Master's degree thesis

LOG950 Logistics

Circular Economy Potential in the Fishing Gear Industry under Extended Producer Responsibility: A company case study

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Preface

This Master's thesis has been written as a general requirement in the master's program in Logistics at Molde University College. Work began on the thesis in December of 2018 and was completed in May of 2019.

We want to express our sincere gratitude to our main supervisor, Professor Harald M. Hjelle of Molde University College, for his valuable insights and guidance throughout the duration of this project. He possesses a unique ability to motivate students and was able to lead us back on track at times when we felt overwhelmed or uncertain.

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Finally, we would like to thank our friends and family who have supported us through these two years of studies in Molde, and especially for their support and understanding in the past 6 months while we were writing this thesis.

Molde, May 2019
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Abstract

Recent years have seen a surge of interest in the problem of plastics pollution in the environment, and especially in the ocean. It is part of a larger trend where it has become clear that the economic linear status quo and its related activities are unsustainable. Circular Economy is presented as a possible solution to mitigate the negative externalities of economic activity. The purpose of this master thesis is to explore the concept of circular economy, as well as its potential application in a context of extended producer responsibility for fishing gear and its implementation potential and possible benefits in a fishing gear case company and supply chain.

We have found that while the current circular maturity in the studied case company is basic, there is willingness to implement circular principles at the company level, but that it depends on overcoming economic and organizational barriers. There seems to be unexploited business opportunities relating to fishing gear circularity, and a lack of infrastructure or applicable technology makes capturing this potential difficult. We also found that external intervention may be necessary for implementation throughout the supply chain, or across the domestic industry. The idea of closed loops for materials is an ideal within Circular Economy thinking, but in the examined company and industry, technical and organizational barriers exist which make closed loops impossible at present.

Keywords: Circular Economy, fishing gear, plastics, extended producer responsibility, sustainability, closed loop.

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List of abbreviations

B2B – Business-to-Business

B2C – Business-to-Consumer

C2C – Consumer-to-Consumer

CE – Circular Economy

CEBM – Circular Economy Business Models

CEO – Chief Executive Officer

CLSC – Closed Loop Supply Chain

EE – Electrical Equipment

EMF – Ellen MacArthur Foundation

EOL – End-of-life

EPR – Extended Producer Responsibility

EU – European Union

FNR – Fishing Nets and Ropes

GE – Green Economy

IE – Industrial Ecology

IPPC – Intergovernmental Panel on Climate Change

IPBEC – Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services

ISO – International Organization for Standardization

MARPOL – International Convention for the Prevention of Pollution from Ships

MPRSA – Marine Protection, Research and Sanctuaries Act

NTNU – Norwegian University of Science and Technology

OECD – The Organization for Economic Co-operation and Development

OEM – Original Equipment Manufacturer

PE – Performance Economy

PRO – Producer Responsibility Organization

PRP – Product Responsibility Provider

PSS – Product Service Systems

RQ – Research Question

SD – Sustainable Development

SE – Sharing Economy

SINTEF – Independent Research Organization (Norwegian: Stiftelsen for industriell og teknisk forskning)

SME – Small and Medium Enterprises

UK – United Kingdom

UN – United Nations

US – United States

WEEE - Waste Electrical and Electronic Equipment

List of definitions

Circular economy - an economic system that replaces the 'end-of-life' concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes.

Closed loop supply chain – a system in which EOL products are recycled into materials, which are then used in the production of the same or similar products.

Collective producer responsibility – a schema where producers take responsibility for the same product group regardless of the brand or producer.

Extended producer responsibility – a schema where producers take responsibility for the environmental impacts of their products throughout the product's life-cycle. Responsibility can be legal, economic, physical or informational.

Individual producer responsibility – a schema where producers take responsibility of their own products only.

"Pays-as-you-throw" principle – a model where end-users are charged for disposing waste.

"Polluter-pays" principle – the idea that the one that pollutes should pay for the cost of cleaning up or otherwise managing the pollution or waste. In this thesis, polluter-pays principle is used referring to the producer of a product as the polluter.

Producer – manufacturer, importer and distributor of products.

Reverse logistics – the process of recovering end-of-life products with the purpose to capture value through reuse, refurbish, remanufacture.

Value – financial or non-financial benefit.

1.0 Introduction

Rising awareness about effect of plastic pollution

The detrimental effect that human activity has on the environment and ecology has been known for a long time, and protection efforts on land have been known to exist as early as in the latter half of the 19th century in colonial Africa in order to combat overhunting, overpopulation and subsequent exploitation of limited natural resources (Goldstein, 2005). It was not until the 1970s, however, that this concern started to extend to the world's oceans with the establishment of environmental policies like the US MPRSA for marine environments and the international MARPOL convention for the maritime industry, the latter of which gained an amendment in 1988 explicitly banning the disposal into the sea of all forms on plastics (IMO, 2018).

While awareness and environmental policies saw an upturn around 50 years ago, it seems that it is only in recent years that the global population has realized the graveness of the current situation regarding pollution of the world's oceans. A World Economic Forum report published some years ago provides the most cited consequence of such pollution today, namely that *"by 2050, there will be as much or more plastic in the ocean as there is fish"* (World Economic Forum, 2016). It also reports that plastic is ingested by half of the world's sea-turtles, and nearly all of the world's seabirds.

In January 2017, a Cuvier's beaked whale swam ashore outside Bergen in Norway and was found to have more than 40 plastic items clogging its digestive system (Lislevand, 2017). Both in Norway and the rest of the world, the whale became a symbol of plastic pollution of the marine environment, and the problematic overuse of plastic in every level of our lives. This has led to both consumer activism initiatives like beach cleanings, lifestyle changes and grassroot pressure on producers to use less plastic in their products, as well as increased pressure on policymakers in order to facilitate change at a systemic level.

Plastics and production companies

Plastics first gained traction as a manufacturing material in the 1950s, and in the 70 years that have passed since then, world production of plastics has increased 220-fold, with an especially sharp increase in the decade between 1990 and 2000, when plastics production

doubled in volume from 100 to 200 million metric tons annually (Statista, 2018). The annual production figure is expected to more than triple by 2050, compared to 2014 production levels (World Economic Forum, 2016).

For companies relying on plastics as a manufacturing material, reducing their plastics consumption is often not an option in neither a short-term or long-term perspective, without proven quality substitute materials (Charter, 2018). There is also a question of how much responsibility a manufacturer can take upon themselves to prevent pollution, all while the end-consumer often is the one doing the polluting.

Taking responsibility for products even after the point of sale is generally incompatible with traditional transactions in a linear economy, where the responsibility and risk associated with the product's externalities transfer from producer to consumer alongside the physical product.

When it comes to minimizing pollution or detrimental effects on society and the environment as a consequence of the use or misuse of the products, extended producer responsibility (EPR) can be an effective tool. However, it is not likely that such responsibility will be initiated by production companies on their own, especially when it does not add to the company's profit or benefit aside from "goodwill" and is not required by law or regulation.

Policy makers begin to take action

In Norway, Pollution Control Act (1981) places responsibility on the polluter through the **'polluter pays'** principle. Expecting the correct behavior from the consumer regardless of individual knowledge is questionable practice if the end-goal is to eliminate pollution. It may be more beneficial to lay this responsibility on the party who produces the product or service which generates the polluting potential because there would then be fewer actors to follow up, and the producer is better able to reduce pollution early in the product's life-cycle. Facilitating correct consumer behavior through the establishment of easy-to-use systems for convenient disposal of products that have reached their end-of-life state is also becoming an increasing focus both for policymakers and companies alike.

Several governments and regions are becoming serious about tackling plastics pollution, and also see uncaptured value in recycling and reuse as a potential for economic growth. In Europe, a recycling industry for plastics exists, but due to historical large scale exports of

plastic waste to developing economies for recycling, and especially to China, the industry in Europe is underdeveloped and has a much lower capacity than the domestic plastic waste produced would require if it were to be recycled locally (Hammerstrøm, 2018a, 2018b, 2018c).

The European Union and Circular Economy

Early in 2018, the EU launched its common Plastics Strategy towards 2030, and within this document they describe plans for quadrupling the plastics recycling capacity within Europe, creating 200,000 new jobs in the process (European Commission, 2018). Developing the continent's recycling industry is a prerequisite for a successful implementation of a Circular Economy (CE), a system based on a collection of economic and philosophical principles that aim to decouple economic activity from the consumption of finite materials, and for the "take-make-dispose"-model of industrial activity to be a concept of the past (Ellen McArthur Foundation, 2018).

United Nations Sustainable Development Goals

Following CE principles, the intention is to keep input materials in the economic circulatory system for several iterations, and to eliminate waste. This strategic commitment on the part of the EU is also in line with several of the 17 UN Sustainable Development Goals for 2030 (UN, 2018b), of which at least six (#9, #11-15) can be connected to benefits gained by a circular system with less waste. The sustainable development goals are the fruit of decades worth of efforts on the part of UN member states, and are the most visual representation of "The 2030 Agenda for Sustainable Development", the UN's shared guidelines for achieving and securing peace and prosperity for both people and the planet.

> *"The goals recognize that ending poverty and other deprivations must go hand-in-hand with strategies that improve health and education, reduce inequality, and spur economic growth – all while tackling climate change and working to preserve our oceans and forests".*
>
> (UN, 2018b)

Figure 1: *Sustainable Development Goals.* (Source: UN, 2018a)

Extended Producer Responsibility Schemas

The aforementioned EU Plastics strategy also includes plans for Producer Responsibility Schemas for several industries, and among them producers of fishing and capturing gear. Producer Responsibility Schemas are regulations which require manufacturers and importers to take responsibility for the products they sell when those same products reach their end-of-life phase. The OECD defines Extended Producer Responsibility (EPR) as:

> *"OECD defines Extended Producer Responsibility (EPR) as an environmental policy approach in which a producer's responsibility for a product is extended to the postconsumer stage of a product's life cycle. An EPR policy is characterized by: (1) the shifting of responsibility (physically and/or economically; fully or partially) upstream toward the producer and away from municipalities; and (2) the provision of incentives to producers to take into account environmental considerations when designing their products…»*
>
> *(Norsirk, 2018)*

Examples of existing schemas can be the WEEE-schema, which is an EPR on small electric appliances. In Norway, this is administered by third-party service company Norsirk AS, which offers complete EPR services to companies who do not wish or are unable to have an in-house solution.

Situation in Norway and readiness of the industry

A report published by Mepex in May 2018 (MEPEX, 2018) found from an analysis of beach cleanings and the results of a trial project called "Fishing for Litter" that most of the marine plastic debris in Norway stems from the fishery industry, and in particular from plastics related to fishing and capturing gear. It also summarizes available information on different producers of fishing gear, as well as the estimated material flow of different kinds of fishing gear, separated into seagoing and coastal fishing fleets. Finally, it also attempts to give some estimate on how much of the fishing gear might be recyclable, identifying increasingly complex products and rapid electrification as challenges to recyclability (Sundt & Skogesal, 2018).

The same report was submitted to policymakers as a knowledge basis in order to evaluate whether a producer responsibility schema should be implemented in Norway, even before EU implements similar measures on the continent as a result of their Plastics Strategy. The knowledge that the EU is planning for such an implementation gives more momentum to a Norwegian solution, so that Norway to a larger degree may control and adapt the EPR to Norwegian conditions by being pre-emptive. Amidst changing external circumstances for firms in the fishing gear production industry, it is interesting to explore how they can adapt to this new reality where being circular and green is paramount to keeping competitive advantages and contributing to a shared sustainable future. Could the implementation of CE be an answer, and is the industry ready for it?

1.1 Research questions

The purpose of this research is to explore and investigate the current status, readiness and opportunities for a producer of fishing gear in Norway to implement and create value through circular economy principles in a context of EPR.

To perform the research analysis, we introduce the following research questions:

1. *"What is the current understanding of Circular Economy and how has it developed?"*
2. *What value can be created from product circularity for fishing gear, and who can benefit from it?*
3. *Is there a potential for closed-loop supply chains for fishing gear companies in Norway?*

4. *Which upstream and downstream activities drive or prevent implementation of circular thinking in this industry?*
5. *Is there a stronger case for either 'polluters pay' or 'pay-as-you-throw" principles under a circular mode of operation?*
6. *What are the benefits of a circular mode of operation under each EPR scenario?*

1.2 Structure of the thesis

The thesis is structured as follows. It starts with an introductory chapter containing an introduction to the problem, the research objective, what research questions will be explored and an overview of the thesis structure, followed by a list of definitions.

Following the introductory chapter, the second chapter includes a more extensive write-up on EPR, an important background factor for our research. The chapter goes on to describe approaches to EPR, as well as presenting a summary of existing schemas in Norway, and what is known about EU's plans for EPR for fishing gear in Europe.

Then, a literature review chapter on circular economy follows. The chapter explores the CE concept and its many building blocks, contemporary influences and interest, and relationship with some alternative concepts. We attempt to make sense of the many definitions existing for CE before presenting core components found in the concept. After looking at the state of implementation of CE and its related policies, we present tools that are generally recognized as beneficial for implementation, including the British Standard which we have also used as a framework for our empirical research. The literature review chapter ends with a summary of expected benefits, as well as limitations and criticism of CE as a concept.

The fourth chapter is on methodology. The chosen research design for the thesis and the case selection process is described along with the method of data collection and analysis. Research quality and limitations are also described in this part.

Next, the fifth chapter details the empirical analysis part of our thesis and describes in detail the process, data collection, analysis and findings of our empirical case study.

Following the presentation of the empirical analysis is a discussion chapter, where we see whether we are able to answer the research questions posed in the first chapter.

Finally, we provide a summary followed by a conclusion and recommended further research on this topic.

2.0 Extended Producer Responsibility

Since 1980 EPR has been implemented by a range of countries as a response to municipalities' and taxpayers' increasing burden of product end-of-life management. In 2001 the OECD produced a Guidance Manual for EPR introducing possible implementation options, their benefits and disadvantages. The manual's general guiding principles state that EPR schemas should provide incentives for producers to change product design, stimulate innovation, adopt a life-cycle approach, clearly define responsibilities, improve communication across the supply chain and consider both mandatory and voluntary approaches with periodic evaluation (OECD, 2016).

There are about 400 EPR schemas worldwide, and most EU members have already adopted and implemented EPR schemas for e.g. packaging waste. Now institutions call for more ambitious EPR schemas and also for integration with circular economy objectives in the frames of the EU Plastic Strategy and the EU Action Plan for CE (Watkins et al., 2017).

To pursue the objective of our research, we will initially discuss the origin of the term "extended producer responsibility", approaches to its implementation, as well as existing schemas in Norway and the European Commission proposal for a fishing gear EPR schema.

2.1 EPR definition

Lindhqvist (2000) first formulated the definition of Extended Producer Responsibility (EPR) in 1990. In a report to the Swedish Ministry of Environment Lindhqvist gives the following definition:

> *"Extended Producer Responsibility is an environmental protection strategy to reach an environmental objective of a decreased total environmental impact from a product, by making the manufacturer of the product responsible for the entire life-cycle of the product and especially for the take-back, recycling and final disposal of the product. The Extended Producer Responsibility is implemented through administrative, economic and informative instruments.*

The composition of these instruments determines the precise form of the Extended Producer Responsibility".

(Lindhqvist, 2000)

Using the idea of shifting responsibility from consumers and municipalities to the producers of products, Lindhqvist (2000) develops the concept of EPR based on the analysis of Swedish and international recycling and waste schemas to promote Cleaner Production in his doctoral thesis.

He suggests the following EPR model, which shows an overlap between different kinds of responsibility:

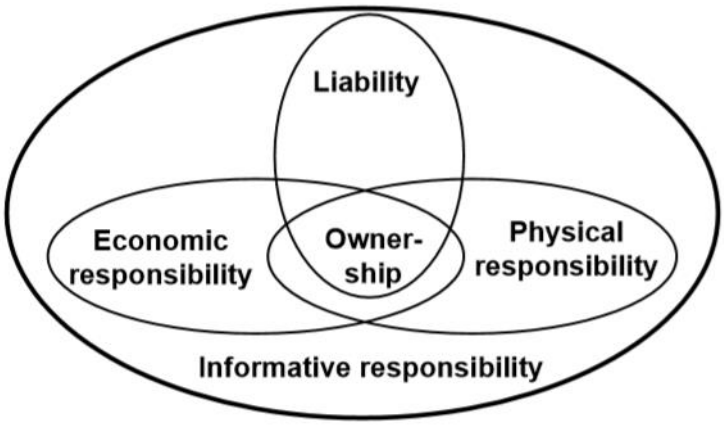

Figure 2: *Models for Extended Producer Responsibility*. (Source: Lindhqvist, 2000)

In this model, *liability* means legislative responsibility for environmental damage caused by a product, meaning that the producer is legally responsible for any such damage or cost.

Economic responsibility implies that the producer under EPR pays the total or partial cost of collecting, recycling and disposing of products.

Physical responsibility refers to the physical management of a product throughout its entire life-cycle by the producer.

Informative responsibility entails environmental labelling and content declaration for products by the producer.

By retaining these responsibilities, the manufacturer keeps *ownership* of the product and becomes solely responsible for the negative consequences of its environmental performance.

In other words, Lindhqvist (2000) concludes that EPR should be implemented based on legislative, economic and informative mechanisms where the main principle is the "polluter-pays" principle and allocates responsibility primarily to one actor – the manufacturer. This is done to avoid a situation where "everybody's responsibility" becomes "nobody's responsibility" (Tojo, 2004).

In contrast, Davis (1998) explains EPR as allocation of responsibilities on the producer mainly due to their capacity to minimize pollution at the source, even though production is not necessarily the most polluting phase of the product's life cycle. Moreover, Davis et. al (1997) suggest allocating the environmental burden across the product chain; including both producers, distributors and end-users. They then define EPR as:

> *"the principle that the actors along the product chain share responsibility for the life-cycle environmental impacts of the whole product system, including upstream impacts inherent in the selection of materials for the products, impacts from the manufacturer's production process itself, and downstream impacts from the use and disposal of the products".*
>
> (Davis, Wilt, & Barkenbus, 1997)

Current EPR programs often necessitate that the costs associated with end-of-life management be included in the price paid by the end user. This is also in line with an extended "polluter-pays" principle, as some pollution does happen after the production phase, for example in relation to use and disposal (Tojo, 2004).

Based on Davis' definition, the OECD has created its EPR definition as follows (Lindhqvist, 2000):

> *"a concept where manufacturers and importers of products should bear a significant degree of responsibility for the environmental impacts of their products throughout the product life-cycle, including upstream impacts inherent in the selection of materials for the products, impacts from manufacturers'*

> *production process itself, and downstream impacts from the use and disposal of the products. Producers accept their responsibility when designing their products to minimize life-cycle environmental impacts, and when accepting legal, physical or socio-economic responsibility for environmental impacts that cannot be eliminated by design".*
>
> (OECD, 2006)

EPR schemas and the distribution of responsibility for product end-of-life management have been debated in many Western European countries, Japan and the United States. While some of them were putting the responsibility solely on producers, others argued that the excessive focus on product design would neglect the goal of sustainability and leaned more towards shared responsibility (Lindhqvist, 2000).

It is difficult to assess and recommend the most successful type of EPR schema, so the OECD recommends countries to evaluate each case based on their geography, economic and demographic circumstances (OECD, 2016).

2.2 Approaches to implementation of EPR

There are different approaches to categorizing EPR schemas based on implementation mechanisms. (Tojo, 2004) classifies responsibilities in EPR schemas as *mandatory* (legislative), *negotiated* (between government and industries) and *voluntary* (initiated by industries) when referring to policy implementation instruments. She further proposes, from the perspective of implementation mechanisms like the establishment of take-back systems, that producers can take responsibility of their own products (*individual responsibility*) or be responsible for similar products regardless of the brand (*collective responsibility*). The former classification refers to how responsibility is initiated (*mandatory, negotiated or voluntary*) and the latter to how that responsibility is executed (*individually or collectively*).

(Tojo, 2004) also suggests that a producer is financially responsible on an individual basis if they pay for end-of-life management procedures of their own products. There is also individual physical responsibility when producers are involved in downstream collection procedures of their own branded products. Finally, they have an individual informative responsibility when they aggregate, keep and monitor their own product systems. Commonly, *individual responsibility* is prioritized as it gives producers great freedom in

managing product life-cycle improvements. There is a lot of discussion around individual responsibility, and it is difficult to clearly define and measure its upstream effects.

Presumably, *collective* EPR schemas are more easily to measure as they aim to increase collection and recycling rates. While the term "collective responsibility" is often misinterpreted and used as a reference to take-back systems, its final objective is the same as with an individual EPR: to close the material loop through waste management activities and separate collection systems. Although collective EPR excludes the improved end-of-life design phase, from a long-term perspective, the amount of collected waste can be regarded as source reduction.

Due to prejudice about individual responsibility and a lack of empirical data, organizations tend to misdoubt adoption of an *individual responsibility* EPR schema, while *collective responsibility* EPR schemas are criticized in that producers become disinterested in the recycling of products from other brands. In both cases, separate collection remains an important part of the supply chain where developed infrastructure plays a significant role.

One approach to avoid disagreements is to allocate responsibilities either through *legislation* (mandatory schema) or *negotiation* (between government and industries or just within industries). The latter takes away the burden from authorities who may not have sufficient knowledge of relevant issues (OECD, 1997).

An alternative approach to the implementation of EPR based on the creation of takeback systems is described by Spicer and Johnson (2004), who suggest choosing between OEM Takeback, Pooled Takeback and Third-Part Takeback:

- **OEM Takeback** refers to a system where original equipment manufacturers (OEM) are directly responsible for end-of-life management of their own product and take physical and economic responsibility for this. It includes activities like take-back, demanufacturing and component or material recovery. The benefit of this EPR type is informative efficiency and feedback due to a low variety of products and qualified expertise, which facilitates closed-loop reuse. At the same time, specialization and product-specific expertise can be considered drawbacks of this type of EPR as it does not cover orphaned products or products from other brands. Geographic dispersion

and the need for developed logistical networks complicate the adoption of this system, where OEMs depend on the government authorities, municipalities, retailers and other industry associations in the process of product collection. Moreover, it will be economically challenging for small and medium enterprises (SMEs) to take direct end-of-life responsibility, and they will most probably need to outsource this function (Spicer & Johnson, 2004).

- **Pooled Takeback** system (Lindhqvist, 2000) implies subcontracting of end-of-life responsibility to a Producer Responsibility Organization (PRO), and in particular to retailers, as it has been proved that customers are more likely to return EOL products to the retailer's outlets. Savaskan, Bhattacharya, and Van Wassenhove (2004) claim that CLSC based on retailer collection is the most effective option. Spicer and Johnson (2004) suggest that organizations with this specialized function have more capabilities to cover a broader range of goods, including imported or orphaned products. The strongest feature of pooled systems is a focus on reverse logistics with an expanded network of demanufacturing facilities, while a drawback is that the upstream effect in this system is weaker than in *OEM takeback*. The question on how to share the collective economic cost between PRO members (Spicer & Johnson, 2004) enhances another important issue of capturing value across the reverse supply chain (Govindan, Popiuc, & Diabat, 2013).

- **Third-Party takeback** assumes that end-of-life responsibility is carried out by a Product Responsibility Provider (PRP) on behalf of the OEM who would pay a fee to the PRP. Through competitive bidding processes, OEMs have opportunities for better system design, increased focus on specialized products and components, as well as financial risk management. On the other hand, third-party organizations may face difficulties with identification of products and the materials they are made of, and subsequently recognizing suitable markets for further sale (Spicer & Johnson, 2004). This problem could be alleviated through the introduction of product material passports.

2.3 Existing EPR schemas in Norway

There exist some operative EPR schemas in Norway. The first EPR schema was introduced for battery collection and recovery in 1990. It was followed by covenants on packaging

(plastic, liquid board, fibre-based, glass and metal) in 1995, on EE products in 1998, rechargeable batteries in 2000 (OECD, 2003) and EOL vehicles in 2003 (Lovdata, 2003).

In 2001, a guidance manual for EPR publication was published, and the OECD held a seminar on such implementation where member states could share information on their existing practices. Norway presented the case of plastic packaging, and the seminar's final report (OECD, 2003) has provided a layout for comparison between different EPR schemas. We have compiled a summary of three existing schemas in Norway presented in **Table 1**, using the most up to date available sources. The purpose of the summary is to give an idea of how EPR schemas are implemented in Norway and what mechanisms are used to both establish and measure their continued effect.
Based on described approaches to EPR implementation in the previous section, we can define *mandatory*, *negotiated* and *voluntary* EPR schemas where takeback systems are organized either collectively or through third-parties.

There is also strong support for the 'polluter-pays' principle, where collective economic responsibility in the form of collection fees is shared between industry members. EPRs for EE products and EOL vehicles have high collection and recovery targets as well as market coverage; however, the EPR on plastic packaging has both low targets and lower measured performance. Listed EPRs are based on *Pooled Takeback* and *Third-Party Takeback* systems, meaning that none of the manufacturers hold individual responsibility for product life-cycle activities. Although the listed EPRs were implemented decades ago, the schemas continue to face implementation barriers such as low sorting efficiency, logistical issues and lack of solutions for orphaned products that altogether prevents material loop closure.

Name of programme*	EPR on plastic packaging[1]	EPR on EE products[2,3]	EPR on EOL Vehicles[4]
Aspect	**Description**		
1. The type of the programme	Negotiated agreement	Voluntary collective	Mandatory collective
2. Implementation date	1996	1998	2003[5]
3. The scope of the programme	Plastic packaging from industry and households	a) Products and components that depend on an electrical current or electromagnetic field; b) Equipment for the generation, transfer, distribution and measurement of these currents and fields.	Vehicles belonging to classes M1 and N1 and to three-wheeled motor vehicles excluding motor tricycles.
4. The distribution of responsibility	Packers and fillers pay the fee; Plastic packaging producers develop the recycling capacity; Retailers are "controllers" in order to reduce number of free-riders.	Each distributor, seller or otherwise merchant trading EE products must be a member of a return organization approved by the directorate of environment (Miljødirektoratet). This can be done individually or alongside others, or through a 3rd party.	Each producer or distributor is responsible for the proportional amount of EOL Vehicles according to the producer's market share of sales that year.
5. The estimated number of producers	In 2003 there were approximately 1050 companies pay fee to PRO	In 2002 there are around 12 000 EEE companies in Norway. As of March 2008, 3640 producers have become members in one of the four take-back companies.	The number of producers/importers is 25[6]
6. The percentage of market coverage	30% of all plastic waste is packaging	---	97% of all cars imported by importers in Norway[7]
7. Is there a PRO? If yes, list duties of the PRO.	Yes, Plastretur: "develop, run, manage, monitor and organise collection and recovery of plastic packaging to meet the objectives of 50 % energy recovery and 30 % material recycling".	Four collectively financed take-back companies are registered and authorized by SFT: Elretur AS., RENAS AS, Ragn-Sells Elektronikkretur AS and Eurovironment AS	The company overseeing the return schema, Autoretur, is jointly owned by all car importers in Norway, and represents 40 different car brands.
8. What is the fee payment?	1,70 NOK per kg (0,21 Euro). Materialretur is a "economic PRO" for all the EPR programmes in Norway, responsible for organising the collection of fees and for reducing the number of free-riders. The fee is paid four times a year.	This fee is a demand from the Ministry of Environment. The fee is determined by the authorized take-back company and put on their respective members. The basis for calculating the fee is not standardised by the authorities.	See 4
9. Colleciton targets	30 % material recycling; 50 % energy recovery.	at least 75%-85% of the waste must be recovered out of which 55%-80% should be re-used or recycled[8].	95% end-of-life vehicles recovery; 85% recycling of recovered vehicles and the remainder used for energy recovery.
10. Raising customer awareness	Posters, information brochures and some commercials; Meetings with the parties	Informative responsibility entails the environmental labelling of the products by producers. Distributors and merchants trading in EE products have an extensive obligation to inform the end-customer(s) about the return schema, and the possibility of returning EOL EE products free of charge. This should be done by clearly visible written information in all marketing materials and by posters in the sales area(s).	The producer is responsible for satisfactory information to the public and other affected stakeholders about the return system for EOL cars
11. Orphan products	Threre is no problem	The merchant must accept similar products up to one year after he last sold that kind of product.	The fee cannot be collected for the privately imported cars because of the privacy laws which will not allow Autoretur to access registries of the owners of privately imported cars[7].
12. Free riders	Via Grüne Punkt and retailers demanding membership in Materialretur	The number of members is increasing from year to year, however "free riders" are still a problem	---
13. Implementation barriers	Low efficiency in sorting, both in households and in sorting plants; Lack of marked products telling whether the packaging could be recycled or not.	A critical issue in Norway is that most WEEE takeback companies are located near the capital Oslo; Transportation of EEE from south to north, and WEEE back, contribute to a sizeable environmental load, especially emissions to air; Transportation, especially in winter road conditions, involves the risk of accidents.	20-30k privately imported cars risk being excluded from the car return system each year, and may be dumped in nature[7].

Table 1: *Existing EPR schemas in Norway* (Source adapted from: OECD, 2003)

[1] (OECD, 2003)
[2] (Román, Ylä-Mella, Pongrácz, Solvang, & Keiski, 2014)
[3] (Norwegian Environment Agency, 2013)
[4] (Norwegian Environmental Agency, 2019)
[5] (Lovdata, 2003)
[6] (Bilimportorene, 2019)
[7] (TU, 2019)
[8] (Lovdata, 2019)

2.4 EU proposal for EPR schema for fishing gear collection, recycling and reuse

Fishing net recycling proposal

In May 2018 EU Commission has published a "*Proposal for a Directive of the European Parliament and the Council on the reduction of the impact of certain plastics product on the environment*" (EC Europa, 2018b). The objective of the document is, in particular, to prevent and reduce the marine litter from single plastic items and fishing gear containing plastic. In the broader context of a transition to CE, this initiative aims to support innovative solutions and new business models. Tackling marine litter, innovative design, investments into marine litter prevention (new port reception facilities and recycling of fishing nets) will create new jobs and boost the competitiveness of businesses through CE principles. The EU commission foresees certain measures related to single-use plastic items and fishing gear (**Figure 3**).

This proposal supplements current legislation with a revised *Port Reception Facilities Regulation and Fisheries Control Regulation.* Both regulations aim to strengthen the delivery of waste from ships and reporting on the retrieval of lost gear. The proposal uses the '***polluter-pays*'** principle for fishing gear by ensuring that producers of fishing gear containing plastic take responsibility for the waste phase of their product; ensuring collection, recycling and re-use and including incentives for fisheries to return gears to collection.

The proposal (Europa, 2018b) also suggests handling the contribution of abandoned, lost and discarded fishing- and aquaculture gear to marine littering through the introduction of EPR schemas. This option is considered in the proposal to have the highest potential impact, as it facilitates the implementation of policy instruments on the reduction of marine littering from such gear. It has also been suggested not to exempt SMEs from participation in the initiative as "*European companies who have already adopted circular design and business models will have a larger market and enhanced trade, investment and business opportunities*" (EC Europa, 2018b).

	Consumption reduction	Market restriction	Product design requirement	Marking requirements	Extended producer responsibility	Separate collection objective	Awareness raising measures
Food containers	X				X		X
Cups for beverages	X				X		X
Cotton bud sticks		X					
Cutlery, plates, stirrers, straws		X					
Sticks for balloons		X					
Balloons				X	X		X
Packets & wrappers					X		X
Beverage containers, their caps & lids			X		X		X
- Beverage bottles			X		X	X	X
Tobacco product filters					X		X
Sanitary items: - Wet wipes				X	X		X
- Sanitary towels				X			X
Lightweight plastic carrier bags					X		X
Fishing gear					X		X

Figure 3: *A summary of targeted single-use plastic items, fishing gear and the measures foreseen in the Commission's proposal*. (Source: EC Europa, 2018b)

An additional measure foreseen for fishing gear is '*Raising awareness*' through informing customers about *(a)* available re-use systems and waste management options for fishing gear and *(b)* the impact of marine littering by fishing gear made of plastic.

Proposal for a new Port Reception Facilities Regulation

Since it came into force 17 years ago, the circumstances relating to the EU Directive on *Port Reception Facilities Regulation* have changed significantly, and especially when it comes to marine plastic littering. The directive was adopted to regulate the availability of port reception facilities and the delivery of waste to those facilities. However, its current scope does not prevent increased volumes of marine litter and waste generated by ships. The regulation is therefore undergoing a much-needed revision, and a proposal for new regulation is aiming to improve operational efficiency in ports while reducing marine littering through incentives and enforcement measures.

A few options are proposed by the EU Commission, where the most preferred policy implies alignment with the *MARPOL Convention*, a full range of incentive and enforcement

measures for vessels, as well as mandatory delivery of waste. It is expected that these options will be associated with additional compliance and operational costs (expansion of collection facilities, new capacity and further waste treatment). New cost recovery systems ensure that the operational and administrative costs of port reception facilities are **paid by ships,** regardless of actual waste delivery to ports. The system design should provide no incentive for ships to discharge waste in the sea, and fees can be reduced for ships which manage their waste in a sustainable and environmentally friendly manner (EC Europa, 2018a).

Fisheries Control Regulation

The EU Commission's proposal of an amended *Fishery Control Regulation* includes at least two new requirements: one for marking gear and one for carrying retrieval equipment on board. The proposed new regulation also includes marking and identification of vessels, crafts, fishing aggregation devices, buoys and cords. Information about lost fishing gear should be put into the log book, including information about the date when gear loss occurred, type of fishing gear lost, coordinates and a description of measures undertaken to retrieve it (EC Europa, 2018c).

Future regulatory regime

On March 27, 2019, the EU Parliament approved a new law banning single-use plastic items, and simultaneously mandating EPR for a range of products, among them fishing gear. The law will come into force in 2021 (European Parliament, 2019). Besides setting high collection and recycling targets, it strengthens the application of the 'polluter-pays' principle by making fishing gear producers, not fishermen, responsible for the collection of lost items at sea, giving strong incentive to develop systems to hinder such loss or intentional dumping of gear. The application of the 'polluter-pays' principle directly reflects the OECD definition of EPR where *"manufacturers and importers of products should bear a significant degree of responsibility…"* (OECD, 2006).

3.0 Literature review

3.1 Introduction

Rising awareness for the environment

Since the turn of the millennium, climate change and environmental protection have become the focal point of political agendas and public interest all over the globe. From Al Gore's work on increasing public awareness about man-made climate change with the movie "An inconvenient truth", for which he shared a Nobel prize (Institute Nobel, 2007) to international reports like one from IPCC warning that some parts of the globe will become uninhabitable unless we act soon (Hoegh-Guldberg et al., 2018) and from IPBES warning that the status quo is on course to make more than 1,000,000 species extinct in the next few decades (IPBES, 2019) - the impact of human activity on our natural surroundings has fast become one of our most pressing contemporary challenges.

Orphaned materials under scrutiny

While measures to curb harmful emissions and air pollution, as well as achieving an international consensus regarding commitments and reduction targets has been and continues to be important, particular attention has also been placed on the management of non-biodegradable materials, many of which are orphaned. "Orphaned" refers to end-of-life products that nobody assumes responsibility for, and which are abandoned. In particular, awareness concerning the proliferation of micro- and nano- plastics and pollution of the natural environment and ecosystems has risen sharply in recent years (UNEP, 2016; Villarrubia-Gómez, Cornell, & Fabres, 2018; Vince & Stoett, 2018). In 2016 a World Economic Forum report warned that externalities under a business-as-usual scenario would result in as much plastics as fish in our oceans by the year 2050 (World Economic Forum, 2016).

Growing interest in CE

Throughout the past three decades, a major argument against committing to emissions reductions has been the expected damage to value creation and the economic system (US Senate, 2016). Now, a previously niche economic concept is gaining renewed and growing interest from academia, politicians and the general public as a potential mitigation tool for both greenhouse gas emissions as well as ecosystems pollution and resource depletion by

human activity (Ellen MacArthur Foundation, 2013a; European Comission, 2018b). CE is presented as antithetical to the current linear economic system – a paradigm shift (Merli, Preziosi, & Acampora, 2018) taking the focus away from limitless consumption and a "one-way-street" for materials, and towards cyclical material flows, principles of reduction, reuse and recycling, while still satisfying a growth and value-creation requirement, with a goal of gradually decoupling value-creation and economic activity from resource consumption (Ellen MacArthur Foundation, 2013a, 2013b, 2014).

3.2 Concept origin

The concept of CE has existed since at least the early 1990s, and while the exact origin of the concept is contested, some authors give credit to Pearce and Turner (1989) for providing the first framework and employing the term "a circular economy" (Andersen, 2006; Ghisellini, Cialani, & Ulgiati, 2016; Su, Heshmati, Geng, & Yu, 2013) In this framework, the authors describe a closed-loop system considering everything as an input for something else (Su et al., 2013) and based on the premise that the environment has three main economic functions; as a provider of resources, as a sink for waste and emissions, and as a life support system. They also argue that the cost of environmental externalities should be priced into products that affect these functions (Ghisellini et al., 2016). While Pearce and Turner (1989) are given credit for coining the term and providing the first framework, the general idea is credited to the works of Jarrett and Boulding (1966) in some research papers (Ghisellini et al., 2016; Lieder & Rashid, 2016).

Other authors claim that it is not possible to trace the CE concept back to a single author or point in time, and that the concept as it appears today has been continuously developed and refined, building on a range of ideas and works published both before and after 1989 (Ellen MacArthur Foundation, 2013a; Geissdoerfer, Savaget, Bocken, & Hultink, 2017). CE is then a bundle of ideas that have collectively taken hold (Gregson, Crang, Fuller, & Holmes, 2015).

3.3 Contributing ideas and works

Out of the many ideas and works credited with having influenced and shaped the current concept of CE, some appear more often in literature and appear to enjoy a higher degree of consensus as being contributing ideas to CE. Several authors give a comprehensive list of

works they consider most influential on CE in the form it exists today (Ellen MacArthur Foundation, 2013a; Geissdoerfer et al., 2017; Korhonen, Honkasalo, & Seppälä, 2018) and while the exact works differ, they all seem to agree that the earliest ideas appeared in the late 1960s and early 1970s, exemplified by the works of Boulding (Jarrett & Boulding, 1966).

Other works that are frequently credited with significant contributions to CE are Performance Economy (Stahel, 1982; Stahel, 2010), Industrial Ecology (Frosch & Gallopoulos, 1989), Regenerative Design (Lyle, 1996), Natural Capitalism (Hawken, Lovins, & Lovins, 1999), Biomimicry (Benyus, 1997), Cradle-to-Cradle (McDonough & Braungart, 2002) and The Blue Economy (G. A. Pauli, 2010).

Closed system Earth and Laws of Ecology

Kenneth Boulding was a U.S economist who insisted that the economy had to be seen as part of a closed system. In his 1966 essay (Jarrett & Boulding, 1966) he argues that there is a need for the economic system to fit itself to the ecological system because all natural resources are limited, hereunder arguing that a well-functioning economic system ought to be circular in nature. Boulding describes the closed-system Earth as one with virtually no exchange of input or output with the outside, where everything within the system is looped. Boulding's work has paved the way for the field of Ecological Economics, which has had a contributing role to CE (Bruel, Kronenberg, Troussier, & Guillaume, 2019).

In his 1971 book "The closing circle: Nature, Man and Technology", ecologist Barry Commoner brings attention to the damaging aspects of the linear economy, and how it fundamentally differs from the cyclic processes in the natural environment surrounding us. According to Commoner, the environmental issues and impending crisis is merely a symptom of a fundamentally flawed economic system. This echoes Boulding's argument of the economy needing to be considered but a part of a whole and aligned with ecological systems. Interestingly, Commoner also predicts the proliferation of micro- and nano-plastics, citing the increase in the use of synthetic fibers in among other things, fishing gear, and the very characteristics that give these materials economic value as the culprit for future ecological damage. Both authors wrote their works amidst a growing trend of environmental awareness, and Commoner in particular is credited with popularizing the topic with the US public (Commoner, 1972).

The main takeaway from Commoner's work is *the laws of ecology* summarized in four simple statements:

1. *Everything is connected to everything else.*
2. *Everything must go somewhere.*
3. *Nature knows best.*
4. *There is no such thing as free lunch.*

In particular, we see that the first and second laws can easily be recognized as underlying truths to CE with regards to waste management and systems thinking, while the fourth law touches practical application and rationale for circularity as an ideal.

Performance Economy

Some years after the popularization of Boulding and Commoner's works, in 1976, Walter Stahel and Genevive Reday wrote a report for the European Comission titled "Substituting Manpower for Energy" (Product-life Institute, 2017a; Stahel, 1976), about the inherent wastefulness of disposing of old products instead of having them repaired. In the report, the authors introduce principles making up a "Loop Economy" as seen in **Figure 4**, reminiscent of contemporary descriptions of the CE (Product-life Institute, 2017b).

Stahel (2010) further developed these ideas in his later publications and involvement in the Product-life Institute throughout the 1980s and 90s, including the ideas of selling performance or utilization instead of physical goods and slowing the material flows through reuse, repair and reconditioning, both of which are central elements of the contemporary CE concept. Selling utilization rather than products is considered the main contribution to CE (The British Standard, 2017). Stahel (2016) considers Performance Economy (PE) but a form of CE, and according to him, the form with the most potential for profitability from a business perspective:

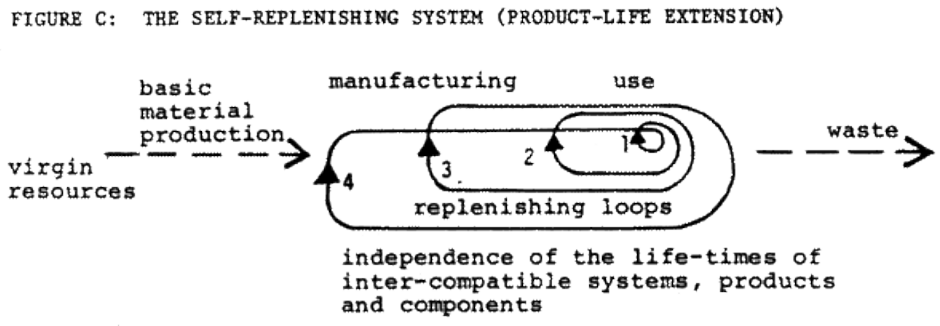

Figure 4: *The Loop Economy*. (Source: Stahel, 1976)

Industrial Ecology

Another contributing concept is the field of Industrial Ecology (IE), which is the study of material and energy flows through industrial systems (Ellen MacArthur Foundation, 2013a), and which focuses on emulating nature and employing it as a model. IE builds on the work of Boulding (Bruel et al., 2019). The concept was introduced in the article "Strategies for Manufacturing" (Frosch & Gallopoulos, 1989) where the authors put emphasis on the increasing amounts of waste generated by traditional industrial processes, and use diminishing resources and the difficulty of waste management as a rationale for creating industrial ecosystems where everything is looped.

In industrial ecosystems, processes transform circulating stocks of materials into new forms and products through the means of perpetually recycling materials. Another distinct feature is that the waste or by-product of one industry or process serves as input for other processes in the same or a different industry, thereby to a large extent eliminating the very concept of waste in a complex, interlinked system reminiscent of natural ecosystems (Andersen, 2006; Ellen MacArthur Foundation, 2013a). This idea also appears in many modern definitions of CE (Kirchherr, Reike, & Hekkert, 2017) and appears to be IE's main contribution to the concept (The British Standard, 2017). IE requires changing the industrial design of both processes and products, and the goal is to perform as close to a living ecosystem as possible (Bruel et al., 2019).

Regenerative design

Architect John Tillman Lyle has influenced CE through his work with human ecosystems and Regenerative Design (RD), where he argues that conscious ecosystem design is necessary in order to achieve a sustainable future (Mang & Reed, 2013). In his book "Regenerative Design for Sustainable Development", Lyle (1996) contrasts human designs with nature, writing that "*Where nature evolved an ever-varying, endlessly complex network of unique places adapted to local conditions*…" "…*humans have designed readily manageable uniformity*".

Lyle criticizes the linear system's degenerative capabilities and writes that it is only a matter of time before such systems destroy the resources that sustain them. He also introduces models and techniques for the design of regenerating, or self-renewing flows of energy and

resources that he considers essential pieces of a consciously designed human ecosystem (Mang & Reed, 2013). The very idea of design that regenerates its energy or material usage has become a common idea in contemporary CE product and system design (The British Standard, 2017).

Biomimicry

Also contributing to the design aspect of CE is the concept of Biomimicry. In her publication, biologist and educator Benyus (1997) adds to upstream considerations of sustainability by popularizing the idea of consulting nature in the innovation- and design phases of new products and systems. Her rationale is that nature, through its billions of years of research and development, has already found the optimal configuration for systems and processes and that we only need to look to it to find efficient solutions to the many environmental and other challenges poised.

Benyus writes that in order to tap into the knowledge stored in the living environment surrounding us, nature should be used as a model to be emulated, a measure for evaluation and a mentor to learn from (Ellen MacArthur Foundation, 2013a).

Natural capitalism

Contemporary to the Biomimicry movement, the book "Natural Capitalism: Creating the next industrial revolution" (Hawken et al., 1999) builds upon and complements the ideas described so far. The authors argue that while the natural resources and ecosystem services that enable life to exist are of immeasurable value and have no real substitutes, the current economic system fails to appreciate them and continues to liquidate what the authors call "natural capital". The book provides examples of how following certain principles could allow businesses to shift towards proper valuation of natural capital, without having to wait for a global consensus on the monetary valuation of said resources.

The four principles of Natural Capitalism (NC) are:

1. *"To radically increase the productivity of natural resources in order to save operating costs, capital investment and time."* Large parts of the inputs to contemporary industrial productions systems end up as waste because they are not utilized in an efficient manner (Lovins & Lovins, 2001). This must change in order to secure a surplus, allowing the implementation of subsequent principles.

2. *"Removing the very concept of waste by closing material loops and creating an economy based on nature's design."* Every by-product of production should be able to be returned harmlessly to nature as a nutrient, or to be used as input in another production process.
3. *"Moving from a business model based on the sale of goods, to one based on the provision of service and utility."* Instead of selling a car or a light bulb, transportation or illumination is provided as a service.
4. *"Reinvesting in natural capital with the surplus gained from the three previous principles."* Rather than taking the entire surplus out of the system as yield to shareholders, it should instead be reinvested into growing and securing natural capital through the means of planting trees or otherwise improving conditions for ecosystems.

As we can see, NC contains elements found in both IE (second principle) and PE (third principle), and its main contribution to CE, while not specified in most literature, seems to be the intrinsic valuation of natural resources (The British Standard, 2017).

Cradle to cradle

Cradle to Cradle contributes to the innovation and stewardship principles (The British Standard, 2017) of the CE concept, with emphasis on design (Nancy M. P. Bocken, de Pauw, Bakker, & van der Grinten, 2016; Ellen MacArthur Foundation, 2013a; Geissdoerfer et al., 2017). Published in 2002, the work by architect William McDonough and chemist Michael Braungart describes a design vision with biological and technical cycles, where products are designed with their end-of-life stage already considered. Cradle to cradle places emphasis on letting biodegradable inputs and waste return to nature in a non-harmful manner as nutrients, while non-biodegradable technical inputs are recycled for reuse under closed stewardship programs (Johnson, 2007). An important prerequisite for this cyclical system is knowing the molecular composition of materials used (Ellen MacArthur Foundation, 2013a).

Where the traditional IE considers design and stewardship of a product from cradle-to-grave, McDonough and Braungart's contribution lies in consideration of every stage of a product's life-cycle, even post-end-of-life. The consideration is done already in the design phase,

where products are carefully constructed for ease of deconstruction, in order to allow materials to enter the aforementioned cycles (McDonough & Braungart, 2002).

Blue Economy

In 1994, Gunter Pauli was asked to reflect on the future of business models as a preparation for the COP3 summit in Japan. In contrast to the traditional approach in business where the focus lies on a company's core competency and efforts to streamline and optimize this, Pauli claims that in order to achieve a more sustainable future with regards to job creation and zero emissions, businesses have to shift towards using all of their available resources to the fullest potential while meeting all basic needs of local communities (G. Pauli, 1997, 2019). In some ways, it can be seen as moving away from the rigid specialization that has been the norm since the time of The Wealth of Nations (Smith, 1937) and classical economics.

The book "The Blue Economy 3.0" (G. A. Pauli, 2010) gives hundreds of case-study examples of businesses who have shifted from a single revenue model to a multiple revenue model by internalizing more business opportunities through the use of resources to their full potential - by Pauli also called "clustering". A coffee company could for example, in addition to serving coffee, also use the coffee grounds to grow mushrooms, then utilize or sell the remaining grounds as nutritious animal feed or fertilizer. Blue economy's main contribution to CE is the idea of using resources in cascading flows, utilizing all its potential in as many iterations as possible (The British Standard, 2017):

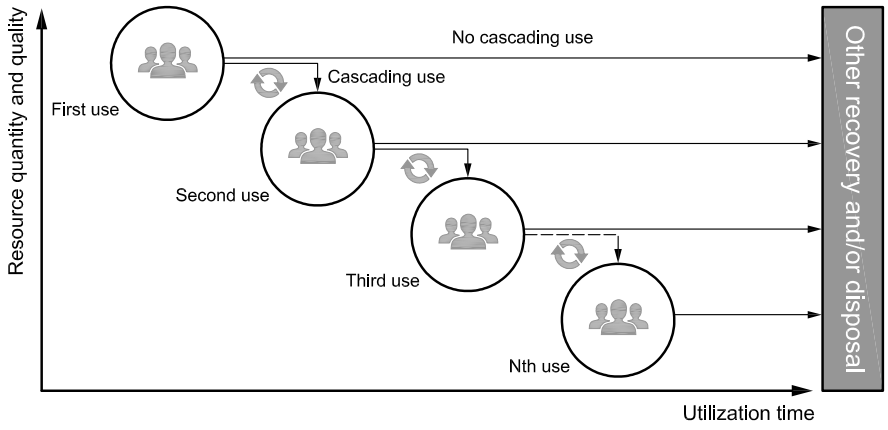

Figure 5: *Cascading resource usage*. (Source: The British Standard, 2017)

3.4 Contemporary influence and academic interest

3.4.1 Ellen MacArthur Foundation

CE is a contemporary concept and is continually being re-evaluated and reformed by experiences from practical application projects and new research. An important driver of

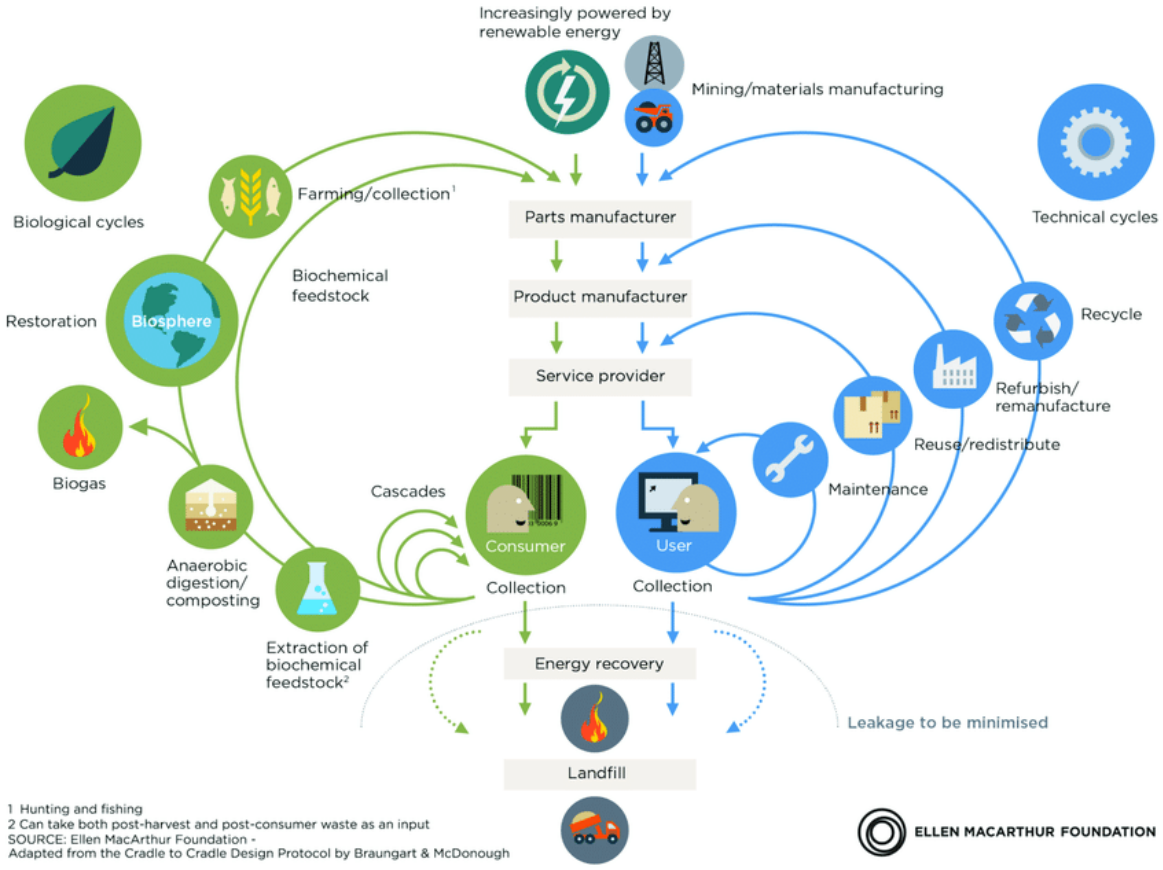

Figure 6: *Diagram explaining the flows within Circular Economy*. (Source: Ellen MacArthur Foundation, 2013a)

this continuous evolution is the UK-based Ellen MacArthur Foundation (EMF), a non-profit organization seeking to inspire the next generation through a framework of CE (Geissdoerfer et al., 2017) and acting as a collaborative hub where policymakers, businesses and academia can find common ground.

The foundation has published a number of informative all-encompassing reports (Ellen MacArthur Foundation, 2013a, 2013b, 2014) on CE, as well as several more detailed reports from situational or industry case-studies (Ellen MacArthur Foundation, 2017b, 2018, 2019) and other initiatives led by or partnered with the foundation (Ellen MacArthur Foundation, 2017a, 2019). The foundation's report on the ongoing effort to establish a new plastics

economy (Ellen MacArthur Foundation, 2017a) describes the importance of establishing a well-functioning post-use market for recycled plastics, which is an essential part of a CE for non-biodegradable materials.

The EMF has popularized its definition and diagram (**Figure 6**) of CE. The diagram shows cycles for biological and technical nutrients, the different stages of circularity from narrow to wide circles, and a focus on minimizing waste and external exchange (leakage) from the system to the outside.

3.4.2 Rising academic interest in CE

In recent years, academic interest in the field of CE has had a substantial uptick (Ghisellini et al., 2016; Merli et al., 2018). The publishing trend for peer-reviewed research papers with "Circular Economy" as its main topic is seeing an increasing trend following an exponential pattern (Merli et al., 2018). A literature review performed for a ten year period (Geissdoerfer et al., 2017) found that the publication of such papers grew from less than five in 2006 to more than a hundred in 2016.

A simple recreation of the search performed in the (Geissdoerfer et al., 2017) literature review for papers published after 2010 and including publications in 2017-2019 seems to corroborate with the assumption of a continued trend. It shows that annual publications rose to around 480 in 2017, more than 900 in 2018, and with 360 papers published between January 1st and the middle of April 2019 (**Figure 7**):

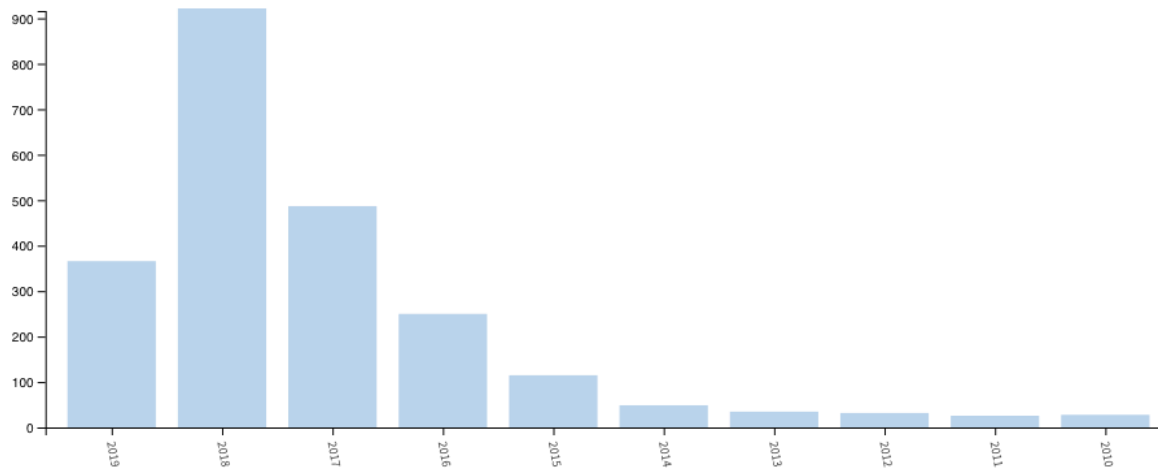

Figure 7: *Count of articles with topic "Circular Economy" in Web of Science in the period 01.01.2010-18.04.2019*. (Source: Web of Science, 2019)

The search also showed that while China was dominating publication statistics with almost 29.2% of all research papers on CE from 2006 to 2016, the years 2017-2019 has seen a Euro-centric shift with China's share falling to 11.5%. Europe's share was 57.2% in the first period, and 81.7% in the second period. The total count of articles in the first period was 555 and in the second period 1757, so while shares of the total have changed, all countries have actually increased their publication count of articles.

3.5 Complimenting concepts

Within the sustainability spectrum, CE is not the only economic concept to attempt tackling the many environmental and social challenges presented by the linear economy, and not the only one to gain popularity in the past decade. Among more mainstream complementing concepts are Bioeconomy (BE) and Green Economy (GE), joining the older idea of Sustainable Development (SD) (Brundtland, Khalid, & Agnelli, 1987), as keys to a more sustainable future. (D'Amato et al., 2017) compare CE with BE and GE respectively, attempting to do a comprehensive analysis of the differences and similarities between the concepts. (Geissdoerfer et al., 2017) compare CE with SD (Brundtland et al., 1987) in order to differentiate between the concepts and establish their relationship to each other.

According to (D'Amato et al., 2017), the aim in CE is for actors in the system to have no net effect on the environment around them, while achieving minimal external inputs and going far in eliminating the concept of waste output. The focus within CE is on the product and its life-cycle. BE, on the other hand, advocates that inputs to industrial systems should come mainly from renewable biological resources and puts emphasis on research and technology as an enabling factor. Both concepts revolve around better utilization of resources and improved resource productivity, but with different means and emphasis.

GE can be described as resource efficient, low carbon and socially inclusive and was found to have a broader spatial and temporal perspective than both CE and BE while including core aspects of both concepts (D'Amato et al., 2017). GE is the only one of the three to include social aspects like justice and public participation. The lack of social dimensions in CE is supported by (Homrich, Galvão, Abadia, & Carvalho, 2018) in their literature review which includes analysis of the triple bottom line (Elkington, 1998) in CE research. Other authors have suggested that both CE and BE can be considered concepts within a GE as an umbrella term (Loiseau et al., 2016). All three concepts were found to share a limitation in

that none of them challenge the paradigm of continued economic growth (D'Amato et al., 2017).

When it comes to SD, (Geissdoerfer et al., 2017) found that SD is a much broader and vaguer concept than that of CE, and points out differences in origin, goals, motivation, priorities, agents and timeframes among others. Where SD is more flexible, open-ended and can be adapted to situational context, CE has a clear goal of closed loops and reduced external resource input, as well as the elimination of waste. Where SD considers all aspects of the triple bottom line, CE prioritizes the economic system.

In literature, scholars view CE as one of several options which can be combined to achieve sustainable development (N. M. P. Bocken, Short, Rana, & Evans, 2014; Weissbrod & Bocken, 2017) and it is even suggested as a tool that could directly help implement many of the UN Sustainable Development Goals (Schroeder, Anggraeni, & Weber, 2019). Similar to GE, SD could therefore be seen as an umbrella term under which CE is a tool amongst many others, depending on which aspect is to be achieved.

3.6 Definition and exploration of the CE concept

As with sustainability before it, the definition of CE seems to vary widely based on the emphasis of each scholar or research paper (Geissdoerfer et al., 2017). Some definitions are narrow and explicitly focus on certain tools or aims of circularity measures, while others are wider and less detailed in their description. A common opinion seems to be that CE is a concept without a unified, unilaterally agreed upon definition and that some authors even mistake the concept for other established ideas (Kirchherr et al., 2017). This may be detrimental to further development in the field, but it might also be argued that a set definition may not be suitable when establishing a new socio-economic paradigm (Masi, Day, & Godsell, 2017). While there is a general consensus on the goals and means of CE, the problem remains of how to define it, making it an essentially contested concept (Korhonen, Nuur, Feldmann, & Birkie, 2018).

There have been some attempts at analyzing different definitions found in contemporary literature, notably an analysis of 114 different definitions (Kirchherr et al., 2017) through the usage of 17 different coding dimensions. A limitation of the Kircherr analysis was the necessary step of quantifying qualitative definitions, and through this possibly distorting

them from their complete original meanings. (Homrich et al., 2018) did similar research with a smaller, different sample of 35 definitions. Besides these comprehensive analyses, there exist at least 7 other literature reviews on CE (Kirchherr et al., 2017).

3.6.1 Different definitions

Definitions in the public sphere

The most well-known definition for CE is also the one with the most publicity (Geissdoerfer et al., 2017; Schut, Crielaard, & Mesman, 2016), namely the definition provided by the EMF in their well-known *Towards the Circular Economy* report series:

> *"A circular economy is an industrial system that is restorative or regenerative by intention and design. It replaces the end-of- life concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse and return to the biosphere, and aims for the elimination of waste through the superior design of materials, products, systems and business models".*
>
> (Ellen MacArthur Foundation, 2014)

This was also corroborated for academic use in the (Kirchherr et al., 2017) paper, where the above definition was used in 10% of papers in their total sample. However, looking at different publications from the foundation, it seems their definition is also subject to change and evolution (Ellen MacArthur Foundation, 2015, 2017a) as befitting its status as an emerging concept. The definition includes a basic component that is present in all of EMF's iterations, namely that of CE being a restorative or regenerative system by intention or design. In the toolkit for policy-makers released in 2015, a slightly different definition including some other key elements is being used:

> *"The circular economy is one that is restorative and regenerative by design and aims to keep products, components, and materials at their highest utility and value at all times, distinguishing between technical and biological cycles. This new economic model seeks to ultimately decouple global economic development from finite resource consumption. It enables key policy objectives such as generating economic growth, creating jobs, and reducing environmental impacts, including carbon emissions".*

(Ellen MacArthur Foundation, 2015)

Here, the idea of keeping objects at their highest value at all times is explicitly mentioned, along with the ultimate aim of CE, which is decoupling economic development from the consumption of finite natural resources. Additionally, the potential for job creation is mentioned as the document is geared towards policy makers.

Definitions by policy makers

Among other definitions easily accessible to the public is the one employed by the European Commission in the documents relating to their CE Action Plan and subsequent reports, describing CE as:

> *"…where the value of products, materials and resources is maintained in the economy for as long as possible, and the generation of waste minimized…"*
>
> (European Commission, 2015)

This definition is more simplified than the one popularized by the Ellen MacArthur Foundation, and omits many important measures, tools and aims that the Action Plan and reports go on to describe. The Chinese Circular Economy Promotion Plan of 2008 also defines CE in simpler terms while referencing the 3R framework (Su et al., 2013):

> *"a general term for the activity of reducing, reusing and recycling in production, circulation and consumption".*
>
> (The British Standard, 2017)

Definitions in Academia

As previously mentioned, there exist numerous research articles on the topic of CE, and the number of yearly publications is seeing an exponential trend. Many of these articles propose their own definitions of CE, although often they appear limited and focused only on the aspects to be analyzed by each research paper in particular (Kirchherr et al., 2017) possibly due to the length limitations imposed by peer-reviewed journals, or that some aspects appear self-evident to the authors. Another reason may be the emerging status of the field, and its position as a multi-disciplinary concept, which may lead academics of different schools of

thought to speak past one another instead of participating in a common global forum (Reike, Vermeulen, & Witjes, 2018).

Looking at definitions from arbitrary research papers would therefore not be useful without knowing their context. Instead, definitions provided by Homrich et al. (2018) and Kirchherr et al. (2017) may give a better insight into the range of ideas incorporated in the conceptual understanding in Academia. Homrich et.al (2018) proposed the synthesized definition:

> *"CE is a strategy that emerges to oppose the traditional open-ended system, aiming to face the challenge of resource scarcity and waste disposal in a win-win approach with economic and value perspective".*
>
> (Homrich et al., 2018)

Kirchherr et al. (2017) found that only three papers had definitions which included most of the 17 CE dimensions outlined as a basis of their research, and that out of them the clearest one was:

> *"Unlike the current economy, which is largely based on the principle "take-make-waste", the focus point in a circular economy is to not unnecessarily destroy resources. This implies far more than the reduction of waste through recycling, stresses the following focal points: reducing the consumption of raw materials, designing products in such a manner that they can easily be taken apart and reused after use, prolonging the lifespan of products through maintenance and repair, and the use of recyclables in products and recovering raw materials from waste flows. A circular economy aims for the creation of economic value, the creation of social value as well as value creation in terms of the environment".*
>
> (van Buren, Demmers, van der Heijden, & Witlox, 2016)

While including references to the 3R framework, hierarchical priorities, environmental quality, economic prosperity and social equity, it lacks references to the systems perspective, consideration for future generations and new business models as an enabling factor (Kirchherr et al., 2017). The authors therefore propose a synthesized definition of CE that includes all 17 dimensions:

> *"...an economic system that replaces the 'end-of-life' concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes. It operates at the micro level (products, companies, consumers), meso level (eco-industrial parks) and macro level (city, region, nation and beyond), with the aim to accomplish sustainable development, thus simultaneously creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations. It is enabled by novel business models and responsible consumers".*
>
> (Kirchherr et al., 2017)

This definition can be used as a reference when exploring the core concepts that CE consists of, and the tools that enable its implementation.

3.6.2 Core components

It is essential to have some knowledge of the core components of the modern understanding of CE in order to understand the definitions provided in-depth. While the definition of CE is contested, certain core components seem to have achieved a somewhat broader consensus, albeit not strictly unanimously understood. All the core components mentioned below can be found in numerous research articles and are supported by comprehensive literature reviews.

The R-framework

The idea of an R-framework is a core component often mentioned in various types of CE research (Ghisellini et al., 2016; Sihvonen & Ritola, 2015; Q. Zhu, Geng, & Lai, 2010). It most commonly consists of Reduce, Reuse and Recycle, as well as variations thereupon. While these three Rs are described as a core component (Korhonen, Honkasalo, et al., 2018), it can also be extended to include a fourth term, Recover (European Commission, 2015) or even frameworks with as many as 6 (Jawahir & Bradley, 2016) or 9 to 10 terms (Potting et al., 2017). The latter one is the most detailed of all the frameworks published to date (Reike et al., 2018) and can be seen in **Figure 8**.

The R-frameworks provide strategies for establishing loops, slowing loops and narrowing loops, however, while the inclusion of an R-framework is found in much of the research on

CE (Kirchherr et al., 2017; Reike et al., 2018) there is no standardization to speak of, not even when considering each term's meaning (Reike et al., 2018). For example, while "Recover" is used to mean the recovery of usable components for reuse in subsequent life-cycles in (Jawahir & Bradley, 2016), it is used to mean energy recovery by incineration in (Potting et al., 2017) and a combination of both in official EU documents (European Commission, 2015).

Hierarchies of R

Another feature in CE research is a clear hierarchy of priorities when it comes to the R-frameworks applied (van Buren et al., 2016). In a recent literature review on CE, 60% of the sample was found to clearly define a hierarchical structure of Rs (Reike et al., 2018).

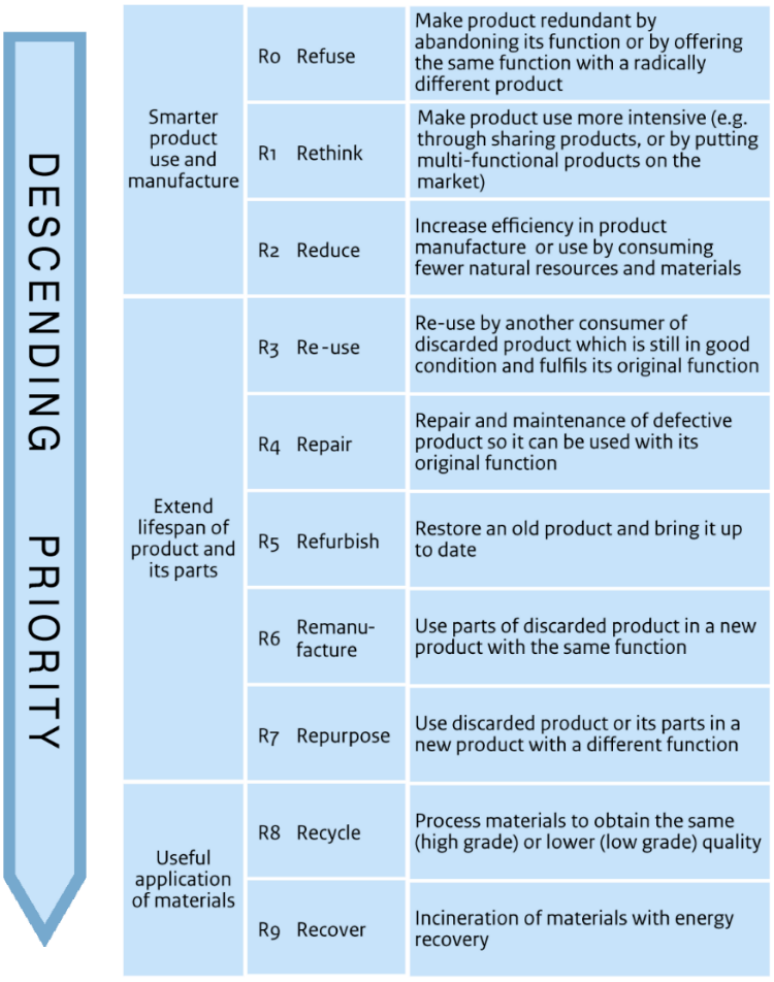

Figure 8: *The most detailed R-framework identified, with an example of R-hierarchy.* (Source adapted from: Potting et al., 2017)

As seen in **Figure 8**, there is usually a descending priority from the first R to the last R, where the first R is seen as a more efficient strategy for achieving the objectives of CE. In a more straightforward 3R framework, *Reduce* takes priority over *Re-use*, which again takes priority over *Recycle*. According to acclaimed CE contributing author Walter Stahel, *Recycling* is the least sustainable option of the three in terms of profitability and resource efficiency (Stahel, 2014).

The descending hierarchy naturally becomes a priority over the previously mentioned, and somewhat ideologically similar idea of cascading usage of resources emphasized by (G. A. Pauli, 2010), which would first come in at the R6, R7 and R8 stages in **Figure 8**.

Everything is looped

Looping has been a central component of CE throughout its development and continued evolution. The R-framework is an expression of strategies which can facilitate looping, and the hierarchy an expression of the length of loops, as well as the distance from the original purpose of the product. Reike et al. (2018) developed a ten stage R-framework similar to the one by (Potting et al., 2017) in **Figure 8**, where they classify all Rs up to repair as short loops, the following up to re-purpose as medium loops, and the remaining strategies as long loops.

Looping can either happen in closed or open variations, which is mostly relevant when the product reaches the long loop stage of recycling and beyond. An open loop is when the recycled materials of the product, also called recyclate, gain new lives as raw materials for products that are not the same as the product they originally came from (The British Standard, 2017). For example, plastic granulate from recycled fishing nets can become raw materials for the creation of sneakers or carpets. This is more common than closed loops, where the recyclate becomes an input for the same process or product, at the same production facility as the original product came from. In the simplified figure below, the dotted arrow shows a closed loop while the hollow arrow shows an open loop.

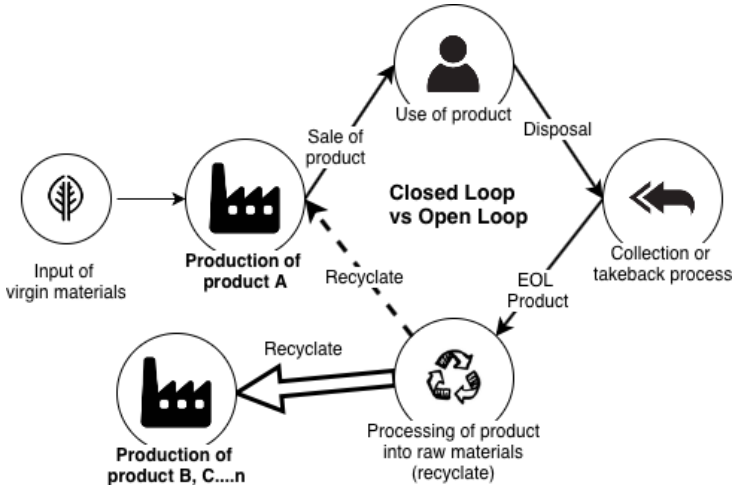

Figure 9: *Open and closed loop of a product*. (Source: Own)

In publications by the EMF, looping is considered sources of value creation and include four principles:

i) "the power of the inner circle", which emphasizes simplified design and material usage in order to allow the product to circle in the short loops at a higher speed and frequency;

ii) "the power of circling longer" referring to maximizing the number of consecutive cycles in an R-framework;

iii) "the power of cascaded use" which adopts Pauli's idea of cascading, thereby maximizing utility and retaining product value in cascades and;

iv) "the power of pure circles" which lifts up the benefits of uncontaminated material streams resulting in more efficient collection and redistribution/remanufacturing (Ellen MacArthur Foundation, 2013a).

Controlled reverse logistics

Often called the backbone of CE, reverse logistics systems are considered essential to the execution of CE activities. The term refers to all processes of reclaiming products and materials from the end user, where the aim is to capture further value from the product, even if it has fulfilled its original purpose (The British Standard, 2017). Reverse logistics can therefore be used to support several of the elements in the R-framework aiming to extend product lifecycle or facilitate subsequent value creation. In reverse logistics, roles are switched and the end-customer becomes the "supplier", forming a "reverse supply chain", albeit with some changes in actors from the normal supply chain. Reverse logistics can be organized as schemas, systems or programs, often as a result of take-back policies introduced by government (Klausner & Hendrickson, 2000).

3.7 Political support and implementation

Geng and Doberstein (2010) describe implementation as happening on either a micro-, meso-, or macro level, and gives examples of CE projects and initiatives on each level. The micro-level refers to companies, consumers and even individual products, while the meso-level refers to eco-industrial parks or industry clusters, and the macro-level to larger organizational units like cities, regions, countries and international projects.

The actual implementation of CE appears to still be in its infancy, and while policy-makers worldwide have supported the concept through such publications as the "EU Action Plan for a CE" from 2015 and "The Chinese Circular Economy Plan" from 2009, delivery of the CE seems to still be limited to individual companies and industry clusters running trial projects in various stages at micro- and meso-levels (Ghisellini et al., 2016). There exists no comprehensive review of implementation at the different levels, only individual research papers detailing implementation at specific geographic locations (Millar, McLaughlin, & Börger, 2019) with many such articles focusing on China.

In addition to China and the EU, there is also ongoing work in Norway to create a national plan for CE, but not much is known about it as it has yet to be officially announced outside of a news interview (Fjeld, 2019).

3.7.1 China

China is considered the first country in the world to officially vote CE into its national laws, and did so in 2008 after having formally accepted the concept six years earlier (Geng & Doberstein, 2010), with the laws coming into effect starting from 2009. Funding from the government has been readily available for both theoretical and applied research projects throughout this period China's approach to CE is described as a "top-down" approach, where the government plays an active role in implementation (Ghisellini et al., 2016).

Research literature shows that the CE Law and its connected policies have been effective in its first period (Wu, Shi, Xia, & Zhu, 2014) and also that implementation at the meso-level is underway, with more than a hundred completed, in progress, or planned demonstration-type eco-industrial parks across the country as of 2014 (Zeng, Chen, Xiao, & Zhou, 2017).

Such parks aim to close loops and share resources and by-products between companies in order to achieve minimal leakage to the outside.

It has been found that government intervention is necessary and that they should play a leading role in the transition to CE (Geng & Doberstein, 2010). However, the many policies backing up the Chinese CE Promotion Law are criticized for being too focused on the means, and lacking a holistic perspective with clear ambitions for what they should achieve (J. Zhu, Fan, Shi, & Shi, 2019).

3.7.2 European Union

EU launched its Action Plan for a CE in late 2015, containing an overarching strategy for furthering CE in the Union, as a tool for developing a sustainable, low-carbon economy which excels in resource efficiency and remains competitive (European Commission, 2015). The plan gives a rationale for each focus area, as well as summarizing its 54 planned actions for implementation by the year 2020. More recently, CE has been mentioned in EU documents as one of several areas that will lead to a climate-neutral economy:

> *"The road to a climate neutral economy would require joint action in seven strategic areas: energy efficiency; deployment of renewables; clean, safe and connected mobility; competitive industry and circular economy; infrastructure and interconnections; bio-economy and natural carbon sinks; carbon capture and storage to address remaining emissions".*
>
> (European Comission, 2018a)

In 2019, the EU Commission published a report on all their efforts to date, as well as a comprehensive overview of actions undertaken (European Commission, 2019a, 2019b). The report shows that in just over three years, most of the actions have either been implemented or are in progress, among them the development of an EPR-schema for fishing gear, as well as increased obligation to mark such gear. Additionally, the EU has created a set of measurement indicators available on a dedicated website where progress towards circularity can be observed at the union level as well as on the member state level.

The EU places emphasis on involving several levels in the Union, from member state governments to individual companies and consumers, and has what is described in the

literature as a "bottom-up" approach (Ghisellini et al., 2016). Still, one of the main barriers in the EU has been found to be a lack of awareness or interest at the micro-level with consumers and companies (Kirchherr et al., 2018).

There is also an emphasis on developing a state-of-the-art recycling industry within the EU, as currently the region suffers from an inability to transform wastes to resources at sufficient quality and capacity (Gregson et al., 2015). The status quo has been exporting excess waste to developing countries for processing into resources, but lately, countries like China have closed their borders for this trade in order to alleviate their own pollution problems, a measure that will have implications for CE development in other regions (Qu et al., 2019).

When it comes to policy, everything seems to be favorable for successful implementation of CE principles at all levels. However, up until now research has found that only limited progress towards practical implementation has been made (Kirchherr et al., 2018) and that significant effort still is needed in order to keep the momentum CE currently enjoys.

3.8 Tools for CE

While overarching policy and strategies are needed in order to facilitate the implementation of CE at all levels in the economy, there also exist more practical policy instruments and tools that can be utilized. From a business perspective, novel business models can be a driver of CE implementation while simultaneously providing new value capturing opportunities. From a policy-maker perspective, instruments like EPR, CE targets and measurement indicators are recommended tools by the EU, among others.

3.8.1 Circular business models

Business models define how a company does business, and once established, it is challenging to change that model (Nancy M. P. Bocken et al., 2016). A business model can help define how the company captures value from its products and value-adding activities (N. M. P. Bocken et al., 2014).

Circular Economy Business Models (CEBM) is a field of research with limited volumes of publications to date. (Geissdoerfer, Morioka, de Carvalho, & Evans, 2018) describe a CEBM as one that narrows, slows or closes resource loops, while at the same time intensifying or dematerializing them. They also write that CEBMs should build on sustainable business

models, which provide sustainable value in a long-term perspective, while proactively managing multiple stakeholder interests. In a recent paper, Lüdeke-Freund, Gold, and Bocken (2019) conducted a review of 26 different business models extant in literature and proposed six main trends for value creation in CEBMs supporting the same criteria proposed by (Geissdoerfer et al., 2018). These six were:

i) Repair and maintenance - proposing value to customers through extended product life, where companies must choose between offering warranties or selling products as a product-service-system with an up-front premium;

ii) Reuse and redistribution - requires the establishment of reverse logistics operation. Value proposition lies in prolonged access to familiar products at a reduced price, where companies can act as curators or brokers, earning on making second-hand products available to the market again;

iii) Refurbishment and remanufacturing - requires the establishment of reverse logistics operation. Proposes value through refurbishing or remanufacturing EOL products in order to give customers access to high or as-new quality products at a reduced cost, saving on raw materials for the company;

iv) Recycling - can create value through freeing up materials for use in production of new products, and the value proposition is often green input (recycled raw materials) or green products (made from recycled raw materials). The company can save on material costs, or earn on product differentiation by using green inputs;

v) Cascading and repurposing - seeing opportunities to use waste as green input or as part of products, earning on the creation of multiple revenue streams and using all available resources to their fullest potential in several iterations. The value proposition lies in the elimination of waste and disposal-needs, as well as capitalizing on what would otherwise be waste from a company's core activity;

vi) Organic feedstock - The end-stage of cascading. Once all technically and economically viable cascades have been explored; biological components can be processed into biofuel or composted for nutrient recovery, which both can act as green input for production processes

and thereby closing loops. The value proposition lies in utilizing waste to create input for production, saving on input costs.

The British Standard BS8001:2017 (see section 3.8.3) also mentions business models but does not go into particular detail. It lists six primary forms of execution of business models in order to support CE value propositions (The British Standard, 2017):
i) On-demand - In this business model, products are made to order once a customer demand is quantified, and an order is placed. Stock keeping can be minimized, and product redundancy is mostly avoided. Customization of products is possible.

ii) Dematerialization - Physical assets can be replaced with digital infrastructure and virtual services, saving costs without lowering perceived value for customers.

iii) Product life-cycle extension/reuse - The standard lists four strategies under this model. Product life-extension where products are designed in order to last longer and to be repaired or refurbished, and where such a service is offered; facilitated reuse, where the producer facilitates reuse of older models, with or without repairs; product modular design, where products are designed in order to let the customer buy upgrades without having to change the entire product at once; and Re-furbish/-pair/-manufacture/-condition where the producer can earn on a previously EOL products from a subsequent user by restoring it to "as new"-quality.

iv) Recovery of secondary raw-materials and by-products - The standard lists recovery and recycling, which is value optimization by recovering or recycling materials in closed or open loops for technical materials. It also lists incentivized returns, where the producer offers incentives in order to have customers return products they no longer want for a second life and value capturing opportunities for the producer, either through a self-initiated take-back system or as part of an EPR schema.

v) Product as a service/Product-Service-Systems (PSS) - Lease agreements where the company provides access to a product or a service but makes no promise on the results or performance level of the product or service. PSS may include service agreements to ensure a certain performance level, but the main characteristic of the model is earning on allowing customers access to a good without having to buy it. Ownership and responsibility for the

product remain with the leasing company, and the model is usually associated with higher revenues over time than a traditional sales model. Under this model, we also find performance-based service, where the customer pays for a certain delivery of performance or achieving certain results, for example paying lighting by the lux (light intensity per area). This may be offered with lease agreements to form a combination model, as in leasing a physical washing machine for a set amount of washing cycles.

vi) Sharing Economy or Collaborative Consumption - the final model provided by the standard is where the company provides a sharing platform that allows customers to purchase access to, or utility of, certain products at a price point which is much lower than if they were to buy the good in traditional sales transaction for their exclusive use. The model is common with freight forwarders, who provide platforms for customers to efficiently share shipping container space on sea voyages, or in cities which provide bike-sharing systems where access is gained for a limited amount of time from common hubs.

3.8.2 EPR as a transitional mechanism towards CE

Along with the development of CEBMs, a possible pathway to encourage organizations to integrate into CE is developing policies aimed to increase resource efficiency and to close material loops. Although businesses and consumers play a central role in the implementation of CE principles, local and national authorities are encouraged to accelerate this transition through a regulatory framework, and giving EPR a transitional role in the shift towards CE (Milios, 2018).

Because EPR has two primary goals of incentivizing manufacturers to design resource efficient products, as well as implementing end-of-life collection systems with subsequent reuse and recycling, it can be a cornerstone in the transition towards CE. Since a core EPR feature is the establishment of feedback loops from downstream (end-of-life management) to upstream (product design) (Lindhqvist, 2000), EPR is connected to both product life-cycle improvements and mandatory policy targets, providing a link between eco-design and end-of-life treatment, and between policy and implementation (Zero Waste Europe, 2019).

In a broader sense, EPR implementation and effective collection and recycling of plastics can trigger development of secondary material markets and enhance resource security. It can also reduce the burden on municipalities for plastic collection. However, not all products

are covered by EPR schemes, and some existing EPR schemes have failed to prove their effectiveness (Watkins et al., 2017). Watkins et. al (2017) recommend:

- To harmonize approaches through legislation and guidance;
- To integrate EPR into CE objectives through coverage of a wide range of products;
- To use effective monitoring and measuring techniques to increase transparency;
- To ensure clear allocation of responsibilities for maximum cost coverage and exclusion of free riders (users of the take-back system who are not paying into the system);
- To strengthen financial incentives to stimulate circular products and business models.

Findings on certain types of EPR schemes in Nordic countries indicate high collection and recycling rates. However, opportunities for further improvement remain in the area of product design optimization (Richter & Koppejan, 2016). To address complex challenges and ensure more effective policy interventions, Milios (2018) proposes a policy mix approach of three options for CE: policies for R-frameworks (reuse, repair, remanufacture), procurement policies (e.g. Green Public Procurement) and policy on the enhancement of secondary material markets.

3.8.3 The British Standard 8001:2017

In June 2017 the British Standard Institution launched a guide on the implementation of CE principles in organizations (BSI Group, 2017). It has been developed in cooperation with universities, industries, governmental and non-governmental organizations, as well as individuals and the nature of the guide is advisory rather than prescriptive. The standard's authors claim that it is the first of its kind, while at the same time being applicable in various industries and organizations regardless of size and location.

Organizations which do not have prior knowledge and expertise in CE can utilize the framework as it is written in a non-technical style and has practical application in real-world scenarios. In an effort to move away from linear economy through sustainable resource management, to unlock new revenue streams and become resilient to changing market forces, organizations can consider applying the BSI standard 8001:2017 as a flexible framework for managing implementation processes. The guide "*provides a valuable*

introduction to the practical action organizations can take to accelerate their transition to a circular economy" the project manager at the EMF, Francois Souchet said (BSI Group, 2017).

The guide consists of three main focus areas: "guiding principles", an "8 stage flexible framework" and "enabling mechanisms as supporting guidance" (The British Standard, 2017) as shown at **Figure 10.**

Guiding Principles

The British Standard 8001:2017 (The British Standard, 2017) describes the following principles as prerequisites for successful CE implementation in organizations:

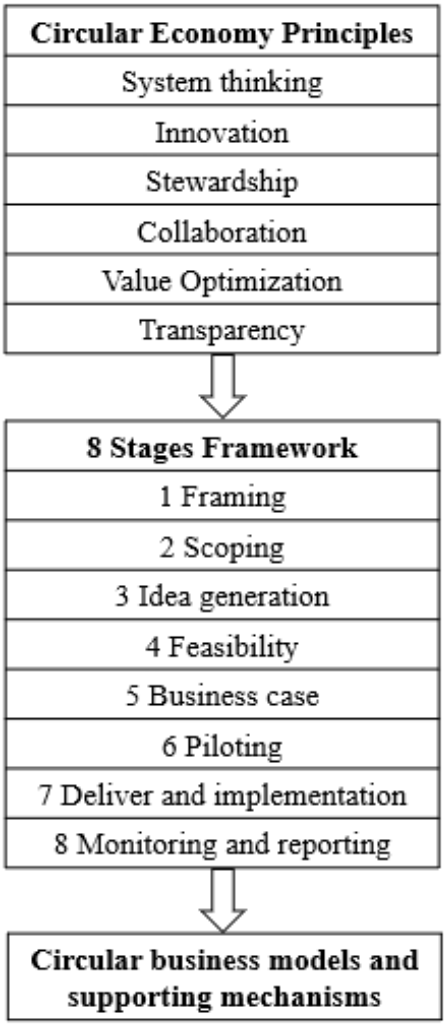

Figure 10. *Overview of the British Standard guide*. (Source adapted from: The British Standard, 2017)

- **System thinking** - views an organization as a part of a larger system with different stakeholders (e.g. suppliers, policymakers and customers), bounded geographically and dependent on many external factors (political, environmental, social, technological or legal). System thinking aims to help organizations obtain a holistic view of their processes and identify the consequences of those processes;

- **Innovation** - facilitates a transition towards CE. Can include new products and services or optimization of existing ones through research and development;

- **Stewardship** - implies that the organization takes responsibility for all decisions and activities throughout the products' life-cycles, taking into account present and future economic, environmental and social externalities. The key issue is information-sharing through the use of materials passports as well as improvement of employees and customers' knowledge and skills;

- **Collaboration** - highlights the importance of collaboration and the development of inter- and intra-organizational relationships. Combining forces is necessary for industries, governments, researchers, consumers and society to succeed in the transition towards CE;
- **Value Optimization** - value can take the form of decreased costs, new revenue streams or quantitative value. Three approaches are described as follows:
    1) The first approach is to minimize waste during the design and production phase, and if the product remains harmful, it is necessary to minimize its negative impact;
    2) The second approach is associated with prolongation of product life-cycles and/or multiple usages. Development of reverse logistics is required along with the creation of repair facilities and novel business models like leasing;
    3) The third approach is to create sharing systems which can help manage spare capacity across different businesses (B2B, B2C, C2C), reduce demand for energy and increase overall efficiency;

- **Transparency** - an integral part of corporate culture in many industries. The circular economy is not an exception and businesses are encouraged to provide information

regarding circular principle implementation within their organizations either voluntary or upon request, unless it breaches legal, commercial, or privacy obligations.

Flexible framework and supporting guidance

The main purpose of the "8 stages flexible framework" is to create a road-map for transformation into a circular mode of operation (**Figure 10**). Ideally, a real business case should exist when testing circular maturity in organizations. The British Standard (2017) denotes that the entry-point for each organization can be different depending on the kind of business and its current level of circularity. However, it is possible to move back and forth from stage to stage throughout the CE implementation process. By using supporting guidance (enabling mechanisms), organizations can analyze and overcome barriers in various parts of their supply chain, from material selection to reverse logistics and waste regulation (**Table 2**). At the same time, it allows for more sustainable management of resources and development of products with long-term business value (Charter, 2018).

Issues	**Economic**	**Technical**	**Policy & Regulatory**	**Behavioral**	**Organizational**
Accounting & Finance	✓				
Anti-trust & competition law					
Chemicals		✓			
Energy & fuels					
Information management			✓		
Liability & insurance					
Logistics & reverse logistics				✓	
Marketing					
Materials markets					✓
Materials selection					
Monitoring & measurement				✓	
Procurement & contract management			✓		
Product design & development		✓			
Waste regulation	✓				

Table 2. *A matrix of enabling mechanisms*. (Source: The British Standard, 2017)

Criticism and limitations

Although the British Standard 8001:2017 was only launched recently, the *guideline on the implementation of circular principles in organizations* has already gained a critical appraisal, in particular amongst researchers and academics. Pauliuk (2018) criticizes the guide for its vagueness, the absence of wider socio-economic impact such as creation of new jobs, and ethical aspects like customer behavior. He also recommends balancing the lack of quantitative instruments for life-cycle assessment and material flow cost accounting by incorporating ISO standards on environmental management (ISO, 2011, 2014) and develop more detailed methodological and measurement guidance for monitoring and reporting.

3.9 Expected benefits of CE

Changing business models and applying policies like EPR can seem like drastic measures for the individual actors in a system, and a question remains of which benefits can be expected from implementation of CE principles on micro-, meso- and macro-levels. Sustainability has a goal of benefiting both the environment, the economy as well as the society at large (Elkington, 1998) and CE can be seen as subsidiary to the broader movement of sustainability (Weissbrod & Bocken, 2017).

There are specific benefits often mentioned in association with CE. Most notably a benefit to the environment through lower levels of natural resource extraction (Ellen MacArthur Foundation, 2014), with avoidance of associated pollution and negative externalities for ecosystems, the avoidance of orphaned waste in nature by merit of CE supportive take-back systems or EPR (MEPEX, 2018), and the reduction of emissions through the slowing of loops by consecutive cycling in the R-framework, as well as increases in renewable energy (Ellen MacArthur Foundation, 2014). Most of the environment-related benefits are found at the macro- and meso-level, as a clean and robust environment is a common good and resource.

Geissdoerfer et al. (2017) write that the primary focus of CE seems to be the economic aspect and that the primary beneficiaries are economic actors choosing to implement it, implying actors at the micro-level. The EMF gives ample examples of the economic benefits associated with CE implementation; At the micro-level, resource efficiency and lowered dependence on virgin raw materials can provide an economic benefit to companies, while

novel business models may give a cost-reduction to the consumer. On a meso- and macro-level, economic benefit mostly consists of cost savings in relation to environmental degradation, but also opportunities through job creation and new waste-treatment industries.

In the social dimension, job creation is the most apparent benefit arising from CE, and a report to the Club of Rome by (Wijkman & Skånberg, 2015) found that in five EU-countries studied, CE has the potential to add between 165,000 and 650,000 new jobs depending on which decoupling strategy is followed. On an EU-wide level, it is estimated that CE may lead to a net growth of 2 million jobs due to increased resource efficiency (MacArthur, Zumwinkel, & Stuchtey, 2015) and substitution of manpower for energy as virgin material inputs are replaced by existing stock through the R-framework (Stahel, 2011).

3.10 Limitations, challenges and barriers to CE

CE can often appear romanticized, especially when it is described as an economic paradigm shift (Genovese, Acquaye, Figueroa, & Koh, 2017; Korhonen, Honkasalo, et al., 2018; Merli et al., 2018) and while often celebrated, is rarely subject to critical interrogation or analysis in order to identify limitations and weaknesses (Gregson et al., 2015). Still, a few authors have described limitations and weaknesses that apply to the concept. Some concerns are epistemological in nature, like the lack of consensus on a definition and its exact content, while others relate to the practical sphere and implementation of CE.

Gregson et al. (2015) worry that the idea of perfect loops in CE is taken for achievable fact by many actors, while in reality it should be considered an unachievable ideal for a number of reasons; notably that the process of resource recovery itself generates wastes and that perfect recovery is physically not possible due to increasing entropy (Genovese et al., 2017). Also, descriptions of CE rarely account for the flow of materials and resources which are economically non-recoverable (Moreau, Sahakian, van Griethuysen, & Vuille, 2017).

When it comes to implementation, Gregson cites the paradigm-changing nature of CE as an issue because it requires the conscious and conscientious effort of very different actors in a system, making the task potentially daunting and progress inefficient. This is echoed by Sauvé, Bernard, and Sloan (2016) who raise concerns that the cost of developing

infrastructure and supply chains to establish loops may be too high, and that intervention by authorities therefore is necessary in order to facilitate implementation.

In the absence of intervention, Sauvé et al. (2016) claim that a major barrier to CE is that it is more expensive to produce long-lasting, durable goods than their disposable counterparts, and describe the problem as disposables benefiting only the producer due to its lower cost, while durables mostly benefit actors indirectly through environmental improvement or pollution avoidance. Economy is at the core of most decisions taken in companies, and the very nature of economic thinking may also prove a serious challenge to the effectiveness of CE in achieving its goals. (Zink & Geyer, 2017) critically examine CE with regards to an economic rebound-effect, claiming that any improvement in resource efficiency and cost-savings for companies eventually will manifest itself as lower prices to consumers and increased consumption in most product categories, undermining the potential reductions in resource extraction and dependency on virgin materials. This supports beliefs that CE cannot effectively achieve its goals without a simultaneous effort to reduce overall consumption levels and establish a new consumption culture (Korhonen, Honkasalo, et al., 2018).

Kirchherr et al. (2018) research practical implementation from a European perspective and discover evidence of barriers in cultural, market, regulatory and technological categories. Among other things, they find that there is too little interest from both consumers and companies, little willingness to co-operate in value chains without intervention, and a lack of technical ability to deliver high-quality products based on recycled stock materials. The latter is described in detail by Gregson et al. (2015) in a critical review of the European plan for CE, which she claims is unrealistic when it comes to goals for a circular EU, but mainly from an economic perspective rather than a technical one.

4.0 Methodology of the research

4.1 Research design

In our research, we follow the recommendations of Bryman (2001) and Yin (2003) in order to conduct an analysis. Bryman (2001) defines five types of social researches: experimental design, cross-sectional design, longitudinal design, case-study design and comparative study. Further Bryman (2001) describes two approaches: qualitative and quantitative.

We think that the most suitable way of conducting our research analysis is to use a qualitative approach and a case study design with to explore ***'how the implementation of CE principles can help Norwegian fishing gear producer(s) operate under different EPR scenarios'***.
The unit of analysis in this case study is a Norwegian importer and distributor (*henceforth known as 'producer', 'focal company' or 'case company'*) of equipment for fisheries and aquaculture.

For the purpose of our research, we have conducted semi-structured interviews with the company management and administration team. The case is analyzed according to established case-study protocol. The protocol consists of the following sections: 1) An overview of the company case; 2) Data collection procedures; 3) Analysis and interpretation (Yin, 2003).

4.1.1 Case selection

A producer of fishing gear in Norway is selected as a case. We selected a fishing gear producer due to a lack of research on such companies' integration into CE and the status of reuse and recycling of materials within the fishing gear industry in Norway. In particular, we intended to explore the applicability of circular principles from the perspective of a single or multiple producer(s), noting that implementation of EPR for equipment used in fisheries and aquaculture was in the talks among policy-makers. At the same time, this choice allows us to address upstream and downstream issues as producers are intermediate actors and interact with many stakeholders across the supply chain.
Initially, we intended to use a multi-case study design as: *"In general, case studies are the preferred strategy when "how" or "why" questions are being posed, when the investigator has little control over events, and when the focus is on a contemporary phenomenon within some real-life context"* (Yin, 2003). Eventually, one of two targeted fishing gear producers did not want to participate in the research, without specifying why. However, we decided to continue our initial research despite single case studies not being representative for a broader group. We were mainly driven by the motivation to contribute to research on specified issues by aggregating data on the company level and form a basis for future research in this area.

4.1.2 Applying the British Standard 8001:2017 framework in the company case

Implementation of new ideas and concepts often requires a system perspective as it involves several different stakeholders from both (inter)-national and organizational levels (Kalmykova, Sadagopan, & Rosado, 2018), where legislative bodies play a significant role. As mentioned earlier in Chapter 4, the level of our research is bounded by organizational width (Korhonen, Honkasalo, et al., 2018). When it comes to practical implementation, we observe that numerous study papers are rather abstract and lack definitions of implementation tools and instruments, metrics and measures. Charter (2018) describes the 'triple-bottom-line' sustainable approach by (Elkington, 1998) (economic, environmental and social dimensions) and refers to the British Standard 8001:2017 – the pioneering guide on CE principle implementation in organizations (The British Standard, 2017) which we have decided to apply for our case study as a framework.

Although CE as a concept has existed for a long time, practical evidence of its implementation is limited worldwide. At the initial phase of our study, we struggled with finding an appropriate framework with which we could analyze the company case. Our decision to use the British Standard BSI 8001:2017 and the guidance on the implementation of CE principles in organizations (The British Standard, 2017) was due to its uniqueness, its top-down approach from generic to specific issues and its comprehensive and easily understandable narrative. The latter has played an essential role during the interview process, since we suspected from the beginning that fishing gear producers in Norway might not be aware of the concept or had only limited knowledge of CE.

The explorative nature of our study allowed us to ignore the guide's lack of quantitative measures, concentrate on the qualitative part and do the preparatory groundwork for future research. Noting the testimonial nature of the original framework, we have made adjustments in consideration of this being the case company's first participation in an academic research project of this kind. The data collection process is described in detail in the following section and reflects the main focus areas of the standard.

4.1.3 Data collection

Data for the case consists of primary and secondary data. Primary data consists of open-ended, unstructured interviews with the company's personnel within the scope of our research. Documents like government reports, academic articles, and web sources have served as secondary data in order to obtain general case study understanding, as well as an understanding of the CE concept itself. This allowed us to triangulate data and strengthen the evidence of our case study.

All interviews were conducted in person and divided into two phases. Before the interviews, initial contact had been established through e-mail, followed by an initial visit to the company where the general purpose and focus area of our research was explained to the management team. A list of questions was sent a few weeks prior to the actual interview in order to facilitate the process. All three interview guides have been developed based on the British Standard 8001:2017 and the guide for implementing circular principles in organizations (The British Standard, 2017) and adjusted after the first visit to better account for company size, and a relatively informal management style and decision-making process. In total, we have interviewed six team members.

Our intention with the first interview guide was to identify the current stage of CE activities in the company, in other words, to discover existing or future opportunities for transition to a CE. An interview based on this guide was conducted during the initial visit, and the collected information was used to develop subsequent questionnaires related to the second phase of our interviews.

1. Does your organization know how the circular economy may be relevant to its long-term future and resilience?
2. Do you have a strategic plan and direction for your circular economy activity?
3. Have you explored and prioritized a set of ideas or options for how to bring the circular economy to life?
4. Does your organization feasibility plan or approach for how to test and develop ideas?
5. Has your organization unlocked the appropriate resources to pilot and test ideas ad approaches?

6. Has your organization piloted or experimented with ideas/concepts to test and determine viability?
7. Has your organization successfully integrated ideas and opportunities?
8. Does your organization track and monitor progress and have a mechanism to capture ongoing learnings?

Table 3. *Interview guide 1.* (Source adapted from: The British Standard, 2017)

The purpose of the second questionnaire was to evaluate the case company's level of integration into CE through shared vision and adoption of circular principles in the company's strategy and decision-making process:

1. To what extent are you informed about EU/Norway plan to introduce Extended Producer Responsibility for fishing gear and make producers responsible for collecting the equipment after end-of-use and recycling?
2. To what extent does you company care about social and environmental impacts from upstream activities and acquisition of materials and downstream issues associated with end-of-life phases of fishing gears? Why?/Why not?
3. To what extent does your company keep all the products/components at their highest value (e.g. product longevity, multiple-cycle use, repair centers)?
4. What strategies have been adopted to prolong life of the products, components and materials (e.g. parts and components can be easily disassembled)?
5. Have you thought what happens to your products at the end-of-use? Why?/Why not? If not, does anther party get value from your product at the end of phase?
6. To what extent are you open to communicate and ready to disclose information relevant to the transition to circular mode of operation (e.g. composition of materials, chemical ingredients in products, anticipated lifespan of the product, repair manuals, etc.)?
7. The transition into circular mode of operation might require external collaboration with key actors. To what extent do you currently collaborate with businesses (partners, suppliers), government, academia, civil society and consumers to enable sustainable management of resources?
8. Innovation is a key to the transition to a more circular mode of operation. During our first visit you have mentioned a new equipment that can bring additional value to your current activities. Could you please describe the new business idea?
9. Would you say that the new business solution might benefit the environment and increase/save costs? Why?/Why not? How?

10. Is there any way Norwegian authorities could enhance the attractiveness of this type of solutions through policy instruments, investments or changes in the regulatory regime? If so, which supporting policy actions would you like to see?"

Table 4. *Interview guide 2*. (Source adapted from: The British Standard, 2017)

The final interview guide served as an instrument to explore the company's opportunities and concerns related to transition into CE and to identify which circular business model(s) would be considered by the company as most suitable noting internal and external factors.

1. There are at least three different approaches to EPR implementation: Original Equipment Manufacturer (OEM) Takeback, Pooled Takeback and Third-Party Takeback? Which one of these scenarios do you think is the most acceptable for fishing industry in Norway? Why?/Why not?
2. Any of these scenarios would potentially mean increased costs (creation of take-back systems and new jobs, communication with customers, participation fee, etc.). Currently, the prices paid for fishing gear and nets (FNR) do not include economic value of caused environmental damage. How do you think your organization would deal with the increased costs (e.g. polluter-pays or customer-pays)? Why?/Why not?
3. To support innovations, an organization might need to invest over a longer term than previously (as internal rates of return might not be appropriate). To what extent does you company ready to undergo transition to more sustainable mode of operation and adopt the principles of circular economy?
4. How would your organization evaluate, monitor and measure the effectiveness of innovations?
5. Systems that rely on less input of new materials can lead to a significant energy savings either through reduction of raw materials or through reuse and recycling of secondary raw materials. Do you think it could area of your focus? Why?/Why not?
6. EU Commission's proposal of amended Fishery Control Regulation includes the new requirements on marking gear (e.g. place of origin, producer/importer name, chemical composition of materials, guidance how to disassembly, reuse, repair, etc.). How do you think your company might develop or use such mechanisms (e.g. product passports)? Why?/Why not?
7. To what extent does your company take into account the social, economic and environmental aspects through the material's life cycle: a) sourcing of materials; b) end-of-life of materials (whether they can be easily reused/recycled);

c) end-of-life of product (how intensely a product is likely to be used - with or without repair)?
8. Reverse logistics (e.g. take-back systems) is the backbone of circular economy. There will be a need to establish relationships with collection operators and recycling processors. Is there any way Norwegian fishing industry could voluntary initiate, negotiate and organize this process? Why?/Why not?
9. The transition to a circular mode of operation includes end-of-use considerations at the procurement stage. To what extent does your company ready to change supply contracts to support circular economy objectives?
10. How would you re-design your product to meet circular economy objectives: a) end-of-life recycle; b) end-of-life recycle and remanufacture; c) end-of-life reuse (product life extension); d) lease agreement?

Table 5. *Interview guide 3.* (Source adapted from: The British Standard, 2017)

The interviews lasted anywhere from 12 minutes to 1 hour depending on the interviewee and their position in the company. The questions did not follow the initial listed order, and the interviews took the form of casual semi-structured discussions rather than formal interviews.

4.1.4 Data analysis

In the data analysis, we intended to follow the strategy of theoretical proposition (Yin, 2003). Our research questions helped us to prioritize the collection of certain data which was presumed more relevant for the case study. We sought to uncover, using the example of our case company, the state of circular thinking in the fishing gear industry of Norway, the applicability of CE principles in the industry, upstream and downstream challenges and opportunities towards its implementation and practical opportunities for circular business realization.

To alleviate problems associated with biased data (Eisenhardt & Graebner, 2007), we decided to interview as many different employees as possible, considering company size and availability of personnel on the day we visited. All the interviews have since been transcribed and sent to the interviewees for review in order to avoid misinterpretation. The collected

data allowed us to perform an analysis where our main objective was to find support in the theoretical concept for our empirical evidence.

4.2 Research quality

4.2.1 Reliability

Bryman (2001) describes reliability as a way to decide if the study is repeatable. In other words, it intends to measure whether the research method is consistent. It also relates closely to the term replicability. To enable future researchers to replicate our findings, we have developed a case study protocol - a major tool for increasing reliability in a single-case study (Yin, 2003). Furthermore, six semi-structured interviews have been recorded and transcribed, which makes it possible for other researchers to analyze our collected data and which reinforces the reliability of the current study. The majority of interview questions were open-ended, and interviewees had relative freedom and flexibility in answering them. Interviews done in the future might not receive the same answers despite using the same interview guides. This can be due to a change in circumstances and an increasing awareness in the company employees on the topic researched. The likelihood of disparity between original findings and potential replicated ones means that the reliability of this study can be regarded as low.

4.2.2 Validity

Validity is associated with the integrity of conclusions derived from research (Bryman, 2001). As explorative case-studies are criticized for a certain level of subjectivity due to personal conclusions and opinions, we have tried to increase the quality of research and strengthen both its construct as well as internal and external validity (Yin, 2003).

Construct validity is associated with an operational set of measures used to collect data. In our study, we have referred to multiple sources of evidence. In addition to direct semi-structured interviews, secondary data in the form of theory and supporting documentation was used to develop the study concept. The latter helped us establish a link between the research questions and case study findings. Additionally, a draft of the case study report has

been sent to the interviewees for review and approval, thus increasing the trustworthiness of results.

Internal validity has not been given attention as this is "only a concern for casual (or explanatory) case studies" (Yin, 2003), and not as relevant for explorative case studies.

External validity is related to the problem of representativeness. The empirical findings of a single case study usually have a weak basis for generalization (Yin, 2003). To test theory and replicate original findings, the use of multiple case study or survey research is recommended as a methodological instrument for conducting future analyses.

5.0 Empirical analysis

Chosen research methodology assumes case overview, analysis and implication of findings. The basis for analysis is the set of research questions presented in the introduction chapter. We discuss collected data and define similarities and differences between case findings and theory. We then interpret the results and give further suggestions.

5.1 Case overview

Introduction to the case topic

We attended a two-day conference in Ålesund in April of 2018 on the topic of CE and fishing gear, hosted by the EU-supported multi-national project "Circular Ocean". In Norway, the project was managed by the sustainability department at the Norwegian University of Science and Technology (NTNU) and was due to conclude its four-year project period shortly after the conference. The conference summarized the research undertaken and its findings on the topic in many of the participating regions.

Inspired by the challenge presented at the conference, which mainly focused on derelict and abandoned fishing gear and the problem of Ghost Fishing, we asked a representative from NTNU about the potential of writing a master thesis related to this topic. From the representative, we learned that the project would likely be continued under a different name, "Blue Circular Economy" starting in the autumn of 2018, and also that there were talks of EPR for fishing gear in Norway.

Later that year, we attended a five-day innovation camp hosted by a project organization under the Ministry of Trade, Industry and Fisheries. Included in this camp was attendance at an industry conference where actors in the fishing gear industry, fisheries and related companies participated. A chance meeting between us, the CEO and another representative from our focal company led to an understanding that the focal company was interested in participating in our master thesis project. We had some correspondence with the focal company throughout the autumn semester, and by January 2019, we had come to an understanding of a topic, research questions and method.

In our thesis project, we wanted to gauge the readiness of the fishing gear industry with regards to a potential national or international EPR for fishing gear. We would do this by exploring the current state of circular maturity and attitudes in a case company, as well as their opinions on barriers and drivers for a more circular mode of operation through conducting interviews in a case study.

The Industry

The fishing gear industry in Norway has a long history, and while the production or creation of fishing gear traditionally was an artisan craft done locally by each fisherman or by a skilled artisan, the 19th century saw fishing gear production companies being established and a resulting shift from artisan craft to industrialization (Dybdahl, 2018). Today, the industry consists of a handful of medium to large-size actors and several smaller niche companies. Almost none of the actors have any part of their own production of gear remaining, and all actors import large parts of their stock or materials from outsourced production facilities in Asia.

The industry is characterized by several companies offering standardized, relatively undifferentiated products, and the main production materials are various kinds of plastics. Traditionally, the larger actors have covered the entirety of the Norwegian coast through strategic storage facilities and offices. This presence is supplemented by smaller actors offering niche equipment or service.

The focal company

The focal company is one of the medium- to large-size actors in the fishing gear industry in Norway and has existed since sometime in the latter half of the 20th century. They have less

than 100 employees and are experiencing continuous growth and increasing market shares. The company is characterized by being innovative and somewhat disruptive, having had some novel solutions that have led to industry development throughout its operating history. According to themselves, they place emphasis on being pioneers in fishing gear development and being able to offer customers the most effective and safe fishing gear available on the market, at attractive prices, and with an unmatched quality standard.

Similar to its competitors, the focal company does not have local production of FNRs, but rather import ready-made products to their specification from large factories in Asia, or import components for assembly locally in Norway.

In addition to traditional sales of fishing gear, the company offers replacement of worn parts of certain gear, in particular for types of FNR where the nets are refurbished with new materials. This work is performed by an external protected company providing meaningful work to marginalized
social groups. Because this protected company has a limited processing capacity, the focal firm is working on developing an innovative machine or robot to improve capacity. A third-party recycling intermediary handles waste material from the refurbishing service before it is exported to recycling in the EU.

Typical customers of the focal company are commercial coastal fisheries and aquaculture companies, as well as those who enjoy recreational fishing on a non-commercial scale. Aquaculture has a smaller, unspecified share of the company's custom, while fisheries have the majority.

Within the fisheries segment, 80% of the customers are commercial-scale fishing companies, while the remaining 20% are those enjoying recreational fishing. Apart from the refurbishing service, customers have also expressed interest in a reverse logistics service for more product types, and the focal company is working on establishing partnerships with third-parties for onwards handling and processing of end-of-life FNRs.

The case: External pressures

The potential introduction of EPR to prevent abandonment of fishing gear, subsequent ghost fishing and environmental and oceanic pollution could be seen as a threat to the fishing gear

industry as it operates today. The industry operates within the traditional linear economy and may not be prepared for changes an EPR would require of them, namely a shift towards a more circular mode of operation. The EU has nominated EPR as a promising tool and transitional mechanism for a functioning CE in their union-wise plastics strategy, and in March 2019 it voted in favor of amendments to the waste-directive, which includes requirements of EPR for fishing gear containing plastics (European Parliament, 2019). Simultaneously, work has been undertaken in Norway to chart the feasibility of a domestic EPR for fishing gear (MEPEX, 2018) and the government is in the initial stages of work on a national strategy for the circular economy (Fjeld, 2019).

As seen in the upper part of **Figure 11**, political action on CE and impending fishing gear EPR by both the EU and Norway acts as external pressures on the case company and its supply chain. In addition to this, new regulations or outright bans on the import of harmful waste in several countries in Asia is closing a traditional avenue of waste disposal for many companies, including producers of fishing gear. This pushes forth change by necessity, as customers of the case company are constantly requesting disposal options for purchased products that have reached their end-of-life stage.

Current practice, potential opportunities and their barriers

In the bottom part of **Figure 11**, we have attempted to illustrate current practice, material flow, identified barriers and future potential relating to CE in the case company. As per the legend in the bottom right corner, lines have been color-coded to show the state of materials that move between actors, classified as either new products and materials (violet), waste/EOL products and materials (burgundy), or recycled/refurbished/repaired products or materials (green). Current practice is shown through solid lines, while potential opportunities are shown as dotted lines. Identified barriers are shown as large black crosses.

As we can see in the figure, suppliers in Asia provide the case company with new FNRs, and suppliers in Europe provide spare parts and materials. The case company then assembles, stores and distributes FNRs to its customers in fisheries, aquaculture and recreational fishing. Customers send FNRs that have reached their EOL-stage either to the case company or to external repair centers, both able to refurbish FNRs by cutting old nylon netting from the rope frame and replacing it with new nylon. Only about 30% of the sales

volume is returned for refurbishment, while the missing figure is assumed disposed of in other ways.

Once refurbished, products are sent back to the customers for a second product life, while waste nylon cuttings are sent to a recycling agent. Repair centers send their waste nylon directly to the recycling agent, while the case company sends its nylon first to the repair centers. The nylon from the case company's own refurbishment operation is sent along with nylon from customers who refurbish products independently, as a form of goodwill service by the case company. The nylon is then recycled and sold onwards in an open loop system, becoming input for production processes in other industries.

The dotted green lines show the potential for a closed loop system for FNRs, and the dotted burgundy line shows the potential for direct relations between the case company and recyclers. Crosses denote barriers, and all of the elements in **Figure 11** are further described in the next chapter.

5.2 Findings

By analyzing interview transcripts and locating answers to questionnaire questions, we were able to form an understanding of how existing knowledge, attitudes and activities in the case company fit within the British Standard's six CE guiding principles, continuing to loosely follow the Standard's eight stages flexible framework presented in Figure 10. The Standard gives a general description of maturity levels for each principle, and we were thus able to assess where the company seemed to belong based on our findings.

Table 6 shows an overview of our assessment of the case company within each guiding principle and the corresponding circular maturity level. By examining the table, we see that most of our findings imply a basic level of circular maturity. The stewardship and innovation principles imply a pull towards the "improving" level, while collaboration and value optimization implies a pull down to the "unformed" level.

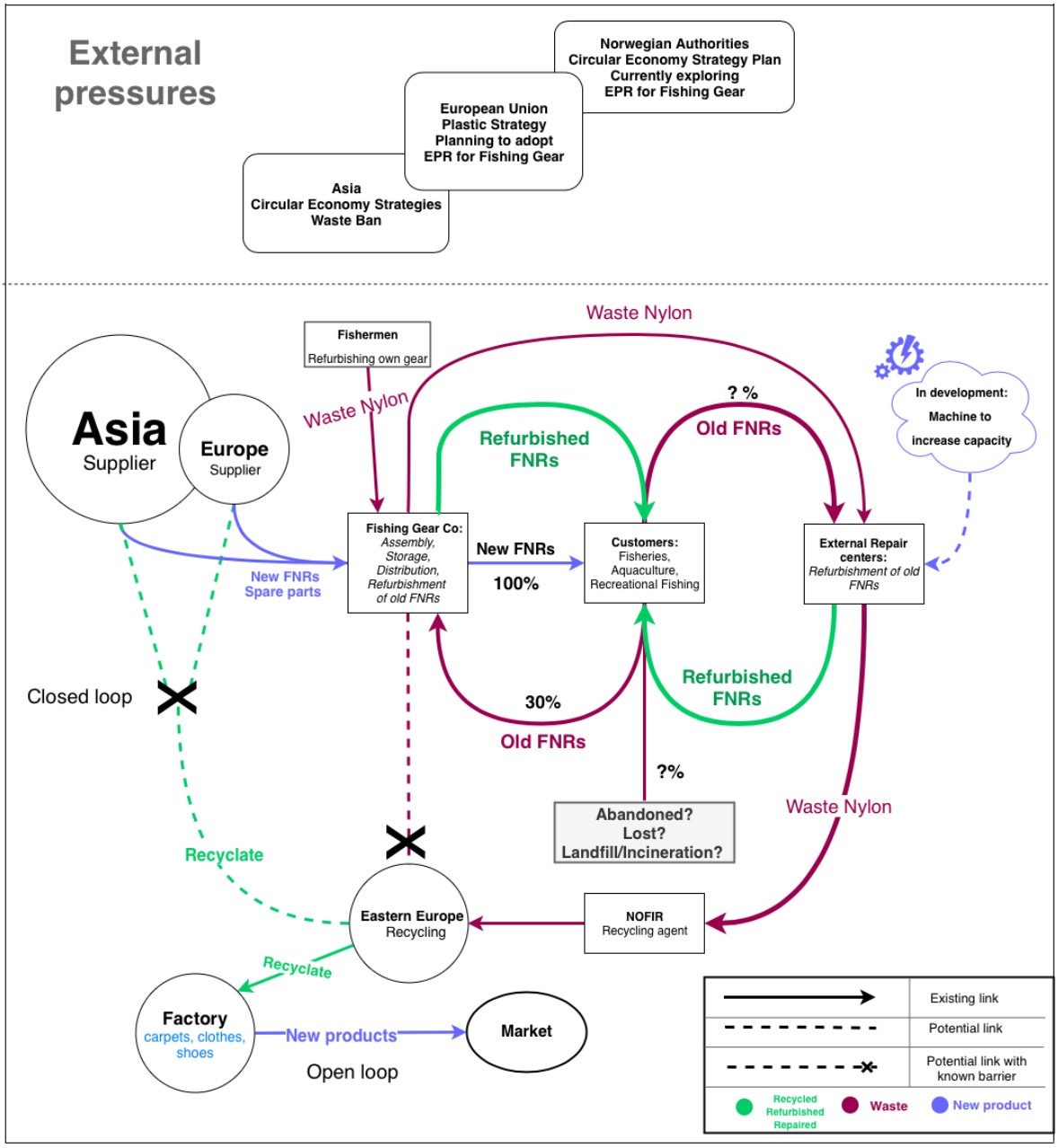

Figure 11. *Overview of the company case*. (Source: Own)

An aggregation of maturity levels across principles gives an average at the "basic" level of circular maturity, which is shown in **Figure 12.** Our assessment also shows that the company displays a strong commitment to move forward, especially relating to the two aforementioned "improving" level principles.

Guiding principles

The following section presents our findings within each CE principle, forming the basis of our assessment summarized in **Table 6** and **Figure 12**.

Our findings show that there are still some unexploited opportunities and unformed actions. In particular, collaboration with industry partners and local municipalities with regards to collection and recycling opportunities seems to be at a lower level. However, principles such as innovation and stewardship are actively explored by the company in their short- and long-term strategies.

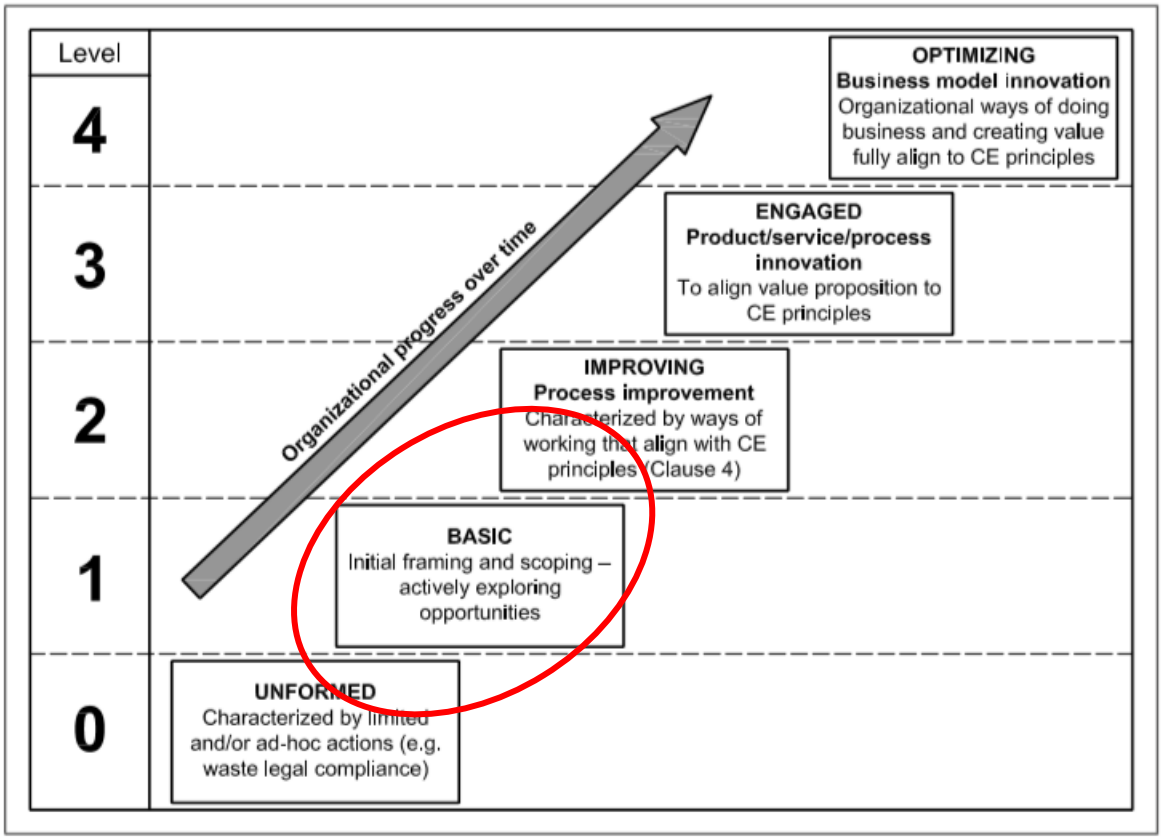

Figure 12. *Evaluation of circular maturity in the case company.* (Source adapted from: The British Standard, 2017)

Principle	Level of circular maturity				
	Unformed	Basic	Improving	Engaged	Optimizing
System thinking		Company has started to use system thinking in processes relating to resource management.			
Innovation		Company has started exploring how innovation can add value to exisitng processes.	Recognizing the need of circular economy activities, the company is prepared to continuously invest in innovation.		
Stewardship		Company recognizes and understands enviromental and social impacts associated with resource management.	Some activity has started in relation to resource management.		
Collaboration	Limited interaction with other supply chain actors and municipalities in relation to downstream issues like collection and recycling.	Company has initiated some activities with research institutes regarding circular product design.			
Value Optimization	Economic value is still prevailing in the decision-making process.	Company has explored some opportunities related to the product longevity, reuse and repair.			
Transparency		The management team recognizes the importance of transparancy and is ready to share information from upstream suppliers to downstream partners, however, there is no particular action plan.			

Table 6. *Circular maturity level in the case company.* (Source adapted from: The British Standard, 2017)

System thinking

We observed that the company has only just started employing a systematic view on processes relating to resource management and the end-of-life phase of their products. System thinking is somewhat unstructured, lacks an overarching plan with particular goals and measurements, and currently manifests itself only as sporadic actions and initiatives.

The company's tactic against external market forces and policy regulations is reactive rather than proactive. The management team often travels domestically, and participates in events within the broader fishing industry where *"the environmental issues … are supplement to the main agenda"*. However, the case company seems to understand the importance of having a systems perspective and tries to apply it in their decision-making processes when interacting with actors both inside and outside their supply chain.

One internal initiative related to system thinking is the company's decision to insource its accounting function as of January 2019, prior to which all such functions were outsourced. After the insourcing initiative, only the salary and compensation functions remain outsourced. The reason for insourcing was a desire to have more control of financial

processes related to procurement, sales and inventory, as well as budgeting and reporting in relation to these processes.

Innovation

The company is actively exploring and developing an idea of a new machine which automates the process of cutting old netting from rope frames in FNRs, before attaching the new ones. According to interviewees, the fishing rope frame has an approximate lifetime of ten years, while the nylon netting is changed more frequently (every season/year) depending on fishermen and the intensity of use. Only 20% of the machine's capacity will be dedicated to net cutting, while 80% will focus on refurbishing (applying new nylon). If this new idea is materialized, the company has a real opportunity to further adopt at least two circular business models, such as i) repair and ii) recycle.

Current practice of repairing and refurbishing FNRs is somewhat dispersed and arbitrary in nature. The case company offers its customers repair services on-site, but also cooperates with external repair service companies such as Dragsund ASVO. Should fishermen have a need to repair or dispose of old nets, they can either have this done via the case company, or through Dragsund ASVO who in turn has direct relationships with plastic collection companies and recycling intermediaries such as Nofir.

By developing and using this hypothetical new machine, the company aims to achieve the following objectives:

1) Improve control and take full responsibility for their own products' entire life cycles, and in particular, increasing the share of the repair and refurbishing market for their own products. More control is needed to guarantee the quality of repaired and refurbished products, something the case company is unable to do today if the service has been performed by an external party.

2) To gain economies of scale for old nylon waste. If they can attain high enough volumes, they intend to deliver old nylon directly to recyclers abroad, bypassing intermediate organizations such as Nofir. Economies of scale would also allow them to offer their services cheaper, which has the potential to give them better control of material and

product flows, ensuring safe and environmentally friendly repairs and waste management for larger volumes of FNRs than at present.

The majority of interviewees recognize the need for innovation and support working on improvements with a long-term perspective in mind, regardless of whether their first 'circular project' pays off.

Stewardship

The focal company shows a strong commitment towards product stewardship through better control of activities related to collection and repair/refurbishment of EOL products. Currently, the case company repairs approximately 30% of its sales volume of FNRs on-site and through collaboration with external repair services, while the fate of the remaining 70% is unknown. In the future, the realization of their new business idea could significantly improve the repairing process and increase the collection rate of EOL products. The interviewees expressed that they are willing to and would like to offer take-back services covering more products for their customers, but that there are barriers that hinder the feasibility of these services, such as collaboration issues and financing.

Collaboration

Collaboration efforts associated with the transition to a circular mode of operation is relatively limited. It mostly covers upstream processes such as (eco)-product design development in cooperation with Norwegian research institutes like SINTEF, the Møreforskning and Havforskning Institutes.

As for downstream activities, the case company does not currently have any direct local or international relationships with collection companies like Nofir. The company used to export old nylon directly to their recycling partners in Vietnam, but a recent wave of bans on the import of certain types of wastes in Asian countries has effectively put a stop to this. Interviewees recognize that domestic downstream infrastructure for plastic collection and recycling is underdeveloped, and believe active government intervention is required to improve it. They also seem positive towards joint efforts within the industry in order to organize collection infrastructure (take-back systems) and establish new relationships with recyclers abroad, but only if it is deemed profitable. A critical barrier that must be overcome is an unwillingness to share information; *"we are competitors and do not share all the*

information, but if we overcome it, it is possible to create a joint organization", one of the interviewees point out.

Interviewees mention an ongoing effort to find partners in order to offer a take-back system for EOL seine ropes to customers. This product has only recently become available from the case company and does not make up a large part of their sales. However, in the total market for fishing gear in Norway, seine ropes make up a substantial share of sold gear.

At present, seine ropes are not collected for recycling, and little is known about the products' fates at EOL. It is assumed that a substantial volume goes to energy recovery through municipal waste management programs. According to interviewees, the company experiences a steady stream of requests from customers who seek to dispose of these products. Seine ropes contain valuable metals like lead and steel on the inside, in quantities that present a good business opportunity if they were to be recovered for recycling. Currently, the challenge seems to be a lack of adequate methods to efficiently separate plastic elements from the metals inside, and therefore difficulty in finding downstream partners who offer recycling services. The company has not considered changing the design in order to ease disassembly at EOL, possibly due to the cost of product development and design.

Value Optimization

For a majority of interviewees, economic potential and value-creation prevails in decision-making processes, and also in the idea of a new refurbishment machine. It seems that the case company lacks belief in potential demand for products adhering to circular principles, because as pointed out in an interview, *"customers still base their buying decisions on prices rather than on environmental concerns"*. Instead, impending policy changes are pressuring the case company to seek business opportunities that will facilitate operation by environmentally sound solutions. Such solutions have traditionally only contributed to companies' reputations and image, but now environmental solutions are being recognized for their revenue and market share contribution as well.

It is necessary to mention that the case company already understands how individual control of processes from materials procurement until the end-of-life phase is beneficial for all parties in the long-term circular perspective. If the new business idea materializes, they can

achieve wider supply chain effects in the upstream associated with circular product design, and downstream through increased collection rates of FNRs.

Returning to the value proposition and new business model development of the case company (**Figure 13**), we observe that they can **create value** for customers, society and environment through the products or services they would like to offer (*Who, What*). However, they still need to work out the processes associated with value delivery and capture (*How, When*):

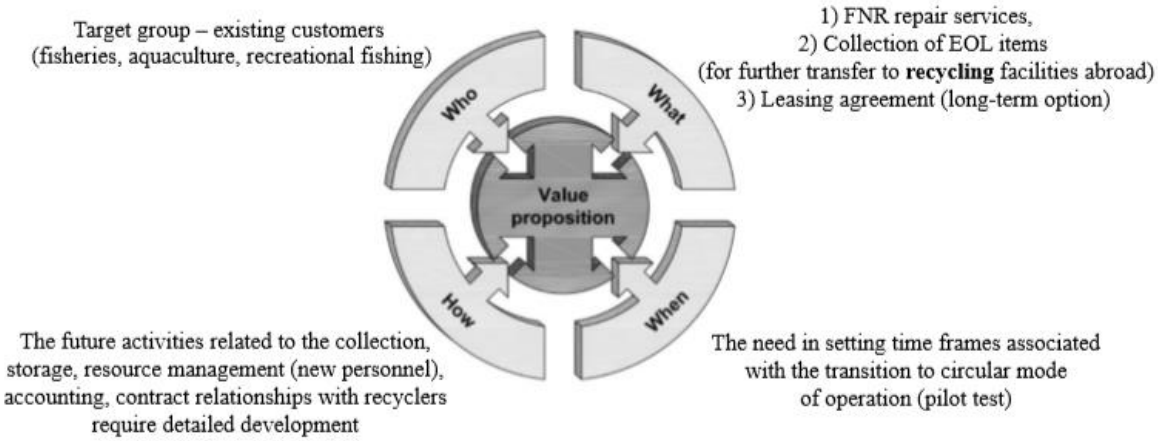

Figure 13. *Overview of value proposition development by the case company*. (Source adapted from: The British Standard, 2017)

The new machine is currently at the project development stage. **To deliver value**, the company needs to develop and manage a range of processes associated with the collection and storage of old FNRs, as well as establish new relationships with recyclers. Still, the financial success of the machine in **capturing value** in the long-term depends on a range of other factors, most of which are outside the company's control.

As an alternative option for value optimization, the case company considers leasing FNRs to aquaculture companies as they *"have more potential due to larger investments and volumes than fisheries and recreational fishing"*, says one interviewee and admits that this idea requires further development.

A potential idea for capturing value through offering a take-back system for FNRs with valuable components which can be recycled is offered by another interviewee, saying that

lead and steel can achieve a relatively high price on the secondary market and that the potential volume could be large enough to make this profitable (economic value). The avoidance of potential dumping in nature that a take-back system could contribute to would also be valuable (environmental value) and building up a new supply chain to accommodate the take-back system could lead to the creation of new jobs or businesses (social value).

Transparency

Basic information on material composition along with product range is available at the case company's website. Customers are additionally provided with information on how to repair FNRs and other types of products on-site and through external actors. In addition, certificates of products that are issued to customers upon request make it possible to track the product in the future. Here, one of the interviewees refers to Metizoft AS (www.metizof.com) which *"maintains a special database with all related certificates… Amongst other things, the company allows monitoring and tracing of the fishing companies and their specific products based on the certificates and it gives some further opportunities for recyclers too"*.

A different interviewee adds that in case new policies regarding marking and transparency on products will arrive, both the information and technology are readily available to facilitate this. The question remains how meticulously it should be done, and whether the cost should be borne by producers, customers or society through subsidies.

Enabling mechanisms

As suggested in (The British Standard, 2017), the adoption of CE principles in an organization can be supported by economic, technical, regulatory, behavioral and organizational factors. At the same time, there are certain issues that prevent the transition to circular mode of operation. Based on information collected from the second part of our conducted interviews we have identified and distributed the case company's issues as shown in **Table 7**.

Economic issues

It became evident that the majority of problems associated with the circularity in general and upcoming EPR in particular has an economic component. We can point out that in the upstream part of supply chain the case company has more capabilities to manage their

activities related to the product design, material selection, purchasing and logistics due to established processes and long-term partner relationships in Norway, Europe and Asia. Information sharing including fishing gear marking also does not require significant financial investments. However, the downstream issues especially related to reverse logistics are challenging and raise many questions within the company.

Issues	Economic	Technical	Policy&Regulatory	Behavioral	Organizational
Accounting & Finance					
Change Management					
Energy & fuels					
Information management					
Logistics & reverse logistics					
Materials markets					
Materials selection					
Monitoring & measurement					
Procurement & contract management					
Product design & development					

potential issues-identified
potential issues-unidentified

Table 7. *Matrix to identify potential issues in the case company*. (Source adapted from The British Standard, 2017)

Besides the underdeveloped collection and recycling infrastructure, interviewees point out that in case a future burden lies solely on producers, customers will still be affected by an increase in prices. Interviewees have suggested and responded favorably to a proposal on financing and incentivizing take-back and collection systems through implementation of a deposit-schema, where the customer could pay a premium upfront and regain a part of this premium in exchange for bringing EOL FNRs back to the company, who would then forward it to recycling.

Another way to offset new collection fees is to discover new revenue streams, something the focal company is attempting to do through their exploration and development of the new business idea regarding the automated cutting and attaching of nylon on rope frames. As per current Norwegian tax legislation, companies which explore and implement innovations through new business projects are able to get a certain amount of tax reimbursed, and this is something that our focal company relies on.

Technical issues

Due to technical requirements, it is unlikely that the focal company will utilize recycled materials and remanufacture FNRs in the short to medium term. A new technology that allows for a better quality in recycled materials is necessary for such an initiative to be feasible. All interviewees claim that only virgin materials can guarantee the quality and function required of fishing nets, especially when they are intended for use 200-300 meters underwater. There has been some exploration of using recycled materials in the past, but none of the resulting products have met the quality standards required by the focal company's customers.

Customer behavior also remains conservative and fishermen prefer buying products made out of new materials only. It seems, however, that the range of products made out of recycled materials is slowly, but surely expanding in other industries.

Policy & Regulatory

One prominent issue is constantly reinforced environmental protection policies in Asian countries. These countries have been playing the role of main supplier for some decades after production was outsourced from Norway to low-cost countries. After Vietnam copied China and introduced a ban on the import of certain wastes, the case company has stopped collecting and sending old nylon directly to their Vietnamese partners.

A recent regulation on air pollution prevention and subsequent steel production limitations in China triggered delays in the supply of materials (steel) to Europe. The case company anticipates growth in both amount and intensity of upstream issues associated with new regulations and emphasizes how it is vital to collaborate with partners "who take environmental responsibility seriously and follow their governments' regulations'. At the same time, the focal company does not have a strategy to reflect changes in their material markets.

Additionally, policies or the lack thereof could play a role in the financing of CE initiatives. Several interviewees recognize the need for governmental intervention in the form of financial assistance in order to support innovation and development of sustainable practices. The lack of policy is also an issue in take-back systems and reverse logistics, and the consensus seems to be that little will be effectively done to develop these functions unless policy requires it.

Behavioral issues

Based on the interviews in our case company, we can observe the relationship between customer and industry behavior. Without changes in customer attitude, it is difficult to stimulate adoption of CE principles by FNR producers. Interviewees do not seem to agree on whether the will to engage in circular initiatives is present with customers, some claiming segmentation based on age, while others claim that the interest and will to engage in initiatives beneficial to the environment has been present for at least two decades, regardless of age group. The continued requests for take-back systems for more product groups than what is offered today could imply that the will is indeed present with customers; however, some interviewees question how deep that will go and if it exists regardless of increased cost to the end-customer.

In the meantime, legislative actions like the introduction of EPR plays a decisive role in changing industry behavior towards circularity and overall sustainability.

Organizational issues

The case company realizes that in order to respond to market forces and new government regulations locally and internationally, they need to be proactive and change the organization of processes, activities and labor. At the moment, their circular vision and strategy are still unstructured, but a few fragmented actions speak in favor of positive movement towards the implementation of changes. The recent insourcing of their accounting function indicates that the company incorporates a holistic view of processes. The company is willing to take control of the whole product life cycle through timely reporting on purchasing, sales and stocks. It reflects at least two of their objectives - to be more competitive and resistant to continually changing market forces, as well as to guarantee the success of future business innovations. However, they do not currently have a system in place to monitor and measure

the success of new business ideas and projects against their vision, strategy, objectives and terms.

5.3 Discussion

The purpose of this thesis was to explore CE benefits and implementation potential in the context of an impending EPR for the fishing gear industry in Norway. We set out to learn more both about CE as a concept and the fishing gear industry as exemplified by our case company. In the previous chapter, we presented findings from our empirical research based on principles in the BS 8001:2017 CE implementation framework. In the following chapter, we will discuss the empirical findings as well as what we have learned through our literature review and see whether the research questions posed at the beginning of the thesis were answered. We will also reflect on the thesis' contribution to the topic researched.

CE understanding

The first research question we posed at the beginning of this thesis was *"What is the current understanding of Circular Economy and how has it developed?"* - A question asked both to satisfy our curiosity as well as to contribute to the thesis, as available information on CE intended for the general public did not explain the concept adequately. The literature review has helped us form an idea of what contemporary understanding seems to be, and how the concept has evolved with time.

From our reading, we have come to see that CE is a continuously developing field where changes in understanding are driven by both academic research, practitioners and policymakers alike. CE has been in development since the 1970s and borrows some of its central ideas from several other concepts and works like; Laws of Ecology; Performance Economy; Industrial Ecology; Regenerative Design; Natural Capitalism; Biomimicry; Cradle to cradle; and Blue Economy, bringing the best aspects of these ideas together in one unifying concept. Still being actively developed, the concept may change as time passes and it gains popular recognition.

There seems to be little consensus on the exact content and definition of CE, except for the following core elements: i) The existence of an R-framework; ii) a hierarchical order within said framework; iii) that circular economy aims to improve sustainability through keeping materials, products and their components within a looping system; iv) that the concept can

be applied at three different levels (micro-, meso-, macro-) and; v) that reverse logistics play a key role in facilitating CE practice. It must be mentioned that the above points are selected at our own discretion, based on recurring themes we were able to pick up on through our reading, as well as those supported by existing peer-reviewed literature reviews.

Further, we found that a consensus of CE goals seem to be: i) lowering dependence on virgin material extraction or creation due to resource scarcity concerns, and in the case of synthetic materials due to environmental concerns; ii) improving the condition of the natural environment by minimizing waste-creation and; iii) providing new value capturing opportunities for existing stock of goods and thereby contributing to improvement in economic, environmental and social dimensions.

The modern understanding of CE ranges from it being just another promising and useful tool to achieve the long-term goals of sustainable development (SD), to it being an economic paradigm shift which will change the very foundation of how we do things and how we live our lives.

Fishing gear circularity value and beneficiaries

The second RQ was regarding product circularity, value and economic beneficiaries: "*What value can be created from product circularity for fishing gear, and who can benefit from it?*". From both our reading and later the empirical analysis findings, we have seen that there is an already well-exploited opportunity to repair and refurbish fishing gear in order to extend its lifetime. The existence of forms of refurbishing operations was known to us before starting the project, documented in, e.g. the MEPEX industry EPR feasibility report from 2018 (MEPEX, 2018). However, the exact organization of this operation for the specific company and the different actors involved was not documented beforehand as far as we are aware.

At the micro-level, refurbishing is a valuable activity for the company's customers who can use parts of their gear for longer periods for a lower cost (*economic value*) than replacing all the gear, and also for the company, who provides this as a service against payment. At the meso-level, repairing and refurbishing old gear allows for the creation or sustainment of jobs (*social value*) locally or regionally. At the macro-level, it prevents some emissions and pollution (*environmental value*) through shorter transport distances, proper disposal of EOL

materials and a slowed loop for product replacement, which also may lead to a lower rate of natural resource extraction at scale.

As for recycling of the nylon by-products of repair and refurbishing activities, value is currently created for economic actors in the recycling industries abroad, as well as for actors in production industries not related to fishing gear. There is also some economic value in it for the middleman who assumedly collects the by-products and exploits economies of scale to earn on arbitrage. For the fishing gear companies themselves, there is currently little revenue or economic benefit from this recycling activity, except for the avoidance of cost related to disposal into waste management systems.

Despite being well-established, this revenue stream has more potential through an expansion of capacity and a reorganization of the disposal/sales chain. The existing capacity is not sufficient in order to meet the total demand for refurbishing and leaves no room for growth. With higher capacity, more of the by-products could be controlled by a single actor (the case company), allowing for a real earning potential through economies of scale, establishing direct links with recyclers and cutting the middleman whom today gets all the economic benefit.

The case company is exploring this through the development of a machine which could increase capacity at the repair and refurbishing facilities, and significantly reduce refurbishing cost for the end customer. A negative effect of this is that it might make disposal (collection of by-products by middleman) more expensive for those who are not current or future customers of the case-company due to factors like distance, as market shares are divided between the case company and the existing actor in the market.

We have also learned that there is a currently unexploited potential for recycling or processing of other types of fishing gear, in particular, seine rope containing significant quantities of valuable and recyclable metals like steel alloys and lead. Today, these products are incinerated, and there is a question of developing appropriate technology and infrastructure in order to ease the disassembly process and facilitate recycling. There is a constant stream of request from end-customers for the producers to collect and recycle these kinds of products. From this potential business opportunity, there can be an element of economies of scale if an actor is to establish itself as a collector and processor for volumes

of seine rope in Norway. Currently, no such actor is established, so there is no competition for market shares in this particular recycling business. Today, the value represented by this EOL gear is assumed lost.

Norwegian fishing gear production and closed material loops

CLSC, defined by us as from a product life-cycle perspective, meaning that the product is recycled, and the recovered materials utilized in the production of new iterations of the same or very similar products, has been found to not be possible in the fishing gear industry in Norway. Our third research question asked whether there was a *potential for such closed loops in the fishing gear industry in Norway*. Our answer is based on the assumption that the major actors in this industry are more or less homogenous, and all have a similar organization of production and recycling/disposal. Our assumption stems from knowledge gained from personal communication with representatives for two competitors of the case-company (prior to the start of this research project) at the industry conference mentioned in the case description.

The reasoning for a low potential for closed loops is twofold: First, it is a question of technology. The recycled materials are not of a quality that allows the new product to have equal strength and function as a product made from virgin materials. This finding reflects concerns in other case studies, like those presented in (Charter, 2018). Unless there is substantial development in recycling technology allowing materials to regain near-virgin quality, it is not likely that closed loops for fishing gear will be possible in the near future. Second, it is a question of organization. Even if the technology reached an appropriate level, the location of recycling and production is too spatially dispersed and achieving closed loops would therefore require significant investment into the supply chain, which may not be profitable. This could be overcome by back-shoring production from Asia, but that is a topic for another discussion.

Drivers and barriers for CE thinking in the fishing gear industry

The next RQ was "*Which upstream and downstream activities drive or prevent implementation of circular thinking in this industry?*". Our empirical findings showed that collaboration between the case company and upstream actors in the forward supply chain (research institutes, design) with regards to CE is stronger if aided by a shared vision and shared objectives. International regulatory frameworks and regional environmental policies

encourage producers to work towards the achievement of sustainability goals and the implementation of CE principles. They become more committed to value creation through improved (eco)-product design, material selection and procurement in cooperation with suppliers and researchers. However, to deliver value throughout the whole supply chain, existing infrastructure needs to be developed further and a better collection system established.

The limited number of recycling actors in the reverse downstream increases their power over FNR producers and represents a bottleneck. The creation of a competitive collection market and a developed recycler network could limit producers' dependency and enhance collection rates. If the issues associated with profit distribution from reverse downstream activities are resolved, there will be real opportunities to capture value in the long term.

Who bears the cost of circularity?

When we created this research question, it was still not known who would bear the cost of circularity under a potential new EPR schema for fishing gear. On March 27, 2019 the EU Parliament approved a new law banning single-use plastic items, and simultaneously mandating EPR for a range of products, among them fishing gear. The law will come into force in 2021 (European Parliament, 2019).

Besides setting high collection and recycling targets, it strengthens the application of the 'polluter-pays' principle by making fishing gear producers, not fishermen, responsible for the collection of lost items at sea, giving strong incentive to develop systems to hinder accidental loss or intentional dumping of gear. Allocation of responsibility on producers also implies that they will to a large extent bear cost of circularity. The application of the 'polluter-pays' principle directly reflects the OECD definition of EPR where "*manufacturers and importers of products should bear a significant degree of responsibility…"* (OECD, 2006).

Considering this, our case company has a competitive advantage with regards to preparation for this new burden through innovation and transition to CE. By adopting CEBM like product life-cycle extension or lease agreements, the company can facilitate the reduction of demand for new raw materials and contribute to one of the EPR's main objectives, namely increased collection of EOL products.

The "Pay-as-you-throw' principle features an option *of sharing responsibility between actors across the supply chain,* as well as with end-customers. The empirical data collected in this project mainly reflects the producer perspective, and only briefly touches customer perspectives. This leaves room for further exploration of the idea of incentivized return systems and responsibility from the end-customer perspective. The case company expressed interest in shared responsibility between customers and producers, as the cost may otherwise be too high if not subsidized by the government.

CE operational benefits under EPR scenarios

The background for the thesis describes various organizational forms of EPR, existing practice and approaches towards its implementation. Particular benefits and drawbacks for each type mainly relate to upstream and downstream effects. Our literature review demonstrates that the link between upstream and downstream actors is crucial for the achievement of overall CE objectives. On the one hand, CE provides companies with opportunities to recondition existing business models and explore new revenue streams from more sustainable product design. On the other hand, an impending EPR schema for fishing gear will encourage producers to coordinate activities along the supply chain in ways that promote the collection of EOL products and material looping.

Simultaneous implementation of CE principles at the micro-level and an EPR schema at the macro-level should be seen as conjunctive processes in the context of environmentally sustainable development rather than conditional and separate measures. However, some findings indicate that companies which adopt circular principles at early stages can obtain competitive advantages and better prepare for a future EPR schema.

In practice, the exploration of CE effectiveness by our study contains limitations due to the basic level of circular maturity identified in the case company. To thoroughly examine CE opportunities and its benefits, FNR producers would require government support in the form of tax reliefs or subsidies. This echoes Walter R. Stahel and Genevieve Reday's highlighted prerequisites for successful circular businesses published in the 1970s, namely that it requires sustainable taxation to encourage circular industries (Product-life Institute, 2018). The following part gives an overview of elements that are underdeveloped, and which must

be in place for CE activities to support FNR producers' operation under different hypothetical EPR scenarios.

OEM Takeback

Both theoretical and empirical findings demonstrate that individual responsibility on the part of the OEM induces upstream changes such as environmental improvements of product systems at early stages (material selection and product design). (Charter, 2018) remarks that individual responsibility will require timing, *quality and quantity control* over material flow and the *creation of reverse supply chains* entailing increased demand for *advanced technologies* and *new job specializations*.

The interview analysis indicates willingness in our case company to take control of the product life cycle, to guarantee *quality* and create value by subsequent activities like refurbishment and recycling. A barrier to material looping due to insufficient *quantity* arises if Norwegian authorities introduce responsibility where producers become individually responsible for recycling (in Norway they would then be sending EOL items to be recycled abroad). *Reverse logistics* become economically and environmentally rational only when there is enough volume.

Although the case company considers investments into innovation (*advanced technologies*) as an attempt to offset future costs associated with a mandatory EPR schema, return on investment and new job creation largely depends on the volume of products subject to refurbishment. Moreover, the majority of FNR producers in Norway are small companies without the financial room to support innovative projects targeting product circularity. Individual OEM takeback might also be too large of a financial commitment for smaller companies to bear.

The theory also claims that OEM systems are limited to the products of each OEM's brand, and thus has a lower downstream effect in terms of EOL collection rates. However, the case company is ready to take responsibility for other brands as well. This is achievable due to high homogeneity in the FNR product market, and therefore a relatively similar material composition across brands.

Third-party Takeback

A Third-Party Takeback system assumes that Product Responsibility Providers (PRP) carry out end-of-life responsibilities on behalf of OEMs. In cases where the responsibility is "outsourced", there is a risk of forgetting CE's objective of improving product systems from a life-cycle perspective. Since the collection company's main objective is to reach collection targets, producers are not encouraged to develop products with eco-design unless the latter is secured and mandated through legislation. In addition, the limited number of downstream actors (e.g. Nofir) might lead to monopolistic behavior and unreasonable cost which in the long run would discourage FNR producers from investing into product circularity, and lead to a net zero or even negative upstream effect.

Pooled Takeback

The final approach assumes that industry actors jointly create or outsource end-of-life responsibility to a PRO. Pooled Takeback system is considered to provide the highest downstream effect by covering a more comprehensive range of products (including other brands and orphaned products). Economic issues associated with the volume of EOL products can be resolved through collective responsibility and economies of scale. Thus, in addition to the value created from refurbishment activities, FNR producers can earn on retrieved nylon where reverse logistics systems and recycling networks are established and organized by the PRO. The latter suggests that the viability and success of circular business models are largely dependent on a regulatory regime that assumes collective responsibility. In this case, the producers have opportunities to fulfil their core objectives as well as create sustainable values for society.

Contribution to topic

Through writing this thesis and doing our empirical analysis on a fishing gear case company, we consider the following as contributions to the topic researched:

- The thesis provides empirical evidence that a complete or partial implementation of CE principles in the particular fishing gear company can promote sustainable development, lead to tangible upstream changes and provide a basis for further sustainability improvements to the total product life-cycle.
- Second, it provides evidence that a closed loop supply chain has been partially considered in the case company, but that there are barriers in place which are not possible to overcome at current technological and organizational levels. This can be assumed to

be generalizable to the industry in Norway at large due to overall supply chain homogeneity. CE alternatively provides opportunities for open-loops and cascading of resources.

- Third, the empirical findings give evidence that there is a strong interest and readiness within the Norwegian fishing gear industry to be proactive with regards to a coming EPR schema for fishing gear, and in particular with the case company.
- Fourth, it shows that there is some awareness of sustainability and CE principles in this industry, but that in the case company, this knowledge exists in an unorganized form resulting in ad-hoc and experimental measures and projects.
- Fifth, it supports an assumption that implementation of EPR may lead to a considerable downstream effect, especially as motivation to create new revenue streams and development of necessary collection infrastructure.

The findings in our thesis seem to indicate that there is a strong will to move forward with regards to CE implementation and favorable views on establishing take-back systems given proper funding and incentives. If properly established, such systems could help mitigate the problem of plastic littering from fisheries and aquaculture by incentivizing responsible disposal and returns.

6.0 Conclusion

6.1 Summary

Observing the increasing attention paid to the effect of human activity on the environment and nature's ecosystems, and the serious state of our oceans with regards to marine plastics debris, micro- and nano-plastics, CE has been proposed as a potential solution for mitigating environmental impact and satisfying an economic growth requirement. Its implementation is aided by policy, and especially by policy instruments such as EPR which makes producers responsible for end-of-life management of their products in one form or another. As many regions have reported that the majority of marine plastic debris stems from fishing and capturing gear from the fisheries, EPR for this group of items is about to be implemented in the EU, as well as in Norway.

In this master thesis, we set out to explore the implementation potential and possible benefits of CE principles for a fishing gear case company in light of an impending EPR. In total, we had six research questions which provided some guidance to our project as it progressed. The RQs were centered around CE understanding; value creation potential and beneficiaries of CE implementation in the fishing gear industry; the potential for closed loops; drivers and barriers for CE implementation; the allocation of increased costs related to CE practice; and operational benefits under different EPR scenarios for fishing gear production companies.

To gain a better understanding of the CE concept and to answer the research question relating to this, we did a thorough literature review including more than two hundred initial sources, with more than eighty contributing into the final review. It was important for us to understand how CE had developed since the basic underlying idea was published in the 1970s, and how this development had shaped the contemporary understanding of the concept. We found that the exact content and scope of the concept is contested, but that there exists some consensus on core elements as well as a broad recognition of general aims that the concept seeks to support. The process allowed us to gain a better understanding of the concept ourselves and to later apply this understanding to our empirical analysis.

We executed our empirical research through conducting semi-structured interviews with management and administration employees in our case-company, in a single company case study, as well as utilizing secondary sources to better understand the subject matter. We found that the case company currently shows a basic level of circular maturity, but that they have a strong willingness to continue exploring the implementation of circular principles.

The interviews revealed that the company has an ongoing development project for a new business idea relating to CEBM, and that circular principles are either already in the process of being implemented or are possible to implement with some effort and investment. It also became apparent in the interviews that there was a strong line of support for establishing takeback systems, both in the company and with customers, something that could potentially mitigate the problem of plastic waste from fisheries and aquaculture which are the biggest plastic littering sources in cleanup initiatives.

Overall, we found that there are both existing circular opportunities with potential for growth or expansion, in particular within repairs and refurbishing of gear, as well as potential new

opportunities for value capture and creation, in particular in relations to recycling and establishing direct relationships in the supply chain. These opportunities are within reach for the case company as long as identified barriers are overcome. Capturing these opportunities would support the company in operating under a new EPR-schema in Norway, and while the company itself expresses preference towards a collective system, the implementation of CE principles would be able to support them regardless of the final organization of EPR.

6.2 Limitations and further research

Limitations of this research are mainly related to the lack of representativeness, especially connected to CE practice in other fishing gear producing companies in Norway. According to research design literature (Yin, 2003), a multi-case study gives a stronger basis for generalization and enhances reliability through a larger number of replications.

It would therefore be interesting to explore the level of circular maturity in more actors in the fishing gear industry, considering there are not that many of them, in order to see if our results are valid for more than just the one case company. Further research could also be extended through a survey amongst fishing equipment customers and exploration of the issues associated with customer behavior which is considered to be one of the drivers in the process of transition to CE (Charter, 2018).

There are also intriguing questions to explore in a supply chain perspective, such as the relationship with plastic collection and recycling companies. Amongst other things, the lack of reliable data on downstream issues such as market capacity, reverse logistics and recycling networks limit FNR producers in their decision-making towards material looping and value capture in the long-term. A future long-term quantitative study could investigate the potential number of 'to be disposed' FNRs each year against produced ones, and the current capacity for recycling. The results might trigger the development of a more competitive recycling market, the emergence of new collection companies or enable industry actors to create PRO which is known to be the most effective alternative in the collection of EOL products both in volume and scope (including orphan products).

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Appendix A: Interview guides

Interview guide for the exploratory interviews

(The following information is to be read by the interviewer to the respondent before the core interview starts, and/or shared with the respondent in written form prior to the interview)

> Start recording

Introduction and background

In January 2018, EU published its Plastics Strategy towards 2030. Based on data from beach cleanings and other sources, fishing gear has been found to make up a large portion of plastics in the ocean. The EU suggests Extended Producer Responsibility as a measure to minimize pollution from the fishing gear industry. In parallel, a process has been going on in Norway to establish such a schema for many years. In 2018, a knowledge report was handed over to the directorate of environment, and will form the basis for decisions regarding Fishing Gear EPR in Norway. It is possible that implementation in Norway may happen even before the EU makes it mandatory.
The EU proposal for a Directive to the EU Parliament on the reduction of the impact of certain plastic products on the environment (May 2018) suggests that the organizations who have partially or fully adopted circular principles and transformed their traditional linear business models to circular models will have more incentives to operate under new EPR schema for fishing gear.

The purpose of this interview

The objective of our interview is to explore, using the example of case company, the state of circular thinking in fishing industry of Norway, applicability of circular economy principles, upstream and downstream challenges and opportunities towards its implementation, practical possibilities for circular business ideas realization. etc.

Procedure and anonymity

This interview will be recorded in an audio-file and a written version (transcript) will subsequently be produced based on this audio-file. The transcript will be e-mailed to

you for verification and corrections. After the final version of the transcript is agreed upon by the interviewer and the respondent, the audio-file will be deleted. The transcript will be used in the project as background for developing the project, and as input and reference for academic publications. The transcript will not contain the name of the respondent or the name of the company he or she represents, however, the background information about the respondent and the company will be included in the transcript and when making references to the interview in research reports and papers. The transcript may be shared with other academic consortium partners, but not outside the consortium. When reviewing the transcript, the respondent should also make sure the way the respondent and the focal firm is described, is acceptable.

Start of core interview

Interviewer states: *"This is a semi-structured interview. This means that we do have a "checklist" of topics and questions that we want to cover, but also that you as a respondent should feel free to bring any other relevant information to the table at any time."*

(The following list of questions should be included in the interview. The interviewer may use this as a checklist, and should feel free to alter the sequence of the questions if this is natural. The interviewer should also ask extra questions if necessary to make the respondent elaborate on each issue (typically "how?", "why?" etc.))

Integration into circular economy – part I

1. *To what extent are you informed about EU/Norway plan to introduce Extended Producer Responsibility for fishing gear and make producers responsible for collecting the equipment after end-of-use and recycling?*
2. *To what extent does you company care about social and environmental impacts from upstream activities and acquisition of materials and downstream issues associated with end-of-life phases of fishing gears? Why?/Why not?*
3. *To what extent does your company keep all the products/components at their highest value (e.g. product longevity, multiple-cycle use, repair centers)?*
4. *What strategies have been adopted to prolong life of the products, components and materials (e.g. parts and components can be easily disassembled)?*

5. *Have you thought what happens to your products at the end-of-use? Why?/Why not? If not, does anther party get value from your product at the end of phase?*
6. *To what extent are you open to communicate and ready to disclose information relevant to the transition to circular mode of operation (e.g. composition of materials, chemical ingredients in products, anticipated lifespan of the product, repair manuals, etc.)?*
7. *The transition into circular mode of operation might require external collaboration with key actors. To what extent do you currently collaborate with businesses (partners, suppliers), government, academia, civil society and consumers to enable sustainable management of resources?*
8. *Innovation is a key to the transition to a more circular mode of operation. During our first visit you have mentioned a new equipment that can bring additional value to your current activities. Could you please describe the new business idea?*
9. *Would you say that the new business solution might benefit the environment and increase/save costs? Why?/Why not? How?*
10. *Is there any way Norwegian authorities could enhance the attractiveness of this type of solutions through policy instruments, investments or changes in the regulatory regime? If so, which supporting policy actions would you like to see?"*

(> Stop recording)

Enabling factors – part II

11. *There are at least three different approaches to EPR implementation: Original Equipment Manufacturer (OEM) Takeback, Pooled Takeback and Third-Party Takeback:*

    "OEM Takeback refers to the system where original equipment manufacturers are directly responsible for end-of-life management of the product and take physical and economic responsibilities". *Individual responsibility*

    "Pooled Takeback system implies the subcontracting of end-of-life responsibility to Producer Responsibility Organization (PRO), in particular, to Retailers. It means that fishing companies would collectively deliver this responsibility to PRO". Collective responsibility

    "*The Third-Party* takeback assumes that end-of-life responsibility is carried out by Product Responsibility Provider (PRP) on behalf of OEM (through competitive bid process) who would pay a fee to PRP. *Individual responsibility*

    Which one of these scenarios do you think is the most acceptable for fishing industry in Norway? Why?/Why not?

12. *Any of these scenarios would potentially mean increased costs (creation of take-back systems and new jobs, communication with customers, participation fee, etc.). Currently, the prices paid for fishing gear and nets (FNR) do not include economic value of caused environmental damage. How do you think your organization would deal with the increased costs (e.g. polluter-pays or customer-pays)? Why?/Why not?*
13. *To support innovations, an organization might need to invest over a longer term than previously (as internal rates of return might not be appropriate). To what extent does you company ready to undergo transition to more sustainable mode of operation and adopt the principles of circular economy?*
14. *How would your organization evaluate, monitor and measure the effectiveness of innovations?*
15. *Systems that rely on less input of new materials can lead to a significant energy savings either through reduction of raw materials or through reuse and recycling of secondary raw materials. Do you think it could area of your focus? Why?/Why not?*
16. *EU Commission's proposal of amended Fishery Control Regulation includes the new requirements on marking gear (e.g. place of origin, producer/importer name, chemical composition of materials, guidance how to disassembly, reuse, repair, etc.). How do you think your company might develop or use such mechanisms (e.g. product passports)? Why?/Why not?*
17. *To what extent does your company take into account the social, economic and environmental aspects through the material's life cycle:*
    a) *sourcing of materials;*
    b) *end-of-life of materials (whether they can be easily reused/recycled);*
    c) *end-of-life of product (how intensely a product is likely to be used - with or without repair)?*
18. *Reverse logistics (e.g. take-back systems) is the backbone of circular economy. There will be a need to establish relationships with collection operators and recycling processors. Is there any way Norwegian fishing industry could voluntary initiate, negotiate and organize this process? Why?/Why not? (downstream and potential. Nofir – is a monopolist, is there opportunity or need for a competitive environment.)*
19. *The transition to a circular mode of operation includes end-of-use considerations at the procurement stage. To what extent does your company ready to change supply contracts to support circular economy objectives?*
20. *How would you re-design your product to meet circular economy objectives:*
    a) *end-of-life recycle;*
    b) *end-of-life recycle and remanufacture;*
    c) *end-of-life reuse (product life extension);*
    d) *lease agreement?*

(> Stop recording)

Appendix B: Transcribed interviews

Interview transcript 1

Date of interview:	*25 March 2019*
Duration of the interview:	*49 minutes*
Interview according to	*Interview guides:1) Integration into circular economy; 2) Enabling factors*
Interviewer:	*Elmira Tukaeva*
Interviewer affiliation:	*Molde University College*
Transcriber:	*Elmira Tukaeva*
Transcriber affiliation:	*Molde University College*
Interview type:	*In person with audio recording*
Respondent type:	*An employee of fishing equipment producer in Norway*
Language of the original interview:	*English*
Language(s) of this transcript:	*English*
Transcript reviewed and accepted by respondent, date: 28 March 2019	

The transcript is based on an audio-recording of the interview. This audio-recording will be deleted when the wording of the written transcript is reviewed and accepted by the respondent.

The transcript is not an accurate word-for-word representation of the oral interview, and does not contain any comments on the way the respondent behaved under the interview. The transcript should, on the other hand, convey the meaning of the statements given in proper written language with full sentences.

The letters "I:" and "R:" are used to indicate statements made by the interviewer and the respondent respectively.

English language version

I: Have you had some time to review the interview guide?

R: Yes, I have read a little bit, but not in full.

I: During the interview you may still ask me the questions and I will try to clarify it as much as possible before you will start answering. The main purpose of the interview is to gather the opinions and thoughts related to the research, but not to get the accurate answers.

I: So, the first question is the following: have you been informed about the intentions of Norwegian government to implement extended producer responsibility for fishing gear or that was us who first told you about it?

R: For me it was you.

I: Your company is operating in the fishing industry for many years. Has your company considered social and environmental issues related upstream activities and acquisition of materials and downstream issues associated with end-of-life phases of fishing gears? Since the purchasing of materials is not an area of your responsibility, could you please advise how much do you care what happens to the products after you sell it to the customers, especially after they will stop using it?

R: I cannot say much about it, but we think about it in general on how to make the things better. For example, we recommend our customers to use a thick rope in order not to lose the fishing equipment in the sea. But coming back to the materials selection, we always track what is new in the market and what is coming next. In addition, we cooperate with SINTEF research organization in Trondheim in the aspects of product design and how we can deal with the product's longevity. So, we consider things like that and act in this direction. But so far, the products that we produce and sell are good enough for our customers.

I: Do I understand you correctly, that nowadays you cooperate both with research institutes and customers for further design of your products?

R: Yes, we usually discuss it in a group together with people form research organization and customers. For us it is important to get a feedback from fishermen who knows what is the best and easier for them to use.

I: Coming back to the customers, do you already recognize that they consider environmental issues or they have other objectives than that?

R: In my opinion, we can observe a small change now. It becomes easier to discuss this kind of problems together with fishermen comparing to what has happened 10 years before.

I: Let's move to the next question: to what extent does your company keep all the products/components at their highest value? By the highest value we mean product longevity, multiple-cycle use, repair centers and other. During our first visit to your company, you have mentioned that nowadays the rope from your fishing net can be used multiple times and the net can be changed ('+', '-') once in a year depending on the customer. What can you say about repair centers, do you have such centers along the Norwegian coastal line, does it belong to your company or you have a partnership with some other companies?

R: We cooperate with Dragsund ASVO. We send the used ropes there; they take out the old nets and send it to Nofir for further processing.

I: With how many repair centers do you have a partnership?

R: So far, it's just one. We can also do it on site – repair fishing nets by disassembling the old net from ropes and putting the new one.

I: How does it work: do fishermen bring fishing nets to you or you pick it up?

R: We do it in both ways. But, for the company like us it is better to take control of our own products, collect and repair old fishing gear nets and ropes (FNRs) by ourselves. Today, many fishermen repair it themselves and we do not know what happens next in the terms of circularity.

I: What is the approximate proportion of your customers who brings you FNR for repairing services?

R: It is probably around 30% of all customers and these are only Norwegian companies.

I: Do you have strategies to prolong life of the products, components and materials? For instance, it could be an option for easy disassembling process.

R: I don't think this is a current issue for us. The nets that we produce and sell can be used for many years as they are durable enough. With disassembling, it is also easy enough to separate the old net from the rope and put a new one, for example. When it comes to the rope itself, at the end of its life we send it to Nofir because it has more complicated disassembling process and we cannot do it ourselves. The led, one of its components, requires a special procedure. I don't think there is anyone doing it in Norway now, maybe in the future.

I: What happens to your products at the end of its use? You have already mentioned that around 30% of FNRs are brought back and repaired. What happens to the rest of it?

R: I do not have any information on that, but, I guess, many do the same as we do. At the final stage, it is sent to Nofir for further processing.

I: The following picture of the whole fishing gear supply chain in Norway comes to my mind, let me share this idea with you: you as a company purchase materials mainly from Asia, assemble the parts and sell final products in Norway. After the usage only 30% of your products are repaired in the partner repair centers and are given the second life, while the rest is collected by Nofir at the end-of-life phase. So far, Nofir is the single downstream actor who deals with the collection of products made of plastic. As we know they send it to Latvia later and it ends up in Slovenia and Turkey where it is finally recycled and/or incinerated. Do you have a partnership with Nofir?

R: We also have heard only of Nofir so far and we do not have a direct partnership with them This is Dragsund ASVO who cooperates with them directly.

I: Coming back to partner repair centers, do you consider to own this kind of repair centers in future?

R: For us it will mean an extra cost as we will need to hire people for this job. In the repair center that I have mentioned, people with limited working abilities perform this job and they get a substantial support from the government while only a small part of their expenses are covered with the fees that companies like us pay for their repair services.
From the other side, we might add that we have a new project related to the development of a machine that will allow us to perform this work on site, to disassemble the old net from the rope and put a new one back automatically.

I: In this case, will the supply chain look similar, will you still be sending old products made of plastic to Nofir or start looking for your own new partners internationally.

R: If we will have enough customers, why should we use Nofir and pay them? It depends on the volume of collected material, mainly nylon, if it is large enough, we can do it by ourselves.

I: But even now, have you tried to find any recyclers outside of Norway?

R: So far, we have had a little discussion on it. We have had an employee from Latvia who tried to find more information. It seems like Nofir is sending it to Latvia for further transfer to Slovenia. This is all that we know. But I think there should be a better system overall for collection and recycling, better than we have now.

I: By saying a better system, do you mean the necessity of a more competitive market and more plastic collection companies?

R: It depends, if there will be enough demand for it, then, it's probably yes. It can be interesting for many actors if there is a potential to earn money, otherwise the government should take care of it.

I: Let's move on to the next question: to what extent are you open to communicate and ready to disclose information relevant to the transition to circular mode of operation? For example, there is a list of your products on your website with composition of materials including polypropylene, polyethylene and nylon.

R: We are open enough for everyone. Moreover, many other fishing producers use the same materials. We would only protect the information related to '*know how'* and new business ideas.

I: During our first visit we tried to present you the concept of circular economy. In particular, we said that the company cannot transit to the circular mode of operation by itself, it needs a cooperation with others. How would you describe your current cooperation regarding circularity with fisheries, government, agencies, universities and research institutions?

R: We collaborate with research institutes such as SINTEF (www.sintef.no), Møreforskning Institute (www.moreforsk.com), Havforskning Institute (www.imr.no / www.hi.no). We are also in contact with Clean Nordic Ocean (www.cnogear.org). I would describe our collaboration more as a peer working. With Clean Nordic Ocean, for example, it is mainly about ghost fishing.

I: What is the purpose of your collaboration, is it more about raising awareness or preventing the ghost fishing and finding the ways and solutions against it?

R: We discuss both issues. By the way, there is an app, using it you can inform about the lost gear and the special troupe will react and try to retrieve it. You can also be a member of Facebook group – Spøkelsesfiske / Ghost Fishing. They provide this service on a voluntary and complimentary basis. They are both diving and using robots to retrieve gear. Although they have started not so long time ago, they already have 2800 members by now and high collection rate. And it is not only about the plastic things, but the marine litter overall. I feel like there is a trend that fishermen inform about the lost gear more often by their free will.

I: Could you please tell more about the new business idea of a machine which will take away the old net from rope and out new one?

R: Our main purpose is to attract more customers and money. At the same time, it will also have an environmental effect as we will take care of the whole process from product design to collection and repairing. Nowadays, if fishermen repair old FNRs it by themselves, we do not know what happens after to our products.

I: During our first visit, one of your colleagues mentioned that previously you have been sending old nylon to Vietnam for recycling. After Vietnam introduced ban on waste import, what do you do now?

R: We send it to Nofir through repair centers. And I think there is a need for more companies than just Nofir.

I: Have you already made any calculations on profitability of your new business idea and new machine?

R: No, it's just an idea so far. We are at the beginning of the project and there is no any analogue in the Norwegian market yet. 80% of the machine's functionality will about rigging the new net and only 20% is about taking the old one away. We also plan to get a tax reimbursement from the government due to investments into the new idea and new project. As per the current legislation, we have a possibility for that.

I: Do you know if this legislation covers already the circular economy or it is applicable to any kind of business?

R: To all businesses.

I: Let's move on: Is there any way Norwegian authorities could enhance the attractiveness of this type of solutions through policy instruments, investments or changes in the regulatory regime? So, you have already mentioned that there is a possibility to reimburse the tax due to the new business idea. What kind of other support would you like to see from the government?

R: Then the government, perhaps, will need to organize the place where we can deliver the old FNRs like today we have the collection places for other products.

I: We are done with the first guide, so let's move on to the second one which is a little bit more detailed, but the number of questions is the same.

I: As it is shortly described in the second interview guide, there are, in general, three types of extended producer responsibility: direct, pooled and third party. Which one do you think will be the most appropriate for your company and Norwegian fishing industry overall and why?

R: I think the third-party system is the most appropriate. At the second place I would put pooled takeback system and on the third place – OEM takeback.

I: Why?

R: I think the direct responsibility potentially means very high additional cost, especially for a company like us where we have only 17 employees in total. There are 3 to 4 big fishing equipment producers in Norway, then 2 or 3 like us and the rest are small companies with 2-3 employees in total.

I: Anyway, if you sign up for other two schemas, you will most probably pay certain fees to them? There are two general principles: 'polluter-pays principle' and 'pay-as-you-throw principle'. Who do you think should bear the burden, fishing gear producer of manufacturer?

R: I think, at the end the fishermen will bear the burden anyway. If we will increase the price, which we will most probably do, at the end the fisherman will still have to pay. But I

don’t know how the return system should work because there is a great variety of fishing equipment we are talking about.

I: To support innovations, an organization might need to invest over a longer period of time than previously (as internal rates of return might not be appropriate). To what extent does you company ready to undergo transition to more sustainable mode of operation and adopt the principles of circular economy? Coming back to your new business idea, if you fail, will you continue to move in this direction or stop?

R: That’s very difficult to answer if we need to do so or not. We don’t know as the market can change. If there will still be a trend, then we need to cooperate closer with the government and companies. Since we are a small company, it is better to do it in partnership and share the costs.

I: How do you plan to evaluate and measure the effectiveness of the business idea?

R: There is no any special system in place, it is just all about the profitability.

I: Systems that rely on less input of new materials can lead to a significant energy savings either through reduction of raw materials or through reuse and recycling of secondary raw materials. Do you think it could area of your focus? Imagine, that your Asian supply partners offer you secondary materials. Will you accept it?

R: The problem is the proof of quality. The rope should to be strong enough, that is why it must be made out of virgin materials.

I: What about nylon?

R: For some other products, yes, nylon can be used for the second time, for example my socks that I wear now are made out of used nylon. But I don’t think this is the case for fishing equipment, again, due to the requirements on its durability and so on.

I: Do you know if customers prefer to use products made of secondary materials?

R: Not the fishermen and not today. But is also depends…

I: There is a proposal of EU Commission on amended Fishery Control Regulation includes the new requirements on marking gear. Does your company already mark the fishing equipment? If not, do you have all the capabilities to do so? Do you think it is expensive process?

R: If it is just marking and labeling, it is not difficult and not expensive. But all of these products will go 200-300 meters down in the seas, so it has to be considered.

I: Do you consider using technological solutions such as GPRS and other?

R: Not for the equipment which is used under the water.

I: To what extent does your company take into account the social, economic and environmental aspects through the material's life cycle: a) sourcing of materials; b) end-of-life of materials (whether they can be easily reused/recycled); c) end-of-life of product (how intensely a product is likely to be used - with or without repair). Which one of this currently suits your business approach?

R: I would say that for us it is important what happens at the end-of-life and how to recycle the products and remanufacture it.

I: There will be a need to establish relationships with collection operators and recycling processors. Is there any way Norwegian fishing industry could voluntary initiate, negotiate and organize this process? Why?/Why not?

R: I think it is possible that companies that fishing companies can combine their efforts together and create such an organization in the future.

I: To what extent does your company ready to change supply contracts to support circular economy objectives?

R: I'm not sure that we need to change suppliers, instead we can work together on the product design and/or involve them into this process.

I: How would you re-design your product to meet circular economy objectives: a) end-of-life recycle; b) end-of-life recycle and remanufacture; c) end-of-life reuse (product life extension); d) lease agreement? As for the last option, I can give an example of Ikea, which now not only sells the furniture to customers, but also leases it. In this case you will also be a leasing company.

R: We have already had such discussions related to some products, but not FNRs. We also observe that many fishing companies have such agreements for some of their products, through the bank, not directly. As for the life cycle extension, we already do it partially. Concerning recycling, it is possible, but again, I think, that secondary materials can be used in other industries than production of fishing equipment.

I: Do you think that you as a producer should be responsible for the whole process until recycling phase and after that your responsibility is finished?

R: Yes.

End of interview.

Interview transcript 2

Date of interview:	*25 March 2019*
Duration of the interview:	*1 hour 03 minutes*

Interview according to	*Interview guides: 1) Integration into circular economy; 2) Enabling factors*
Interviewer:	*Elmira Tukaeva*
Interviewer affiliation:	*Molde University College*
Transcriber:	*Elmira Tukaeva*
Transcriber affiliation:	*Molde University College*
Interview type:	*In person with audio recording*
Respondent type:	*An employee of fishing equipment producer in Norway*
Language of the original interview:	*English*
Language(s) of this transcript:	*English*
Transcript reviewed and accepted by respondent, date: 28 March 2019	

The transcript is based on an audio-recording of the interview. This audio-recording will be deleted when the wording of the written transcript is reviewed and accepted by the respondent.

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The letters "I:" and "R:" are used to indicate statements made by the interviewer and the respondent respectively.

English language version

I: To what extent are you informed about EU/Norway plan to introduce Extended Producer Responsibility for fishing gear and make producers responsible for collecting the equipment after end-of-use and recycling? Have you heard about it before your participation in our research project?

R: Yes, I have heard about it before. We travel a lot and participate at different meetings where this kind of questions are raised and we are asked to share our opinion, for example, how we as a company can contribute into this process.

I: To what extent does you company care about social and environmental impacts from upstream activities and acquisition of materials and downstream issues associated with end-of-life phases of fishing gears? Why?/Why not?

R: I think that both directions are important for us. First, we are trying to choose the suppliers who also think about environment. Second, we participate in seminars where we speak with the customers on different kind of issues, including recycling possibilities.

I: To what extent does your company keep all the products/components at their highest value (e.g. product longevity, multiple-cycle use, repair centers)? What is the area of your focus, one or the combination of these options?

R: With some of equipment we take it back and repair, for example, fishing nets and ropes (FNRs). It depends on the customer how often they send it for repairing, the quota, the place they are fishing and way the use FNRs impacts the frequency of repairing services. Some fisheries believe that the best equipment is the new one, so they change it more often, others use FNRs for more than one season. We repair FNRs both in-house and outside of a company and earlier we also did that in Vietnam, but not anymore. We also advise our customers that we can repair plastic tanks for carrying the fish (we hire a person from outside on a contract base), so they are able to choose whether to fix old or buy new ones.

I: So far, can we say that 2 product types out of a full range of products can be repaired?

R: I think so.

I: Can it be applicable to other types of products?

R: I think that the ropes at their end-of-life can only be recycled and we don't do it here in Norway. I: What strategies have been adopted to prolong life of the products, components and materials? This question differs from the previous one. In particular, it touches the issues associated with the possibility to disassemble easily the product parts at the end-of-life phase for further recycling purposes.

R: We have thought about it and I know that nowadays there is some work being done both in Norway and internationally in order to engage companies and others actors to contribute and create better recycling opportunities. I don't know what is the progress on that, but we understand that we as a company should have a profile on it because of the environment.

I: For recyclers, it is important to know what the product is made of otherwise they will have to invest in the process of screening the materials. When you purchase materials from Asia, do your suppliers give you the information of materials composition in full so that you could share it easily with customers and other downstream partners?

R: Ideally, it should be like that. I'm not 100% sure that this is our case, but we are trying and doing the best what we can. Some companies that we work with in Asia a good enough in this perspective, maybe some are not. But when it comes to the sharing of

information, we are ready to deliver all the related information. Right now, along with the delivery we send the certificate of a product. It does not contain much information, but important notes, like the place of origin and etc. and it is possible to track the product. At the same time, if our FNRs reach the recycler, then they get all the useful information, I think. This is not a general rule to send it to every customer, only by request, mainly for aquaculture companies, fisheries with big boats who have to have such a certificate in order to get their products sold.

R: Currently there is a company in Norway which maintains a special database with all related certificates called Metizoft AS (www.metizof.com). Among other things, the company allows to monitor and trace the fishing companies and their specific products based on the certificates and it gives some further opportunities for recyclers too, I think.

I: Let's move to our next question: have you been thinking on what happens to your products at the end-of-use? If not, do you think anyone can obtain value from it?

R: I don't know what happens next. The way it has been done before - it has been thrown away into the sea. In the recent years, fishermen started thinking of environment and dealing better with it by bringing old FNRs to the right spots. But if you look around Norway, you can find many things which have been thrown away or lost 30 years ago and they are still remaining in the nature.

I: What could you say about your company as a producer and seller of FNRs? How do you think it can be treated at the end-of-life?

R: We should organize a take-back system and send old products to the companies which can deal with it further.

I: To what extent are you open to communicate and ready to disclose information relevant to the transition to circular mode of operation? The phrase 'transition to a circular mode of operation' probably sounds very loud, please do not be disrupted by it and still try to answer? For example, we know that on your website there is a list of products with the composition of materials. Besides that, you could provide such information as lifespan of the products and repair manuals. Do you think you could also add this or the information you provide at the moment is enough?

R: We understand that we as a company are a part of recycling chain and we think we should incorporate this kind of information in agreement with our customers.

I: The transition into circular mode of operation might require external collaboration with key actors. To what extent do you currently collaborate with businesses (partners,

suppliers), government, academia, civil society and consumers to enable sustainable management of resources? What is the range of organizations you collaborate with right now and how would you describe your partnership? I think, in particular, Molde University College is the first one of this kind you are dealing with, isn't it?

R: For our company it's new and we are still a little bit sceptic, I think. We ask ourselves why actually we should do this, but we hope our company can learn from it. Another example is that in January 2019 the head of our company has attended the seminar organized by RundeMiljøsenter regarding the marine litter and how to prevent it. He has insured the organizers that they can rely on our support and we are ready to share the information and contribute to it as much as we can. In addition, we travel a lot throughout Norway and participate at various meetings related to environmental issues and exchange our opinions and views on how to make the things better.

I: Who participates in this kind of meetings?

R: Mainly business companies who produce different kind of fishing, maritime, aquaculture equipment. I must add, that the environmental issues that we discuss are supplement to the main agenda.

I: What about government agencies? Do they participate and do you see them involved in finding better environmental solutions?

R: We hear nice speeches about it, but there is a long way from speeches to real actions. We are all have to be loud enough to protect environment from marine litter, but it requires a lot of investments and the government is not good at it.

I: What about the suppliers of materials who are mostly located in Asia? How do you collaborate with them in this perspective?

R: It is not my area of responsibility. But I know that one of the plants in China that produces steel products, have been recently banned by the government to produce as much as they did before, this is how they try to prevent the air pollution. We as a fishing equipment producer also buy some materials from Norwegian companies which in their turn purchase materials from Chinese partners. So, at one point, it appeared that all of us ran out of stock and we experienced some delay problems.

I: Besides the delays in materials delivery, do you experience any other problems with suppliers due to this kind of restrictions in China?

R: Not yet, but it will come, I think. We should go in front and choose the suppliers which take environmental responsibility seriously and follow their governments' regulations.

I: Numerous sources suggest that innovation is a key to the transition to a more circular mode of operation. During our first we have learnt a little bit about new machine which is supposed to bring additional value to your current business activities. Could you please tell us more about it?

R: Yes, I know that we have such a plan. This is the only business idea that we have so far.

I: Will it increase or save your costs?

R: In my opinion, if we go forward, it will pay itself and we'll become more effective.

I: Is there any way Norwegian authorities could enhance this kind of investments and business ideas. What kind of support do you expect from the government?

R: They already do a lot, but need to do even more, especially be the part of investments, develop related environmental regulations, prepare both companies and customers in order to make the transition smoothened.

I: We have finished the first part of the interview and now can move to the second and final one.

I: Probably you have heard about the classification of extended producer responsibility. There are three main types: direct responsibility, pooled and third-party. Which one do you think is best for your company in particular and for Norway in general?

R: The third-party take back system seems to be the easiest. The direct responsibility is a good one because you can even do the things better by controlling the whole process.

I: Any of these types will potentially mean increased costs. Who do you think should cover this cost, producers or customers?

R: I think the related expenses should be shared somehow between fisheries and producers. It seems like the costs will be increased across the whole supply chain. If producers become individually responsible for collection and recycling of FNRs, it will lead even to higher prices as producers will have to organize the whole process by themselves.

I: Coming back to the new business idea, if you fail, will you continue investing into innovations?

R: Yes, we will still be continuing as this is in line with our strategy.

I: And how would you measure and monitor it? Do you have any system in place to track and monitor a new project, its phases and results?

R: Some parts of the process are structured, some not. We are not good enough in it today and we should have some system like that.

I: Are there any actions already being done towards systemizing it?

R: Yes, we are in the process now.

I: Systems that rely on the use of new materials can lead to energy savings worldwide. The idea is to use secondary materials instead of virgin. Do you think your company could start using secondary materials?

R: In future it could be used partially, but not fully. It's just an idea in general.

I: In May 2018 EU Commission published the proposal related to the products which contain plastic. One of the proposed amendments relates to Fishery Control Regulations, in particular, gear marking which has to be compulsory. How will your company deal with it in case it becomes obligatory?

R: We can do it. It could be both mechanical and electronic solutions. Some part of our products is already marked manually, mainly the ones where it is easy to do. But if there will be a certain regulation, we can get ready for it.

I: What is the most important aspect for you as a producer: selection of materials, the future possibility to easily recycle it or repair, or combination of it?

R: We should think overall about sustainability and take care of the future too. We as company should be the part of the decisions related to material purchase, although I know that in the real life it's all about prices, transportation costs, but we need to try to find a balance to satisfy many things.

I: The next question is about take back systems. There will be a need to establish collection and recycling facilities. Do you think Norwegian authorities could support you and how? Do you think that producers can combine their efforts and voluntary establish this organization?

R: It is possible that producers can do it and it will take a long time, I think. The thing is that we are competitors and do not share all the information, but if we overcome it, it's possible to organize a joint organization.

I: So far, we have heard only about one company, Nofir, which collects plastic and sends it for further recycling to other countries. Do you think there should be more companies like that in Norway? Do you think the future association of fishing gear producers could establish another company like that?

R: Absolutely yes. We should be a part of it together with the government as it will provide a good platform for further actions.

I: In the context of circular economy during the procurement process companies need to think about the end-of-life phase of their products in terms of easy disassembling,

recycling, etc. To what extent does your company ready to change suppliers to support circular economy objectives?

R: I suppose it will take some time to change the suppliers. The partners that we work with right now in Asia and Europe already represent a pool of good companies. We regularly discuss our perspectives and, again, it's all about prices and being competitive in the market. It seems like now customers still base their buying decisions on prices rather than on environmental concerns.

I: And the last question is about re-design of your current products to meet circular economy objectives. What options are the most appropriate for your company: a) end-of-life recycle; b) end-of-life recycle and remanufacture; c) end-of-life reuse (product life extension); d) lease agreement? With the first three options you have become a little bit familiar during our interview while the last one (lease agreement) might sound new. I can bring you the example of Ikea which recently started leasing its furniture to customers instead of selling. Can it be your potential business activity in future?

R: If we start from the last one (d) (leasing agreements), it can be applicable to our aquaculture customers, I think. They have more potential due to larger investments and volumes then fisheries and recreational fishing. Concerning (c) product life extension, we already do some reparations. I cannot say much about (b), in particular, what happens after the material is recycled. As for (a) end-of-life recycle, we do not do it and I think, right now, it just becomes garbage at the end.

End of interview.

Interview transcript 3

Date of interview:	*25 March 2019*
Duration of the interview:	*37 minutes*
Interview according to	*Interview guides:1) Integration into circular economy; 2)Enabling factors*
Interviewer:	*Lisa Holm*
Interviewer affiliation:	*Molde University College*
Transcriber:	*Lisa Holm*
Transcriber affiliation:	*Molde University College*
Interview type:	*In person with audio recording*
Respondent type:	*An employee of fishing equipment producer in Norway*

Language of the original interview:	*Norwegian*
Language(s) of this transcript:	*English*
Translator:	*Lisa Holm*
Translator affiliation:	*Molde University College*
Transcript reviewed and accepted by respondent, date: 13 April 2019	

The transcript is based on an audio-recording of the interview. This audio-recording will be deleted when the wording of the written transcript is reviewed and accepted by the respondent.

The transcript is not an accurate word-for-word representation of the oral interview, and does not contain any comments on the way the respondent behaved under the interview. The transcript should, on the other hand, convey the meaning of the statements given in proper written language with full sentences.

The letters "I:" and "R:" are used to indicate statements made by the interviewer and the respondent respectively.

English language version

I: Now we start with the first part of the interview. I will ask some questions and we can use them as a basis for a conversation. I will read the question as it appears on paper, and we'll take it from there.

I: To what extent are you informed about EU/Norway plan to introduce Extended Producer Responsibility for fishing gear and make producers responsible for collecting the equipment after end-of-use and recycling?

R: I am not informed about that.

I: Ok, so you haven't heard about this at all before now?

R: No.

I: Is this a topic that has been talked about in the industry previously? That producers should take some responsibility?

R: Yes, it had been talked about, but nothing has really come from it.

I: To what extent does you company care about social and environmental impacts from upstream activities and acquisition of materials and downstream issues associated with end-of-life phases of fishing gears? Why?/Why not?

R: Today, we cooperate with a company called Furene. It's a protected company so the people who work there have limited working abilities, and they cut the nets for us. They then

send the net cuttings to a company in Bodø called Nofir, who manages the recycling effort. Last year the protected company sent 23 metric tons of nets onwards for recycling.

I: And when you say nets, this is only the part that is cut off from the fishing net?

R: Yes, the roping frame is kept. Only the old netting in the middle is cut out, and we then replace it with new nets.

I: These nets in the middle are made from Nylon, correct?

R: Yes, they are made from Nylon. The status quo here is that everything that is cut off through this partnership is sent onwards for recycling. I think the recycling process is done at a factory in Eastern Europe, where they make new products from the nylon. What products they recycle it into is not something I know.

I: You are the purchasing manager here, and I have understood that this company doesn't not have any in-house production. That makes you responsible for all procurement of materials and goods. Is all the production located in Asia?

R: Yes, we have production in Vietnam.

I: Have you ever thought of reusing the old nylon cuttings in the production of new nets, or do you exclusively prefer virgin materials to be used in production?

R: I would take a guess based on my experience and say that only virgin materials are used in the production.

I: And is this something you as a purchasing manager think about? Let's imagine a situation where you were to choose a new supplier or renegotiate a production contract, would you consider reuse of materials as a factor?

R: I think it is very much dependent on product quality. I don't really know much about the current content of our products, that's information that the CEO would have. However, I know we have been talking to our suppliers about roping prices, and they responded by suggesting a recycled materials rope. The downside was that its breakage strength was much lower than that of a virgin material rope.

I: I want to tell you about another company in this region. They have been working on the reuse of materials for several years now, not in fishing nets, but in a different plastic product for the aquaculture industry. They have developed some methods to test the strength of recycled materials and have successfully been able to use a large share of recycled material in their production of new products. The difference is of course that they have their own in-house production. The point of sharing the example is that it's not impossible to use second-hand materials, but it requires investment and effort over time.

R: Two weeks ago, we had a meeting with Franzefoss, a company that deals in recycling and return systems – and they were interested in ropes. Especially Seine Ropes and getting the metal out of it.

I: Yes, because in seine ropes there is steel, right?

R: Yes, it consists of steel and dan line fibers, that is PE. And they have received these ropes before, but it has stopped. It wasn't a profitable business for them to recycle it. So, the question is what can be done in order to make it profitable.

R: Also, back to the company that cuts the nets for us. We asked what they were paid for the materials they sent on (to Nofir) and they said they were happy just to get rid of it at no cost to themselves. I'm thinking that this is probably material that could be worth around 2-3 NOK per kilogram in a marketplace. We got some price quotes from England, and those were the prices offered.

I: Yes, and according to this new strategy that the EU is working on they are actually trying very hard to establish a market for this kind of recycle. The latest report that I read from the 4th of march said that there was a supply and demand deficit of around 4 million metric tons. That the amount of plastic recycle on the supply side exceeds the demand by that amount, I mean. So, they're working on getting the market to more of an equilibrium now.

I: Anyway, let's move on a little bit.

To what extent does your company keep all the products/components at their highest value (e.g. product longevity, multiple-cycle use, repair centers)?

I: Do you do any repairs of products?

R: No, we only do montage of nets. And in that case, we do of course repair broken rope and such. The customer doesn't need to buy a new rope and throw away the old one just because it's broken when he's getting new nets applied.

I: Because a rope is used more than once?

R: Yes, such a rope has a lifetime of around ten years. During this time, of course it may happen that it gets stuck and breaks.

I: It's good though that you repair the rope if it's broken.

I: When I was little, I remember older ladies sitting on the factory floors sowing nets where I grew up. I think they were repairing them. Is this not done anymore?

R: Back when we had our own production of nets, we needed some people to go over and repair production errors. This was before the net went onwards in the process for dying and stretching.

I: But now the production is so good that there are no production errors?

R: No, they are still there. But now all our production is moved to Asia, so the work is done there now.

I: I see. So, let's do a quick summary. The lifetime of the roping frame of the fishing nets is much longer than the lifetime of the nylon nets in the middle. Because of that, the nylon is often replaced onto the same roping frame several times.

R: Yes, and we also see that we sell plastic tubs to the industry, these are also made of materials that can be easily recycled.

I: Is this a product that is returned to you afterwards?

R: No, we don't get them back. The customer needs to return it to recycling or waste management services on their own. I don't know if there are specialized return systems for that.

I: Okay, but if extended producer responsibility for plastics is implemented. Maybe you could have a deposit schema or something similar to ensure that it is handed back in? It all comes down to economy, so it's necessary to internalize the cost of collection and recycling into the product price.

R: Yes, exactly.

I: Do you have any thoughts around this? Do you think the customers would be willing to pay more if it was a real possibility?

R: Well, that is how it works in other industries. TV/Electronics and the likes of it. It's not even a question there, you just have to pay the price to get it right. But it has to apply to everyone, not just some companies.

I: Yes, that would be the case in a producer responsibility schema.

R: And then we also import and sell on to other companies who then sell the products to the end-user - distributor functions. So, then the question is where the cost should be put. Between us and them, or between them and the end-user. Who is responsible?

I: I actually think a more practical solution would be emulating the solution done in the car industry – are you familiar with it?

R: Yes, you hand in the old product and get a receipt for it.

I: Yes, and there all the companies are financially responsible for recycling and the return system, according to their market share in the previous financial year.

What strategies have been adopted to prolong life of the products, components and materials (e.g. parts and components can be easily disassembled)?

R: What comes to mind is that we are always focusing on having the best quality of product possible, so that it naturally also lasts longer. I can't really imagine that many of our products can be partially repaired or replaced. We have some cheaper nets that we sell to hobby fishermen, and there we have made a new product which can have the netting replaced when it's exhausted. That way they don't have to throw away the roping frame and buy a new net entirely. Of course, in this scenario they pay a bit more up front, but it's quickly saved when you get to use the net more than one season.

I: So here you are actually emulating the industry market model in the hobby segment?

R: Yes, that's right.

I: Okay. How about end of life, have you thought much about what happens to the products when they've reached the end of their lifetime? Why or why not? If not, does another company get value from your products when they can no longer be used?

I: I think actually that we answered this question. We talked about NOFIR.

R: Yes, we've talked about this.

I: To what extent are you open to communicate and ready to disclose information relevant to the transition to circular mode of operation (e.g. composition of materials, chemical ingredients in products, anticipated lifespan of the product, repair manuals, etc.)?

R: Well, our products are very similar to our competitors' products. We have changed some minor things, amount of fabric, and for example in floating rope, the mixture of different chemicals in the plastic there. But it's not really a problem to say what's inside them.

I: Okay, so this wouldn't be competition sensitive information?

R: No, I shouldn't think so.

I: So then, the degree of openness is quite high.

I: The transition into circular mode of operation might require external collaboration with key actors. To what extent do you currently collaborate with businesses (partners, suppliers), government, academia, civil society and consumers to enable sustainable management of resources?

I: Do you have any external partnerships today? I know about this with Nofir, but are there any other things that could be mentioned here?

R: We are cooperating with Møreforskning and such, it's about trying out new product types and new markets for the same products. I haven't had very much to do with it. That one piece of equipment can be used for more than just one species and such.

I: So, you mean that equipment can be reused to capture other species as well, eliminating the need to have two different types of equipment?

R: Yes, so if you've bought equipment to capture codfish, you may be able to use it to capture crayfish as well. In different seasons of course. That's the kind of research project Møreforskning are doing for us.

I: That sounds like it saves a bit of resources in the sense that it would reduce the need to keep several pieces of equipment.

I: Moving on. Last time we were talking to four people. You were not among them. It was mentioned that the company is thinking about making a machine that could do the cutting of nets, and also perhaps apply new nets. Do you have any thoughts around this? Is this instead of the partnership with the protected company?

R: Yes, I think that's what will happen.

I: Will it then be more economical for your company that it is done like this, rather than keeping the partnership with the company that cuts the nets?

R: Well, one key issue is that this company is not able to cope with the volume.

I: So, there is a capacity issue.

R: Yes, they take a lot of it, but are not able to take everything. So that's where it's pressing a bit. And we have talked about this, if it becomes a machine that only cuts nets, that we could probably have it at this company to take the volume they are not able to take. They will use it, even though we own it. If we can have it apply new nylon as well as we might have to have it here. Currently, we have a partnership with Amatek in Sykkylven.

I: So, if you are able to create such machines and can have some economies of scale, and can offer a lower price on the cutting – then you could have better control of the materials and where they end up afterwards?

R: Yes, of course. And we have done it like that. Well, you know there are many fishermen who cut their own nets, right. And they often have to pay a few NOK to get rid of the cuttings. So, we have said that they can deliver the cuttings to us, then we add it to the cuttings we get from our cutting operations and recycle it all together. It's much better than the cuttings being thrown into the sea, or that they get burned at the beach.

I: And do you get any revenue from this?

R: No, we consider this a kind of free service.

I: When it comes to the government and their intervention, how do you think they should act in order to incentivize sustainable business in this industry?

R: I think that in this industry, nobody does anything before they have to. Or, if there is economy in it, they will probably do it on their own.

R: For example, we've just started selling seine rope last year and already we have gotten a few questions about taking back old ones that are at end of life. We are having trouble finding partners who can take this further. We had a meeting with Franzefoss because they may have some factories in their network that can recycle this. Until now the old seine ropes have either been dumped in the sea, or they have been "lost". That's not legal, to "lose" them. Or they have been delivered to waste management for energy recovery or landfill.

I: I see. Okay, then we are done with the first part. Now I will ask some questions about extended producer responsibility.

I: There are at least three different approaches to EPR implementation: Original Equipment Manufacturer (OEM) Takeback, Pooled Takeback and Third-Party Takeback. So, then the question is; Do you think one of these could be a better option than the others for this industry?

R: Yes, the first option is probably not practically doable. This country is wide and then there is this thing about outsourcing and how it is done. And about cooperation in the industry, if you can get everyone to cooperate not just one or two companies.

I: Yes, there is this model from the car industry. All the importers have collaborated in making a third party owned by the importers. It's not exactly an external party in that it has no relation to the companies, but it has its own leadership, accounting, organization and so on. This co-shared company is responsible for collection and gets some economies of scale from that.

R: I can see that with this model. If each company had its own external partner then it would be inefficient and there would be no economies of scale, really.

I: I have thought about this quite a bit, and it seems the model where all the companies in an industry go together about creating a co-owned third company seems practical. That competitors, or colleagues if you can call them that, cooperate.

R: I agree.

I: Do you think this would be doable without the government demanding it first? (2-8)

R: No, I don't think so.

I: So, the government would have to intervene and say that the industry has to do this?

R: It might happen partially, if there is money to be made on it. There's the situation with the nets, they are only saving the fee to the waste management. If there was more

economy in it, say that you could sell the old nets for 2kr/kg or similar, I think more would happen on its own.

I: Yes, and now we're touching another idea. When you sell a new net to a fisherman. How much does a new net weigh?

R: Around 2-3 kg, but if you consider the rope framework as well it will be around 15 kg.

I: Okay, so let's imagine that there is a deposit schema in place. That when you buy it you also pay a deposit, like with plastic bottles and aluminum cans, to ensure it is returned for recycling. Maybe such a deposit could be calculated per kilogram? And maybe the deposit could be a bit high, so that you wouldn't just have incentive to return your own nets, but also if you find abandoned and derelict fishing gear dumped in nature, that could give you some money if you returned it.

R: You mean stealing your neighbor's fishing nets? (Laugh)

The way it is today, the big fishing companies return almost all of their equipment for recycling. Then you have the small ones that cut nets themselves. They may just put it somewhere where it could end up lost.

I: And then we get on to who should carry the economic cost of collection and recycling. Did we agree that it needs to be baked into the price the customers pay?

R: Yes, but then there is the issue of whether it should be included in the price, or specified on the bill as a return fee. I think they have that on electronic equipment. And on bottles you have it specified on the receipt so you know you've paid a return fee.

I: Yes, maybe specification could be good so that customers are aware of it?

R: Yes, I think so.

I: That you actually pay for the return, so to get back that sum they need to actually return it.

Okay, let's see. Next question. Do you think that if somebody came up with an idea in this company, which would have a slow return on investment? Let's say 10 or even 20 years, but the investment would be beneficial in the long run, and would have a smaller impact on the environment. Do you think this would be interesting for the company?

R: I think that if it was profitable in the long run it would definitely be interesting, yes.

I: How do you think the company should evaluate the effect of new ideas and measures for sustainability? Purely economic or in some other way?

R: You should of course evaluate it economically, but you also need to consider the environment.

I: How do you think it could be evaluated if you consider the environment?

R: Well, if we had some kind of account where we knew how much netting that was recycled, and how much was not, out of a total. For example, we know that the company that cuts nets for us delivered 23 tones for recycling last year. We don't know how much came from us, since they also do work for others. We know that most of it comes from us, but not exact figures. We don't have any papers or documentation on this.

I: Do you think it would be good to have documentation on this? More information available?

R: Yes, and I think that those who are good at it could probably use it in their marketing as well. It's very trendy to be environmentally conscious.

I: Yes, when you consider microplastics and such. That's a pretty dire issue.

R: Yes, it is.

I: Yes, and then we have the example that was mentioned earlier. That another company in this area has attempted to use recycled materials in their products. Now the question is if it could be interesting, or even possible for your company to also consider this kind of measure. You did mention some problems with strength.

R: Yes, if you're going to use it for the same type of product, quality is an issue. However, if you use it in new products, for example fleece jackets, it would be easier to re-use.

I: Okay. This is what we call an open loop in logistics. You may already know it?

R: Yes.

I: If we have a closed loop, the material is reused to make a new unit of what it came from. A closed circle or loop for that product. While with an open loop, the materials go by a market, so that others can buy the materials for use in other products.

R: They have also talked about this, with the company that does the cutting. If we can reuse the material for something ourselves. We have an ongoing dialogue to investigate that as far as I know.

I: Yes, okay. So, the ones who recycle it has asked about this?

R: Yes, it might have been the recycling company because they had some ideas.

I: Okay, so let's go back to the EU. In their plans they also include increased standards for marking equipment, as well as material passports. Do you think the company will be able to meet this kind of standard in a good way, and how?

R: Well, marking the gear is not really a problem with all the technology that exists today. GPS and similar. So, the question is rather how small a unit should be marked? A

chain of nets could have 30-50 different nets. Is it enough with one mark for each chain, or do you need more? It could get stuck and get ripped in two, for example.

I: Yes, exactly. And then there's the issue of material passports. That the content of the product is known so it's easy to know where to recycle it if you happen to find a lost fishing net. And also, that you can go to the webpage and look up the product and see that it contains x and y.

R: Yes, we talked about that.

I: So, let's move on. How do you think about environmental, economic and social aspects when procuring materials and components?

R: I don't think it's being thought of very much. When we purchase goods and materials it's mostly about the quality, user-friendliness and strength. That it can take the loads it will have to endure. I don't think recyclability is considered at all. 80% of what we sell goes to large boats, and there you have some kind of return system. (Nofir) And then there's the aquaculture industry, that's also a growing market for us. They are good at recycling.

I: Is this a new market for the company?

R: We have been there for 3-4 years, and it's a growing market for us. We supply them with ropes and similar goods.

I: The last time we were here we were shown a new kind of rope. It was designed in a way so that where the current status quo is to cut the ropes when they are being changed, with a risk of some rope cutting ending up in the sea, this rope could just be untied quickly and easily. No need to cut the rope so that it breaks. Keeping the structural integrity at EOL. This did not affect strength or function, but was much easier to collect and process for recycling.

R: Yes, that's right. However, I don't think reuse has been thought of with that rope. I don't know if there is a return system for this rope either. I think there probably should be.

I: How long could a product be expected to last, with or without reparation during its lifetime. That might be a factor, you told me earlier that you had thought of it.

R: Yes, the nets themselves last for around two seasons, while the rope frame lasts for ten. So, the fram can be reused and fixed with new nets at least 5-6 times before it reaches end of life. It depends a little bit on the usage.

I: So, what might be a bit of a challenge is the issue of creating a loop for the cut off nylon nets.

R: Indeed.

I: And we talked about the air of cooperation, that it might be such that a return system isn't going to happen from a initiative from the industry itself.

R: I definitely think the government needs to intervene if something is to happen there. They need to put pressure on the industry.

I: And then we come to the second to last question. This is quite relevant to your role. To what extent do you think the company would be prepared to change its supplier if alternatives with better sustainability are available? Would the company care about sustainability if all other factors were the same?

R: We do have large factories that are our suppliers. We have previously demanded that the quality needs to be higher than what they usually make, so that they can have a longer life-time. They will last longer and not have to be changed so often.

I: Okay, and then this is the last question. Do you think that a business model, maybe to the biggest customers, where you do a leasing model could be possible? That the company owns the fishing gear, and that the customers lease it for a set sum each month or season? Could that work?

R: I don't know, but I know that with the plastic tubs that we sell, there is a bit of leasing in the next stage. We don't lease it, but we sell them to a company that does the leasing.

I: Is there anything you would like to add related to the theme at hand that you feel you haven't had a chance to say yet?

R: No, but I really think the government needs to put some pressure on the industry. Then people will think economy and see opportunities to regain some costs.

End of interview.

Interview transcript 4

Date of interview:	*25 March 2019*
Duration of the interview:	*23 minutes*
Interview according to	*Interview guides:1) Integration into circular economy; 2)Enabling factors*
Interviewer:	*Lisa Holm*
Interviewer affiliation:	*Molde University College*
Transcriber:	*Lisa Holm*
Transcriber affiliation:	*Molde University College*
Interview type:	*In person with audio recording*
Respondent type:	*An employee of fishing equipment producer in Norway*

Language of the original interview:	*Norwegian*
Language(s) of this transcript:	*English*
Translator:	*Lisa Holm*
Translator affiliation:	*Molde University College*
Transcript reviewed and accepted by respondent, date: 13 April 2019	

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The transcript is not an accurate word-for-word representation of the oral interview, and does not contain any comments on the way the respondent behaved under the interview. The transcript should, on the other hand, convey the meaning of the statements given in proper written language with full sentences.
The letters "I:" and "R:" are used to indicate statements made by the interviewer and the respondent respectively.

English language version

I: This is an interview with leader of sales for fishery at the company.

I: In what degree are you informed about EU and Norway's plans to implement extended producer responsibility for companies who produce or import fishing gear containing plastics?

R: Do you mean how I personally am informed, or how the company is informed?

I: Have you heard of this before?

R: I haven't heard so much about it, but it has been a constant topic how this could be solved. The biggest problem is between us and the next actor in the chain, to put it that way. I mean the actor who can recycle it. Today the nylon is recycled, because that's relatively easy to find partners for.

R: Dan line and such products should also not be a problem, it's on the receiving side we have a challenge today.

I: Do you mean that they don't have enough capacity?

R: No, more that nobody is accepting it. The same goes for seine ropes, lead ropes. We can't find anyone who will take it in for recycling. This is a big industry and is something that needs to be solved. The way it is now, these ropes are burned on a beach here or a beach there.

I: That sounds like both a waste of potential resources and also potentially harmful to the environment, when recycling is a possibility.

R: Yes, and we've had requests onwards about this. For a long time actually.

I: But it hasn't resulted in anything?

R: No, we haven't been able to find a partner to take this in for recycling.

I: Then we are talking about a lack of a recycling industry for these products being a barrier.

R: Yes.

I: How do you think the company considers environment and social considerations in upstream activities like purchasing materials and products, and downstream activities related to the end of life of the products? Does the company take some responsibility today? You have said that it's being thought about a lot.

R: Yes, we really want to be able to recycle it. To collect it here and be able to send it on for recycling.

I: So, there is a strong wish to have a functioning return system?

R: Yes, and that is the case with the fishermen as well. We often get questions like *"Do you accept returns of EOL ropes?"* and similar. Unfortunately, we have to tell them that we can't accept it, because there is nowhere to forwards it for recycling. This has been an issue for a long time, and we have worked very hard to try to solve it.

I: So, would you say. By the way, how long have you worked here?

R: Almost two decades.

I: Ok, so if we look at the past 10 years or so. Have you noticed a change in the environmental consciousness in customers?

R: No, I think it has always been there. But again, the last puzzle piece is missing. It has been raised several times in various forums within the fishery industry.

I: I have read that there have been some trials around this, but that none have succeeded.

R: Yes, and it's not a problem with either the first level (fishermen) or the second level (producers), but the fact that nobody is able to take it in for recycling. Instead, you have to pay an arm and a leg to get rid of it.

I: Okay, so it's not about the willingness to recycle then.

R: No, I think both producer and fishermen could have shared the task easily.

I: Okay, and to move on a little bit on this topic. How do you think the economy of it could be solved? Let's pretend that an actor who can recycle it is present and willing to take it, how the financing be solved?

R: I think a deposit schema could work, like we have on bottles.

I: You think this could actually work?

R: Yes, I think so. If you pay 500 NOK more, just to say an arbitrary sum, when purchasing a rope. Then you know that when the rope no longer can be used, you can return it and get part of that deposit back.

I: Okay, and what is the actual cost of a rope?

R: Well, that was just an example, the deposit must of course be relative to the price of the product.

I: Could you suggest an acceptable level, perhaps? Based on your experience and industry knowledge?

R: Of course, with the rope and everything that is in the net. If you were to return it. Well. A net today may cost 1300-1600 NOK. If this price went up by a few hundred NOK, it wouldn't be noticed. Especially if some of it was returned to you when you returned the net for recycling.

I: But would that be enough incentive to return it? Would it be worth the effort?

R: Yes, I think so. Many customers are asking us where they can return it, or if we are able to take it back.

I: So, then these couple of hundred NOK, some of it could be use to finance a return system?

R: Maybe.

I: From the others I have talked to, some of them gave me an impression that there might exist a generation gap in this industry. That the older generation may not be so interested in sustainability and environmental issues.

R: Well, I have been here for almost two decades and this question is definitely not new. It's not always asked by the youngest fishermen either. But of course, even if there is a generational gap in opinion, it's still important to do this.

I: Yes, we all want to be able to harvest from the ocean in the future as well. It wouldn't be very wise to destroy our own living, if it can be phrased like that.

R: Exactly, and the fishermen see this issue very clearly.

I: Let's move on to question number 7. About partnership with external actors. The transition into circular mode of operation might require external collaboration with key actors. To what extent do you currently collaborate with businesses (partners, suppliers), government, academia, civil society and consumers to enable sustainable management of resources?

R: We have a cooperation with those who are cutting the nets, and they are cooperating with some Latvian company who recycles the netting.

I: And this is the only partnership you know about per now?

R: Yes, when it comes to circular economy and recycling, I think this is the only one. We are of course looking for alternatives. We have an employee here who is fluent in Russian, and she has been working on this to find a partner in eastern Europe. However, we haven't been successful yet.

I: Ok, now let's talk about extended producer responsibility. There are at least three different approaches to EPR implementation: Original Equipment Manufacturer (OEM) Takeback, Pooled Takeback and Third-Party Takeback. Which one of these scenarios do you think is the most acceptable for fishing industry in Norway? Why?/Why not?

I: Do you think one of these methods could be better than others for this industry?

R: I think that if we could have an external organization owned by all the companies in the industry. That could be a good solution.

I: And you think it would be easy to cooperate in this case?

R: Yes, because I think everyone is interested in returning this, and especially if the fishermen could pay a deposit upfront to be returned. I think they are very interested in being able to return these items somewhere.

I: Okay, but you also think you could easily cooperate with competitors and other actors in the industry? Is there a good climate for cooperation?

R: It should be possible to create a good climate for cooperation if it doesn't already exist. That membership model could also probably work, also combined with a deposit schema. And maybe a small fee to finance the administration of the return schema.

I: Would this deposit schema be based on product type or rather by weight? That you would pay a set sum of deposit per kilogram, to make the administration easier.

R: Yes, definitely.

I: Okay, next question. Do you think there could be room to change the business model from pure sale to a kind of leasing option in this industry?

R: That's hard to say. There is a leasing model for plastic tubs today, to fish processing plants and such.

I: Is this a product you supply?

R: We sell these plastic tubs to the fisheries directly, or to companies who lease them onwards. What I meant is that there are solutions like this for plastic products.

I: Would this be possible to do for nets and similar products as well?

R: Hard to say. It's a good intended for some rough use, so it might not be very good in the sense that you wouldn't take as good care of it if you are leasing it as if you own it. It could be expensive for the one leasing it.

R: You also have no guarantee that it doesn't break. Leasing for a car is one thing, but with a net so many things can happen. A seal could swim into it and rip it in two, for example. It would be very hard to define what condition it should be returned in.

I: So, if a seal swims into the net, is it then possible to repair or mend it?

R: They don't really have time for that. It's not like in the old days when you sat down and repaired something.

I: I think I was thinking more if it was possible to offer repairs as a paid service from Frøystad.

R: It would be too expensive compared to cutting the broken ones off and applying new nets. However, taking them out and recycling them for reuse, that would be much more economical.

I: I see. Economy is of course very important.

I: And it's not possible to reuse the nylon in new nets after it has been recycled?

R: I can't say much about that, it's not my area of expertise.

I: And then we have the question about government intervention. How do you think the government can make it easier to develop or use a return system?

R: Subsidies probably, that they somehow subsidize those who are able to recycle it 100%. For example, seine ropes, with plastics and steel. If you're going to start separating these it will be quite costly. Today it is simply burned off, if the ropes are sent for recycling. Only the metal is recycled.

I: Could subsidies then include subsidizing development of machines that could separate these components?

R: Yes, that's a good idea. Then you could perhaps recycle almost all of it.

I: Because seine ropes are rather standardized, or is there variation in them?

R: They are pretty standardized. Not any big differences at least, but the smaller boats use lead inside, while the larger ones use steel wires.

I: Okay, and both lead and steel are materials with both sales and reuse value.

R: Yes, especially lead. It only increased in price as time goes by.

I: Do you have anything else you would like to add about sustainability or recycling that you feel you haven't had the chance to say yet?

R: No, not really. The way it is today we attempt to find recycling solutions for as much as possible, but there are products where this has not resulted in partnerships.

I: What I bring with me from our conversation here is that it's not an issue with willingness to recycle or return from neither fishermen nor producers, but that the main issue is that nobody is there in the other end to receive and recycle the materials in an economical way. There is no developed market for recycling.

R: Yes, for us that is the biggest challenge.

I: Okay, then I would just like to thank you for taking the time to talk to me.

End of interview.

Interview transcript 5

Date of interview:	*25 March 2019*
Duration of the interview:	*13 minutes*
Interview according to	*Interview guides:1) Integration into circular economy; 2)Enabling factors*
Interviewer:	*Lisa Holm*
Interviewer affiliation:	*Molde University College*
Transcriber:	*Lisa Holm*
Transcriber affiliation:	*Molde University College*
Interview type:	*In person with audio recording*
Respondent type:	*An employee of fishing equipment producer in Norway*
Language of the original interview:	*Norwegian*
Language(s) of this transcript:	*English*
Translator:	*Lisa Holm*
Translator affiliation:	*Molde University College*
Transcript reviewed and accepted by respondent, date:13 April 2019	

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The letters "I:" and "R:" are used to indicate statements made by the interviewer and the respondent respectively.

English language version

I: We now start recording of conversation with leader of sales seine rope at the company.

I: First a short introduction of our project and us. We are students studying logistics at Høgskolen i Molde, and are doing a project where we attempt to place the company into a framework about sustainability and circular economy. Have you heard of Circular Economy before this?

R: No, it would be nice if you could do a quick explanation.

I: Circular Economy is really about reducing waste and making product loops. Reuse and recycling, that's important in this context. It is done to save resources and money, and also with respect to environmental concerns. The environment is the main motivation behind Circular Economy's popularity rise the past few years.

I: We have made some questions, but not all of them are relevant to everyone. Some of the reason we are doing this is that EU has stated that they consider introducing extended producer responsibility for fishing gear – and we know that what happens in the EU also usually happens in Norway.

R: Yes, usually it happens here first.

I: Yes, that is probably true. The directorate of environment has already commissioned a feasibility study on this that was finished in May of last year. It is now under consideration. It might therefore happen in Norway before it happens in the EU.

I: So, we want to look at how companies can prepare and what can be done to meet this. I've heard a lot about seine ropes in the other interviews. Among the information we have gotten so far is that it's problematic when it comes to recycling of seine ropes. What are your thoughts around this?

R: Well, what should I think about it. I have thought a bit about it, because these ropes are replaced relatively often.

I: How often?

R: At least once a year.

I: And these are the ropes with steel inside.

R: Yes.

I: Then it results in quite a bit of waste, if it's replaced once each year. Is this a product category that the company sells a lot of?

R: Not yet, since it's a relatively new product for us. We haven't sold so much of it yet, but the total share of fishing equipment in Norway for seine ropes is quite large.

I: Okay, and we can probably consider that the recycling problem is the same everywhere, with all companies selling this, because the problem seems to be the next actor who can take it in for recycling?

R: What I know is that it's challenging to create a return system. It's also challenging to recycle because there is steel and rope in the same product.

I: So, one challenge is to separate the materials?

R: Yes, that's what I think.

I: Because both PE, PP and steel is possible to recycle separately, but the combination is making it challenging.

R: Yes.

I: You told me that you haven't worked here very long. If we think of the future, what would you like to see happen when it comes to this?

R: That a return and recycling system was developed is probably more than sensible.

I: Why do you think so?

R: Because otherwise it'll be left abandoned somewhere.

I: Do you think this is a big problem?

R: Yes, if it's abandoned, be that on a quay, in nature or at the bottom of the sea. Well, it's not exactly a good thing.

I: No, it's also a potential resource wasted when that happens.

Do you think it would be possible to reconsider the seine rope design in order to ease the separation of seine ropes when they reach end of life?

R: I don't know.

I: Have you talked to the customers a bit while you've worked here?

R: No, not very much.

I: Would you say that there has been any focus on the environment issue and sustainability during your training period?

R: Yes, it has been mentioned a few times.

I: So, would you say that the company cares about the environment and societal issues?

R: Yes, but it's always a challenge to get somebody to pay for it.

I: How do you think this could have been solved, without me suggesting anything first?

R: I don't really know. The politicians know how to solve it, they could just add some fees. I don't know though.

I: You haven't had the time to think about this yet?

R: No, that's right.

I: I talked to somebody earlier today who mentioned that it would be good if there was a deposit schema. That a fee is added for recycling, and also a deposit sum per kilo. The latter of which the customer would get back if the product was returned for recycling. Do you think this could have been possible?

R: It probably wouldn't be very popular, since it's an extra expense.

I: But part of it is returned as a deposit?

R: Yes, but who will administer it? Nobody is going to administer something for free.

I: We could take a look at extended producer responsibility. (…explains three ways of organizing EPR).

R: I think perhaps the third option would be better.

I: That you pay a membership fee to a third party, and also a fee for each kilogram or ton that you submit to the system?

R: Yes, or, which one was it that... I just know that in my life I've sold quite a lot of cables. In this there was a 1% recycling fee hat financed a system like this. I think this could be something to consider.

I: Do you think the customers would accept this, if it applied to all producers and distributors?

R: Yes, they wouldn't really have a choice then, would they?

I: There might be some dismay, but it's better to get back some money that to not get back anything, right? Because I think they would have to get some money back, in order to incentivize them to hand it back in for recycling. A fee to finance the system, but also a deposit which is recoverable.

R: Yes, but one problem is that many of our customers live in very rural places. If they have to send the product x miles for recycling, then the deposit would be eaten up by the costs.

I: Okay, so how about exploring offering a discount when you buy a new rope and hand in the old one?

R: Well, somebody has to pay for it. It is an expense no matter how you look at it.

I: But isn't it a large expense in the long run if nothing is done about it? That it ends up in the sea and such, I mean.

I: Okay, moving on. Which role do you think government could have in this?

R: Well, they have to create the rules and demand action. Nothing is going to happen by itself.

I: Yes, but that's not unlikely that it will happen soon. But, economically and such. Do you think it could help if the government offered subsidies to get such a system started?

R: Yes, it would. But I'm not a big fan of subsidies.

I: No, but as you said, in the free market nothing will happen on its own unless it's profitable. So, government intervention probably would be necessary somehow.

R: Yes, that's true.

I: Now I actually think we've got most of what is relevant to you covered. You haven't worked in this industry previously, correct?

R: That's right.

I: Since you've worked here such a short time I don't know if I have any more relevant questions. A lot of it is historic and based on the individual's experience. However, it was nice to hear some of your thoughts around this. Thank you.

End of interview.

Interview transcript 6

Date of interview:	*25 March 2019*
Duration of the interview:	*13 minutes*
Interview according to	*Interview guides:1) Integration into circular economy; 2)Enabling factors*
Interviewer:	*Lisa Holm*
Interviewer affiliation:	*Molde University College*
Transcriber:	*Lisa Holm*
Transcriber affiliation:	*Molde University College*
Interview type:	*In person with audio recording*
Respondent type:	*An employee of fishing equipment producer in Norway*
Language of the original interview:	*Norwegian*
Language(s) of this transcript:	*English*
Translator:	*Lisa Holm*
Translator affiliation:	*Molde University College*
Transcript reviewed and accepted by respondent, date: 13 April 2019	

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English language version

I: If you could quickly describe your responsibilities and position, please.

R: Yes, well it's storekeeping. We receive goods and we send goods, and we also are in charge of the net hotel.

I: The net hotel?

R: Yes, we keep nets for our customers until they need them. Either just as a storage service between seasons, or because we've produced the nets and are keeping them until pickup. It involves a bit of logistics.

R: The net montage is also my area. I provide them with everything they need sent up or down to storage.

I: Yes, okay. When we made these questions, we didn't know who we were going to interview. As you mentioned to me before the interview, you don't know how relevant these questions are to you.

R: Yes, I don't really know how I can contribute to this.

I: But we're also interested in hearing different employees' thoughts around sustainability and measures to improve it in all the processes in the company. Have you seen the background description we sent out?

R: Yes, I have looked at it.

I: The background is the problem with ocean plastics, and it's becoming a severe problem. Some research reports state that almost 80% of the plastic that washes ashore actually originates from this industry, the fishing gear industry and fisheries. Rope cuttings, broken nets etc.

R: Yes, it's probably just thrown overboard.

I: So, because of this we are interested in what people in the industry are thinking about this, and how it can be avoided. The EU has suggested that all producers and distributors of fishing gear, and this company falls into this category, should be responsible somehow so that it doesn't end up in the ocean. We can take a look at the questions, and see if we find something that's more relevant.

I: To what degree would you say that the company cares about the environment and societal effects when it comes to upstream and downstream activities like procurement of materials, logistics, dispatch and so on.

R: Okay, so how much does the company care?

I: Yes, is there a focus on environmental effects?

R: I think it's mostly in everyone's head right now, that not so much is actually done about it. Personally, I think about, well, now it's mostly regarding storekeeping and not so much about the nets themselves, but I think about what I could personally contribute with. I could probably make sure we use less plastics. Because we use quite a lot of plastics.

I: Are you talking about packaging plastics?

R: Yes, packaging plastics.

I: That's probably not entirely straight forward. You think you use too much plastic as packaging?

R: I think that we, when we pack goods for dispatch, use quite a lot of unnecessary plastics. Often there is a reason, that it shouldn't fall over during transport and such, but I think there's a big potential for reduction there.

I: Could it be possible to replace plastics with a different material, perhaps?

R: Yes. Now I don't really know if I answered the questions correctly. I was just thinking about my role in this.

I: It's good that we hear different views around this and get to hear everybody's thoughts. Your working days and how routines could change for the better. So packaging plastics, there's just too much of it, then.

R: Yes, we put plastic on everything that goes out the door, pretty much. Some of it is not necessary. I think there's big potential for reduction there.

I: Packaging plastics may not be very easy to recycle, so the best option here is to focus on reduction of use. We are doing a project on circular economy and there you have 3 Rs in English. Reduce, Reuse and Recycle. Those are the principles. So, when it comes to packaging, "Reduce" is probably the most suitable approach.

I: By the way, how long have you worked here?

R: I'm in my third year here now.

I: Have you notices any measures the company has done while you have been working here that had a goal of improving sustainability or environmental friendliness?

R: No, I don't really have much to do with that. They are talking about it up in the offices, but I don't really know.

I: What do you think Is needed for the company to go from talking to doing, then?

R: Well, if we had been able to create a functioning return-system.

I: Return system for what?

R: For nets and such. Because usually, you know, fishermen cut the nets and it may very well be thrown overboard. And not just nets, old rope as well. But a return system has to be profitable for us as a company, and it also needs to give some value to the customer. Why should the customer come back with it if he doesn't get anything from it, you know? Finding a good solution for a return system. And the nets are recycled, you know? We send it on to recycling. But what could we do in order to make the customer deliver it back to us, rather than, well...

I: Okay, so here's a relevant question. Do you think the customers would appreciate, for example, a deposit schema, like the one with plastic bottles? Could this be included in the selling price?

R: Yes, I think so. But the large fisheries and fishing companies are quite good at this. They hand it back in and recycle it. The problem is with hobby-fisheries and non-professionals. And often the older generations. Throwing it overboard is an easy solution in those cases.

I: Okay. Well, back to a deposit schema. I have talked to others about it as well, and if we don't know how it would work, the general idea at least seems good.

I: We could also talk a little bit about innovation. If somebody comes up with a good idea, do you feel there's room for airing it, that it's an open environment?

R: Yes, I think so. I don't have a different impression at all. If I have an idea I feel completely secure in going to my leader and telling them about it, and that it will be received in a good way.

I: That's good.

R: Yes, that's very good.

I: Have you talked to anyone about this packaging plastics thought then?

R: No, not anyone except for my colleagues downstairs. I often tell them when I think more plastics is unnecessary.

I: So, you and your colleagues downstairs, you are the ones who decide when plastics is necessary or not?

R: That's right.

I: So, you can actually impact this quite a lot then.

R: Yes, we can impact it. But this is kind of something that is from me, as a person. My own thoughts.

I: Yes, I see. But it's very good that you're thinking about this. Being aware.

R: Yes, I think I am aware. But you know, when it's not necessary it's not necessary.

I: Yes, and if you can impact reduction and you actually do it, then you've already done the environment a great service.

I: And in this point here, question 5, I think this about reduction in materials usage and increased recycling is quite relevant. You are right that many of my questions are more relevant for someone who sits in the offices, rather than you who work downstairs.

R: Yes, exactly.

I: But I'm very happy to hear your thoughts around packaging plastics, because I honestly think this is something that I would never have heard from anyone in the offices.

R: No, they probably have other things to think about. We decide ourselves how much plastics should be used for each unit of good. And I think there is a lot of unnecessary usage, as I talked about.

I: So, you don't have any guidelines that say, for example, that you should try to minimize the usage of packaging plastics, or consider if it's necessary?

R: No, we don't.

I: Would you like it if there were such guidelines?

R: Yes, I think it would be good if we had that. That would be positive both for the environment and we would also save some time.

I: And also, you wouldn't feel that you...

R: Always is the one to tell others that we don't need to use that much, yes. That I'm the one who's nagging about it all the time.

I: But that's good. Maybe we can suggest that to the ones in the office.

R: Yes, I think that would be good.

R: As I mentioned, I don't think I have too much more to contribute.

I: No, but I think that we have had a very good conversation and that you've given us good information. We can use this somehow. Thank you for wanting to talk to us.

End of interview.