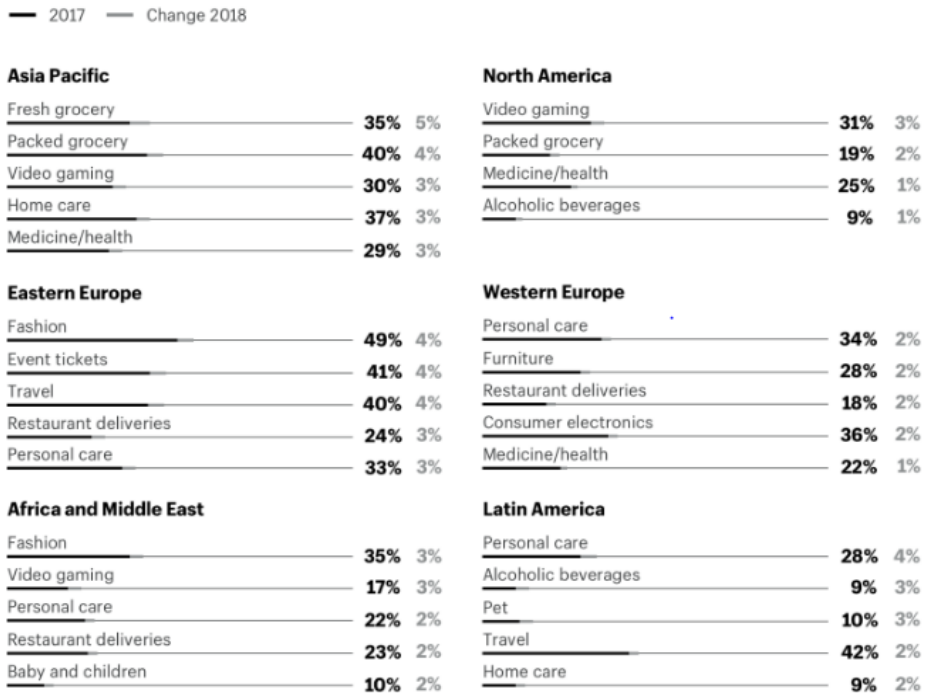


Figure 5.8 Online purchasing mapping by product categories per region (Orendorff, 2019).

Besides the market size and the power of the top E-commerce players among countries, the market characteristics also have roles in determining the needs of packaging modification in the online channels. In terms of market characteristics, Asia region has an advantage of the large population number. Nevertheless, they are more price sensitive, compared to Europe and the US. The sustainability concern has been growing, but has not been the main purchase driver (IE-Ishikawa, 2021). Through a quick screening on some E-commerce platforms in Indonesia, the satisfaction of the consumers was mainly driven by the safe and secured package, the high delivery speed, the good quality of product, the affordable price, and the responsive sellers. On the other hand, in Europe and the US, the consumers have adopted a higher degree of sustainability concern. In some cases, sustainability aspect has been one of the main purchase drivers. Some E-commerce platforms have also shown their commitments towards sustainability, for instance Amazon with its Climate Pledge, a commitment to be net zero carbon across the business by 2040 (Amazon, 2021). The international and the regional commitments (e.g. Paris Agreement) and the government policies are one of the main drivers of these sustainable business practices.

Sustainability aspect is an important issue to discuss, because depending on the degree of the sustainability concern, the packaging solutions could be significantly varied. For instance, regardless the size of market, countries with a low sustainability concern could keep the current practice of extra-cushioning and multiple layers of package to protect the products. On the other hand, countries with a high sustainability concern will be against the overpackaging practice, and therefore require a new solution of packaging for E-commerce. Sustainability concern is growing globally, but every region, every country and even every organisation might be in different stages and speed. For instance, as regions, following the goal statement in the Paris Agreement, the EU and the US aim to be climate-neutral by 2050 (European Commission, 2021; Parry, 2021). Sweden, as a country, aims for the same target by 2045 (Government Offices of Sweden-Ministry of the Environment, 2020), while China in 2060 (McGrath, 2020). Amazon, as a company, wants to achieve it by 2040 (Amazon, 2021).

Tetra Pak might find this fact challenging, as a sustainable packaging solution might be easily adopted by one country and not by another. Nevertheless, as a global packaging supplier with an ambitious sustainability goal, Tetra Pak must be able to induce the standardised sustainable practices across countries. Extra efforts might be required in several countries, but it would be paid off as Tetra Pak could be the pioneer of a sustainability movement through packages, especially in E-commerce. This could also positively promote the realisation of the 12th SDG of the UN, Responsible Consumption and Production.

The infrastructure and the environment also play important roles in defining the suitable packaging design for a specific region. IE-Ishikawa (2021) explained that in some countries in the APAC region, bad road condition remains a challenge for transportation even for the B&M stores. On the other hand, the US, the EU, and

the UK have more developed and standardised infrastructures. Asia also has relatively higher temperature and humidity, which might lead to different packaging requirements to achieve the same level of protection.

Finally, the level of technological advancement, including the degree of automation, also defines what packaging solution is needed by a specific region, even more specifically by a particular E-commerce player. Manual handling is still common in Asia. IE-Ishikawa (2021) explained that even some producers in Asia are still struggling with the unstandardized manual handling in the B&M channels. Meanwhile, the companies in Europe and America generally have adopted advanced automation systems with high degree of integration.

All those factors above create geographical barriers for designing a single packaging solution for E-commerce worldwide. From Tetra Pak's perspective, up-to-date, the on-going packaging development projects are mostly oriented to the Amazon's packaging certification standard. The fact that Amazon's performance strongly outweighs the other E-commerce players might be one of the strongest reasons, but not the only reason. As mentioned in the earlier section, at the moment Amazon has the most standardised packaging certification method in the E-commerce field, although its ISTA 6-AMAZON.COM for SIOC also has a limited coverage area, within the North America region (ISTA, 2016). The availability of the packaging certification standard as well as the strong market position of Amazon in the US have driven the advanced progress of Tetra Pak's E-commerce packaging development in America region.

6 Conclusions and Final Remarks

This final chapter presents the answers to the RQs presented in Chapter 1, the concluding recommendations for Tetra Pak, as well as the personal reflection to give some insights of the possible future development of this project. The contribution to the 12th UN SDG is also discussed at the end of the chapter.

6.1 Conclusions

This thesis was aimed to answer three RQs, presented in Chapter 1. The elaborated answers would be presented in this section.

RQ 1. What are the factors that trigger specific packaging requisites in E-commerce which are different from the current packaging solutions?

There are some characteristics of B&M and E-commerce that elicit the potential need of different packaging solution between these channels. Compared to B&M, packages in E-commerce must withstand more pressures and mechanical shocks due to the higher number of touch points, the early package breakdown, and the unstandardized package configuration throughout the supply chain. The current packaging is designed to withstand the B&M distribution model, which is way milder compared to the E-commerce distribution.

Nevertheless, not all types of E-commerce channels are subjected to these differences. E-grocers and omnichannel players have almost similar supply chain with B&M, as they mainly use the offline stores as the fulfilment centres. Therefore, the points mentioned above are applicable to the pure players and D2C (e.g. Amazon), but not the omnichannel players with the micro fulfilment centres (e.g. ICA). A careful need analysis is important to avoid overpackage and underpackage in a particular channel.

RQ 2. How should the packaging for liquid products be designed to fulfil the product, the logistics, and the consumer requirements in E-commerce channels?

Making changes is risky. Thus, when changes are about to be made, the new solution shall consider the needs of all actors and stakeholders, i.e. the producers, the E-commerce players, and the consumers. For all actors, it is important that the

packaging protects the product throughout the supply chain and until the end of its shelf-life. Besides providing good protection, the offered solution must also be sustainable and cost-efficient.

Related to the protection feature, it is important to give the mechanical protection that can withstand all the pressures throughout the supply chain. On top of that, similar to the B&M channel, the packaging must be able to provide good barrier properties which protect the product against its deterioration factors. The producers and the E-commerce players highlight the importance of packaging roles in logistics and communication. From the logistics perspective, the package must have an optimised shape and size, fit to the system (both the manual and the automated handling), promote flexible, fast and efficient handling, as well as enable easy tracing and tracking of the products. From the communication perspective, unlike in the B&M, the consumers' first purchase decisions in the E-commerce are not highly affected by the packaging visual. It is more dependent on the digital promotions, such as the picture on the website, the product description, and the reviews/ratings. Thus, the packaging's role is more pivotal to convince the re-purchase by promoting consumers satisfaction through the after-purchase experience. The aspect of consumer engagements could be fulfilled by fulfilling their needs of functionality, convenience, availability, and consistency.

RQ 3. For Tetra Pak, what should be considered to fulfil the gaps between the current portfolio and the expected packaging requirements in E-commerce?

As a global packaging supplier, Tetra Pak has already had some building blocks to fulfil the above requirements. These include the brick packaging shape, the paper-based packaging materials, the aseptic packaging, the packages for chilled products, as well as the technology of track and trace and digital printing in its packing solution. Furthermore, as part of the attempts to secure the E-commerce channel, some development ideas and projects have been initiated at Tetra Pak. From the discussions with the interviewees, there are some points that might be worth to consider for the further development stages.

Firstly, it has been questioned whether the development shall be focused on the primary package or the secondary package. From the discussions, modifying the primary package will be advantageous as the primary package will give value throughout the chain, even until the end use of the product. A strong primary package might also open an opportunity of the secondary packaging removal, which is preferable in terms of minimising the needs of handling along the supply chain. Furthermore, primary packaging is the core competence of Tetra Pak. Nevertheless, modifying the primary package might include a difficult pathway for Tetra Pak and the producers, as it means the current portfolio could not be used for the online channels. It also requires a high investment in not only the materials, but most probably also the machineries at Tetra Pak and at the beverage manufacturing site.

On the other hand, modifying the secondary package might retain the current primary packaging portfolio as well as the existing filling and packing solutions.

Nevertheless, this solution will be meaningless if repacking is conducted in any stage of the supply chain. Furthermore, it intrigues the impression of waste from both the customers (more handling) and the consumers. When decided to provide secondary package solutions, Tetra Pak must also be ready to enter a higher level of competition, as it is not originally its core competence.

Secondly, the E-commerce packaging innovation could also consider the potency of group sizing. An optimum group sizing could minimize the probability of package breakdown, and therefore the packaging system could serve its ultimate purpose, without the risk of missing any component at some point in the supply chain. For instance, instead of having 12-packs per box and selling them as individual packs, producers could make and sell a box containing 4 individual packs in the online channels. The right sizing could promote less handling in the E-commerce fulfilment centres as well as serving the right purchase size for the consumers.

Thirdly, there was an idea of utilising different barrier properties between the online and the offline channels. This idea was suggested considering a hypothesis that online channels have much shorter lead time compared to B&M, and thereby opens an opportunity of having products with shorter shelf-life. Although some actors stated that online channels might have shorter process lead time, the different shelf-life between the offline and the online channels could trigger trust issues from the consumers that expect quality consistency between channels. Furthermore, from the business perspective, shelf-life is not merely translated into "how long it can stay on the consumers' shelf", but more into "how much flexibility is offered by this product".

Finally, in order to be accepted, it is important to note that every change should be aligned with the expectations of the targeted market. This acceptance level might be affected by the geographical factor. The solution offered as well as the associated campaigns and the promotional measures shall correspond to the respected values and the purchase drivers in the specific regions.

6.2 Recommendations for Tetra Pak

E-commerce has grown quickly in the past couple of years. This growth is predicted to continuously incline in the future. Analysing the business potential, tapping into this area seems to be a rational movement for all actors. Tetra Pak as a global packaging supplier has observed this opportunity and has started some packaging development projects to serve the E-commerce channels. Extending from the answer to RQ 3 which mainly discussed the multi-dimensional perspectives of the on-going development projects, there are some more recommendations which might be worth to look into to choose the right target market and define the suitable innovation strategy.

Firstly, it is true that E-commerce is growing, nevertheless there are several types of players within it. Each player has different types of supply chain and strives in different categories of products. Although serving all types of players might be the ultimate goal to secure the channels, it seems that due to the high variations of supply chain, there is no one solution that fits for all. Therefore, it might be more relevant for Tetra Pak to observe which player strives in packed beverages products. Then, from there Tetra Pak could learn the pain points and create the effective solutions for them.

Secondly, not only about the type of players, Tetra Pak could also map the geographical potency to ensure a high success rate of the packaging innovation. Issues that drive purchase decision in each country are different. Thus, it is important to understand the behaviour of the consumers, the producers, and the E-commerce players in the targeted country. For instance, in relation to the sustainability issue. All countries in the government level have a high concern towards sustainability. Many are committed to participate in the Paris Agreement's mission. Nevertheless, they have different strategies to reach the goal. The consumers from some countries are also not so driven by sustainability issue when buying products from E-commerce.

With a great ambition towards sustainability, Tetra Pak might see this both as a challenge and an opportunity. As a challenge, any offered sustainable packaging solution might have different rate of market penetration among countries. Nevertheless, the ability to standardise the sustainable practices worldwide, even pioneering the sustainability movement through packaging in some countries will further strengthen Tetra Pak's position as a global sustainable packaging supplier, promoting the 12th SDG of the UN, Responsible Consumption and Production.

It was discussed in the beginning of the project that E-commerce might have a significantly shorter lead time compared to B&M, which opens an opportunity to have a shorter shelf-life of products. Nevertheless, based on the interviews, there is a high variation of lead time within E-commerce. Therefore, it would be difficult to standardise how shorter the shelf-life could be. An idea to modify the packaging barrier properties for sustainable goals is interesting to explore, however it might be more relevant if the categorisation is not based on the market channels, but based on the product categories and the turnover rates. For instance, the replacement of the aluminium foil layer could be applied to the packaging of a product which is less susceptible to oxidation and has a high turnover in the market, regardless it is sold in the online or the offline channels.

Thirdly, the heart of innovation is the goal to solve problems. Therefore, it is essential to offer a solution that matches the needs. Tetra Pak must carefully define what shall be kept and what shall be changed to arrive at the expected result, without being over spec nor overbudget. Observing the development plan of each player might also be interesting. For instance, the omnichannel players are most likely to expand the utilisation of stores as fulfilment centres. This opens the opportunity for

Tetra Pak to keep its initial portfolio. Or, some pure players might plan to fully repack all the orders fulfilled from their WHs to standardise the protection features. This is a pre-caution that innovating the secondary package might not be too relevant for Tetra Pak. Another example, it is known that cap and big size of package increase the vulnerability of damages, meanwhile there is an increased trend of meal subscription business model. So, maybe the solution for this channel can be a kitchen-size product which would be finished in one recipe, thus re-closable feature is no longer necessary. Some players also develop their system to adapt the current packaging portfolio. Thus, without a good communication and alignment, the new offered solution might be a hassle instead of a solution for them.

To conclude, change means cost, thus, it might be wise to invest only on the profitable and efficacious changes. This can only be possible if the offered solutions solve the actual problems of the targeted market.

6.3 Reflection and future research

This thesis has been a fascinating learning journey that lead me to a completely new perspective of E-commerce and food packaging. E-commerce had never been a topic of my studies. Therefore, in the beginning of this project, it was important for me to learn the basic knowledge before entering the intermediate stage of proving the hypothesis of specific packaging needs for E-commerce, and the advanced stage of defining and categorising the specific needs.

In terms of the selected research method, both the literature reviews and the semi-structured interviews have given a lot of information that helped me throughout this learning process. The most interesting part was the opportunity to talk to many actors with different perspectives and point of interests. The data gathered have enriched the dimension of learning, expanding the area of discussion.

As much as this journey has been fruitful for me, there were some limitations that, from my perspective, could be improved in the future studies. The first one was related to the composition of the interviewees. More than three fourth of the interviewees are from Tetra Pak. Although they come from different departments and even different regions, they basically see things from the packaging supplier point of views. An attempt to explore others' perspectives have been employed, such as interviewing the E-commerce players, the retailer, and the manufacturer. Nevertheless, the number of the interviewees from these categories were too low compared to the ones from Tetra Pak. It would be more interesting if the studies could include more actors from different background.

The second limitation was related to the limited number of previous studies found on the particular subjects, leading to an unbalanced composition between the literature reviews and the interviews result in the discussion part. Due to the

confidential issue, the information related to product requirements were all gathered from the literature reviews. Up to date, no prior research has been found related to the packaging barrier properties and specific needs of shelf-life in E-commerce. In addition, it was also a challenge to find information about packaging variation for PBDA. Meanwhile, for the E-commerce packaging requirements, the information found in the literatures were general and not as practical as what have been gathered through interviews at Tetra Pak. For this part, the literature reviews mostly cover the quantitative data of the market shares and the growth trend of E-commerce as well as the qualitative data of the regional policies on sustainability and the packaging assessment method at a particular E-commerce. Nevertheless, the practical and comprehensive packaging requirements in E-commerce were mainly analysed from the interviews results. This imbalance proposition might be also due to the limited time to complete the project, in which there was no much time left to look upon more literatures after the analysis of the interviews results.

The third limitation is the broad scope of the research in such limited amount of time. The results and discussions might be sufficient to answer the research questions, nevertheless there is still room to dive deeper and get into more specific results. Taking into account this limitation, this study is considered as the first step to identify the packaging requirements in E-commerce. The basic points that have been identified in this study could be a direction for the future studies and research. For the next stage, it is highly recommended to narrow down the scope and divide the studies into several projects. By doing so, the researcher could expand the subjects and objects of the studies, gathering insights from more actors with different backgrounds. The employment of more literature reviews could also be helpful to capture different points of views.

6.4 Contribution to UN SDG

E-commerce has grown fast in the past decade. Compared to the traditional in-store shopping, E-commerce produces 70-85% more CO_2 emission (Escursell, et.al., 2020). This is mainly due to the extra packaging use and the last-mile delivery service. Aware of the adverse environmental impacts of the business practices, many E-commerce players, including the big three, Amazon, Alibaba, and Walmart, have set their sustainability goals, comprising some aspects, such as optimising the packaging material use, utilising more recyclable and/or biodegradable packaging materials, and increasing the materials recycling rate.

Collaborating with one of the biggest global packaging suppliers, Tetra Pak, this thesis project is expected to give insights about the packaging requirements in E-commerce, as well as to identify both challenges and opportunities for packaging innovation. With regard to sustainability, some potential solutions include; 1) replacement of aluminium foil with more environmentally-friendly materials; 2)

modification in the primary and the secondary packaging as well as the grouping strategy which optimise the protection feature, while minimising unpacking, repacking, and/or overboxing; 3) removal of unnecessary promotional attributes from E-commerce packaging, as the purchase decision is found to be more impacted by digital promotion and previous consumers ratings/reviews.

Nevertheless, as different countries and E-commerce players adopt different concern towards sustainability, one solution might not fit for all. Creating a right packaging solution for E-commerce might be both a challenge and an opportunity for packaging suppliers, including Tetra Pak. A success to unlock this challenge will contribute to the 12th UN SDG, Responsible Consumption and Production.

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Appendix A Interview Guides

A1. Interview Guides for Tetra Pak's Employees

1. How do you see the difference between offline and online channels? And what are the impacts to the packaging requirements?
2. How do you see the current packaging portfolio of Tetra Pak for tackling the E-commerce requirements?
3. Related to the innovation direction:
   - How do you see the options between innovating the primary and the secondary packages?
   - How do you see the demand of individual packs and group packs in E-commerce?
   - How do you see the demand of ambient and chilled products in E-commerce?
   - Do you see any difference of lead time between offline and online channels?
     - What is your opinion if there is an idea of having a shorter shelf-life product in the online channels by implementing different barrier properties in the package?
4. How do you see the packaging requirements in the pure players and in the E-grocers or multi/omnichannel players?
5. How do you see an idea of having different packaging in online and offline channels? What are the challenges and the opportunities?
6. Is there any final recommendation for this project? How do you expect this project to contribute to the current on-going E-commerce packaging development?
7. *[Questions related to the projects presented by the interviewees]*

A2. Interview Guides for E-Commerce and E-grocers

1. Can you share your supply chain map?
   a. How is the mechanism of your order fulfilment?
   b. How do you forecast the demand? And how do you manage the inventory control?
2. What are the criteria of food and beverages that could be sold in your platform? (e.g. shelf-life, storage condition, etc.)
3. How do you pack your products?

a. Are there any specific requirements both for primary and secondary packaging?
b. Is there any repacking process? If any, why? And could you share the repacking process?

4. What are the challenges of selling food and beverage products in the online channels? How do you manage them?
   a. General challenges
   b. Specific challenges for ready-to-drink (RTD) products
5. In your opinion, how beverage packaging could better support the E-commerce business models?

A3. Interview Guides for The Producer with Internal E-commerce Platform

1. What motivated you to choose online channels for selling your products? What are the benefits of selling products in the online channels?
2. What types of products do you sell in the online channels?
   a. Are there any specific criteria applied?
   b. Could you share what are the differences between the products that are sold online and offline?
3. Can you share the supply chain of your online channels?
   a. Can you share the mechanism of your order fulfilment?
   b. How do you forecast the demand? And how do you manage the inventory control?
4. Do you see any difference of lead time between offline and online channels?
5. How do you pack your products?
   a. Do you use different packaging with the ones that are sold in the offline channels? If yes, is there any specific packaging criteria for fulfilling the order from the online channels?
   b. Is there any repacking process? If any, could you share the process of repacking?
6. What are the challenges of selling products in the online channels?
   a. General challenges
   b. Specific challenges for ready-to-drink (RTD) products
7. How do you see the opportunity to have different packaging in the online and the offline channels?
8. How do you foresee the online market potency?