



**IDENTIFYING SUSTAINABLE SUPPLY CHAIN RISKS AND RISK MANAGEMENT PRACTICES FOR RECYCLED PLASTICS: A CASE STUDY FOR UPMRA-FLATAC**

Lappeenranta–Lahti University of Technology LUT

Bachelor's Programme in Supply Management, Bachelor's thesis

2022

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Examiner: Junior researcher Iryna Maliatsina

## ABSTRACT

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### **Identifying sustainable supply chain risks and risk management practices for recycled plastics: A case study for UPM Raflatac**

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44 pages, 4 figures, 4 tables and 5 appendices

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Keywords: recycled plastics, risk management, sustainable supply chain management

The use of plastic on a global scale creates huge problems, although the negative effects of plastic are widely known. Companies that specialize in the plastics business and want to implement sustainable supply chain management need to start changing their practices regarding the social and environmental problems of plastics. Many solutions are available, but these require new business methods. The use of recycled plastics as a raw material instead of virgin plastic is one example of a sustainable solution. However, the implementation of new methods requires risk identifying and risk management methods.

In this bachelor's thesis, the risks related to recycled plastics were studied and risk management practices were developed. The emphasis was especially on risks with sustainability issues. This bachelor's thesis is a case study for UPM Raflatac, which manufactures labelling materials. Four (4) experts from the sustainability and labelling fields were interviewed for the study. Two of them work for UPM Raflatac itself, and two for UPM Raflatac's suppliers.

The results of the study reveal that there were 26 risks, and 24 practices were developed for risk management. Risks were sorted into sustainability risks, internal risks, and external risks. Risk management practices were developed for UPM Raflatac using Fan & Stevenson's (2018, 214-217) study, which implemented these 24 practices step by step. The research can be considered reliable and provides a good basis for future research, which also wants to examine the risks and risk management practices related to recycled plastics.

## TIIVISTELMÄ

Lappeenrannan–Lahden teknillinen yliopisto LUT

LUT-kauppakorkeakoulu

Kauppätieteet

Anni Haarakangas

### **Kestävän toimitusketjun riskien ja riskienhallinnan käytäntöjen tunnistaminen kierrätysmuoveille: Case-tutkimus UPM Raflatacille**

Kauppätieteiden kandidaatintyö

44 sivua, 4 kuvaa, 4 taulukkoa ja 5 liitettä

Tarkastaja: Nuorempi tutkija Iryna Maliatsina

Avainsanat: kierrätysmuovit, riskien hallinnointi, kestävän hankintaketjun hallinta

Muovin käyttö globaalilla tasolla aiheuttaa valtavia ongelmia, vaikka muovin negatiiviset vaikutukset ovat laajasti tiedossa. Yrityksien, jotka ovat erikoistuneet muovibisnekseen, ja haluavat toteuttaa kestävästä hankintatoimea, pitää alkaa muuttamaan toimintatapojansa liittyen muovien sosiaalisiin sekä ympäristöllisiin ongelmiin. Monia ratkaisuja on tarjolla, mutta nämä vaativat uusia liiketoimintamenetelmiä. Kierrätysmuovien käyttö raaka-aineena neitseellisen muovin sijaan on yksi esimerkki kestävästä ratkaisusta. Uusien menetelmien implementoiminen vaatii kuitenkin riskien arviointi- ja hallinnointimenetelmiä.

Tässä kandidaatin tutkielmassa tutkittiin riskejä liittyen kierrätysmuoveihin sekä muodostettiin riskien hallinnointikäytännöt. Painoarvo oli etenkin kestävyysliittävissä ongelmissa ja riskeissä. Tämä kandidaatin tutkielma on case-tutkimus UPM Raflatacille, joka valmistaa tarralaminaatteja. Työtä varten haastateltiin neljää (4) asiantuntijaa kestävyys- sekä tarralaminaattialoilta. Kaksi heistä työskentelee itse UPM Raflatacilla, ja kaksi toimittajayrityksissä.

Tutkimuksen tulokset paljastavat, että riskejä oli 26 kappaletta ja riskien hallinnointiin muodostettiin 24 käytäntöä. Riskit lajiteltiin kestävyysriskeihin, sisäisiin riskeihin ja ulkoisiin riskeihin. UPM Raflatacille kehitettiin riskien hallinnoinnin käytännöt, joiden muodostamiseen käytettiin apuna Fan & Stevensonin (2018, 214–217) tutkimusta, johon implementoitiin nämä 24 käytäntöä vaihe vaiheelta. Tutkimusta voidaan pitää luotettavana, ja se antaa hyvän pohjan tuleville tutkimuksille, joissa halutaan myös tutkia kierrätysmuoveihin liittyviä riskejä ja riskien hallintakäytäntöjä.

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# 1 Introduction

The use of plastics is increasing, though the negative impacts of plastics are known. Still almost 380 million tons of plastic are produced worldwide every year and only 9% of all plastic ever made has been recycled (Latham 2021). Plastic takes many years to break up. For example, plastic bottles take up to 450 years to decompose. (WWF 2021) Plastic causes fierce environmental pollution and still at least 10 million tons of plastic is dumped to oceans every year (Plastic Oceans International 2021). Firms need to focus more on their responsibilities in environmental issues, as they may otherwise threaten their existence in the future. Therefore, it is profitable for firms to move towards environmental management approach. Many firms have started to use more sustainable production methods, such as upgrading technology and using recycled raw materials. (Radonjić & Tominc 2007, 1-2) Implementation of more sustainable methods thus require risk management practices. The goal of this thesis is to discuss about the sustainability risks of recycled plastics in the supply chain – more precisely in UPM Raflatac’s supply chain.

## 1.1 Background and topic

UPM Kymmene Oyj has six different businesses: UPM Biorefining, UPM Energy, UPM Raflatac, UPM Specialty Papers, UPM Communication Papers and UPM Plywood (UPM 2020a, 40). This thesis focuses only in UPM Raflatac, which produces labelling materials for mostly packaging products. (UPM 2021a)

Since this thesis is a case study for UPM Raflatac the sustainability risks of recycled plastics will only be identified from UPM Raflatac’s point of view. UPM has named various targets for 2030. Some of the targets are for instance 100% coverage of participation to UPM Code of Conduct training and continuous supplier auditing based on systematic risk assessment practices. (UPM 2020a, 21) UPM Raflatac participates in The New Plastic Economy

initiative led by The EllenMacArthur Foundation. UPM Raflatac's related commitments include enabling their customers' plastic packaging to be fully re-usable, recyclable, or compostable by 2025. (UPM 2021b)

Because of UPM Raflatac's commitments, it is necessary to identify the practices for risk identification. Risk recognition for recycled plastics is important because of the uncertainty in the future. In a supply chain, almost everything is very closely connected, so even the smallest risks and incidents have a very big effect in the whole supply chain. Identifying the risks in the early stages of supply chain is profitable and can save from many internal and external damages. (Fajar & Ardi 2021, 4)

The author of this thesis has as well worked in sourcing-related tasks at UPM Raflatac. Therefore, practices of the company's risk and supply chain management are more or less known. The author has used her own experience and knowledge from the company. This has helped to create more informative research. Also, author's personal interest towards sustainability practices in this specific area has affected the choice of this topic. The topic was considered together with the author and few employees from UPM Raflatac to match author's interest and to benefit company's risk and supply chain management practices.

## 1.2 Objectives and research questions

This thesis observes risks from sustainability's point of view in a supply chain management. The objective for this thesis is to identify the risks of recycled plastics in a supply chain and recognize the risk management practices. The thesis will consider other than sustainability risks too, but the main perspective is to discover the sustainability risks and practices for company's management. The research and objectives are defined from UPM Raflatac's point of view. Theories, tools, and methods are used to reach the goal of identifying the risks. Also, interviews conducted in this study are an essential part when forming the results. The research question and sub-question will be:



*Q1: What are the risks linked to recycled plastics?*

*Q2: What are the practices of recycled plastics risk identification, risk assessment, risk treatment, and risk monitoring?*

The main objective is to identify the risks of recycled plastics in UPM Raflatac's supply chain management. The sub-question defines the practices for risk management. The final answers are based on the theoretical framework and interviews. The results will be presented in the section 4.

### 1.3 Research structure

This research consists of six sections: introduction, theoretical framework, methodology, results, and conclusion. Introduction steers the reader into the thesis and gives a picture about the researched case. Introduction consists of the topic and background, objectives and the research questions, theoretical framework, and limitations and lastly research methods. Theoretical framework introduces the literature which has been used in this research to reach the wanted objectives. Theoretical framework gives a comprehensive picture about sustainable supply chain management (SSCM) and supply chain risk management. After this, the methodology and key findings will be discussed. The research will analyze the sustainability risks in recycled plastics at UPM Raflatac's supply chain and form practices for risk management in recycled plastics. Lastly, research's reliability will be analyzed, and further future research are being considered.

### 1.4 Theoretical framework and limitations

The key concepts of theoretical framework will be shortly explained in this chapter. This helps the reader to understand the concepts better during the literature review, as this thesis may hold some complex themes. The key concepts will be explained more in the second section.

**Recycled plastics:** Recycled plastics are a form of a secondary raw material, which have been processed with different processes after its use. Recycled plastics can be divided into two categories: mechanically or chemically recycled plastics. In the mechanical process, the plastics are processed into secondary raw materials. In mechanical recycling the chemical structure does not change. In chemical recycling plastics are decomposed back to monomers. Chemical recycling is considered as a heavy industry and is also more expensive and challenging than mechanical recycling. (PlasticsEurope 2021a) When referring to recycled plastics in this research, it stands for secondary raw materials or feedstocks of recycled plastics which have been handled with either mechanical or chemical recycling process and are either post-industrial (PI) or post-consumer (PC) waste.

**Sustainable supply chain management: Supply chain (SC)** is a flow of materials and products throughout a chain, where usually three or more entities take part of. There are several independent companies participating that chain in various points. Different organizations are involving to the process through upstream and downstream. Upstream means all the production and activities before making the actual product and downstream means the process after the product has been manufactured. (Quain 2019) A supply chain can consist of multiple functions, such as raw material sourcing, assembling, transportation, finance, and customer service. There can be less or more entities taking part to the supply chain. The main idea of a supply chain is to create customer satisfaction. (Chopra 2018, 15-17) An example of a simple supply chain can be seen on a figure 1 below. **A supply chain management (SCM)** is a cooperation and agreement between three or more companies, where each function performs from the ultimate supplier to the ultimate customer (Mentzer, DeWitt, Keebler, Min, Nix, Smith & Zacharia 2001, 2-5). **Sustainable supply chain management (SSCM)** is implementing organization's long-term sustainable and responsible values and goals into organization's supply chain management. In SSCM organizations have internal and external processes linked to sustainability. SSCM involves stakeholder engaging and transparency in the economic performance. (Touboulic & Walker 2015, 16-18)



Figure 1: An example of a supply chain. (Jespersen & Skjott-Larsen 2005, 11-15)

**Supply chain risk management:** Risks in supply chain management mostly appear from man-made problems or natural disasters. Especially if the company has outsourced many of its operations, for example transportation and raw material sourcing, the supply chain risks are valid. Supply chain risk management aims to reduce the consequences of risks to acceptable level with certain practices. (Fan & Stevenson 2018, 204-205)

This research is limited for UPM Raflatac only. Therefore, the sustainable risk management of recycled plastics is only observed from UPM Raflatac's point of view. The results consider only UPM Raflatac's risk management practices towards recycled plastics. The results also consider only one particular industry and company, which should be noted when observing the results.

## 1.5 Research methodology

The research for this thesis has been done by using qualitative research methods. Qualitative research method gives a holistic view of the researched objective. Qualitative research method is also more flexible than quantitative and gives more information about the social reality. This method is ideal for the thesis and its objectives, since the research question will be observed from UPM Raflatac's point of view. The purpose is to use scientific theories and concepts along the research. This thesis is a case study where the purpose is to understand the topic from a deeper view. Case study is also a start for real action. (Metsämuuronen 2008, 16-17)

The method for collecting data is to hold interviews for employees in UPM Raflatac and for their suppliers. Interviews will be semi-structured, which means that the questions and order will be almost the same for all. UPM Raflatac's and supplier's questions vary slightly. The reason for that is because the interviews are held for different companies, therefore they'll also have different knowledge of diverse areas. The questions are still very alike, which helps with comparing and analyzing the answers with each other later. In semi-structured interviews, the interviewees can answer the questions with one's own words. (Eskola & Suoranta 1998) In semi-structured interview the interviews can give information which was not noticed when planning the research questions (Puusa & Juuti 2020, 111). The goal is to do individual interviews for employees and suppliers especially from film label and sustainability area. Since the interviews are done only for a few people, the results cannot be generalized (Alasuutari 2011). The plan is to interview two employers from UPM and two suppliers. The interviews are very important considering the research, since a lot of crucial information is shared via the interviews. The interviews contain information about UPM Raflatac's and their supplier's supply chain and risk management, products where recycled plastics are used and responsibility related targets.

## 2 Theoretical framework

This part of the thesis discusses about the key concepts which were mentioned in the chapter 1.3. Theoretical framework main focuses are sustainable supply chain management and risk management. There will be also discussion about recycled plastics, as they are one of the main concerns in this thesis. Sustainability is a relevant part of this thesis; therefore, it has been seen important to define that topic before determining sustainable supply chain management. Theoretical framework is illustrated in the figure 2 below.

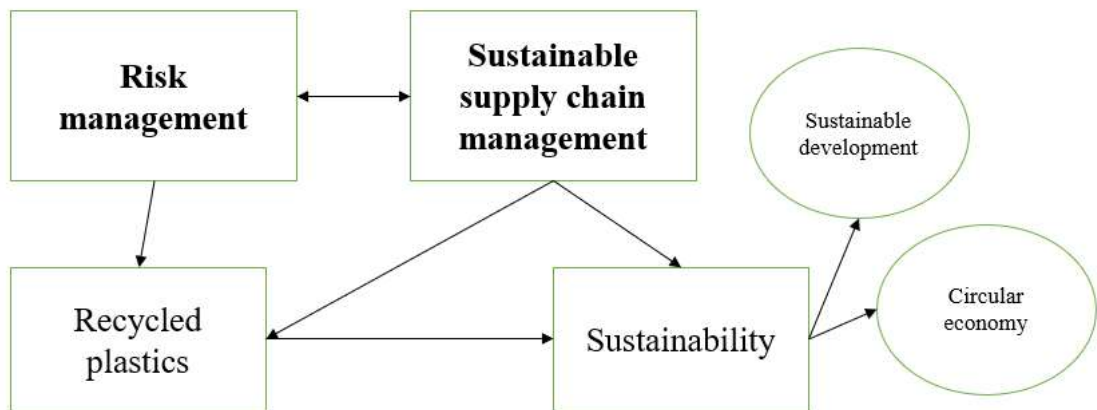


Figure 2: Theoretical framework.

### 2.1 Sustainability

The concept “sustainability” is very vast, and many firms define sustainability differently. Term of sustainability, in German “*Nachhaltigkeit*”, was first brought up already in 1713. This idea was fabricated from the worry of excessive harvesting. (Kuhlman & Farrington 2010, 3437) The idea of sustainability in modern times emerged when sustainable development was defined in Brundtland’s Commission in 1987 (Howarth 1997, 445). In literature, sustainability does not have standardized definition, and it may have various explanations in different sources (Moore, Mascarenhas, Bain & Straus 2017, 1-2).

Ben-Eli defined sustainability as such:

*“A dynamic equilibrium in the process of interaction between a population and the carrying capacity of its environment such that the population develops to express its full potential without producing irreversible adverse effects on the carrying capacity of the environment upon which it depends” (2018, 1339-1340).*

Sustainability is a wanted ecological condition, but it is also demanded for long-term capital investment (Allen & Hoekstra 1993, 98). Many researchers have pointed out balance, long-term and well-being when defining sustainability. Sustainability can be defined as a state where natural and man-made resources remain at least constant for the future while well-being does not decrease. (Kuhlman & Farrington 2010, 3436, 3442) Schramade (2017, 88) has pictured sustainability in the context of a firm as:

*“Sustainability is about creating and investing in a corporate capacity for systems change and holistic thinking, not just box-ticking.”*

Sustainability can thus mean different aspects for firms and investors. In addition to sustainability a firm still needs to maintain its financial continuity. Ortiz-de-Mandojana’s and Bansal’s study (2016, 1627-1631) finds that firms which perform social and environmental practices have higher rates of survival in long-term and attract more customers than firms which don’t perform social and environmental practices.

### 2.1.1 Sustainable development

In 1987 Gro Harlem Brundtland in *Our Common Future* -report (1987, 41) defined sustainable development as such:

*“Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”*

The purpose of sustainable development is to have the opportunity for all to meet their basic needs and have opportunities for better life. It also notes the use of natural sources, securing the ecosystems, energy efficiency and its use and economic growth. (United Nations General Assembly 1987, 41-44) Sustainable development and the use of its key concepts may help

firms to expand their view of needed actions and enhance commitment. SDG's give perspective of the goals which firms tends to perceive. (Zimon, Tyan & Sroufe 2020, 220-221, 232)

In 2015 the United Nations adopted 17 universal Sustainable Development Goals (SDG's) in order to advance better living and protection of the planet by 2030. Various countries have committed to the SDG's to end poverty, fight against climate change and preserving the earth's nature. Each goal has its own purpose. The 17 SDG's are listed below. (United Nations 2021)

Table 1: The 17 SDG's (United Nations 2021).

1. No poverty	10. Reduced inequalities
2. Zero Hunger	11. Sustainable cities and communities
3. Good health and well-being	12. Responsible consumption and production
4. Quality education	13. Climate action
5. Gender equality	14. Life below water
6. Clean water and sanitation	15. Life on land
7. Affordable and clean energy	16. Peace, justice and strong institutions
8. Decent work and economic growth	17. Partnerships for the goals
9. Industry, innovation and infrastructure	

Corporations are responsible for committing to the SDG's, especially for those goals where corporations have the biggest impact (such as goals 7, 9, 12). Usually, corporations are the main actors behind these issues, and hold the possibility to influence these goals. Many companies have already implemented some of the SDG's to their action plans and annual reports. If a company is about to implement some of the SDG's to its strategy, it should choose which specific one(s) they are about to engage to. It is also recommendable to use certain targets or Key Performance Indicators (KPI's) to follow company's progress. UPM Raflatac has implemented SDG's to its strategy. For instance, it has contributed to the goal 12. (UPM Raflatac 2022)

SDG's can also be seen as financial investments. When investing into companies' which have implemented SDG's in their strategy, investors are returning to society and corporations where the desired goal is to channel funds towards productive investments. Companies which have SDG's as a part of their strategy will probably have better expectations for the future as they may have already done actions for more sustainable and responsible action plans. Regulations and tax payments considering for example fossil fuels, carbon and water will most likely tighten in the future. Therefore, companies which have adapted to SDG's will probably have it easier adapting to changes and less risks. Companies which are engaged to sustainable solutions are usually seen as innovative and modern, which will more likely attract talented employees. Also, use of SDG's may answer to the needs of stakeholders, as many people are worried about injustice and climate change. (Schramade 2017, 87-95)

### 2.1.2 Circular economy

In a circular economy the value of the materials and products is maintained as long as possible (Stahel 2016, 435-436). Circular economy is heavily linked to supply chain management since the focus is to use sources and raw materials in a society's cycle as long as they have value. For example, recycling plastics and using them as raw materials again is part of circular economy. Circular economy is not only reusing and recycling, but it is also repairing, maintenance, modern and more innovative design, and less strenuous and consuming options for the globe. The idea is to lead our society towards more sustainable and responsible use of resources. The goal is to reduce the negative effects of consumption and production and to mitigate the environmental impacts of such (Del Río, Kiefer, Carillo-Hermosilla & Tönnölä 2021, 10).

Circular economy business model's goal is to create value. Sustainable business model creates value for stakeholders, for the company itself and its customers. Collaboration between networks to achieve the greatest value is mandatory in circular economy business models. (Lüdeke-Freund, Gold & Bocken 2019, 36-37, 40-41) Companies may have different perspectives when defining circular economy and business models linked to it. For instance, UPM recycles and reuses materials and products efficiently. The goal is to reduce waste and



create innovative solutions. (UPM 2020b) For instance Rafecycle, which is a recycling solution for liner waste. The liner waste is collected, picked-up, and then the waste is produced to new label materials, paper, PET products, or other circular products. (UPM Raflatac 2022a)

Also, firms and organizations must implement circular economy into their actions. In 2020, the EU introduced a new circular economy action plan (CEAP) in order to reach the 2050 climate neutrality target. The EU has noted the rising use of plastic and proposed compulsory requirements for recycled content and the reduction of waste measures. The European Commission suggested many regulations for plastics and especially for plastic packaging materials, such as setting targets for packaging waste. (COM/2020/98) Hence, due to upcoming regulations and legislations, organizations need to change their direction to towards more circular economy orientated strategy.

## 2.2 Recycled plastics

The production of plastics starts with oil, gas or plants and is then continued into ethane or propane. Ethane and propane are then processed in high heat, in whereas they turn into monomers. After this the monomers are mingled together in a catalyst which gives a polymer fluffiness. Then the polymer is melted, cooled, and lastly cut into small resins. The pieces will be sent to a customer where the polymer is melted again into its wanted form. Plastic contains of polymer, which is made of a smaller molecules, monomers. The manufacturing process may vary depending on the type of plastic. (Plastic Industry Association 2021)

Mechanical recycling includes collection, sorting, washing, and grinding. Mechanical recycling has its challenges, as there's a large variety of different plastic types. The quality of the new material can be weaker if different plastic types have been mixed together during the mechanical processing. Also, the quality of plastic usually may degrade in result of conditions during the mechanical process. In chemical recycling the plastics are restored back to either monomers or feedstocks. Chemical recycling is considered as heavy industry and

is therefore quite expensive and challenging. Chemically recycled plastics are a great option for food packaging for example, since the quality does not decrease as it does in the mechanical recycling. (Ragaert, Delva & Van Geem 2017, 27, 29-32, 41)

The waste which occurs from plastic industry is called either post-industrial waste (PI) or post-consumer waste (PC). Post-industrial waste comes during the manufacturing phase and post-consumer waste happens when the product is disposed and comes to its end-of-life. (Ragaert et al. 2017, 25) Recycling itself can be divided into closed-loop or open-loop recycling. In closed-loop recycling the disposed material is quickly connected back to the production cycle and the material can be used again without any flaws in the quality. For example, mechanical recycling is mostly closed-loop recycling. Closed-loop recycling is mainly used in post-industrial waste, as the quality does not decrease. (Ignatyev, Thielemans & Vander Beke 2014, 1581) In open-loop recycling the original plastic is used for different product or material as it was before. (Ragaert et al. 2017, 29)

The use of recycled plastics as a secondary raw material can be difficult for many reasons, though it supports circular economy. As already discussed in previous chapters, recycled plastics may suffer some quality decreases during the recycling process. This will influence to the use of a plastic since low-quality plastic can't be used for all purposes. Also, the availability of recycled plastics is quite low from time to time. (Huysman, De Schaepmeester, Ragaert, Dewulf & De Meester 2017, 47) Recycled plastic as a secondary raw material may also be expensive, so the danger is that supply and demand do not meet each other (Shen, Worrell & Patel 2010, 45).

### 2.3 Sustainable supply chain management

Theories in sustainable supply chain management have started in 1996 and increased bit by bit. In 2013 there were 60 different theories written about sustainable supply chain management. (Touboulis & Walker 2015, 17) The definition of a “perfect” sustainable supply chain management (SSCM) is organization's practice or strategy when making a profit in a long-

term period while not harming any natural or social systems. SSCM can also be defined as green supply chain management and responsible supply chain management. The performance of a supply chain should be measured by the chain's impacts on ecological and social systems, not only on profits. SSCM is extending the basic idea of a supply chain management and implementing the dimensions of the triple-bottom-line (TBL), where environmental, social, and economic perspectives are noted. TBL helps to recognize the needed activities for a better performance. (Meixell & Luoma 2015, 70) The purpose of TBL is to use business for good and have a comprehensive picture of all these three dimensions in organization's functions. Organizations should not only focus on the profits but also their impacts on social and environmental matters. (University of Wisconsin 2021)

As "perfect" SSCM does not exist, sustainable supply chain management requires innovative thinking and solutions from the organization which practices or aims for SSCM. Organizations need to be committed and implement the operations of SSCM to organization's strategy. SSCM needs to be part of the economic goals and not diminish the desirable profits to have engaged stakeholders and employees. Organization also needs to have day-to-day conversations about the concerns of social and environmental issues. Cooperation with suppliers and partners is important, as nowadays the different functions of supply chains are closely connected. Long-term suppliers are considered as important factors in SSCM and the buyer organization can help suppliers to have more sustainable supply chain management and encourage them for more responsible solutions. Transparency of the supply chain ensures trust into organization's operations from customer's and stakeholder's side. For example, organization can use certifications or standards to confirm chain's transparency and traceability. (Pagell & Wu 2009, 38-39, 51-53)

Especially companies which have implemented sustainability and responsibility themes into their company's strategy need to have suppliers which also support innovative and sustainable supply chain management solutions. Sustainability is important as studies have shown that sustainability plays a vital role in organization's long term supply chain management. Also, it is a no-brainer that customer's opinions matters when it comes to company's economical performance. As customers are more aware of environmental and social issues,

companies need to be aware of the environmental and social risks as they can lead to huge costs in corporate image and customer satisfaction. (Dai & Blackhurst 2012, 5474-5476)

### 2.3.1 Transparency and traceability in SSCM

Transparency is information which is easily available for suppliers, customers, and other entities in a supply chain. Transparency is a very important part of a sustainable supply chain management, as lack of information can cause problems in organization's credibility. One product can go through multiple entities during a supply chain, such as manufacturers, transporters, assemblers, storage facilities and retailers until it reaches its end-customer. Hence, it is necessary to ensure the transparency of the supply chain if concerns about product's origin, sustainability information, and processes appear. SSCM transparency requires cooperation from all entities participating to the supply chain network. (Bai & Sarkis 2020, 2145-2146)

Traceability is fundamental part of a sustainable supply chain management. Traceability means that a raw material's life cycle is traceable. For example, when it comes to a product which has been produced from recycled plastics, the life cycle of all or some of the feedstocks used in the product are traceable. Traceability does not only contain information about feedstock's properties but also information about feedstock's owner in various phases of a supply chain, data about sustainability and legality, and processing conditions. Record keeping is important part of traceability. (Olsen & Borit 2013, 142, 145, 147-149)

Chain-of-custody certification is an essential part of a transparent supply chain. Certification is usually voluntary instrument which is offered by a third-party partner. Certification offers classified and verified proof of sustainable and responsible actions along the supply chain. In chain-of-custody (CoC) traceability system the whole supply chain is certified. This means that each entity which has been handling the product or its feedstocks needs to have a valid certification so the end-product will be CoC -certified. If even one entity in the supply chain lacks a certification, the end-product is no longer CoC -certified. There are various

certification possibilities. For instance, recycled raw materials usually need certification and sustainably grown forest sector products. Mass-balance approach allows to mix certified and non-certified raw materials together. (Hinkes & Peter 2020, 1164-1165) This means that certified end-product may also consist of non-certified raw materials (Mol & Oosterveer 2015, 12263). Mass-balance approach may increase performance and remove cost-barriers in recycled plastics business. It encourages supply chains to use more sustainable technologies, which would have been more economically unprofitable before. (Beers, Schumacher, Migler, Morris & Kneifel 2022, 4-5)

One example of standardization is ISO standard, which is independent, international, and non-governmental organization. ISO standards are quality management standards for organizations to use. (ISO 2021) Most common ISO standards used in SSCM are 9001 and 14000. ISO 9001:2015 is used for quality management, which aims for effective systems, improvement processes, and customer satisfaction (ISO 9001:2015). ISO 14001 is about environmental management systems. ISO 14001:2015 standard is for forwarding environmental performance, environmental responsibilities, providing value for environment and for the organization. (ISO 14001:2015)

### 2.3.2 Stakeholder relations in SSCM

Stakeholder may be an individual or a group of people who can influence and be influenced by an organization. Stakeholder or stakeholders can be shareholders, employees, government, media, suppliers, customers, and distributors. Stakeholders' role is important in SSCM, as they create pressure for sustainable and environmental practices and help organizations to implement these practices into actions. Stakeholders are usually the voice of a public opinion and have a powerful influence of public's desires. Stakeholders pressure forwards awareness of sustainability in a supply chain. This can arise from customer's demands for more sustainable and responsible actions in an organization. Also, government can draw attention to sustainability issues and media has a big influence on people's purchasing decisions. The next step from awareness is sustainability adoption in a supply chain. This means

that the organization adopts some sustainability goals into their strategy. The last step is implementation of a sustainability practice. (Meixell & Luoma 2015, 69, 71-73, 75-79)

### 2.3.3 Ethical business behavior

SSCM does not only require actions from supplier's side, but also from the focal company's side. It is important to implement ethical business behavior practices to company's strategy. Ethical business behavior starts from company's own organizational culture, which will create the foundation pillars for the ethical business behavior. Ethical business behavior has formal structures, standards, and processes, which are usually implemented to some practices inside the organization. For instance, UPM has its own code of conduct for suppliers and for the employees. Code of conduct usually consists of the organization's own ethical rules related to business and management of the employees. It requires the stakeholders, suppliers, and employees to behave in terms of the standards defined by the focal organization. The characteristics of ethical business behavior should be long-time perspective, effective actions by the leaders, balance between the stakeholders, have a clear vision of values and missions, and unity of internal and external processes. (Ardichvili, Mitchell & Jondle 2008, 445-446, 448-449)

## 2.4 Risk management

Economic systems and networks are more global than ever before. One product may have gone through various processes in different countries before it reaches its end-customer. Globalization, increased outsourcing, and complexity of modern supply chains have brought up risks, and all functions are predisposed to uncertainty. Therefore, risk management is needed especially in SSCM, where lies many risks regarding availability, transparency, and price premium. Risks also occur from natural disasters, such as hurricanes or flooding. Human activity causes risks as well, for example global finance crises and terrorism.

This section focuses on risk management in supply chain management and business functions. Risk management is activity to prevent losing business value. In a supply chain the risks are connected to the goals which need to be accomplished within the supply chain network. Supply risk is considered as a triggering event, which means that most of the risks occurring in the chain are understood as events of series. Supply chain resilience measures how well the supply chain can cope with vulnerability, ergo how well the supply chain can respond to damages or maintain activity during stressful situations. Supply chain resilience is important context when managing supply chain risks. It tells the ability to overcome or minimize supply chain risks. (Heckmann, Comes & Nickel 2015, 119-120, 122-126)

Operational risks in a supply chain are caused by unsuccessful events or an event which has been triggered by a supply chain's systems, people and/or processes. Operational risks may arise in a flow of upstream and downstream and all which is connected to a supply chain network. One misfortunate event can cause fierce harm to the whole supply chain network, where the main goal for all is to create customer satisfaction. Internal risks are unsuccessful occurrences happening in a focal company which may lead to troubles in a supply chain. Internal risks may be for instance miscommunication, lack of information, problems at manufacturing or transportation between two parties. External risks are events which are caused by a factor outside the supply chain. External risks are more difficult to manage, as company's operational management may not be able to affect the origin factor. Therefore, company's management should build supply chain resilience.

In addition to operational risks, disruptional risks are always unexpected and challenging to handle once they happen. Disruptional risks are not predictable and are caused by human-made or natural disasters. For instance, severe flooding or terrorist attacks are disruptional risks. (Salamai, Hussain, Saberi, Chang & Hussain F. 2019, 49297-49298) In research performed by Shafiq, Johnson, Klassen & Awaysheh (2017, 1389), a sustainability risk has been defined as:

*“The potential occurrence of an incident associated with social and/or environmental shortcoming or failure by a supplier.”*

Sustainability risk can be connected to operational risk, since both can be foreseeable and prevented with correct business management practices (Salamai et al. 2019, 49297). Sustainability risks mostly occur during the upstream processes. Sustainability risks can be categorized to (i) social issues, (ii) ecological issues, and (iii) ethical business conduct issues. Social issues usually relate to working conditions, such as use of child labor or decent pay. Secondly, ecological issues consist of matters related to environment and nature – such as emissions, recycling, the use of clean water, toxins, and fossil-based fuels. Lastly, ethical business conduct issues can be for instance corruption, fraud cases, or cooperation with questionable organizations. (Hoffmann, Busse, Bode & Henke 2014, 166-168)

All in all, Fan & Stevenson (2018, 210) have defined supply chain risk management as such:

*“The identification, assessment, treatment, and monitoring of supply chain risks, with the aid of the internal implementation of tools, techniques and strategies and of external coordination and collaboration with supply chain members so as to reduce vulnerability and ensure continuity coupled with profitability, leading to competitive advantage.”*

Supply chain risk management (SCRM) assures the control of vulnerability and the ability to minimize costs, but also makes sure the possibility for business continuity and profitability.

## 2.5 Risk management practices

This thesis will use Fan’s & Stevenson’s study (2018, 206, 208) about supply chain risk management (SCRM) risk identification, risk assessment, risk treatment, and risk monitoring. This practice also follows ISO 31000:2009 risk management approach. The updated approach, ISO 31000:2018, provides guidelines for risk-based decision making for any type of organization (ISO 31000:2018). The risk management practice is illustrated below in the figure 3.



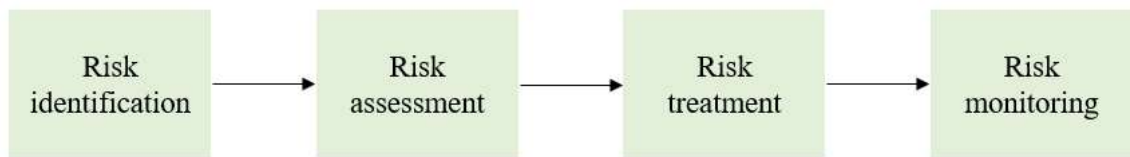


Figure 3: Supply chain risk management practice (Fan & Stevenson 2018, 206).

**Risk identification:** The first risk management practice is risk identification. Risk identification practices include identifying the possible risks. First, the possible risks need to be recognized and measured. Then the possible risks need to be managed and evaluated whether the risks are intrinsic. If possible risks appear, proper evaluation needs to take place.

**Risk assessment:** The second practice of risk management is risk assessment. Risk assessment can be done with qualitative or quantitative methods. Mostly the risk assessment is subjective, as every organization has its own way of doing the risk evaluations, which works best for the organization. Though, combining data and using own subjective risk evaluation methods leads to the most effective solution. The first factor of risk assessment practice is SCR prioritization, which stands for prioritizing the risks. It is unfortunate but organizations can't probably deal with all risks, since risk management requires big investments. Therefore, it is needed to prioritize the highest risks because risk assessment practices usually need to act immediately. As it was discussed before, supply risks are usually triggering events. SCR inter-relationship perspective means to identify the critical risks which may cause other risks, what can be called as a domino effect. Risks can be categorized to positive dependence or negative dependence. Removing a risk with a positive dependence can help to mitigate other risks and removing a negative dependence can create more risks. SCR assessment strategy is also one of the practices included in risk assessment. Mostly organizations have their own strategy or practice for assessing risks. These practices should consider immaterial losses and consequences of risks, organizations should also pay attention to other indicators outside manager's own experience and organization's performance, and lastly the causes of the risk sources should be examined. In the figure 3 is illustrated the risk assessment actions.

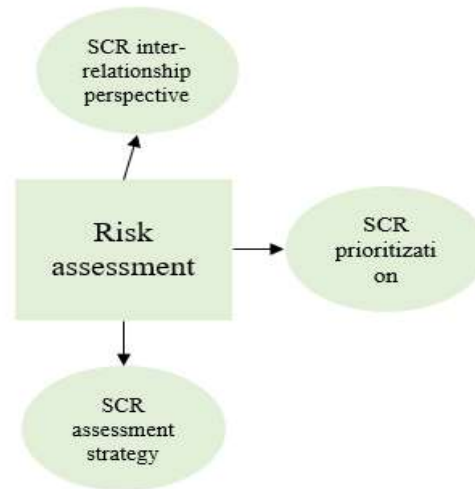


Figure 4: Risk assessment factors (Fan & Stevenson 2018,215).

**Risk treatment:** In risk treatment practice there are five risk treatment actions outlined. The first one, risk acceptance, means that depending on the context the best option for risk treatment may be to accept the risk. After the risk acceptance the risk should still be tracked and if consequences of the accepted risk start to escalate, then organization should start actions to minimize, transfer, share or avoid it. Risk avoidance action means that organization avoids situations or events which may put them into a risk. In other words, an organization is removing the source of a possible risk. For instance, avoid cooperating with questionable firms. Third action is risk transferring, where the risk is transferred to another party with different actions, such as with insurances. Risk transferring works better for disruptional risks than sustainability or operational risks, because disruptional risks have a lower probability to happen but higher influence. The fourth action, risk sharing, includes another party sharing some of the risks or all of them with a focal company. Risk sharing also works well with disruptional risks. The final action of risk treatment practice is risk mitigation. Mitigation activities suit best for operational and sustainability risks, as they have high probability but lower impact. Risk mitigation aspires to lower the risks into acceptable level. Organizations should examine first either risk acceptance, avoidance, transferring or sharing actions. As supply chain risks are triggering events, mitigating a risk may have positive or negative dependence to another risk source.

**Risk monitoring:** Risk monitoring, the last action of risk management practices, stands for on-going evaluating and monitoring of the risk sources. Important aspect of risk monitoring is to constantly have updated and reviewed information. Researchers have suggested to have management systems for risk monitoring, such as surveillance and early-warning management processes, and other tools to identify the risks. Mostly organizations use risk monitoring practices in their already existing management routines or for instance, using key performance indicators or other performance measurement systems. (Fan & Stevenson 2018, 214-217)

### 3 Methodology

This chapter will define the research methods, data and the process of data collecting. Methodology section creates a comprehensive picture of the conducted research, where other researchers receive a possibility to repeat the study. Methodology section explains why the certain methods have been chosen and why the research should proceed with the certain methods. (Paltridge & Starfield 2007, 114-119) The research method section explains how the data has been collected. (Darian-Smith & McCarty 2017, 130) As this thesis is a case study examining UPM Raflatac's sustainability risks in recycled plastics and creating holistic risk management practices, interviews are the most ideal way to carry out the data collecting. In other words, the research was conducted with qualitative methods. First, the research method is introduced and then the data is presented.

This thesis has been chosen to conduct as a case study with multiple data sources. A good case study is where the case has been studied deeply to give comprehensive perspective of the examined case (Creswell 2013, 98). In a case study where there are multiple data sources the researcher forms data from many sources, which are the interviews in this case. (Creswell 2013, 45, 99). As discussed, interviews were chosen as the research method. In addition, case studies are especially used in business-context studies (Bryman & Bell 2015, 71). This research is done in a business-context, which gives a picture about how the phenomenon works in real life. (Eriksson & Kovalainen 2008, 4-6, 38)

#### 3.1 Research method

The interviews were performed for four experts: two experts from UPM Raflatac, one expert from supplier company A and one expert from supplier company B. The experts will remain anonymous in this study as well as the two supplier companies, which will be called as supplier A and supplier B. Experts are illustrated in the table 3 below. Any other information about the experts will not be given in this research.

Table 2: Introducing the experts.

<b>Who</b>	<b>Field</b>	<b>Company</b>
Expert 1	Sustainability & responsibility	UPM Raflatac
Expert 2	Film business	UPM Raflatac
Expert 3	Film business	Supplier A
Expert 4	Film business	Supplier B

The interviews were held in October and November 2021. For expert 1 and 2 the interviews were held in Finnish, and for expert 3 and 4 the interviews were held in English. All interviews were held on Teams, which is a communication and cooperation platform. The interviews were semi-structured, where the author had formed the interview question beforehand. Semi-structured interviews are commonly used in business science (Koskinen, Alasuutari & Peltonen 2005, 105).

There were 13 questions in total for each expert. Koskinen et al. (2005, 109) suggested that functional interview frame has 5 to 12 questions. Thirteen questions were practical for this research method, as the author managed to gain enough valuable information. The questions can be observed from the appendix 1., which were held for experts 1 and 2, and appendix 2. which were held for experts 3 and 4. The questions were almost identical, expect the form of the questions varies little, since every expert holds differing knowledge of each field. The first question for UPM Raflatac was a bit different for suppliers A and B, where UPM Raflatac's questions 1. and 4. were combined to question 1. in appendix 2. Also, UPM Raflatac did not have the question "Can you tell the origin of your recycled plastics?". This was revealed in other parts of the interview during discussion with UPM Raflatac.

The experts were chosen because of their knowledge and background related to recycled plastics and sustainability fields. The interviews were mandatory considering the research since otherwise valuable information considering risks and practices related to recycled plastics and other important information regarding the supply chain of recycled plastics would not have been gained. The author knew experts 1-2 beforehand while working at UPM

Raflatac, and experts 3-4 were contacted via email and proposed for interviewing. By interviewing UPM Raflatac and its suppliers, a comprehensive approach towards the supply chain, risks and practices regarding recycled plastics was successfully achieved.

### 3.2 The data

The research question and the sub-question will be answered based on theory and qualitative research. The qualitative research was conducted as a case study with multiple data sources, where the data was collected with interviews. The interviews were recorded in Teams, so the author had the change to repeat the interviews and the collected data. For analyzing the collected data, the author has used content analysis framework methods. In content analysis method the collected text is analyzed using different methods. Content analysis helps to understand certain themes and approaches towards the researched matters. The purpose of content analysis method is to summarize the material without losing valuable information and then make the conclusion about the researched theme. (Vaismoradi, Jones, Turunen & Snelgrove 2016, 100-101)

The data, which will be analyzed with the content analysis methods, are the interviews. The purpose of using the content analysis method is to gather a wide range of information into a compact and informative form. In data-driven content analysis, the first step was to listen the interviews again couple of times. All the interviews were transcribed since the text is then more flexible and easier to analyze. After this, the data was read again comprehensively. The text was reduced, so subjects and matters which aren't related or necessary for the research questions were cut off. Text about the risks and practices towards the researched topic was highlighted with different colors with code words "risk" and "practice". (Tuomi & Sarajärvi 2018, 94, 110-112)

The highlighted code words "risk" and "practice" are the main themes determined by the author. In other words, responses from the interviewees were coded into their own categories. (Hsieh & Shannon 2005, 1277-1279) The code word "risk" stands for the risks

regarding recycled plastics, and the code word “practices” is for practices to reduce or control the risks. Next step was clustering of the data which stands for finding the similarities from the material. Previously highlighted texts were now reduced to simplified expression, then to subcategories. After this, the subcategories were reduced to upper categories and lastly to main categories. Conceptualization process forwards the clustering process to conclusions. (Tuomi & Sarajärvi 2018, 112-115) For example, table 4 below is showing how the author performed with clustering and conceptualization with one of the main categories, “Risks in recycled plastics” (risks).

Table 3: Examples from the interviews with Expert 3 (Tuomi & Sarajärvi2018,112-115).

Original expression	Simplified expression	Subcategory	Upper category	Main category
"If we talk about a second part of risks, if some materials are used from recycled sources, chemically recycled at the moment, the risk is there is nothing available"	Availability in recycled plastics varies, forecasting is difficult	Availability can vary enormously	Availability	<b>Risks in recycled plastics</b>
"Product will just not be available"	There simply can be a situation where there just is not recycled plastic available	Possibility that nothing is available		
"Again the quality varies even for products which don't have the direct food contact because it's not fit for use"	Quality varies enormously	Quality variability	Quality	
"Our product which we have is not controllable so you never know what you get. Every delivery and every pallet you receive is varying in quality and in mechanical properties"	The plastic is not easy to control and predict, so it can always be different	Quality is not predictable		

The author decided beforehand to define the main categories, “risks in recycled plastics” (risks) and “practices in recycled plastics” (practices), since it outlines the interviews for the research questions. “Risks” category is for the first research question and “practices” is for the second research question. There were 191 highlighted subcategories, which formed 50 upper categories. The questions for the experts were outlined to only concern the main categories, for which reasons there weren’t much discussion about anything else than plastics,

risks, practices, and sustainability issues. This helped to create precise approach to the re-searched themes.



## 4 Results

In this section, the results to the main question “What are the risks linked to recycled plastics?” and the sub-question “What are the practices of recycled plastics risk identification, risk assessment, risk treatment, and risk monitoring?” will be answered. The results will be examined based on the interviews, conceptualization, and clustering processes, where the categories were gathered. In addition, the main question and sub-question will be answered also based on the information from theoretical framework. There were two main categories developed during the clustering processes, which were “risks in recycled plastics” and “practices in recycled plastics”. First, the results will cover the first main category, “risks in recycled plastics” (risks), which will answer the main question. The second main category, “practices in recycled plastics” (practices), will address the sub-question.

### 4.1 Risks in recycled plastics

This section will answer to the main question “What are the risks linked to recycled plastics?”. Altogether, 26 risks were identified. Since there’s a great number of risks, the risks have been specified to “sustainability risks”, “internal risks”, and “external risks”. The main focus is on the sustainability risks, but also results from internal and external risks will be discussed superficially.

#### 4.1.1 Sustainability risks

As discussed previously, most sustainability risks usually appear during the upstream process. According to Hoffmann et al. (2014, 166-168) sustainability risks have been categorized to (i) social issues, (ii) ecological issues and (iii) ethical business conduct issues. In addition, these risks identified from the interviews are observed from the SSCM point of view. These identified sustainability risks may threaten the supply chain resilience, which then lead to negative outcomes, such as financial and reputation losses. There were 10 sustainability risks recognized, which were: transparency, traceability, trust, social responsibility,

safety, reputation, fraud cases, wrong information flow to customers, life cycle, and recycling processes. Sustainability risks are introduced in the table 5 below:

Table 4: Sustainability risks.

1. Transparency	2. Reputation
3. Traceability	4. Fraud cases
5. Recycling processes	6. Wrong information flow to customers
7. Social responsibility	8. Life cycle
9. Safety	10. Trust

From the sustainability risks, transparency was considered the biggest risk of all. Transparency measures the availability of information flow for each entity of the supply chain (Bai & Sarkis 2020, 2145). The biggest issue with transparency is that, for example, if the material really consists of recycled material and if the chain is really from responsible sources as the suppliers claim. Transparency risk can be both (i) social and (ii) ecological issue. An organization needs credible data of the supply chain of a recycled plastic in order to be confident the chain is socially and ecologically compliant. Expert 1 pictured the issue with transparency as such:

*“We need to be able to verify that we are actually sourcing the amount of recycled or renewable stuff which we are selling and that the chain is solid...” -Expert 1*

The focal company and the suppliers need to have a valid proof that the recycled raw material is actually recycled and certified (Expert 1 2021). Otherwise, there can be problems with reliability. Correct form of certification may be the only way of confirming the transparency of recycled plastic. Every interviewed expert confirmed that transparency is a risk. Expert 2 highlighted why certification in transparency is important:

*“Of course we need to be able to present the proof to our customers and end-customers that we have an approved, audited, and certified procedure by a third-party organization for recycled plastics.” – Expert 2*

After transparency, traceability battles with the possibility of tracing a raw material’s whole life cycle. (Olsen & Borit 2013, 143) Traceability was mentioned four times, but will be presented now because of the close connection to transparency and trust, which will be presented next. Sustainable supply chain management requires traceability practices ergo to have trust from suppliers’, customers’, and stakeholders’ side. Post-consumer waste can be collected from uncertain sources; therefore, the focal companies can not trust if there has been some use of child labour or unethical working conditions. (Expert 1 2021) As UPM has selected as focus the goal 8 “decent work and economic growth” and the goal 12 “responsible consumption and production” from the UN’s SDG’s, it is vital to know the whole supply chain of a raw material (UPM 2022b). Traceability is both social and ecological issue. As expert 1 mentions below, traceability is a risk especially in social responsibility:

*“Post-consumer waste as it is a raw material for these recycled plastics so then who collects it and under what circumstances.” – Expert 1*

The second most noted risk was trust. Trust was discussed with experts while also discussing about transparency and traceability. These three aspects have strong connections each other, since supply chain traceability requires transparency from each entity, which may affect to each entity’s trust in the markets. Trust can be seen as a (i) social issue since trust is immaterial actor between the focal company and a supplier. Trust between the suppliers’ and focal company is needed for the supply chain to function, as well as fulfilling the needs of stakeholders. (Pagell & Wu 2009, 38-39, 52) Expert 1 pictured the issue from the stakeholder and supplier side as following:

*“We need to be credible in the direction of customers and brands...” -Expert 1*

Also, trust is a risk from other perspectives: the recycled plastics market is still a developing trend, so understanding about the issues concerning for example technical features, certification, and manufacturing may not be clear for all. Expert 1 stated that:

*“It is important to keep one’s eyes open and follow the actions of the suppliers, not because they would do something bad on purpose, but because there’s still different interpretations in the market and necessarily understanding everywhere may not be adequate enough.” – Expert 1*

The third aspect of trust risk is that the market may not be developed enough yet in order to have beneficial outcomes marketwise. As mentioned earlier in the theoretical framework section, recycled plastics as raw materials can be quite expensive. Therefore, there is a trust risk whether it is wise to invest in recycled plastics. (Shen et al. 2010, 45). Expert 3 mentioned that the trust is also in people’s opinions whether the recycled raw material is worth buying:

*“First of all there’s a trust risk so do people believe in recycling content to be used in terms of a mass balancing system ... marketwise the risk is does the product have enough trust to be developed with recycled materials”. – Expert 3*

Social responsibility risks are the fourth risk in the sustainability risks. Experts especially highlighted the upstream process: biggest risks are related to the collection and working conditions of recycled plastics, as expert 1 states below. All experts mentioned that mostly recycled plastics are sourced from European countries. In some cases, the raw materials need to be outsourced from less developed countries outside Europe (Expert 3 2021). Social responsibility risk is social (i) and (iii) ethical business conduct issues. Ethical business conduct risks, for example cooperation with questionable organizations are also social responsibility risks. Realized social responsibility risks can seriously damage a company’s image.

*“...there may exist big social risks in the raw material collection...” – Expert 1*

Safety risks were especially mentioned by experts 3 and 4. Safety risk was the fifth most mentioned risk in sustainability risks. It can be categorised to (i) social and (ii) ecological issues. Safety risks in recycled plastics relate to the problem that after the recycling processes the plastic may contain some harmful substances, which are dangerous to humans and nature. Because of this, all recycled plastics can’t be used in all products, such as food contact

packages. This is an enormous risk especially with mechanically recycled plastics. Experts 3 and 4 illustrate the situation:

*“About human safety is that who can be harmed by these products, first it could be our employees because some of these products can generate toxic smells or toxic steams or whatever.” – Expert 3*

*“For packaging food that (safety) is really critical.” - Expert 4*

The sixth risk was reputation, which was mentioned four times. In this case reputation means customer’s and stakeholder’s opinions about the focal company based on its performance in economic, social, and environmental aspects. Reputation is really important aspect in SSCM, because it can lead to costs in corporate image and customer satisfaction. Reputation is a (i) social, (ii) ecological, and (iii) ethical business conduct issue. These all factors affect to focal company’s reputation, whether it is related to poor working conditions, use of toxins or corruption. (Hoffmann et al. 2014, 166-168)

Fraud cases are risks which usually emerge from the supplier side. These are categorised to (iii) ethical business conduct issues. Frauds can be for instance false measurements in recycled content, green washing, and false production method. Fraud cases create trust and reputation issues among supply chain network as the focal company needs to be alert at all times. Here is an example from expert 1:

*“This has not happened to us, but I’ve heard situations where material is claimed to be just like cooking oil, used as a raw material, but then it was something like a virgin bio-based oil that was used as a raw material for that plastic.” – Expert 1*

As the recycled plastic market is still quite new, the awareness in the markets among customers and even the suppliers may be low. Also, because of the current trends about climate change and sustainability, big companies may sell products with wrong claims to customers who do not have the knowledge of recycled plastics (Expert 4 2021). False information for customers is (iii) ethical business conduct issues, because companies use their market power

wrong towards customers who do not have the competent knowledge of the area. Expert 3 explained the situation as following:

*“Sometimes non-sustainable solutions are chosen from brand owners just because people believe that it's good for the environment although it's not”. – Expert 3*

Risk “life cycle” concerns the whole life cycle of recycled plastic; from manufacturing to the end-of-life. Life cycle is a risk because it is always unclear where the product consisting recycled plastic will end up after all. Expert 1 explained that the risk is, for example, that the plastic will be thrown away to a landfill, or even to oceans in the worst case. Recycling processes was also mentioned as a risk. Expert 3 portrayed the situation as following:

*“Most of the countries don't have a separation process and they cannot separate neither colour nor hazardous products in a supply chain.” – Expert 3*

Mechanical and chemical recycling are both difficult and complex procedures which require knowledge and suitable infrastructure. Most countries do not own working processes for recycled plastic.

#### 4.1.2 Internal & external risks

In this section, the internal and external risks regarding recycled plastics will be reported. These risks will not have as deep analysis as sustainability risks since the noteworthiness of this thesis is in the sustainability issues. However, there were three (3) internal and thirteen (13) external risks identified. The risks are presented together in appendix 3. Internal risks were internal knowledge, mental commitment, and human errors. Internal risks are operational risks, which are usually misfortunate events happening inside the focal company. (Salamai et al. 2019, 49297) As discussed before, recycled plastics field changes rapidly and is still evolving. Therefore, it is a risk if the employees of the company are enough up-to-date and have the required knowledge of the area. (Expert 1 2021) Internal knowledge risk can cover for instance lack of information about the material, problems in internal functions such as sourcing processes and needed certificates.

Recycled plastic as raw material is difficult to handle due to its technical features. The employees may have some mental commitment issues regarding the handling of recycled plastics, as expert 3 states below:

*“The risk from the staff, on their operator side, is why do I have to work with this material, this is so complicated, and the quality impact is so bad.” – Expert 3*

Lastly there’s also human errors in internal risks. Human errors are usually inevitable and can happen to anyone regardless the position. Human errors can be difficult to prevent and can lead to either big or small losses.

External risks consisted of quality, availability, legislations & requirements, price, demand, awareness, technical features, small raw material markets, new business, resources, new trends, different interpretations, and experiment. From all of the risks, quality and availability was mentioned the most by all of the experts: quality 25 times and availability 19 times. Quality, availability, legislations & requirements, and price will be elaborated more deeply. Other external risks will be only briefly explained.

In recycled plastics the quality varies enormously. There can be a situation where the purchased recycled plastic is not fit for use and therefore possibly cannot be used at all. (Expert 3 2021) Recycled plastic can also contain adders or toxins, which is why recycled plastic can not be used for all products, such as food packaging or children’s toys. Quality also influences the whole production line. Expert 4 gives an example below:

*“If we have something which cannot be stretched over here it means we need to stop the line, that’s one issue.” – Expert 4*

The risk in the markets is that there is not enough reasonable priced and good quality recycled plastic available. Especially in chemically recycled plastic, which is today a high-cost industry. And if there is something available in mechanically recycled plastic the problem can be that it is not applicable for every product. (Huysman et al. 2017, 47) Expert 4 explains the situation as following:

*“Second risk will be at availability if you think about chemical recycling. There is no mechanical recycling available for our industry especially and even in chemical recycling you certainly know the capacity limitations. It's extremely, extremely limited.” – Expert 4*

Legislation and requirements ordered by governments and legislators give limitations in the recycled plastic markets. Legislators can rise taxes for virgin plastic raw materials which can be avoided if the company uses recycled plastic instead. Shift to circular economy has set requirements and legislation for the use of plastic, such as the European Commission setting targets for plastic packaging materials (COM/2020/98). Different countries also have different requirements, as expert 3 explains below:

*“Depending on the country where you're in, you get different certificates so we have materials which have FDA food approval, so I can ship it to the US or to any country which accepts FDA food approval, and we could produce a film which is OK for direct food contact. But the same product in Europe, I cannot use for direct food contact, because EFSA has not decided yet how to classify the material.” – Expert 3*

Because of the recycled plastics technical features, it may have different legislations in different countries. Legislations and requirements also change very rapidly, so the companies need to be always aware of the current regulations. Companies should be ready to response to the rapidly changing regulations in plastics, but sometimes there can be a risk that financial losses will occur due to changing taxations and such (Expert 1 2021).

Especially expert 1 & 2 stated that the price in recycled plastics is a risk. The price of recycled plastic as raw material can be so high at some times that it is not reasonable to purchase it. Price of recycled plastics is usually even higher than virgin plastic, as expert 2 explains below:

*“Recycled white plastic clearly costs more than what virgin plastic costs, so can we sell it that we get our own out of it or does it go like we have to cover our own margins?” -Expert 2*

Also, the issue with price risk is that companies cannot really have any influence on it. Price development follows the current demand and supply, and in most cases, companies just need



to accept the prices if they want to purchase recycled plastics. (Expert 1 2021) Rest of the external risks are presented in the appendix 4. Each risk has their own explanation and comments from the experts.

#### 4.2 Risk management practices for recycled plastics

In this section the sub-question “what are the practices of recycled plastics risk identification, risk assessment, risk treatment, and risk monitoring?” will be answered. This question will be answered based on the Fan & Stevenson’s (2018, 214-217) study introduced in the chapter 2.5. The practices will mostly cover the sustainability risks, which were identified in the previous sector. Other risks may be also discussed, but not as deeply as sustainability risks. Answers of the interviews will be used to form the practices. Practices portrayed here are only suggestions and created based on the interviews and the theoretical sources.

All in all, 24 practices were identified from the interviews. Mostly mentioned practice was certification, which is a tool for traceability and transparency, usually offered by a third-party partner. In addition to certification, external verification and documentation were also mentioned. Company’s own targets and own trials & assessments were also seen very important regarding the risk management. These four risk management practices were mentioned by all the experts. Rest of the practices are listed in the appendix 5 and will also be explained in the following sections.

**Risk identification:** first there is a risk identification, where the possible risks will be identified and assessed. The possible sustainability risks, which are transparency, traceability, trust, social responsibility, safety, reputation, fraud cases, wrong information flow to customers, life cycle, and recycling processes (table 5), were recognized during this thesis. Practices recognized from the interviews for risk identification are automatized processes, risk evaluations, audits, own trials & assessments, professional knowledge and being part of different organizations. UPM Raflatac could proceed regular risk evaluations, audits, and own trials & assessments, which can reveal some risks which haven’t been noticed before, or

either a new risk. Automatized processes are tools used for risk screening for suppliers or organizations. They can be used manually or be fully automated. For instance, UPM Raflatac uses EcoVadis tool which helps to assess sustainability risks among suppliers and partners (Expert 1 2021).

Risk evaluations are internal processes in the focal company. They may be for example questionnaires to suppliers, or then audits where employees from the focal company visit supplier's manufacturing plants or other units. If not yet done, UPM Raflatac could create and perform own trials & assessments. Expert 3 and 4 (2021) both discussed about their own trial processes for raw materials, where the materials are screened and trialled to secure there are not any risks with the raw material. These processes can also identify new risks. Professional knowledge, which is mental capital held inside the company, is one practice for risk identification. UPM Raflatac should ensure that employees dealing with the risks associated to recycled plastics possess the adequate professional knowledge, and therefore can identify the risks more easily.

Lastly, being part of relevant organizations helps the company to identify and implement the risk management practices to its functions. UPM Raflatac participates to the initiatives led by the Ellen McArthur Foundation (UPM 2021b). These kinds of organizations also can be referred as stakeholders. Stakeholder cooperation is important in SSCM, thus it raises awareness in the whole supply chain network. Therefore, risks can be identified in the supply chain.

**Risk assessment:** Next step from risk identification is risk assessment. The first action for risk assessment is SCR prioritization, where the supply chain risks should be evaluated with the highest and lowest risk for the organization. In recycled plastics, the highest risks in sustainability risks were transparency and trust, according to how many times the experts discussed the two risks during the interviews. The lowest risks were recycling processes and life cycle. In the second action, SCR inter-relationship perspective, the sustainability risks should be categorized to positive and negative dependence. Understanding the dependences between the risks will help with the prioritization. UPM Raflatac should categorize the

positive and negative dependences. In this case, categorizing will not be performed, as it requires more data and evidence behind than this study can give.

SCR assessment strategy is the last action of risk assessment. UPM Raflatac should further develop their own strategy for assessing the risks, and how to take into account all the consequences, indicators, and risk sources. Risk assessment procedures according to the interviews would be risk evaluations, audits, automatized procedures, and own trials & assessments. Risk evaluation can be for instance KPI's (Key Performance Indicators) where the risks can be assessed. In addition, audits can reveal the importance of each risk, and also own trials & assessments. Automatized processes can be created for risk assessment, where the program automatically assess a risk based on a data which it receives.

**Risk treatment:** The third practice is risk treatment, which holds five risk treatment actions; risk acceptance, risk avoidance, risk transferring, risk sharing, and risk mitigation. These actions will be analysed based on the practices from the interviews. Risk acceptance was listed one of the practices by the expert 2 (2021). Risk acceptance is a practical method especially with quality risk – as mentioned before, sometimes nothing cannot be done about recycled plastic's quality but accept it. Quality risk is therefore shared with the whole supply chain network. From the sustainability risk point of view, there is not many risks which can be accepted. Expert 1 answered to the question number 12 for UPM Raflatac (appendix 1) as following:

*“Well, from the point of view of sustainability risks, there may not be such (risks that can be accepted without mitigation efforts). Sustainability risks must be taken into account.” –  
Expert 1*

*Risk avoidance:* In risk avoidance the company avoids situations or factors which may put them into a risk. The root cause of a risk is attempted to be diminished or deleted. These are proactive processes, such as external verification, certification, documentation, code of conducts, due diligence, internal compliance, internal training, agreements, implementing sustainability matters to everyday life, and new innovations. All these practices listed are actions

to prevent the possible damage. External verification, certification, and documentation are practices to predict the risks associated with transparency, trust, traceability, and safety. UPM Raflatac should always require external verification, certification, and documentation from its suppliers.

Code of conducts, due diligence, and internal compliance actions can prevent fraud cases, trust risk, social responsibility risks, and reputation in external and internal factors. Code of conducts and due diligences usually determine the minimum demands in order to do business with the focal company. If the supplier does not comply with the demands, there most likely will not be business between the two parties. Internal compliance and code of conduct hold different alignments for the employees working inside the focal company, for instance guidance for ethical business behaviour. UPM Raflatac already has these three practices implemented to its strategy (Expert 1 & 2 2021). The further suggestion is to always have these actions up to date and educate the suppliers and employees if there is something unclear with these procedures.

Internal training is a risk management process, where the focal company educates its own employees. For example, UPM Raflatac educates its employees, so they know what to require from suppliers and other entities in the supply chain network. It is easier to avoid risks when the employees are educated for situations where there are especially operational risks. Agreements are made with the suppliers to ensure the availability of the recycled plastics. (Expert 2, 2021) Therefore, the availability risk can be avoided.

Implementing sustainability matters to everyday life is one of the practices, which is important part of sustainable supply chain management. Organizations aiming for SSCM should implement daily conversations about such matters to the organization's culture. Expert 2 and expert 4 answered to the question "How UPM Raflatac/supplier B notes sustainable development?" (Appendices 1 & 2), and both declared that sustainable development is included to each company's strategy. Expert 2 stated that sustainable development is a day-to-day topic. (Experts 2 & 4, 2021) For instance, there are better future prospects for those companies practicing SDG's. Thus, risk management practice "implementing sustainability

matters to everyday life” can be seen as a risk avoidance action. Sustainability matters should be implemented to every level in the organizations to have committed organization culture for SSCM.

Last action of risk avoidance is the practice “new innovations”. As the recycled plastics is a new and variant field, it is needed to develop and invest into company’s processes in order to avoid risks, which may occur with the sustainability risks, quality and technical features, and many other risks. UPM Raflatac could do new and efficient innovations and designs which would be able to prevent these risks. This is how expert 4 answered to the question number 1 (Appendix 2):

*“We need to have implementation in house with different projects to explore anything if possible...” – Expert 4*

*Risk transferring:* In the third action, risk transferring, the responsibility of the risk is transferred to another party in a supply chain. Risk transferring practices in this case are agreements and requirements for raw material quality. With agreements between the focal company and some other party the risk can be transferred. Also, if UPM Raflatac sets requirements for the raw material quality, the quality risk is then transferred to the supplier. For instance, expert stated that they only accept the purest quality of recycled plastics. Risk transferring may not be the best practice for sustainability risks, as it is more suitable for disruptive risks.

*Risk sharing:* Risk sharing is when other supplier or party is sharing the risk with the focal company. Risk sharing practice was also mentioned during the interviews by the expert 2. In this case, UPM Raflatac can share the availability risk with having multiple suppliers, so it is therefore not dependent on only one flow of supply. (Expert 2, 2021) Also agreements can be one way to share risk. UPM Raflatac and a supplier can agree on specific terms what will happen if some misfortunate event takes place. Therefore, the risk can be shared between the focal company and the supplier. Risk sharing is suitable for sustainability risks and also for some internal and external risks.

*Risk mitigation:* In risk mitigation, the last action of risk treatment, the risk and its consequences will be diminished to reasonable level. Risk mitigation is suitable for all of the practices from the interviews which have been listed until now. In addition, mass-balance approach and raising awareness are risk mitigation practices. Correct mass-balance approach minimizes the risk with raw material's quality and experiment. Raising awareness practice is when UPM Raflatac would do actions in order to promote awareness among the stakeholders. When stakeholders have the adequate knowledge of recycled plastics it reduces the risks related to sustainability, internal and external risks. For instance, when people possess the knowledge related to recycled plastics and sustainability matters, the risks of mental commitment or traceability are more doubtful. Also, long-term stakeholders are also seen to mitigate SC risks and promote SSCM (Pagell & Wu 2009, 51-53).

**Risk monitoring:** After the risks have been identified, assessed, and treated, the last step is to have constant monitoring of the risks. Practices for risk monitoring according to the interviews are UPM Raflatac's own targets, sustainability reports and automatized processes. UPM Raflatac's has some targets where the goal is to make good for external and internal factors. For instance, UPM has made various sustainability targets for 2025 and 2030 (UPM 2021b) (UPM 2020a, 21). After the other steps of risk management practices, UPM Raflatac's own targets are a functional way to keep-on-track the risks. Sustainability reports are a tool where a company reveals information and data about its activity every year. Sustainability reports are suitable risk monitoring practice for UPM Raflatac, because there the company and stakeholders can see the development each year. Lastly there are automatized processes, which is a practical tool for UPM Raflatac especially because of its large number of suppliers and products. Automatized processes help efficiently with the monitoring.

## 5 Conclusion

This bachelor's thesis examined the risks and risk management practices in recycled plastics. Plastic as a raw material faces many issues nowadays regarding sustainability matters. Plastic is produced more than ever before, and still there are not many actions in order to prevent the negative impacts of plastic in environmental and social matters. At the same time, companies should invest more in sustainable operations, as unsustainable business management may cause difficulties in the future. New innovations and sustainable methods will assist companies to more sustainable approaches. However, the industry may lack functional operations in sustainable risk management. Recycled plastics hold many risks due to its technical features and as a new market. Therefore, the risks and risk management practices for recycled plastics need to be examined. The main weight in this thesis was in sustainability risks, and risk management practices were formed based on actions which would support sustainable supply chain management approaches.

The thesis was a case study for UPM Raflatac, which is a labelling material producer. The risks and the practices were studied from UPM Raflatac's point of view, with the help of theoretical sources and interviews which were conducted for four experts in the labelling and sustainability fields. There were two themes in this thesis, which were risks and practices. These themes were formed during the coding and conceptualization processes in the context analysis method. The first theme, risks, answered to the main research question, and the second theme, practices, answered to the sub-question. The main and sub-questions were:

*Q1: What are the risks linked to recycled plastics?*

*Q2: What are the practices of recycled plastics risk identification, risk assessment, risk treatment, and risk monitoring?*

The results revealed that there are 26 risks in recycled plastics. Due to the huge number of risks, the risks were categorized to sustainability risks, internal risks, and external risks.

There were 10 sustainability, 3 internal, and 13 external risks. All the ten sustainability risks were either categorized to (i) social issues, (ii) ecological issues, or (iii) ethical business conduct issues. All the risks can be seen in the appendix 3. Many risks had close connections to each other, but were still named independently, though there might be some differences in risk management practices, effect of a risk and cause of a risk. The four experts had somewhat variable answers but were still all agreeing that sustainability risks are crucial. The most mentioned risks from sustainability risks were transparency and trust, and from internal & external risks the most mentioned ones were quality and availability. All the experts agreed that recycled plastic industry battles with trust and transparency risks in the supply chain network. The risks weaken supply chain resilience, which is why it is necessary to form risk management practices in order to maintain supply chain activity.

There were 24 practices identified from the interviews and with the help of previous literature, and they can be seen from appendix 5. These 24 practices were implemented to Fan & Stevenson's (2018, 214-217) study about risk management practices. All the practices were either placed to risk identification, risk assessment, risk treatment, or risk monitoring. This way holistic risk management practices were able to form for UPM Raflatac based on the interviews and theoretical literature. The study shows that most favoured risk practices from the experts were certification, external verification, documentation, and own trials & assessments. These practices were also in close connection with managing the sustainability risks. Suggestions for risk management in recycled plastics were given, although many of those were already in use at UPM Raflatac, according to the interviews.

## 5.1 Reliability of the research

Reliability of the research method contains of four areas: credibility, transferability, dependability, and conformability. Dependability tells if the research has been logical. This thesis has followed logical patterns of a research: introduction, theoretical framework, methodology, results, and lastly conclusion. Each section has had elaborately considered content, and various sources has been used in order to support the researched theme. All the sources and tools to conduct this research are documented and presented along the thesis. Transferability



measures of similarity can be found in previous literature. The results supported previous literature and gave new aspects in the field of recycled plastics, risk management, and SSCM. This thesis also followed credibility, which tells if the study has been logical with its claims and data. The theoretical literature and qualitative analysis method support each other.

The content analysis method gained to give valuable information about the interviews, where the clustering processes and coding was performed. Also, the data used in this thesis is coming from various sources. There were four individual experts to give important data from the fields of labelling and sustainability. The data received from the experts also supported the previous literature, and conformability of the study was also supported this way. Anonymity of the experts, accurate explanation of the methodology and research methods, previous literature, and carefully managed data would make this study replicable. (Eriksson & Kovalainen 2008, 291, 294)

## 5.2 Limitations & future research suggestions

In terms of reliability, this study can be conducted again by other researchers. However, it needs to be addressed that this study is limited, as it has been done to only one particular company in a labelling business. Therefore, it does not fully represent the recycled plastics field, and comparisons should be considered, and it should not be generalized to a larger sample. However, this study also has influences from two other companies, supplier A and supplier B, where the experts 3 and 4 work. Thus, these two other companies are also working in a film business. The results are observed from UPM Raflatac's point of view.

In case of UPM Raflatac, further studies of this same topic are being suggested. As this being only bachelor's thesis, it failed to give as comprehensive results as the topic would have needed. Sustainability related issues are broad and complex themes; therefore, this researched topic would have needed even wider study to cover all the matters related to risks and risk management practices in recycled plastics. Because of the limited time, resources,

and this study being a bachelor's thesis, this study's topic should have been even more limited. For further studies, more time and deeper aspect to UPM Raflatac's and its suppliers' actions are being recommended. For instance, a certain risk or risk management practice can be examined even more holistically.

This bachelor's thesis will however give valuable information about risks and risk management practices in recycled plastics and offers a good base for future research. It shows the reader how many different risks the recycled plastics hold and what the root cause can be. It is revealed what can be done with different practices, and how many practices there are. The thesis illustrates the complexity of sustainable supply chain management and what risks there are in the field of recycled plastics.

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## **Appendix 1: The interview questions for UPM Raflatac.**

1. How UPM Raflatac manages risks in recycled plastics currently?
2. What kind of goals does UPM Raflatac have for recycled plastics?
3. Why UPM Raflatac has these goals?
4. What kind of risk management does UPM Raflatac perform currently?
5. How important do you currently feel risk management in recycled plastics? Why?
6. What kind of internal risks does UPM Raflatac have?
7. What kind of external risks does UPM Raflatac have?
8. What kind of actions does UPM Raflatac currently have to make supply chain management as sustainable as possible?
9. Could you tell about your products which contain recycled plastics?
10. In which part of the supply chain do you feel that are the most risks?
11. How UPM Raflatac notes sustainable development?
12. Is there any risks which can just be “accepted”?
13. What/which factors have the highest risks?

## **Appendix 2: Interview questions for supplier A and supplier B.**

1. How supplier A/B manages risks in recycled plastics? How is the risk management like?
2. What kind of goals does supplier A/B have for recycled plastics?
3. Why does supplier A/B have these goals?
4. How important do you currently consider risk management in recycled plastics? Why?
5. What are the internal risks in recycled plastics?
6. What are the external risks in recycled plastics?
7. In which part of the supply chain do you feel that are the most risks?
8. Is there any risks which can just be “accepted”?
9. What/which factors have the highest risks?
10. What kind of actions does supplier A/B currently have to make supply chain management as sustainable as possible?
11. Could you tell about your products which contain recycled plastics?
12. Can you tell the origin of your recycled plastics?
13. How supplier A/B notes sustainable development?

**Appendix 3: The risks in recycled plastics.**

<b>Sustainability risks</b>	<b>Internal risks</b>	<b>External risks</b>
Transparency	Internal knowledge	Price
Reputation	Mental commitment	Demand
Traceability	Human errors	Awareness
Fraud cases		Legislation & requirements
Social responsibility		Resources
Life cycle		Competition
Safety		Small raw material markets
Trust		New business
Wrong information flow to customers		New trends
Recycling processes		Technical features
		Quality
		Availability
		Experiment

#### Appendix 4: Rest of the external risks.

The risk	Description	Comments from the experts
Demand	The demand in recycled plastics is still low and can vary as the price also varies.	"We need to be sure in the end that every buyer really wants it, but that's not always easy." - Expert 4
Awareness	Customers and other end-users do not have enough knowledge of plastics and recycled plastics, which can create negative assumptions towards the use of any plastic products.	"If you look at consumer perception to shopping, how does the consumer evaluate if the packaging will be recycled or not?" -Expert 4
Technical features	Recycled plastics are difficult to handle and use, since the quality may decrease in the recycling processes.	"The question is how do you separate these products, how do you isolate them, how do you identify them how do you mark them. They need special areas in special parts of the factory." -Expert 3
Small raw material markets	Forecasting is difficult due to small markets, and also the supply is little.	"This market is small and in no way strongly opened up and shaped yet, so it is very difficult to predict anything in the markets." - Expert 2
New business	The business is not yet fully developed, so companies may have own ways claiming the recycling content. There is no common customs yet.	"How to certify the product for content of recycled material, so there's many nouns ongoing and saying which one will win the race is still a question." -Expert 3
Resources	Big brands have better liquidity, therefore they can buy the recycled plastics from the markets despite the higher prices. Then the risk is that there isn't enough recycled plastic for all fields and companies.	"Big brands might dominate because they have such a huge demand and maybe then better liquidity." -Expert 1
New trends	Due to global trends in sustainability, there can be negative assumptions towards plastic products.	"As following the current trends, which we have to do to defend the plastic business because we are plastic film producer." -Expert 4
Competition	Plastic waste can be used for different purposes, for instance energy recovery, so there is competing end-users. In addition, limited number of recycled plastics causes competition.	"Competition between different uses of recycled plastic." -Expert 1
Experiment	Raw materials can also expire if they are not used in certain period of time.	"We also have the risk that we have too much stuff in stock as raw material and since these products have relatively short self-life, it may be that they are wasted because we are not able to sell them." -Expert 2

**Appendix 5: Practices for risk management in recycled plastics.**

1. Risk evaluations	2. External verification
3. Code of Conducts	4. Certification
5. Audits	6. Company's own targets
7. Mass-balance approach	8. Due diligence
9. Internal compliance	10. Internal training
11. Automatized processes	12. Cooperation with suppliers
13. Raising awareness	14. Agreements
15. Documentation	16. Risk sharing
17. Implementing sustainability matters to everyday life	18. Own trials and assessments
19. Professional knowledge	20. Risk acceptance
21. Sustainability reports	22. New innovations
23. Requirements for raw material quality	24. Being part of different organizations