CO-CREATING A CIRCULAR FUTURE: CASE ECODESIGN SPRINT

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Abstract

The linear economic model is reaching its limits. A proposed alternative is a circular economy, in which material and product value is maximised and waste is prevented through mindful design and innovative business models. The transition to a circular economy requires systemic change in all sectors from business to politics and consumer behaviour. This thesis explores the use of collaborative design in facilitating the transition to a circular economy. Since knowledge creation is perceived to be a source for innovation, the study examines how design methods facilitate the collaborative creation of knowledge and influence participants to foster circular change. A collaborative design workshop where business and design practitioners learn about the principles and opportunities in the circular economy as well as develop concepts to apply the gained knowledge in practice is used to explore the topic.

A thorough literature review of the most relevant prior studies on the circular economy, knowledge creation and collaborative design was conducted to form a basis for the research. Data was gathered through participant observation of a three-day co-design workshop as well as semi-structured interviews with five workshop participants.

The results indicate that collaborative design facilitated the knowledge creation process by supporting the transfer, translation and transformation of knowledge between collaborators. The study identified various elements that enabled and supported the process, which were grouped into four categories: Atmosphere, People, Teamwork and Workshop Structure. Furthermore, the use and generation of artefacts were found to help participants communicate their ideas and create shared meaning. The co-design activity was recognized to have significant impact on the participants and their organizations as it allowed them to acquire deeper knowledge on the circular economy and gain skills to apply the knowledge in business development. This, in turn, advances the change towards circularity.

This study demonstrates the relevance of using collaborative design in developing solutions that promote the shift to a circular economy. By identifying central enablers of knowledge co-creation for the circular economy, this thesis gives guidance for practitioners across disciplines to engage in co-creating a circular future. The study provides support for prior research on the use of collaborative design in complex problem solving and opens possibilities for further research in the context of the circular economy.

Keywords circular economy, collaborative design, knowledge co-creation

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Tiivistelmä

Nykyinen talousjärjestelmä on johtanut ympäristöongelmiin ympäri maailmaa ja sen ratkaisemiseksi on ehdotettu siirtymistä kiertotalouden malliin. Kiertotaloudessa pyritään säilyttämään materiaalien ja tuotteiden arvo kierrossa sekä ehkäisemään jätteen synty hyödyntämällä muotoilua ja innovatiivisia liiketoimintamalleja. Kiertotalous vaatii rakennemuutosta kaikilla sektoreilla, niin yritystoiminnan, politiikan kuin kuluttajakäyttäytymisen saralla. Tämä tutkielma paneutuu kiertotalouden mukaisten ratkaisujen kehittämiseen ja uuden tiedon luomiseen prosesseissa, joissa hyödynnetään yhteissuunnittelun ja muotoilun menetelmiä. Näin ollen tutkimus pyrkii tuomaan esille, miten yhteissuunnittelu edistää ja tukee siirtymistä kohti kiertotaloutta. Aihetta tutkitaan yhteissuunnittelutyöpajan kautta, jonka tarkoituksena on lisätä pk-yritysten ja muotoilutoimijoiden osaamista kiertotalouden mukaisista liiketoimintamalleista sekä tukea kiertotalouden mukaisten ratkaisujen luomista.

Tutkimusongelmaa lähestyttiin kirjallisuuskatsauksen ja empiirisen tutkimuksen kautta. Kirjallisuuskatsauksessa käsitellään kiertotalouden pääperiaatteita, tiedon yhteisluomisen teoreettista taustaa sekä muotoilun ja yhteissuunnittelun strategista roolia ongelmanratkaisussa. Tutkimusaineisto kerättiin kolmipäiväisessä työpajassa osallistuvalla havainnoinnilla sekä työpajan jälkeisillä teemahaastatteluilla viiden osallistujan kanssa.

Tutkimustulokset osoittavat, että yhteissuunnitteluprosessi tukee uuden tiedon luomista mahdollistamalla osallistujien välillä tapahtuvaa tiedon *jakamista, kääntämistä* ja *muuntamista*. Tulosten perusteella tunnelmaan, osallistujiin, ryhmätyöskentelyyn ja työpajan rakenteeseen liittyvät elementit mahdollistivat ja tukivat tiedon yhteisluomista. Artefaktien käyttäminen ja luominen oli keskeisessä osassa osallistujien välisessä kommunikoinnissa ja yhteisen merkityksen luomisessa. Yhteissuunnittelutyöpajalla havaittiin olevan positiivinen vaikutus osallistujiin ja heidän edustamiinsa yrityksiin. Työpajan kautta osallistujat pääsivät kartuttamaan osaamistaan kiertotaloudesta ja soveltamaan oppeja liiketoiminnan kehittämiseen. Edellinen omalta osaltaan tukee kiertotalouden edistämistä tulevaisuudessa.

Tämä tutkimus näyttää yhteissuunnittelun merkityksen kiertotalouden mukaisten ratkaisujen kehittämisessä ja nostaa esiin tiedon yhteisluomisen edellytyksiä ja mahdollistajia. Tutkielma antaa tienviittoja toimijoille alasta riippumatta, jotta he voivat kehittää yhteistyöllä kiertotalouden mukaista tulevaisuutta. Sen lisäksi tutkielma tukee aiempaa tutkimusta yhteissuunnittelun roolista monitahoisessa ongelmanratkaisussa sekä avaa uusia ovia tulevalle tutkimukselle yhteissuunnittelun ja kiertotalouden parissa.

Avainsanat kiertotalous, yhteissuunnittelu, tiedon yhteisluominen

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The best way to predict the future is to design it.

Richard Buckminster Fuller (1895 - 1983), American inventor and visionary

1

INTRODUCTION

1. INTRODUCTION

1.1 BACKGROUND

Estimations say that by 2030, three billion new consumers will take part in the global economy (EMF, 2015). Humans are already consuming natural resources at a pace that exceeds Earth's capacity to regenerate them. Earth Overshoot Day, which marks the date when humanity's annual demand on natural systems surpasses what our planet can renew that year, was on the 2nd of August in 2017 - the earliest date so far (Earth Overshoot Day, 2017). The current linear economic model is sustained by continuous economic growth, which is based on growing production and consumption of natural resources and supported by a throwaway culture. It is built on the false assumptions that there is an unlimited amount of natural resources and that the Earth can absorb pollution and waste infinitely (Mont, 2008).

This ecological overconsumption has led to countless environmental problems around the world, such as deforestation, drought, fresh-water scarcity, soil degradation, biodiversity loss and air pollution. According to environmental scientists Rockström et al. (2009), humanity has already exceeded three of the nine planetary boundaries that mark the safe operating space for human development: biodiversity loss, nitrogen cycle and climate change. Current human economic activities, which are strongly depending on fossil fuels and industrialized forms of agriculture, are pushing the earth systems from the stable environmental state to a less predictable state that could likely cause catastrophic large-scale ecological consequences (Ibid).

It has been recognized that the "take-make-use-dispose" economic model has contributed to rising and volatile prices as well as resource supply disruptions (EMF, 2013). The global resource demand is growing while at the same time resource stocks are declining. According to McKinsey Global Institute (2011), the economic growth of the 20th century was based on the availability of inexpensive resources; however, price levels have risen in the 21st century and they are expected to remain high and volatile for at least the next two decades.

The private sector is starting to realize that there are limits to the linear economic model. Accenture (2014) warns that resource depletion along with volatile and higher price levels will turn into immense losses for companies and nations that are dependent on the use of scarce and virgin natural resources. The global supply of natural resources is declining, which means that the prices of raw materials are rising, and the availability is deteriorating (EMF, 2012). Thus, the continued reliance on natural

resources exposes businesses to serious risk. Accenture (2014) states in their report that "the growth model favoured by economies and indeed most companies for the past 250 years – based on the availability of plentiful and inexpensive natural resources – is living on borrowed time and so are companies that rely on it." To that end, it is becoming clearer that there is a need to delink the rise of prosperity from resource use and to develop new ways to create value (Preston, 2012).

A proposed solution to the aforementioned challenges is the transition to a circular economy, which aims at creating wealth and wellbeing through the sustainable use of natural resources and thus strengthen Earth's carrying capacity in the long term (Sitra, 2017a). Unlike the linear economy, the circular economy is designed to be restorative and regenerative by relying on renewables, minimizing toxic chemicals and eliminating waste by mindful design (EMF, 2012). In a circular economy, consumption is based on the usage and function of the product or service, not on the products or service itself. The materials are not discarded at the end; they are the resource for the development of new products. (Sitra, 2017b.) The overall objective is to decouple the use of energy and natural resources from the economic and social development (EMF, 2012; Preston, 2012; European Commission, 2014).

Circular economy is a relatively new and topical theme in the field of sustainable development. It has gained significant attention not only amongst scholars, but also companies, governments and political institutions have shown interest in the topic. Circular economy is increasingly incorporated in international and national strategies. Most recently the European Commission (2014) and the Finnish Government (Valtioneuvosto, 2015) have published circular economy initiatives. Finland's goal is to become a pioneer in circular economy and cleantech by 2025 (Valtioneuvosto, 2015). In order to fulfil this target, Finland's Independence Celebration Fund (Sitra) and its stakeholders have created a roadmap for the transition to a circular economy at a national level (Sitra, 2016). The potential benefits of transitioning to a circular economy are tremendous. Sitra (2017b) estimates that the added value of circular economy for the Finnish economy would be more than three billion euros a year by the end of 2030.

However, the transition to circular economy requires more than national plans. It calls for systemic change at all levels; from consumer behaviour to business practices and governmental policies. The EMF (2012) amongst other protagonists of the circular economy emphasizes the important role business innovation plays in the shift to circularity. The end of the linear economic model pressures companies to rethink their business operations in a way that reduces the reliance on scarce virgin resources and closes the material loops.

There is increasing evidence that business innovation is key in the transition to a circular economy (see EMF, 2012; Preston, 2012; Schulte, 2013; Bocken et al., 2016; Accenture, 2014), but few research papers have focused on the actual practices of circular business innovation. According to the EMF (2012), circular economy presents enormous opportunities for companies, so if the private sector is going to lead the transition, there is a need to explore how circularity can be incorporated in business development. Antikainen and Valkokari (2016) state that many companies are currently looking into the possibility of transforming their linear business models to circular ones, however, the change has been rather slow. Since circular economy is a complex challenge that requires systemic change and

cross-sectoral collaboration (Ibid), I argue that it is of high relevance to study how practitioners from different fields co-create knowledge for the circular economy and develop circular solutions together.

Business innovation and management literature suggests that strategic design can facilitate business development and the creation of innovative products, systems and services (Brown, 2009; Leifer & Steinert, 2011). Furthermore, design thinking has been acknowledged to work as a successful method in addressing complex and wicked societal issues (Brown &Wyatt, 2010; Jones, 2014). Design as a practice has evolved and developed from its traditional domain of aesthetics and functionality to address global sustainability-related issues (White & van Koten, 2016). When addressing problems of increased complexity, White & van Koten (2016) stress the significance of interdisciplinary and participatory approaches. Jones (2014) confirms that design challenges that deal with social transitions require multidisciplinary engagement. He also notes that design can facilitate the generation of boundary objects, which are defined as common artefacts that support ideation and the transfer of knowledge between individuals with different disciplinary backgrounds (Carlile, 2002). In that way, collaborative design methods can support innovation activities by facilitating collaboration and ideation.

This study investigates the use of collaborative design methods for supporting knowledge co-creation for the circular economy. Knowledge creation is an essential part of cross-sectoral collaboration and using design methods can play a key role in facilitating the process. While there is existing research on the role design thinking (see e.g. Leifer & Steinert, 2011; Scheer et al. 2012) and collaborative design (see e.g. Sanders & Stappers, 2008; White & van Koten, 2006) in supporting learning and knowledge creation, there is a lack of studies focusing on knowledge co-creation in the context of the circular economy and the role design can play in facilitating the process.

1. 2 RESEARCH AIMS

This study reflects on a cross-disciplinary workshop in which principles and tools of co-design were applied to allow participants to gain knowledge on the circular economy and facilitate the development of solutions for the circular economy. The goal of the workshop was to increase participants' understanding of circular business models and circular design principles as well as facilitate the co-creation of circular business concepts. The research is carried out through a review of relevant literature, participant observation as well as interviews with workshop participants in order to gain deeper understanding on the topic at hand. Through these methods, the thesis aims to explore the following research question:

> ***How does collaborative design support the transition to a circular economy?***

The main research question is approached through the following subquestions:

> ***How does the collaborative design process facilitate knowledge creation?***
>
> ***What can be seen as the enablers of the knowledge co-creation process?***

The thesis has three goals. First, to demonstrate the pertinence of collaborative design as an enabler and support for the transition to the circular economy. Second, to bridge the literature of circular economy, knowledge co-creation and collaborative design to form a holistic theoretical framework. And third, to develop practical guidelines of circular innovation for business and design practitioners.

The study contributes to the literature on circular economy, knowledge co-creation and collaborative design by showing the dependencies between these three subject matters. In addition, the research has strong practical contributions since the focus is on a real co-creation case. As an outcome, the thesis offers guidelines for business and design practitioners on facilitating co-creation workshops that have objectives to design solutions that support the transition to a circular economy.

1. 3 METHODOLOGY

The study employs a qualitative case study design. The research questions are explored through observation of a three-day collaborative design workshop called EcoDesign Sprint. In addition to observation, the research methods include semi-structured interviews with participants after the workshop. The workshop data is in the form of audio records, field notes and workshop material. The five interviews are all audio-recorded and transcribed. The research findings are analysed and discussed by reflecting them on the theories of the circular economy, knowledge co-creation as well as collaborative design and design thinking introduced in the literature review.

1. 4 STRUCTURE OF THE THESIS

The thesis is structured in the following way. Chapters two, three and four cover the literature review, which encompass three essential topics of this thesis: circular economy, knowledge co-creation and design thinking. After exploring the relevant literature on the circular economy to form the basis for the research, the main theories of knowledge co-creation and design are explored. Based on a thorough literature review, a theoretical synthesis is presented through which the findings of the research are then reflected upon. Chapter six describes the context of the study as well as the research methods employed. The findings of the research are presented in the subsequent chapter which is followed by the discussion section. Finally, the chapter nine concludes the thesis by describing the contributions of the study and possible avenues for future research.

2

TRANSITIONING TO A CIRCULAR ECONOMY

2. TRANSITIONING TO A CIRCULAR ECONOMY

This chapter provides an overview of the circular economy by outlining the principles, characteristics and origins of the concept as well as demonstrating the need for companies to adopt new circular business models and develop new partnerships. EcoDesign Sprint brings participants together to learn about the circular economy and create business and design concepts according to its principles. Hence, this chapter provides a basis and context for the study.

2. 1 A CALL FOR SYSTEMIC CHANGE

Circular economy (CE) has increasingly gained momentum amongst scholars, companies and policymakers as it shows potential for a system-level shift from the current linear "take, make and dispose" model of resource consumption to a circular and closed-loop model (Ness, 2008). The negative consequences of the linear economic model are experienced all over the world in the form of unstable natural and economic systems that threaten the survival and development of humanity (EMF, 2012; Preston, 2012; Rockström et al. 2009; Yuan et al., 2006). The shift to a circular economy is seen as a way to achieve sustainable development by decoupling economic growth from material input (EMF, 2012). The circular economy aims at promoting a greener economy that is characterized by the sustainable use of resources, innovative business models and ingenious employment opportunities (EMF, 2012; Stahel, 2014).

The transition to circularity requires holistic reorganization of human activity, both in relation to consumption patterns and production practices (Yuan et al., 2006). Ghisellini et al. (2016) also argue that CE aims higher than just regenerating materials and recovering energy. By requiring a broad and extensive approach to the life cycle of a product and process, CE is about radically innovative solutions that take into consideration the surrounding environment and economy and improve business-as-usual (Ibid). The transition to the circular economy necessitates a paradigm shift to the current ways of producing and consuming - a shift that puts sustainability and closed-loop thinking in the core of business (Preston, 2012). The circular economy has the potential to introduce new ways to create wellbeing and prosperity that do not sacrifice material, energy and the environment.

2. 2 CHARACTERISTICS OF A CIRCULAR ECONOMY

Compared to the linear economy in which materials are first extracted from nature, then turned into products and finally discarded, the circular economy proposes a shift in the way we perceive the life-cycle of products. In a circular economy, the material cycles are closed in a way that enables all materials and components of a product to either return back to nature or remain in the economy within closed-loop industrial cycles (McDonough & Braungart, 2002). The materials can circulate in the economy for example through three main activities, i.e. the so called "3R" principle: Reduction, Reuse and Recycle (Yuan et al., 2006; Preston, 2012).

The idea behind *cradle-to-cradle* thinking and the circular economy is to create positive impact on the environment instead of only minimizing the environmental harm (McDonough & Braungart, 2002). According to the EMF (2012), through systems thinking, one can gain better understanding of complex systems and the ways in which different parts affect each other. In order to manage economic activities in a way that regenerates and restores the environment, the links and relations between the parts of the system must be taken into consideration. In addition to "thinking in systems", one of the characteristics of the circular economy is that renewable energy sources power the economy. (Ibid.) In terms of energy use, by rethinking the industrial systems, the circular economy promises to improve the energy efficiency of industrial processes (Clift & Allwood, 2011).

Despite its increasing popularity, circular economy still lacks a clear and commonly accepted definition (Yuan et al., 2006; Preston, 2012). The Ellen MacArthur Foundation (2015, p. 2) frames circular economy as an industrial system 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". According to Preston (2012, p. 1), a circular economy is "an approach that would transform the function of resources in the economy. Waste from factories would become a valuable input to another process – and products could be repaired, reused or upgraded instead of thrown away." Bocken et al. (2016) characterizes the circular economy as design and business model strategies that are slowing, closing, and narrowing resource loops. Governments have also taken an active role in promoting the circular economy and its potential benefits to the economy and environment. The European Commission (2014, p. 2) defines CE as a system that "keeps the added value in products for as long as possible and eliminates waste" by making large-scale changes "from product design to new business and market models, from new ways of turning waste into a resource to new modes of consumer behaviour". Whereas according to China's Circular Economy promotion law, CE is "a generic term for the reducing, reusing and recycling activities conducted in the process of production, circulation and consumption" (Naustdalslid, 2014, p. 305). Although there is no broadly accepted single definition for the circular economy, most of them emphasize the closed or circular flow of materials as well as the use of resources and energy through various phases (Yuan et al., 2006).

The lack of a commonly accepted definition for the circular economy results in the inconsistent use of the concept by companies and governments (Preston, 2012). According to Korhonen et al. (2018), the concept is a set of vague and separate definitions developed from different fields. Preston (2012) suggests that developing a common framework and definition for the circular economy would be beneficial as it would enable wider adoption of the concept, facilitate cooperation as well as prevent confusion around the term.

2. 3 ORIGINS AND DEVELOPMENT OF THE CONCEPT

The circular economy as a concept has its roots in various schools of thoughts that all share the same basic principles – taking insights from living systems. The ideology behind the circular economy is hardly new and has been discussed for decades already, hence, it is difficult to trace its origins to a single author or body of literature.

The term *circular economy* was first introduced by two environmental economists Pearce and Turner (1989) in their article that examined the characteristics of linear modern economic models and the role natural resources have in them. The work of Pearce and Turner was influenced by Boulding's (1966) paper "The Economics of the Coming Spaceship Earth", where the earth is described as a closed and circular system with limited capacity and resources. In his paper, he proposes a shift from the *cowboy economy*, where the earth is exploited limitlessly to a closed *spaceship economy*, in which the earth is seen as a single spaceship with limited resources. He argues that humans should manage natural resources as they were stranded in a spaceship and thus, learn to reconnect with the ecological systems.

The circular economy as a concept has been refined and developed by the following contemporary schools of thoughts: *Industrial Ecology* (Graedel & Allenby, 1995), *Biomimicry* (Benyus, 1997), *Cradle to Cradle* (McDonough & Braungart, 2010), *Natural Capitalism* (Hawken, Lovins & Lovins, 1999), *Performance Economy* (Stahel, 2010), *Regenerative Design* (Lyle, 1994) and *Blue Economy* (Pauli, 2010). The circular economy brings together ideas and principles from these schools of thought under one holistic concept, hence, these approaches form the framework of the circular economy.

2. 4 MODELS OF A CIRCULAR ECONOMY

One of the leading protagonists of the circular economy is the Ellen MacArthur Foundation, which has created a comprehensive diagram that shows the principle of circular economy.

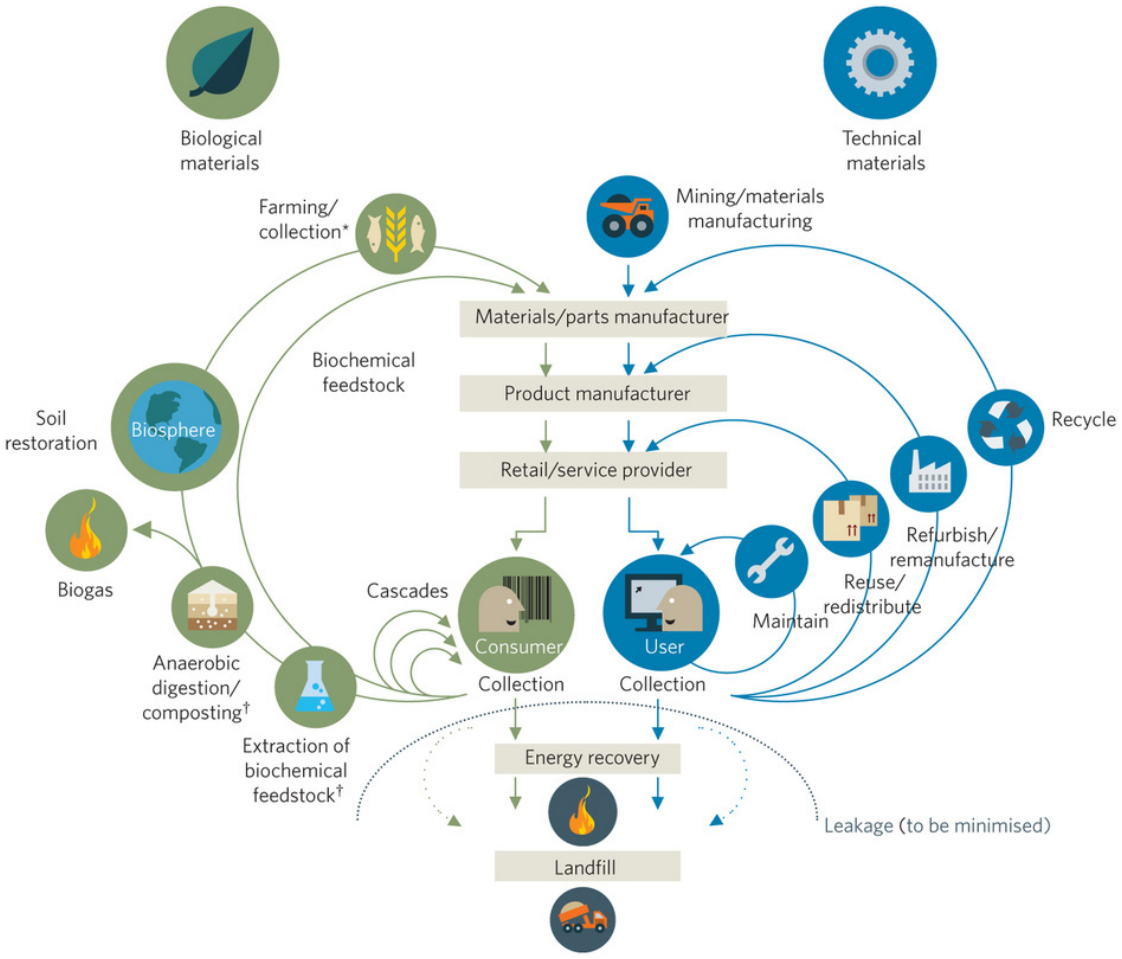

Figure 1: Butterfly diagram (Ellen MacArthur Foundation, 2012)

The butterfly diagram illustrates how the biological and technological materials circle through the economy. The figure shows the flow of two different cycles: the biological nutrient cycle and the technical nutrient cycle. In the circular economy, all materials can be categorized either as biological materials that can return safely to the biosphere, or as technical materials that cannot, hence, they should be kept circulating in the economy (McDonough & Braungart, 2002). The model reveals the various strategies for creating circular loops for products. In the biological cycle, products can be anaerobically digested or composted, used in the extraction of biochemical feedstock or cascaded into other uses. In the technical nutrient cycles, products can be maintained, reused, redistributed, refurbished, remanufactured and recycled.

The circular strategy depends on the product; however, the aim is to keep the product as its highest value for as long as possible. The larger the loop is, the more it requires energy input (Bakker et al., 2014) and the more it loses its value. Since the product should be used as its original use as long as possible before turning it into something else, recycling is perceived as the least favourable option. A commonly used model to demonstrate the hierarchical relations between various loops is given in Figure 2.

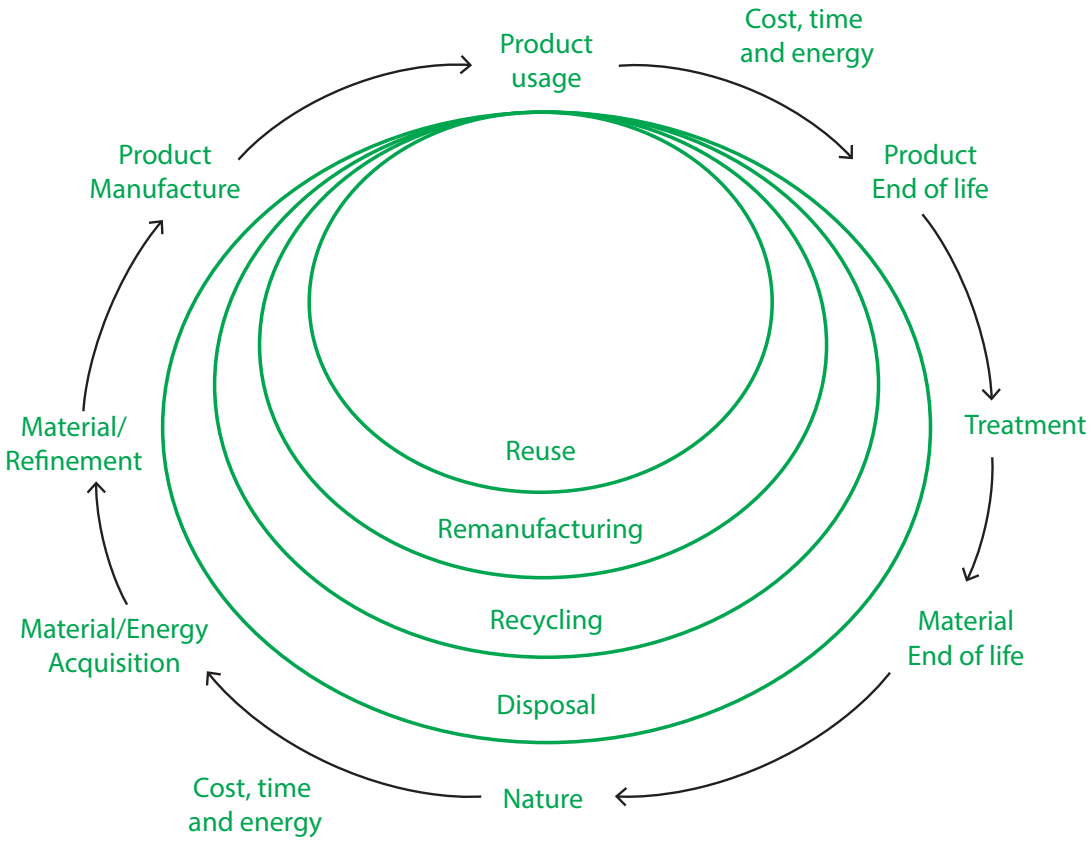

Figure 2: Loops in a circular economy (Mihelcic et al., 2003)

The figure shows that the inner circles, reuse and remanufacturing, require less resources and energy than the outer circles (Mihelcic et al., 2003). The inner circles should therefore be favoured before recycling because they are less expensive and require less energy and time. The product's components and materials should be collected firstly for reuse, refurbishment and repair, only then for remanufacturing and lastly for recycling (Korhonen et al., 2018). Similarly, Stahel (2014) confirms that recycling is the least favourable and sustainable strategy for the circular economy in terms of profitability and resource efficiency. Priority should be given to solutions that enable service-life extension and reuse before recycling. By keeping products at their highest possible value as long as possible, energy and raw materials are saved. Korhonen et al. (2018) adds that it is also cost-effective to keep the product's value circulating as long as possible in the economy after investing large amounts of resources in the production.

2. 5 NEED FOR CIRCULAR BUSINESS INNOVATION AND COLLABORATION

Several authors underline the significant role business models play in the transition to a circular economy (EMF, 2012; Preston, 2012; Schulte, 2013; Bocken et al., 2016; Accenture, 2014). Accenture (2014) claims that most companies do not take advantage of the opportunities circular economy presents to them. The EMF (2012) notes that global challenges relating to demographic trends, infrastructure needs, political risks, globalized markets and climate change all indicate that resource scarcity and price volatility will not cease to increase, which in turn highlights the relevance of acting sooner rather than later in translating circular principles into business models. According to McKinsey Global Institute (2011), three billion new middle-class consumers, mostly from emerging market economies, will enter the global market by 2030. These demographic changes will require resources to support both infrastructure development as well as lifestyles of new middle-class consumers (Preston, 2012).

Nevertheless, companies have a key role in determining consumption practices through their business models. Especially when examining the shift from ownership to performance-based payment models, the creation of an attractive value proposition from the consumer point of view is of high importance (EMF, 2012). Preston (2012) adds that business has profound societal implications since companies to a large extent define how consumers purchase, use and discard products. Indeed, the successful transition to a circular economy will be achieved only if business models are designed and implemented with the principles of sustainability and closed-loop thinking in mind (Ibid).

The circular economy presents companies opportunities to create value, grow and stay competitive despite resource constraints (Preston, 2012). In the circular economy, companies design the use and disposal of products, come up with new ways to generate profit and to optimize the efficiency of the entire value chain (Accenture, 2014). The way businesses operate shifts from selling actual products to generating profit through the flow of materials and products (Bakker et al., 2014). The ultimate goal in circular economy is to delink economic growth from the use of natural resources through innovative circular business models that are based on "longevity, renewability, reuse, repair, upgrade, refurbishment, capacity sharing and dematerialization" (Accenture 2014, 4). Accenture (2014) identifies the following five circular business models based on its analysis of 120 companies that are driving innovation through resource productivity: circular supplies, resource recovery, product life extension, sharing platforms and product as a service. These circular business models enable the continuous reuse of products and materials, while decreasing the dependence on virgin resources (Bocken et al., 2016). Circular business models create more value from each resource unit (EMF 2013), because rather than producing products from virgin resources, companies and consumers reuse what is already in the economy (Accenture, 2014).

To address the systemic changes that the circular economy requires, companies need to shift their mindsets and practices. Bocken et al. (2015) state that especially collaboration across a wider range of stakeholders is needed as a sustainable economy cannot be achieved if actors operate independently according to their own interests. According to Preston (2012), the development of circular business

models requires new networks and partnerships along the supply chain. To be successful, these new models necessitate collaboration between companies as well as better consideration of the end user in the process (RSA, 2013). This view is also supported by the EMF (2012) who stresses the significant role of collaboration in the move to circularity. Challenges in cooperation may even hinder circular business models from becoming efficient and lucrative. Therefore, the successful implementation of these innovative business models necessitates skills in new types of alliance and partnership building. (EMF, 2012.)

3

CO-CREATING KNOWLEDGE FOR THE CIRCULAR ECONOMY

3. CO-CREATING KNOWLEDGE FOR THE CIRCULAR ECONOMY

As discussed in the previous chapter, innovation and cross-sectoral collaboration are prerequisites for a successful transition to circular economy (Bocken et al., 2015). The circular economy suggests a radical reorganization of consumption and production activities (Yuan et al., 2006) in order to keep materials, components and products at their highest value and eliminate waste (European Commission, 2014). Since the circular economy calls for system-level change in all areas from business to politics and consumer behaviour (EMF, 2012), and innovation requires learning and knowledge creation (Esterhuizen et al., 2012); there is a need for facilitating the creation of shared understanding and knowledge on the topic. According to the EMF (2013), mindsets, regulations and industrial systems are all "locked in" a linear model. Hence, tools and methods that enable the disruption of current mindsets, support the development of novel skills and encourage the creation of new knowledge are necessary to advance the transition to circularity.

It is acknowledged by scholars, that knowledge creation occurs in social interaction and collaboration (see Nonaka, 1994; Nonaka & Takeuchi, 1995; Carlile, 2002). Knowledge creation is a social and collaborative process; hence, the term knowledge co-creation is utilized in this paper to refer to the collective and participatory creation of knowledge. Particularly in collaboration situations where actors come from different backgrounds and practices, the methods supporting knowledge creation are highly relevant to examine further.

This chapter introduces the process of knowledge co-creation by presenting the knowledge spiral by Nonaka and Takeuchi (1995), which is considered as the foundations of knowledge creation literature. Furthermore, the link between boundaries and knowledge is explored through the theory of knowledge transformation by Carlile (2002). Finally, this chapter concludes with the discussion on the enablers of knowledge co-creation. The aim is to establish a profound understanding on the main theories in order to explore, in the next section, how design could facilitate and support the process of knowledge creation for the circular economy.

3. 1 KNOWLEDGE CO-CREATION

Knowledge co-creation describes the process and activities of acquiring knowledge and creating new meaning. Krogh et al. (2012), who study knowledge creation in the organizational context, define knowledge creation as a constant process of amplifying the available knowledge within the company's knowledge system. According to Nejatian et al. (2013), the ability of organizations to create knowledge is a key success factor in the increasingly competitive markets. Nonaka and Takeuchi (1995) also argue that knowledge creation process is the source of innovation and generation of new ideas (Nonaka & Takeuchi, 1995). Indeed, innovations emerge through social interactions and collaboration where individuals share and create knowledge (Blomqvist & Levy, 2006).

Knowledge Spiral

The theory of knowledge creation was introduced by Nonaka in 1994 and further developed by Nonaka and Takeuchi in 1995 (Nejatian et al., 2013). The authors studied the process of knowledge creation in organizations and introduced the *knowledge spiral* (Nonaka & Takeuchi, 1995), which is considered to be one of the most influential models in the literature of knowledge management (Choo & Bontis, 2002). Thereby, most of the knowledge management research still relies on Nonaka and Takeuchi's model of knowledge creation.

Nonaka and Takeuchi's (1995) theory of knowledge creation is based on a clear distinction between two kinds of knowledge, tacit and explicit. The distinction between tacit and explicit knowledge was first made by Polanyi (1966) and further discussed by Nonaka (1994) and Nonaka and Takeuchi (1995). According to Nonaka (1994, p. 16) explicit or codified knowledge can be "expressed in words and numbers" and is "transmittable in formal, systematic language". On the other hand, tacit knowledge refers to personal knowledge that is difficult to communicate or share. Tacit knowledge is "rooted in action, commitment and involvement in a specific context" (Nonaka, 1994, p. 16). That is to say, tacit knowledge is subjective and depends on the context while explicit knowledge is more easily identified and transmitted to others. Nonaka (1994) identifies both cognitive and technical elements in tacit knowledge. By cognitive elements, the author means mental models that enable individuals to perceive the world, such as paradigms and beliefs. On the other hand, technical elements of tacit knowledge refer to the concrete know-how, crafts and skills an individual possesses.

Nonaka and Takeuchi's (1995) knowledge spiral, also referred to as the *SECI model*, explains the means in which knowledge of individuals, organizations and societies can be expanded and enriched through social interactions between tacit and explicit knowledge. The authors refer to the interaction between the two types of knowledge as *knowledge conversion*. According to the authors, knowledge creation can be perceived as a process or spiral that goes through the individual, organizational and inter-organizational levels. The model identifies four interconnected phases in the conversion of tacit and explicit knowledge: *Socialization* (from tacit knowledge to tacit knowledge), *Externalization* (from tacit knowledge to explicit knowledge), *Combination* (from explicit to explicit knowledge),

and *Internalization* (from explicit to tacit knowledge). The knowledge spiral is illustrated in the figure below.

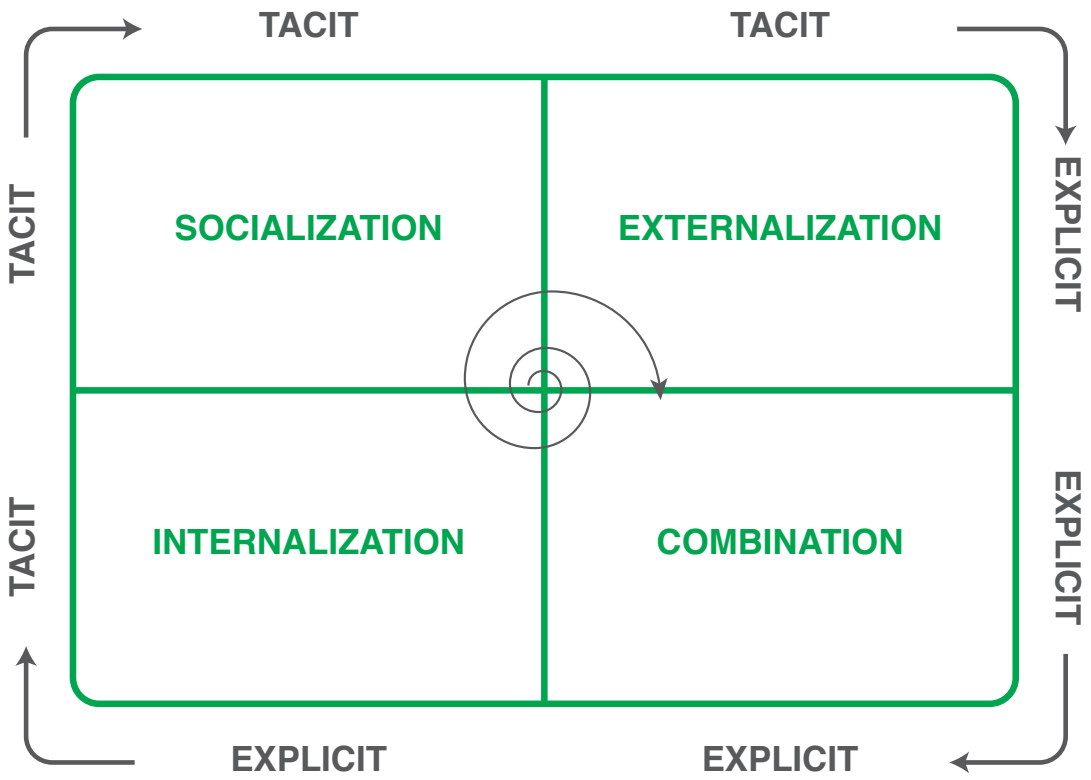

Figure 3: Knowledge spiral (Nonaka & Takeuchi, 1995)

Socialization refers to the activity of sharing tacit knowledge through the interaction between individuals, which supports the creation of new tacit knowledge (Nonaka & Takeuchi, 1995). Nonaka (1994) emphasizes that shared experience, such as observation, imitation and practice, are key in the conversion of tacit knowledge. The objective of the socialization phase is to create mutual trust and understanding between members of a group (Paavola et al., 2004). Externalization is the phase where tacit knowledge is codified into explicit knowledge through the use of metaphors and analogies. This phase enables knowledge to be shared with other individuals, hence, it forms the basis of the creation of new knowledge. (Nonaka, 1994.) Paavola et al. (2004) highlight the significance of externalization in knowledge creation as tacit knowledge is the source of innovation. Therefore, it needs to be articulated to others in order to be transformed into knowledge that makes sense at all levels of the group. Combination is the activity of transferring explicit knowledge to more complex sets of explicit knowledge through combining, editing and processing knowledge. Finally, internalization refers to the phase where explicit knowledge of the group is converted into tacit knowledge at the individual level. This last phase is closely related to *learning by doing*. (Nonaka, 1994; Nonaka & Takeuchi, 1995.) The spiral goes from socialization to internalization after which another cycle of knowledge spiral begins. According to Esterhuizen et al. (2012), the SECI processes have a key role in enabling innovation as they form the foundation and basis to grow innovation capability maturity.

Communities of Practice

According to Polanyi (1966, p. 4), "we can know more than we can tell". Indeed, tacit knowledge consists of embodied expertise and profound understanding of complex and context-specific issues. Therefore, the ability to convert tacit knowledge is of high value for companies and can serve as a competitive advantage (Nonaka et al., 2000). Social interaction and informal learning processes, such as conversations, narratives and apprenticeship among others, are prerequisites for sharing and creating tacit knowledge (Wenger et al., 2002).

Communities of Practice (CoP) are perceived to enhance collective learning through providing individuals with a shared domain, community, or practice. Wenger et al. (2002, p. 4) define a CoP as a "group of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis". Moreover, a community of practice is described to have mutual commitment, a shared goal and a shared repertoire of resources (Wenger, 1998). Thus, according to the approach of CoP, knowledge is created through and within a shared practice, thus, it cannot be separated from its context.

3. 2 KNOWLEDGE TRANSFORMATION

The approaches discussed in the previous chapter consider knowledge creation as embedded in an organizational or communal context. However, knowledge creation is especially relevant when crossing knowledge boundaries between communities of practice. According to Carlile (2002, p. 442), "knowledge is both a source and a barrier to innovation" because knowledge that fosters problem solving within a function can actually prevent knowledge creation across functions. As knowledge is localized, embedded and, invested in practice, the theory of knowledge transformation explains how knowledge is created across knowledge boundaries through an object-mediated process (Carlile, 2002; 2004).

To address the possible circumstances at a boundary, Carlile (2004) identifies three properties of knowledge at a boundary. The author refers to the first property *difference* to explain the difference in the amount and type of knowledge acquired. The second property of knowledge is *dependence*, which is defined as the condition in which actors that have a common goal need to take each other into account in order to achieve that goal. The third property of knowledge at a boundary relates to the *novelty* of circumstances. Hence, managing the lack of common knowledge between actors is seen as the most demanding aspect in knowledge. Difference, dependence and novelty are all properties of knowledge that foster innovation. However, as the difference in the amount and type of knowledge, the number of dependencies between actors and the novelty of knowledge increase, it becomes more and more complex for actors to share and assess knowledge across boundaries. The three properties of knowledge show that there is a need for increasing effort in sharing and assessing discipline-specific knowledge as the complexity increases at a boundary. (Ibid.)

To show how the complexity of managing knowledge at a boundary increases, Carlile (2002; 2004) proposes a framework of three categories of boundaries; *syntactic, semantic* and *pragmatic*, and three processes; *transfer, translation* and *transformation*. If knowledge should be transferred, translated or transformed depends on the novelty of knowledge, as shown in the figure below.

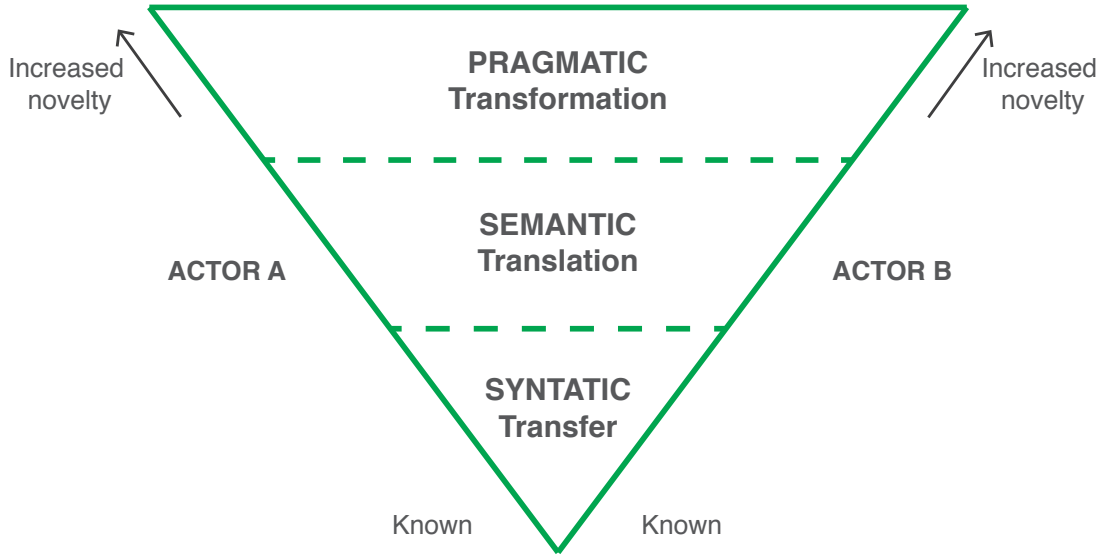

Figure 4: Knowledge transformation (Carlile, 2004)

At the syntactic level, knowledge is transferred between actors through common lexicon or vocabulary. However, as novelty increases, new kinds of dependencies and differences must be identified and managed. At the semantic boundary, a process of learning and creation of shared meanings occurs that enable the translation of knowledge. (Carlile, 2004). Making tacit knowledge explicit (Nonaka, 1994) is a key challenge in this boundary. However, Carlile (2004) notes that Nonaka's SECI model does not take into consideration that the externalization phase might reveal different interests, which, in turn, can create barriers to the creation of common meaning. Thus, he stresses the significance of negotiation as well as the willingness to explore knowledge outside of their own domain of specialization. Lastly, at the pragmatic boundary, the increased novelty results in differing interests between actors. Thus, both common knowledge and domain-specific knowledge is transformed in order to create knowledge at the boundary. Boundary objects, such as drawings and prototypes, may be used to facilitate the negotiation and transformation of knowledge between actors with different interests. Although the boundaries are clearly separated in the framework, the transition between the boundaries are not always easy to identify. The purpose of Figure 4 is to show a process of moving up between the boundaries; the capacities of the boundaries in lower levels are essential as complexity and novelty arises. For example, in order to transform knowledge at the pragmatic boundary, common meaning has to be developed at the syntactic and semantic levels. (Carlile, 2004.)

3. 3 ENABLING CONDITIONS AND SUPPORTING REQUIREMENTS

A place and context for knowledge creation

Knowledge co-creation happens in a context and a place. Nonaka et al. (2000) introduce the concept of *ba* to explain the common context in which knowledge is shared, created and utilized between individuals. *Ba* provides a place and context for interpreting information to become knowledge and moving along the knowledge spiral. Through interaction in *ba*, individuals and the context itself evolve and create new knowledge as depicted in the figure below. *Ba* does not necessarily mean a physical place; it can also mean time and space. In the process of creating knowledge, especially in socialization and externalization phases, participants should be able to share time and space. Thus, *ba* works as a platform for knowledge co-creation. (Nonaka et al., 2000.)

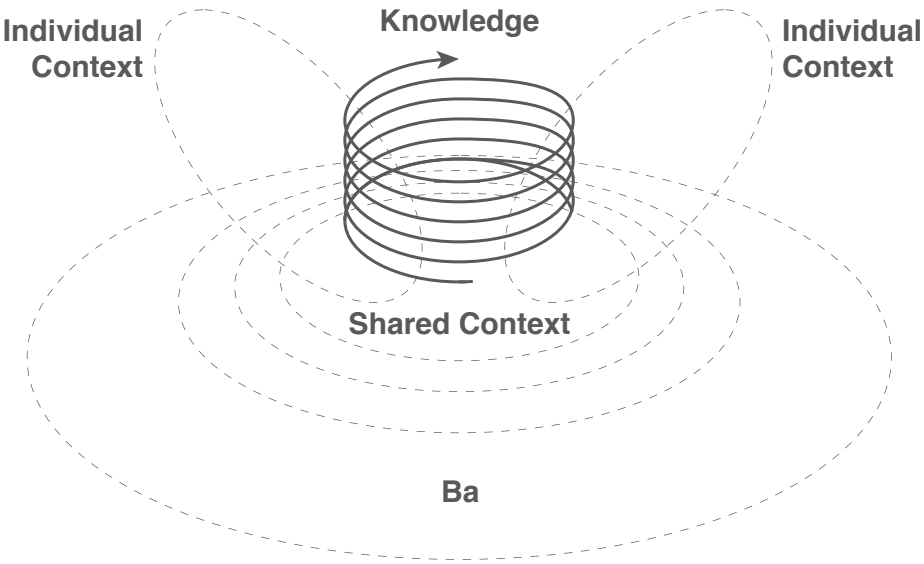

Figure 5: Ba as a shared context (Nonaka et al., 2000)

According to Nonaka et al. (2000), there are four types of *ba*; *originating ba, dialoguing ba, systemising ba* and *exercising ba*, which are defined by two dimensions; the type of interaction and the media used in the interaction (see Figure 6). The type of interaction refers to whether the interaction occurs individually or collectively and the media used in the interaction refers to whether it takes place face-to-face or virtually.

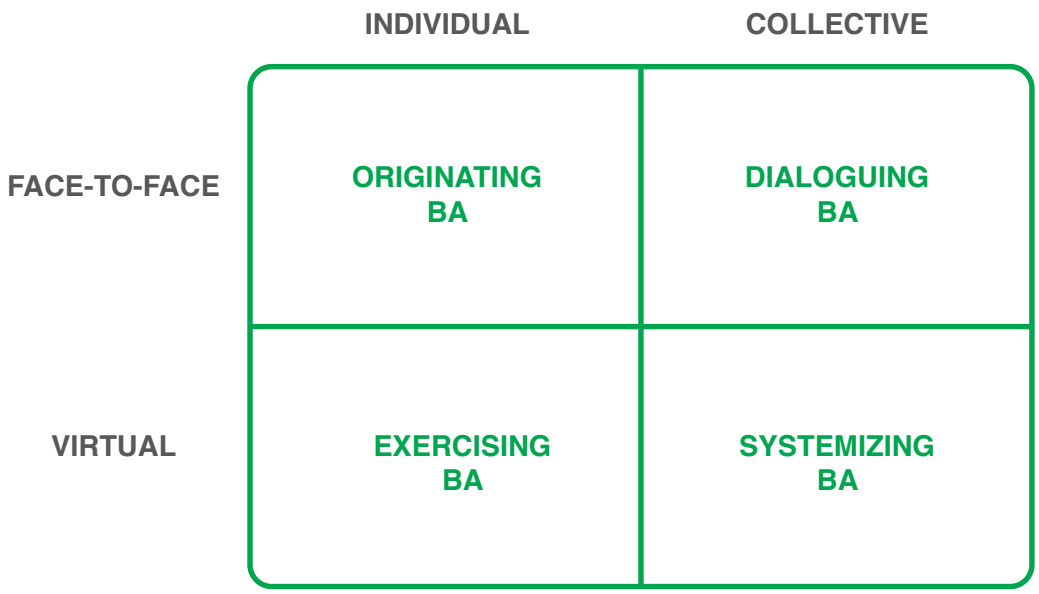

Figure 6: Four types of ba (Nonaka et al., 2000)

As illustrated in the figure above, *originating ba*, which is situated at the intersection between individual and face-to-face interactions, is a place that gives context to socialization and where individuals convert knowledge through empathizing with others. *Dialoguing ba*, which is defined by the intersection between collective and face-to-face interactions, is a place where participants' tacit knowledge is articulated to form concepts through dialogue. Hence, *dialoguing ba* enables externalization. *Systemising ba,* which results from the intersection of collective and virtual interactions, provides a context for combining existing explicit knowledge through information technology. Finally, *exercising ba* refers to the place of individual and virtual interactions, which offers a context for internalization. In the exercising ba, individuals embody explicit knowledge that has been shared virtually. (Nonaka et al., 2000.)

Enabling conditions

Creating a knowledge-friendly culture is an essential aspect of knowledge management. Nejatian et al. (2013) introduce three enablers in the organization culture for successful knowledge creation: *collaboration, trust* and *learning*. Collaborative activities, such as social interactions, open discussion and joint activities, are key enablers of knowledge creation because they help people exchanging knowledge and obtaining shared understanding. Trust enables knowledge creation by decreasing the fear of risk and uncertainty, especially in cross-functional and inter-organizational groups. Therefore, facilitating the building of trust among cross-sectoral groups is seen as a central element of knowledge creation. People should be encouraged to learn in order to create knowledge as the time spent on learning correlates positively with the amount of knowledge created. Organizational learning can be enhanced for example through education, training and mentoring. (Ibid) Blomqvist and Levy (2006) supports the view of Nejatian et al. by arguing that *trust, communication* and *collaboration* are key factors in knowledge creation and collaborative innovation.

According to Nonaka and Takeuchi (1995) *intention, autonomy, creative chaos, redundancy* and *requisite variety* are all enabling conditions of organizational knowledge creation. Knowledge creation process starts with intention since it is the reason and source of collaboration. The essence of intention lies in building the capabilities of an organization to acquire, share and create knowledge. By allowing autonomy in organizational activities, the chances for individuals to find valuable information and motivation to create new knowledge increases. Collaborating groups may encounter fluctuation and chaos during knowledge creation, however, it is essential to note that this intentional chaos differs from complete disorder. Through creative chaos, the interaction between the organization and the external environment is stimulated, which allows individuals to surpass existing boundaries by questioning existing assumptions, re-evaluating the problem and finally resolving it. Redundancy, which refers to the intentional overlapping of information, accelerates the knowledge creation process for two reasons. Firstly, redundancy of information advances the sharing of tacit knowledge because participants are able to perceive the ideas others are trying to express. Secondly, redundancy of information allows people to know their responsibilities in the organization, which helps to manage their thinking and actions. Ensuring requisite variety of knowledge is critical to advance the Knowledge Spiral as it allows balancing between order and chaos. Requisite variety is ensured through the development of a flat and flexible organizational culture or through changing the organizational structure frequently, which enable individuals to gain interdisciplinary knowledge to address the complexity of the environment. (Nonaka & Takeuchi, 1995; Nonaka et al. 2000.) Furthermore, Nonaka et al. (2000) emphasize that *love, care, trust* and *commitment* form the foundations of knowledge creation. Thus, it is essential to build up an atmosphere in which participants feel safe and motivated to share their knowledge.

Supporting requirements

Esterhuizen et al. (2011) study the ways in which knowledge creation processes can increase innovation capability maturity of companies and identify supporting requirements in the four modes of knowledge conversion (SECI) introduced by Nonaka (1994).

According to Esterhuizen et al. (2011), *a culture of trust, empathy and openness* as well as *low levels of lingual and cultural differences* are key in sharing tacit knowledge between individuals. Mutual experiences and activities between individuals strengthen the culture of trust, empathy and openness. Since communication and interaction are central elements in knowledge creation, low levels of lingual and cultural differences are of advantage. Making tacit knowledge explicit is realized through interactions in which *shared values, trust* and *social closeness* are significant. Combination, which is the activity of processing explicit knowledge through ICT, requires individuals to have *a positive attitude towards ICT* as well as *clear roles and responsibilities*. The main goal of the last phase, internalisation, is learning by converting the existing explicit knowledge into tacit knowledge. The central supporting requirements in this phase is to *encourage experimenting* with new knowledge, which is done by creating an organizational culture that promotes learning and tolerates failure. (Ibid.)

Objects of collaboration

According to Orlikowski (2005), in addition to being emergent, embodied and embedded, knowing is always material. Objects and artefacts have the power to motivate and facilitate collaboration across boundaries as well as form the basis of the activity (Nicolini et al., 2012). To understand the different roles objects can have in cross-disciplinary collaboration, Nicolini et al. (2012) propose a pluralist framework of four types of objects: *material infrastructures, boundary objects, epistemic objects and activity objects*. The theories emphasize various means in which objects can foster and facilitate collaboration across "intersecting social and cultural worlds" (Nicolini et al., 2012, p. 614). Nicolini et al. (2012) categorize these four approaches into three kinds of objects: *tertiary, secondary* and *primary objects*. Material infrastructures are considered as tertiary objects of collaboration as they serve as the basic infrastructural support for collaborators, but they are not the objective of the collaboration activity. Boundary objects are categorized under secondary objects of collaboration as they serve as facilitators of collaboration across knowledge boundaries by translating knowledge between participants. Lastly, primary objects encompass epistemic objects and activity objects, which are the objective and the source of motivation for engaging in collaboration. (Ibid.)

Material infrastructure (Star & Ruhleder, 1996), or *scaffolding* as Orlikowski (2005) describes it, is defined as the ecology of objects that support the everyday activities of a group. Contrary to other objects of collaboration, material infrastructure enables and shapes collaboration without being the focus of the activity. Objects falling under the category of material infrastructure are often taken as granted, however, collaboration would be a lot more difficult without them. Furthermore, their role become more apparent when considering the wider ecology of supporting objects. (Nicolini et al., 2012.) Nicolini et al. (2012) lists E-mail system, phones, documents and the built environment as examples of material infrastructure.

Knowledge creation requires crossing different knowledge boundaries, in which boundary objects can serve as a way to translate and transform knowledge in order to collaboratively create new knowledge (Carlile, 2004). The concept of boundary objects was first introduced by Star and Griesemer (1989, p. 393) who define boundary objects as concrete or abstract objects that are "both plastic enough to adapt to local needs and constraints of the several parties employing them, yet robust enough to maintain a common identity across sites". Boundary objects are interpretively flexible across boundaries as they can have different meanings for various individuals and groups, yet their structure is common and recognizable (Nicolini et al., 2012). Carlile (2002) defines three characteristics boundary objects have in a collaborative problem-solving process. First, a boundary object provides shared language for collaborators to recognize their knowledge. Second, it gives concrete means of recognizing and learning about the differences and dependences between individuals and groups. Finally, boundary objects enable the transformation of knowledge. (Ibid.) Examples of boundary objects are repositories, standardized forms, sketches, drawings, prototypes, metaphors, narratives, processes and methods (Carlile, 2002; Nicolini et al., 2012).

Boundary objects can act as central enablers of cross-disciplinary work; however, they do not consider the motivation behind collaboration. Epistemic objects, on the other hand, drive collaboration by providing a desired and shared goal for collaborators (Nicolini et al., 2012). Epistemic objects as a concept was first introduced by Rheinberger (1997). According to the author, epistemic objects are open-ended and serve as the driving forces in the process of knowledge creation "by virtue of their opacity, their surplus, their material transcendence", which is the reason why they are attractive as targets of research (Rheinberger, 2005, p. 406). Thus, epistemic objects embody what an individual does not yet know for sure (Rheinberger, 2005). Knorr Cetina (1997) argue that the construction of epistemic objects is a central source of innovation as they generate new concepts and solutions, hence, it is becoming an increasingly significant element in the work of experts.

Like epistemic objects, activity objects also provide the direction, motivation and meaning for the collaboration activity (Nicolini et al., 2012). According to Leont'ev (1978, p. 66), "the object of an activity is its true motive." The concept of activity objects derives from activity theory (Leont'ev, 1978; Engeström, 1987) that highlights the object-oriented nature of collaboration. Contrary to boundary objects, that act as instruments of knowledge translation, or epistemic objects, that serve as the source of desire, activity objects provoke contradictions and negotiation because they hold together different types of knowledge (Nicolini et al., 2012). Miettinen and Virkkunen (2005) argue that since actors conceptualize activity objects independently, they are by definition emergent, fragmented, constantly expanding and contradictory. Nicolini et al. (2012) emphasize that the discrepancy triggered from the fragmented nature of activity objects are not inevitably barriers for collaboration, as they can create innovation opportunities.

4

DESIGN FACILITATING KNOWLEDGE CO-CREATION

4. DESIGN FACILITATING KNOWLEDGE CO-CREATION

As explored in the previous chapter on knowledge co-creation, multidisciplinary collaboration is a complex activity in which different knowledge boundaries intersect. A potential approach to facilitate collaborative knowledge creation across different boundaries is the use of design methods. It has been acknowledged (Jones 2014) that design supports cross-disciplinary ideation and knowledge transformation through the creation of boundary objects. In co-creation, co-design and participatory design, the boundaries between collaborators are dissolved for the purpose of solving a problem through collaboration. This study uses the concepts co-design and co-creation as synonyms to refer to what Sanders and Stappers (2008, p.6) define as the "creativity of designers and people not trained in design working together in the design development process".

This chapter explores the potential of collaborative design and design thinking to facilitate knowledge creation, learning and problem-solving. By first looking into the evolution of design's role in society, the idea is to form a basis for further discussing design as a tool in complex problem solving. After that, this chapter elaborates on how design methods can enable knowledge co-creation, and finally, the design process is examined.

4. 1 CHANGING ROLE OF DESIGN

Design in management and design discourse

Design has expanded into new fields that go beyond the domain of traditional design linked with physical artefacts (Hassi & Laakso, 2011). It is increasingly used as a strategic tool to foster innovation and improve results. Design has been applied especially in business management (Johansson et al., 2013) to stimulate creativity and solve complex business problems. Design thinking, which refers to the creative strategies and methods designers use in their process (Brown, 2008), is a concept that has gained attention and triggered debate amongst academics as well as business and design practitioners. Many scholars have promoted the advantages of using design thinking in strategy. According to Brown and Wyatt (2010), companies are increasingly incorporating design thinking in their business operations because it enables better brand differentiation as well as faster product and service deliveries to market. Jones (2014) notes that companies of all sizes and types have adopted design thinking to gain competitive advantage over their competitors (Jones, 2014).

Despite the number of proponents for design thinking, the term still lacks a commonly accepted definition. Johansson et al. (2013) argue that the focus should not be on finding a unique meaning for the term, but rather on understanding the different meanings the term embodies depending on its context. The authors make a clear distinction between two discourses: *designerly thinking* and *design thinking*. The designerly thinking discourse is rooted in the academic field of design and aims to explain the characteristics and competencies of designers. The design thinking discourse, on the other hand, refers to the discussion in the field of management, which aims at understanding design's role as a strategic tool in innovation. Since the designerly thinking discourse has a much longer tradition in academia, design thinking is seen as a translation of designerly thinking discourse into a popularized and practical management version. (Ibid.)

From Design 1.0 to Design 4.0

Design's potential to solve wicked societal problems is increasingly recognized because it facilitates crossing traditional boundaries between the private, public and non-profit sectors as well as between different fields (Brown & Wyatt, 2010). Acknowledging that designers are now working with more complex challenges, Jones and van Patter (2009) identify four domains of design that progress from simple to complex and differ in their intention and outcomes. The level of systemic understanding, learning ability and collaboration increases when advancing from simple to complex. Furthermore, the different domains of design necessitate advancement in design practices, research and education to develop abilities to tackle the increased complexity of design challenges. The domains progressing form Design 1.0 to Design 4.0 are depicted in the figure below.

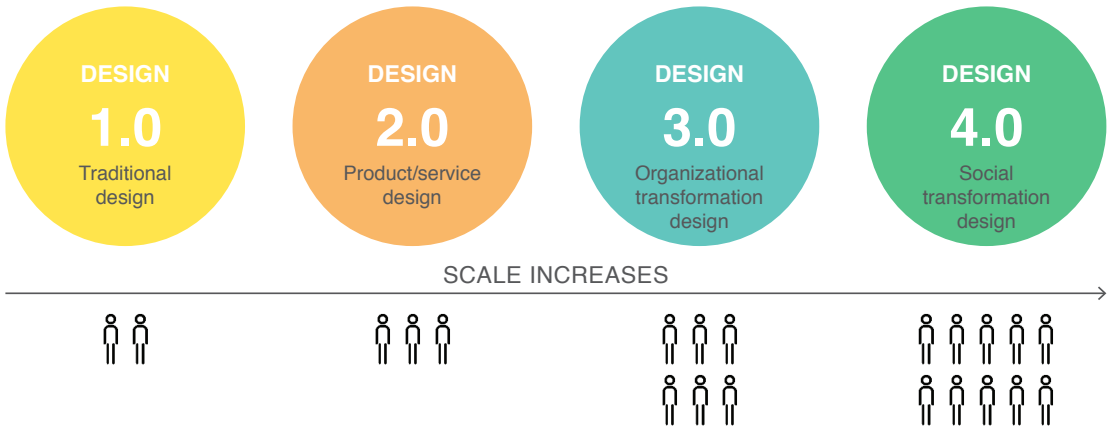

Figure 7: Design 1.0-4.0 (Jones and van Patter, 2009)

The first stage of design, *Design 1.0*, represents the traditional practice of design in which the objective of design is the creation of artefacts and communication. The second design stage, *Design 2.0,* is about design for value creation. *Design 2.0* encompasses service design, product innovation and user experience design. The social complexity increases further between the second and the third

stages as the ladder tackles organizational transformation. *Design 3.0* requires different mindsets, value propositions, disciplinary composition and skills. Contrary to *Design 3.0*, which is bounded by business and strategy, the fourth stage of design is highly complex and unbounded. *Design 4.0* aims at social transformation and deals with social systems, policy-making and community design. The complexity of the last design stage necessitates transdisciplinary collaboration as well as higher systemic understanding than in the other stages. Generative and participatory tools and mindsets are promoted in order to tackle this increased complexity. (Jones, 2014.)

Design addressing issues of increased complexity

The potential of design to solve *wicked problems* has been acknowledged by many (Buchanan, 1992; Conklin, 2006; Brown & Wyatt, 2010; Jones, 2014) as it offers a systemic way to approach complex societal challenges. Wicked problems, as Rittel & Weber (1973) define them, are problems that are ill-defined or tricky, that cannot be solved through conventional problem-solving methods. Because of the open-ended nature of wicked problems, there is no "right" or "wrong" solutions, only "better" or "worse" (Rittel & Weber, 1973). Wicked problems include significant societal and environmental issues that have emerged for different reasons and have become interconnected over time, such as climate change, global poverty and hunger (Jones, 2014). Design thinking is acknowledged to serve as a suitable method to facilitate complex problem-solving because of its multidisciplinary nature (Brown & Wyatt, 2010). Multidisciplinary approaches are increasingly necessary, the more complex the problems become since the number of stakeholders tend to increase simultaneously as discussed through Figure 7. Jones (2014) introduces the concept of systemic design that combines principles of systems thinking and design thinking to provide a design approach that enables addressing the increased complexity of societal challenges, such as the ones identified in the domains of Design 3.0 and 4.0. The systemic design principles will be examined further in the chapter 4.3.

Conklin (2006) refers to design thinking as *opportunity-driven problem solving* to highlight its potential for addressing complex challenges. In an opportunity-driven process the individuals or group that seek to solve the problem shift between the problem and solution space in an iterative and nonlinear manner. Participants of the collaboration activity are thus simultaneously striving to understand the problem and formulate a solution. *Constant learning* as well as *learning-by-doing* are at the core of opportunity-seeking approaches. (Conklin, 2006.) When addressing complex challenges such as innovating for the circular economy, an opportunity-seeking approach is inevitable.

4. 2 SHARED UNDERSTANDING THROUGH COLLABORATIVE DESIGN

An essential aspect in co-creation is recognizing that everyone is creative and able to express their ideas if they are provided with the right experiences and tools (Sanders and Stappers, 2008). Sanders and Stappers (2008) define *co-creation* as an act of collective creativity where there are more than two people involved and utilise the term *co-design* as more narrow sense to refer to the collective creativity of designers and non-designers collaborating in a design process.

According to Conklin (2006), *collective intelligence*, which he describes as the creativity and resourcefulness that a group uses in complex problem solving, is a facilitator of collaboration. Collective intelligence and coherence occurs when participants of a collaborative activity create *shared understanding* and *shared commitment*. However, what hinders collective intelligence is *fragmentation*, which occurs when collaborators perceive themselves as more separate than united. Forces of fragmentation are *social complexity* and *problem wickedness*. Fragmentation happens particularly in complex problem-solving situations when the value of collaboration and social diversity as an approach to solve the problem is neglected. Failing to recognize the wicked nature of problems leads to the use of unsuitable methods and tools to tackle them. The other force of fragmentation, social complexity, refers to the number and diversity of stakeholders involved in a collaboration activity. The multidisciplinary backgrounds of participants make the creation of shared understanding especially complex. Thus, social complexity makes wicked problem-solving even more wicked. (Conklin, 2006.)

Design methods can be used to overcome fragmentation and enable collective intelligence to foster in a co-creation activity. According to Scheer et al. (2012), design thinking supports learning especially through *experience* and *complex-problem solving*. Dealing with complex problems is a matter of negotiation between diverse perspectives and design plays a key role in facilitating the creative transformation of knowledge into new concepts (Kröper, 2010). Scheer et al. (2012) note that design thinking is not only a process of learning but also a mindset and atmosphere that comprises three core elements; *flexible space, teamwork* and *the design process*. Thus, flexibility and adjustability of the collaboration space, cooperation between individuals from different backgrounds and the iterative design process all enhance collective learning and knowledge creation.

Thinking by doing is at the core of design thinking and refers to the highly tangible approach designers employ in creative problem solving (Hassi & Laakso, 2011). Knowledge is created through practice and reflection-in-action (Rylander, 2009). Developing prototypes during the design process facilitates knowledge creation since it enables stimulation of new ideas, formulation and demonstration of abstract concepts as well as exploration of different solutions (Hassi & Laakso, 2011). *Visualization* of intangible concepts and ideas is seen as the main way of sense-making in a design thinking process (Rylander, 2009) because it creates shared understanding amongst collaborators as well as reveals aspects that are non-accessible through verbal communication. This argument is also supported by Leifer and Steinert (2011) who state that drawing is especially useful when expressing abstract ideas. Conklin (2006) proposes that a *collaborative display*, a shared visual medium for interaction between participants, enhances collective sense-making by serving as a dynamic boundary object. As abstract concepts are embodied in the collaborative display, they serve as building blocks for further conversation and collaboration. Thus, a collaborative display facilitates knowledge co-creation through visualization.

4. 3 DESIGN AS A PROCESS

To make use of design thinking in organizations, Martin (2010) argues that it is necessary to understand the balance between exploration and exploitation in the innovation process. He introduces the concept of a *knowledge funnel* to explain how business can advance knowledge and capture value through design thinking (Figure 8).

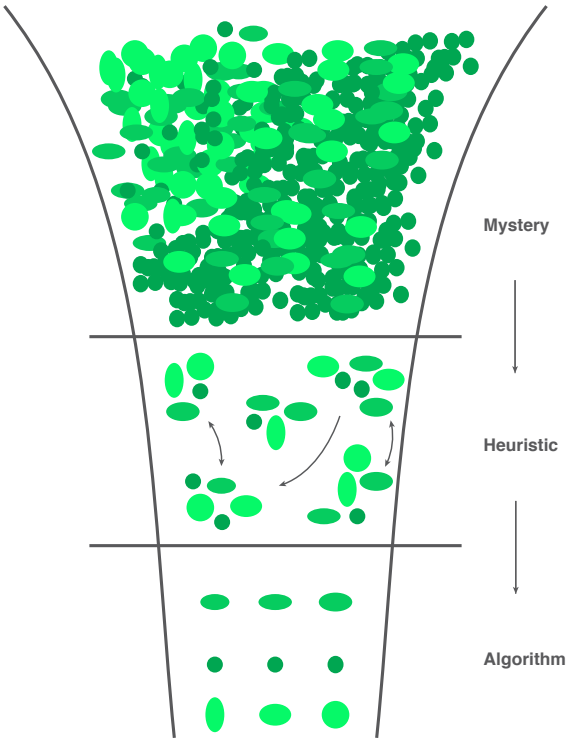

Figure 8: Knowledge funnel (Martin, 2010)

The knowledge funnel represents a pathway of three main stages - *mystery, heuristic* and *algorithm*. The mystery stage refers to selecting a particular challenge to be solved in a market, the heuristic stages refers to formulating an offering for the market, and the algorithm phase refers to codifying the operation into a repeatable formula or algorithm. Advancing knowledge and capturing value requires the successful movement of knowledge through all stages. Creating value through the knowledge funnel requires two types of activities; *exploration* and *exploitation*. Exploration, associated with intuitive thinking, is the process of searching for new knowledge, which happens when moving across the knowledge stages. Furthermore, optimizing value within a certain stage in the knowledge funnel refers to the exploitation of existing knowledge, which is associated more with analytical thinking. The benefit of design thinking lies in its potential to balance between these two different types of activities. (Martin, 2010.)

According to Drews (2009), there is no single way of understanding the design process, however the openness towards the endless amount of possibilities to solve a challenge is one of the main advantages of design thinking. Brown (2009) utilizes the concepts of *divergence* and *convergence* to explain how solutions to a given problem build up in the design process. The purpose of divergent thinking is to create multiple options and let new solutions emerge. The convergent phase, on the other hand, drives the process towards one solution through elimination of options. The combination of divergence and convergence is in the core of design thinking principles and leads to innovation. (Brown, 2009.)

Linear methods are not well-suited for addressing wicked problems (Conklin, 2006), which is why Brown (2008) presents the design process as a system of overlapping spaces rather than as a predefined sequence of steps. The activities taking place during the design process are divided in three spaces; *inspiration, ideation* and *implementation*. Although the design process is iterative and nonlinear, the inspiration space is often the first step since the driving force of design is a problem or opportunity that motivate actors to develop solutions. In the inspiration space, the team conducts research in order to gain understanding of the topic at hand. The second space is ideation, in which a team synthesizes insights from the design research to map opportunities for change or solutions. In ideation, ideas are generated, developed and tested in an iterative manner in order to find the most suited solution to implement. Indeed, implementation is the third space of design thinking. This is where the best ideas developed in the ideation space are turned into concrete prototypes, products, services or action plans. Projects may loop more than once through the spaces as the team refines the solutions and seek for new directions. (Brown, 2008; 2009; Brown & Wyatt, 2010.)

Acknowledging that all design projects are different, the UK Design Council (2015) proposes the *Double Diamond Model* to showcase commonalities in the creative process. As illustrated in Figure 9, four distinct phases can be identified in a design process: *Discover, Define, Develop* and *Deliver.*

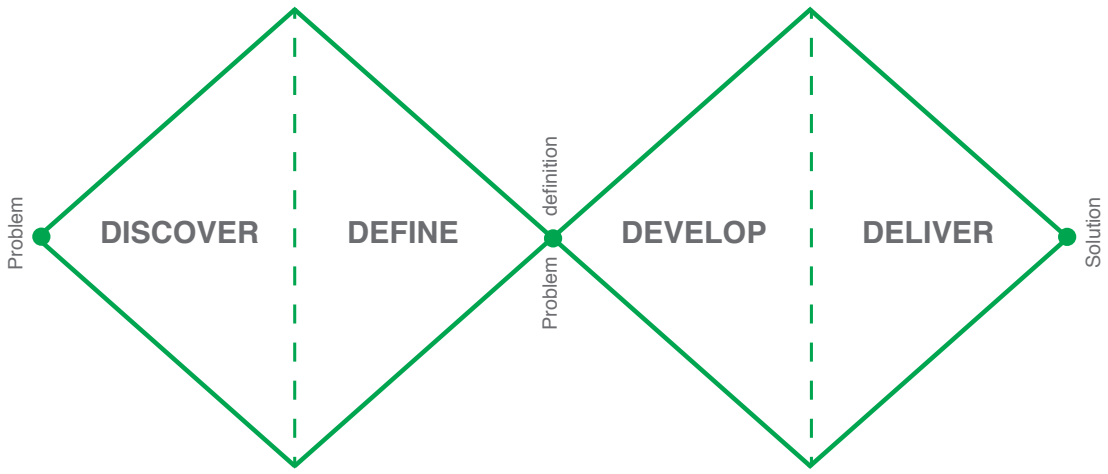

Figure 9: Double diamond model (UK Design Council, 2015)

Divergent and convergent thinking is represented by a diamond shape. The model indicates that divergent and convergent thinking happens twice in the design process, firstly to validate a problem definition and secondly to create a solution. (UK Design Council, 2015.)

Design thinking has increasingly been promoted to serve as a suitable method for solving complex societal problems. However, Jones (2014) argues that design thinking as such lack the capacity to address problems of higher levels of complexity (Design 3.0 and 4.0) and calls for a greater understanding of the systemic nature of design problems. Hence, by combining systems principles with design principles, Jones (2014) proposes a process model for *shared systemic design principles*. The principles are based on meta-analyses and a synthesis of shared principles of design theories and systems theories. As illustrated in Figure 10, the process contains five phases; *strategy, discover, design, develop* and *deploy*. The ten systemic design principles are associated with different phases of the systemic design process. In addition, the process model comprises of three meta-phases; *exploratory, formative* and *evaluative phases*. The process model and its ten design principles are applicable in most design projects, whether it is about developing a commercial product, a healthcare service, or a complex social policy. (Jones, 2014.)

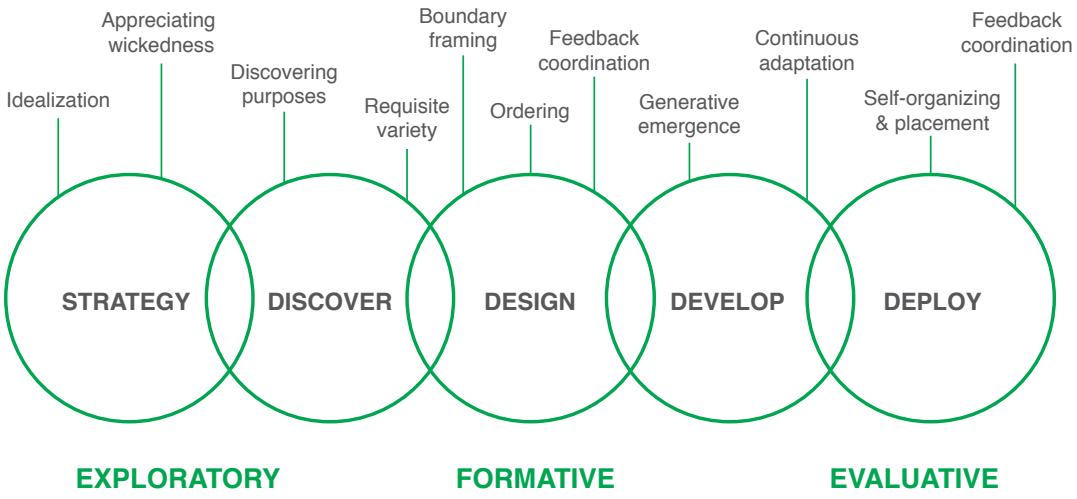

Figure 10: Shared systemic design principles in the design process (Jones, 2014)

The first phase of strategy comprises the principles of idealization and appreciating wickedness, which deal with recognising an ideal state or a set of conditions to achieve a desired outcome as well as acknowledging the systemic complexity of wicked problems. The two principles in the discover phase are discovering purposes, which deals with making sure that the right problem is addressed and requisite variety, which emphasizes the need for a variety of stakeholders to take part in the process. The third phase is the one of design, which includes the principles of boundary framing, ordering and feedback coordination. The boundary framing principle refers to the iterative process of defining the boundaries through consideration of the meanings connected to the boundary frame. Ordering deals with organizing the information and system components in a way that makes sense. Feedback

coordination, on the other hand, relates to the management of feedback in an iterative manner to achieve a desired state. The fourth phase is develop, which consists of the principles of generative emergence and continuous adaptation. Generative emergence reflects the unintended emergent nature of components in a complex adaptive system, while continuous adaptation refers to the temporal pacing and duration of social systems. The last stage, which is deploy, comprises the principles of self-organizing and placement as well feedback coordination. The principle of self-organizing and placement emphasizes the evolution of social systems through adaptation and learning and feedback coordination, which as mentioned previously, deals with managing feedback. (Jones, 2014.)

5

THEORETICAL SYNTHESIS

5. THEORETICAL SYNTHESIS

This chapter summarizes the most relevant theories presented in the literature review in chapters two, three and four. The theoretical synthesis serves as the foundation for analysing and discussing the findings in chapters seven and eight.

The circular economy forms the foundations and context for the research. As discussed in the literature review, the circular economy has been proposed as an alternative model for the current linear economic model that has led to countless environmental and social despair around the world. The circular economy promises to introduce new ways to decouple the advancement of wellbeing and prosperity from resource constraints. This study defines the circular economy according to the definition given by the EMF (2015):

> ***The circular economy is an industrial system 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.***

The transition to the circular economy necessitates a paradigm shift to the current ways of producing and consuming – a shift that puts sustainability and closed loop thinking in the core of business (Preston, 2012). In order to move from a linear economy to a circular economy, radical changes have to be made in all sectors of the society (Yuan et al., 2006). The transition to a circular economy will be achieved only through systemic innovation from business models to regulation (EMF, 2012).

It has been acknowledged (Nonaka & Takeuchi, 1995; Blomqvist & Levy, 2006; Esterhuizen et al., 2012) that innovation requires knowledge creation and learning. The wider literature on collaborative design and design thinking (Jones, 2014; Scheer et al., 2012; Sanders & Stappers, 2008) suggests that design is a suitable tool to facilitate complex problem-solving, learning and the collective creation of meaning. Hence, this study approaches the innovation practices for the circular economy through the theories of knowledge co-creation and collaborative design.

Knowledge co-creation is a social process where individuals create new meaning and understanding through interaction, communication and dialogue (Nonaka, 1994; Nonaka & Takeuchi, 1995; Carlile, 2002; 2004). The two key models of knowledge co-creation process utilised in this thesis are summarized in the table below.

Table 1: Knowledge co-creation framework

AUTHORS	THEORY	FOCUS	LEVEL
Nonaka & Takeuchi (1995)	Knowledge spiral	Creating and expanding knowledge through social interactions between tacit and explicit knowledge	Individual, group, organization and inter-organization
Carlile (2002; 2004)	Knowledge transformation	Transferring, translating and transforming knowledge across boundaries through an object-mediated process	Across specialized domains, (e.g. communities of practice)

According to the *knowledge spiral* or *SECI model* developed by Nonaka and Takeuchi (1995), knowledge creation occurs along the dimensions of epistemology and ontology. Their epistemology lies in the distinction between explicit and tacit knowledge and their ontology relates to the level in which knowledge is created, which are individual, group, organizational and inter-organizational. Hence, the knowledge spiral explicates the process of knowledge creation as a construction of meaning through social interaction. They identify the following four phases in the knowledge co-creation process: socialization, externalization, combination and internalization.

Carlile (2002) discusses how knowledge is created across boundaries through boundary objects in his theory of *knowledge transformation*. According to the author, boundary objects play a key role in managing the lack of common knowledge between actors in order to foster innovation. He argues that the use of these objects can facilitate *transferring, translating* and *transforming* knowledge between individuals at a given boundary. (Carlile 2002; 2004.)

Through the literature review on knowledge creation and design theory, enabling conditions and supporting factors of knowledge co-creation were identified. From the knowledge creation literature, *ba* is considered as a central enabler of knowledge co-creation as it provides the context and place for the activity. Ba provides a place and context for interpreting information to become knowledge and advancing in the knowledge spiral (Nonaka et al., 2000). Furthermore, according to Nonaka and Takeuchi (1995), *intention, autonomy, creative chaos, redundancy* and *requisite variety* enable and support organizational knowledge creation. Nonaka et al. (2000) also state that *love, care, trust* and *commitment* form the foundations of knowledge creation, as the atmosphere and environment plays a central role in making the participants feel safe and motivated to share their knowledge.

Factors such as *trust, empathy, openness, low levels of lingual and cultural differences, shared values, social closeness, positive attitude towards ICT, clear responsibilities* as well as *encouraging environment for experimenting with knowledge* are seen as essential supporting requirements for the process of knowledge co-creation (Esterhuizen et al., 2011). According to Nejatian et al. (2013), *collaboration, trust* and *learning* are key in creating a suitable in creating a knowledge-friendly organization culture. Blomqvist and Levy (2006) state that in addition to collaboration and trust, knowledge co-creation requires *communication*.

Nicolini et al. (2012) introduces a pluralist framework, that takes into account four types of objects that support collaboration: *material infrastructure, boundary objects, epistemic objects* and *activity objects*. The objects of collaboration are categorized depending on the role they play in facilitating the collaboration process: material infrastructure provides the basic infrastructural support for collaboration activities, boundary objects facilitate collaboration across boundaries, and epistemic objects and activity objects serve as the motivation and objective of collaboration. (Ibid.)

As discussed in the literature review, collaborative design methods and design thinking can facilitate knowledge creation. According to scholars (Hassi & Laakso, 2011; Johansson et al., 2013; Brown and Wyatt, 2010; Jones, 2014), design has been increasingly used as a strategic tool to foster innovation, improve competitiveness and solve complex societal problems. Scheer et al. (2012) defines design thinking as a team-based learning method because of its ability in dealing with complex problems and involving participants to experience the process hands-on. *Transdisciplinary teams, thinking-by-doing, collective creativity, collective intelligence, divergent and convergent thinking, shared understanding and commitment, flexible space, teamwork, visualization* and *the design process* were identified from the literature of collaborative design and design thinking as elements supporting collective problem-solving, learning and knowledge creation.

The table on the next page summarizes the enablers of the collaborative creation of knowledge identified from knowledge creation and design literature.

Table 2: Enablers of knowledge co-creation

	ENABLER / SUPPORT	AUTHOR	BODY OF LITERATURE
PRECONDITIONS	Ba	Nonaka & Takeuchi,1995	Knowledge creation
	Flexible space	Scheer et al., 2012	Design thinking
	Design process	Scheer et al., 2012	Design thinking
METHODS	Teamwork	Scheer et al., 2012	Design thinking
	Collective creativity	Sanders & Stappers, 2008	Collaborative design
	Collective intelligence	Conklin, 2006	Collective sense-making
	Learning-by-doing Thinking-by-doing	Conklin, 2006 Hassi & Laakso, 2011	Design thinking
	Learning	Nejatian et al., 2013	Knowledge creation
	Collaboration	Nejatian et al., 2013	Knowledge creation
	Complex problem-solving	Nejatian et al., 2013	Knowledge creation
	Communication	Blomqvist & Levy, 2006	Knowledge creation
	Redundancy	Nonaka & Takeuchi,1995	Knowledge creation
	Creative chaos	Nonaka & Takeuchi,1995	Knowledge creation
	Autonomy	Nonaka & Takeuchi,1995	Knowledge creation
	Visualization	Rylander, 2009; Leifer & Steinert, 2011	Design management
	Combination of divergence and convergence	Brown, 2009	Design thinking
	Experimentation	Esterhuizen et al., 2011	Knowledge creation
COLLABORATORS	Transdisciplinary groups	Jones, 2014	Design thinking
	Requisite variety	Nonaka & Takeuchi,1995	Knowledge creation
	Low levels of lingual and cultural differences	Esterhuizen et al., 2011	Knowledge creation
	Shared values and social closeness	Esterhuizen et al., 2011	Knowledge creation
	Positive attitude towards ICT	Esterhuizen et al., 2011	Knowledge creation
	Clear roles and responsibilities	Esterhuizen et al., 2011	Knowledge creation
DRIVERS	Trust	Nejatian et al., 2013; Blomqvist & Levy, 2006; Esterhuizen et al., 2011	Knowledge creation
	Shared understanding	Conklin, 2006	Collective sense-making
	Empathy and openness	Esterhuizen et al., 2011	Knowledge creation
	Intention and commitment	Nonaka & Takeuchi,1995	Knowledge creation
OBJECTS OF COLLABORATION	Material infrastructure	Orlikowski, 2007; Star & Ruhleder, 1996	Cross-disciplinary collaboration
	Boundary objects	Carlile, 2002; Star & Griesemer, 1989	Cross-disciplinary collaboration
	Epistemic objects	Rheinberger, 1997	Cross-disciplinary collaboration
	Activity objects	Leont'ev, 1978; Engeström, 1987	Cross-disciplinary collaboration

6

RESEARCH DESCRIPTION AND METHODOLOGY

6. RESEARCH DESCRIPTION AND METHODOLOGY

The study examines a co-creation workshop where participants are engaged in building up understanding, fostering ideas and exploring opportunities around the topic of circular economy. The aim of the study is to explore how knowledge regarding the circular economy is created through the use of design methods in a collaborative workshop setting. The research topic is approached through a case study of EcoDesign Sprint, which is a training program targeted for SMEs and design agencies interested in learning about the business opportunities in the circular economy.

The first part of this chapter presents the background of the research, which is followed by the description of the research design as well as the data collection and analysis methods employed in this study.

6. 1 CASE DESCRIPTION: ECODESIGN SPRINT

6. 1. 1 BACKGROUND OF PROJECT

The main objectives of EcoDesign Sprint are to increase participants' understanding of circular business models and circular design principles as well as facilitate the co-creation of circular business concepts for the client company. EcoDesign Sprint concept was developed by Design Forum Finland, a non-profit organization promoting the use of design as a strategic tool in Finnish companies, with the support of Ethica, a consulting company specialized in the circular economy.

In each EcoDesign Sprint, a client company is paired with a design agency, with the purpose of co-creating new circular business and design concepts for the client company. The idea is to develop two circular business concepts; one more feasible concept that could be implemented immediately and another more visionary concept that could take more time to implement. The use of design methods throughout the design sprint are in the core of the training program as the objective is to develop circular economy concepts through collaborative design.

Three companies and three design agencies were chosen to participate in EcoDesign Sprint training programme amongst several applicants in September 2017. The three Sprints were held during the months of December 2017 and March 2018 in Finland. The training program will also be piloted in Sweden and Estonia in May 2018. This thesis examines one sprint held during March 2018 in Helsinki.

EcoDesign Sprint is part of an EU-Funded project, EcoDesign Circle. EcoDesign Sprint, which began in 2016 and will end in 2019, strives to be a driver of innovation in the Baltic Sea Region. The purpose of the project is to bring together actors from the fields of design, sustainability, business and academia, and improve their understanding on ecodesign and circular economy. The Lead Partner of EcoDesign Circle is the German Environment Agency Umweltbundesamt. Other partners involved in the project are Design Forum Finland (Finland), Internationales Design Zentrum Berlin (Germany), Eesti Disainikeskus (Estonia), Lithuanian Designers' Society (Lithuania), Stiftelsen Svensk Industridesign (Sweden) and Gdynia Innovative - Pomeranian Science and Technology Park - Gdynia Design Centre (Poland). (EcoDesign Sprint, 2017.)

The research is commissioned by Design Forum Finland, which has as a goal to develop the EcoDesign Sprint tool further into a service. EcoDesign Sprint is still in its piloting phase and the objective of this thesis is to give input for the development of the service.

6.1.2 ECODESIGN SPRINT TOOL

Each EcoDesign Sprint has three phases that are divided between three workshop days. The first phase, *Understand*, aims at creating a shared understanding of the circular economy amongst participants with the guidance of the circular economy consultant. The second phase, *Ideate*, is facilitated by the design agency with the aim of generating ideas and developing initial concepts. The third phase, *Deliver*, is for the design agency to present the refined concepts and prototypes. The Understand and Ideate phases happen during the first two days of the sprint. After the second phase, the design agency has two to three weeks to develop the concepts further and prepare concepts and prototypes to present to the client company and other participants in the last sprint day. The participants of EcoDesign Sprint are a client company, a design agency, a representative from Design Forum Finland and a circular economy consultant.

An EcoDesign Audit is conducted for each client company participating in the training program prior to the workshop days. The EcoDesign Audit is a monitoring tool developed by the Estonian Design Center as part of the EcoDesign Circle project. The tool maps out the capacity and the degree of utilization of design and circular design in client company's business operations. EcoDesign Audit helps in identifying the opportunities of the company to implement circular economy principles in their business and design strategies. The results of the audit serve as background information and as a starting point for the workshops. In addition, a kick-off meeting between the design agency, Design Forum Finland and Ethica is organized for planning the workshop days before the start of the sprint.

6.1.3 ECODESIGN SPRINT HELD IN MARCH 2018

This study examines an EcoDesign Sprint workshop held on the 5th, 6th and 23rd of March 2018 in Helsinki. The duration of co-creation workshops and the concept presentation day was from 9 am to 4 pm including a lunch break.

The client company is a family owned leisurewear brand from Finland that has been selling sustainable, high-quality and timeless design for decades already. The company has experienced large-scale changes in the Finnish textile industry and consumer behaviour. The desire to find ways to utilize surplus fabric from production, make an impact on consumer behaviour as well as provide consumers with long-life products is one of the reasons why the company wished to take part in EcoDesign Sprint. The client company was paired with a young design agency based in Rovaniemi, Northern Finland. The design agency, which has sustainability as one of their core values, was also enthusiastic about learning more about the circular economy and its opportunities in the field of design.

To ensure the requisite variety, which is a supporting element of knowledge co-creation (Nonaka et al., 2000), participants came from different organizations and disciplines. All in all, eight people participated in the design sprint:

- The owner and two clothing designers from the client company
- Two designers from the design agency
- A representative from the organizing party Design Forum Finland
- A circular economy consultant from Ethica
- The thesis researcher

6. 2 RESEARCH DESIGN AND METHODS

6. 2. 1 CASE STUDY DESIGN

The study is qualitative in its nature since the aim is to explore and gain more knowledge on a phenomenon. Qualitative research aims to understand and interpret, whereas quantitative research aims to explain causality and test hypothesis (Eriksson & Kovalainen, 2008).

To explore the research questions of this thesis, I have chosen a case study design. What is essential in a case study design is the construction of "the case" or several "cases", which means that the research questions aim to understand the case in relation to its context (Eriksson & Kovalainen, 2008). According to Breslin & Buchanan (2008) a case study focuses on the space between theory and practice. It is a suitable method when the subject of study is a new research area, when the researchers cannot control the course of the events and when the study aims to answer "how" and "why" questions (Yin, 2009). Furthermore, "complex and hard-to-grasp business issues" are often examined through case study research (Eriksson & Kovalainen, 2008). Since all of the aforementioned criteria are applicable to this study, a case study (Yin, 2009) is a suitable research strategy for this thesis.

6.2.2 DATA COLLECTION

The data for this research is collected through participant observation of a co-creation workshop as well as interviews with five workshop participants. Altogether, the research material comprises of field notes and audio records of a three-day workshop, workshop documents as well as five transcribed participant interviews.

Participant observation requires that the researchers takes part in the culture or the context being observed (Eriksson & Kovalainen, 2008). Participant observation is a suitable data collection method since the aim is to examine the knowledge co-creation process across multi-sectoral groups and identify the elements that support the creation of new ideas and knowledge. What is interesting in this case is to observe how new knowledge of circular economy is created and how participants collaborate and build on each other's ideas to develop new concepts. The data gathered through the observation of design sprints are in the form of field notes, audio records as well as workshop documents.

In addition to the data gathered from the observation, the research encompasses semi-structured interviews with participants conducted after the workshop. According to Eriksson and Kovalainen (2008), a semi-structured interview is suitable for studying the "what" and "how" questions. In a semi-structured interview, the researcher prepares a pre-defined set of questions and topics but has the freedom to change the order and wording of the questions as well as come up with new questions during the interview. Compared to a structured interview, a semi-structured interview resembles more of an informal conversation. The informal flow of the discussion enables new ideas and concepts to arise more freely. (Eriksson & Kovalainen, 2008.) Through semi-structured interviews I was able to find out what was important for participants in the event, what elements supported their learning and what hindered the co-creation experience.

The workshop and the interviews were conducted in Finnish and they were both audi-recorded. The interviews were conducted by phone one to three weeks after the workshop, after which they were transcribed and translated in English.

The selection of interviewees was based on collecting input from all the participants representing the client company and design agency in order to get as diverse and broad perspectives as possible. Interviews were conducted with three representatives of the client company and two designers from the design agency. Interviewees are classified under the letters C and D; C standing for the client company and D standing for the design agency.

6.2.3 DATA ANALYSIS

The data gathered from the interviews is in the form of transcripts and the data from the observation of the workshop is in the form of field notes. The data both from the interviews and observation was analysed by using content analysis based on coding. Simons (2009) defines coding as a systematic

method of analysis that helps to make sense of the gathered data by breaking it into categories and themes. The usefulness of coding derives from the fact that it helps researchers to create meaning to words and parts of text (Miles & Huberman, 1994). Thus, coding is a suitable method of analysis in this study because the data is in the form of text and there is a need to make sense of the complex data in a systematic way. Through this method of analysis, I was being able to draw connections and identify patterns, themes and meaning (Eriksson & Kovalainen, 2008).

The collected data was analysed with the qualitative and mixed-method analysis software tool QSR NVivo. The data analysis was executed following the Gioia methodology that aims at generating new concepts and theories through systematic qualitative rigour (Gioia et al., 2012). The first step in the process was to download the transcribed interviews and field notes into the software, which was followed by reading through the interviews and identifying the noteworthy words, concepts and phrases that formed first-order concepts. After reviewing and comparing the first-order concepts, they were assigned to second-order themes. After some iteration and re-evaluation of first-order concepts and second-order themes, the following four aggregate dimensions were generated from the data: a) Atmosphere, b) People, c) Teamwork and d) Workshop Structure. The figure on the next page showcases the data structure by showing the first-order concepts assigned with second-order themes and aggregate dimensions.

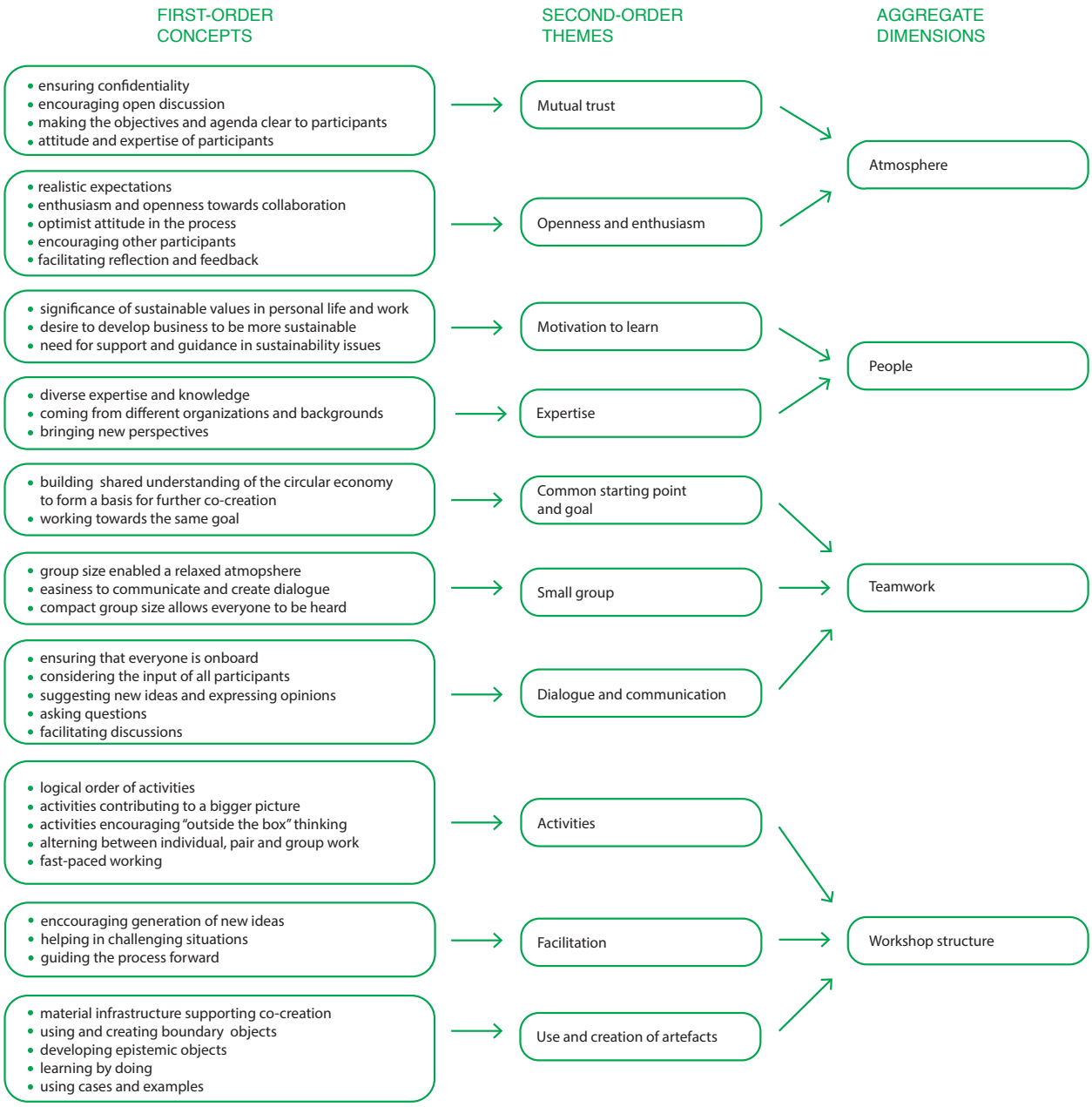

Figure 11: Data structure

6.2.4 EVALUATION AND ETHICAL CONCERNS

A key challenge in qualitative research is to ensure and evaluate the quality and trustworthiness of the study, which should be a constant process throughout the research (Eriksson & Kovalainen, 2008). According to the work of Lincoln and Guba in 1985 (Eriksson & Kovalainen, 2008), assessing the trustworthiness of a study entails four aspects to take into consideration: credibility, transferability, dependability and confirmability.

When evaluating the *credibility* of the study, the researcher asks whether she is familiar enough with the topic, if the amount of gathered data is sufficient to support the conclusions and if other researchers would arrive at similar results based on the same material. To ensure my familiarity on the topic, I have conducted a thorough review of the relevant literature. I also participated in the three-day EcoDesign Sprint and had multiple meetings with the organizer and consultant before and after the workshop, which contributes to the credibility of the study. In regard to the amount of gathered data, audio records and field notes of the co-creation workshop, as well as five transcribed semi-structured interviews is a satisfactory sample in the scope of a master's thesis.

The *transferability* aspect takes into consideration if the researcher has made an effort in her study to draw connections to prior research and results. To tackle this aspect, I reflect upon the prior research throughout the thesis, especially in the introduction, literature review and discussion sections. As the objective of qualitative research is to expand and develop prior literature, the key challenge in theoretical sampling is to find a case that has the most potential to develop new theoretical implications. EcoDesign Sprint is a relevant case to explore since it brings together collaborative design and the circular economy – topics that have been extensively studied separately, but lack theories that combine them and support the synergies between them.

The *dependability* aspect refers to the documentation, logic and traceability of the research. In my study, the methodology chapter explains the reasons for choosing certain methods and the ways in which they have been applied, all in a logical and transparent manner. The research data, which encompasses the workshop and interviews, is documented in the form of audio records, field notes and interview transcripts.

The *conformability* aspect ensures that the readers understand how the findings and interpretations are linked to the data. In this thesis, I have made sure that the data is presented in a clear and concise way by using figures and tables whenever needed. Furthermore, the research process is documented explicitly, and citations are used to clarify the link between findings and interpretations.

In regard to the chosen methods, participant observation and semi-structured interviews, there are some important ethical aspects to take into consideration as there are voluntary participants involved in the study. It is of high importance to always explain the purpose of the study and describe the research process as well as other important aspects to the participants before starting an interview. Lastly, ensuring anonymity and confidentiality of participants is vital and is respected in this study. (Eriksson & Kovalainen, 2008.)

7

FINDINGS

7. FINDINGS

7.1 CO-CREATION PROCESS

Design methods and thinking were used to facilitate collaboration and communication between participants in the development of circular business concepts for the client company. The EcoDesign Sprint process is divided into three phases: *Understand, Ideate* and *Deliver*. In each phase, various methods and activities were used to advance knowledge creation and concept development. Divergent and convergent thinking occurred throughout the process which is demonstrated through the double diamond shape (Brown 2009; UK Design Council, 2015). The sprint process is illustrated in the figure below.

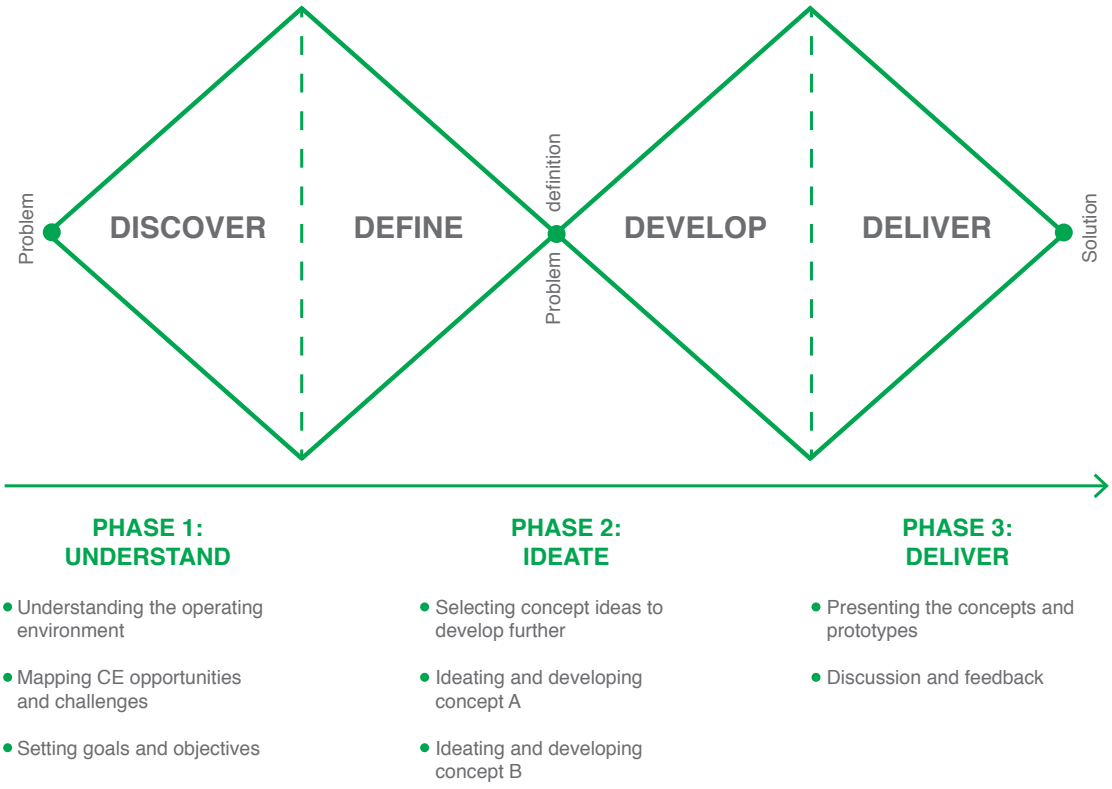

Figure 12: EcoDesign Sprint co-creation process (Adapted from the UK Design Council, 2015)

The first phase of the workshop, *Understand*, aimed at creating shared understanding of the principles and business opportunities of the circular economy as well as the current and future operations of the client company. Through various activities that stimulated divergent thinking, participants discovered opportunities and challenges in the circular economy to form a basis for the second phase of the workshop, *Ideate*. In the convergent part of the ideation phase, participants chose two ideas to develop further from all the ideas generated in the first phase. In the divergent part, participants developed the concepts further. Thus, the objective of the Ideate phase was to create two circular business concepts together as a group. After the second phase, the design agency worked on the concepts on their own for two weeks after which the group gathered again for the last phase of EcoDesign Sprint. In the third phase *Deliver*, the design agency presented the concepts and prototypes which was followed by discussion and feedback.

Objects of collaboration were used throughout the process to motivate and facilitate collaboration and communication across knowledge boundaries (Nicolini et al., 2012). According to Hassi and Laakso (2011), thinking by doing is at the core of the design process, therefore pens, papers, post-its and posters were utilized to support the co-creation process. A circular roadmap was filled out throughout the process, which served as the main boundary object of the EcoDesign Sprint workshops. The circular roadmap is presented in Figure 13.

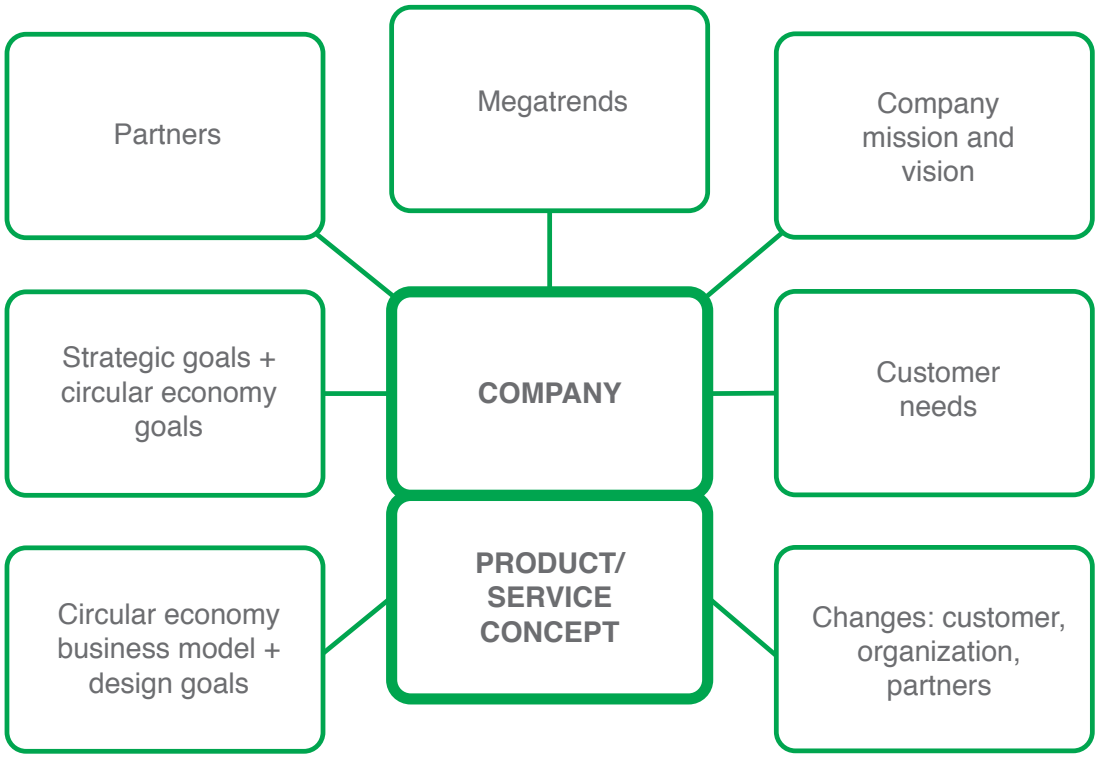

Figure 13: Circular roadmap (EcoDesign Sprint material by Ethica and Design Forum Finland, 2017)

Through various activities, the different sections of the circular roadmap got filled out. The roadmap served as a concrete tool to showcase the progress of the group. At the end of the workshop, it gave a holistic view on the various aspects discussed throughout the design sprint.

7.1.1 PHASE 1: UNDERSTAND

The objective of the first phase was to create shared understanding on the circular economy and its business opportunities. Through various activities facilitated by the circular economy consultant, participants learned about the principles and business models of the circular economy as well as gained understanding on the various megatrends affecting the company now and in the future.

Since the audit and the kick-off meeting were held separately with the client company and the design agency, the representatives of the companies met each other for the first time in the workshop. Since trust is one of the three cultural enablers of knowledge creation (Nejatian et al. 2013), building mutual trust between participants was essential for the successful co-creation of knowledge. The workshop started with participants introducing themselves and sharing their motivations and expectations in taking part of the sprint. After the round of introduction, the facilitator presented the agenda and the objectives of the sprint.

Understanding the current situation

The results of the EcoDesign Audit conducted of the client company's current situation vis-a-vis the circular economy were presented, which was followed by discussion and questions. Participants had the chance to ask the client company questions regarding their business operations. Hence, the results of the EcoDesign Audit presented in the form of slides served as a boundary object that facilitated the discussion and creation of common grounds between participants.

To understand the operating environment more thoroughly, the group was divided in pairs to take part in a *Big Picture* activity. From a pack of megatrends cards, participants were to choose the ones affecting the business operations of the company now and in the future. The cards were then placed on a PESTEC model to identify which political, economic, social, technological, environmental and cultural changes have impact on the company's operations. After going through all the megatrends placed on the PESTEC model, participants were asked to vote for the five most relevant megatrends for the company. The following five megatrends were chosen as the most significant ones and placed on the circular roadmap:

- The significance of the circular economy increases
- Sustainability crisis now
- Emphasis on social capital
- Data means power and wealth
- Lack of trust and growing inequality challenges democracy

In this activity, megatrend cards and the PESTEC model, which both served as objects of collaboration, built shared understanding on the trends affecting various aspects of the business. After the big picture activity, workshop participants filled out the boxes *partners* and *mission and vision* in the Circular Roadmap. The vision statement was to *be the most trustworthy and transparent company operating with closed loop principles* and the mission was to *make clothes that last in an environmentally friendly way and locally.*

Mapping circular economy opportunities and challenges

The next step was to map out the opportunities and challenges for the company in the circular economy by familiarizing all of the participants with the circular economy principles and going through the different phases in the product lifecycle. The circular economy consultant facilitated the discussion by pinpointing essential aspects to take into consideration in each phase of the lifecycle and by showcasing relevant benchmarks. The idea was to generate ideas on what the company could do in regard to the circular economy in various phases in the product lifecycle. Ideas that were generated in the discussions were written on sticky notes and placed on a lifecycle model illustrated in the figure below.

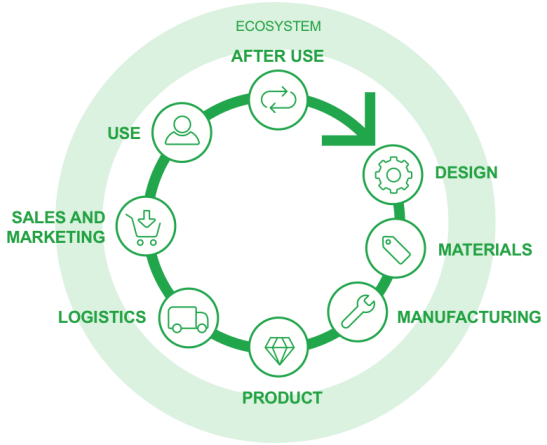

Figure 14: Lifecycle model (EcoDesign Sprint material by Ethica and Design Forum Finland, 2017)

The lifecycle model served as a boundary object as it helped to create common understanding on the essential elements to consider in the lifecycle of a product as well as facilitated the generation of ideas.

Setting goals and objectives

From the multiple ideas generated in the circular value chain activity, the most interesting ones were placed on the Circular Roadmap under *strategic goals + circular economy goals* and *circular economy business model + design goals* for prioritizing them in the next phase.

7.1.2 PHASE 2: IDEATE

The second phase, which occurred during the second workshop day and was facilitated by the design agency, started with an enthusiastic atmosphere. Participants discussed and shared their feelings about the first day, which created a continuum between the first day and second day and helped prevent fragmentation in the group (Conklin, 2006). In addition, a small warm-up activity was organized to create a relaxed atmosphere and get participants into the workshop mindset.

The objective of the second phase of the sprint was to co-create two initial concepts. The design agency would then further develop the concepts and present them on the last day of the EcoDesign Sprint.

Selecting concept ideas to develop further

Before going into ideation and brainstorming, the group was asked to choose two ideas to focus on from all of the ideas generated during the first phase of the workshop. Through open discussion, the group agreed on the following two concept ideas to develop further based on the feasibility, circular economy potential and interests of the participants:

Concept A: Second hand clothing concept
Concept B: Concept enhancing transparency

The concepts served as epistemic objects in the EcoDesign Sprint since they fostered collaboration by providing a desired and shared objective for participants (Nicolini et al., 2012).

Ideating and developing concept A

The first concept chosen to be developed in the workshop was a second-hand clothing concept. The concept was chosen according to the principles of the circular economy, which emphasize keeping the product at its highest value and at its original use as long as possible (Mihelcic et al., 2003; Stahel, 2014; Bakker et al., 2014).

The facilitator asked participants to write as many second-hand concept ideas as possible on sticky notes within a strict time limit of five minutes after which the ideas were discussed and clustered in groups on a poster. From all the ideas placed on the poster, participants were asked to select the most interesting ones by marking them down in silence. Sticky notes, which served as boundary objects in this activity, supported the collaboration by advancing the creation of shared meaning of the epistemic object.

The group was then divided into pairs with each pair tasked with developing one concept further within a thirty-minute time period. Pens, sticky notes, posters and ideation cards were used to facilitate

concept development. Finally, the concepts were presented and discussed in the group. The second-hand concepts were developed based on the following three initial ideas:

- An online platform for buying and selling second hand clothes
- A take-back system for used clothes
- A second-hand pop-up event

Ideating and developing concept B

The second concept was to enhance client company's transparency in the value chain and business operations. It was chosen as the long-term concept because the company had stated their vision to be the most trustworthy and transparent company operating with closed loop principles. Enhancing transparency had already been in the company's agenda for a long time, thus, the decision to focus on this particular topic was understandable.

The ideation of the concept B started with deciding on three core company values relating to transparency: *responsibility, local and quality*. In the first activity, which was called *360*, collaborators wrote one question about each aforementioned value on a piece of paper. The papers then rotated around the table in a fast pace and participants tried to answer them. Participants read the questions and answers out loud, which led to a group discussion about the topics. In this activity, the papers with questions and answers served as a boundary object to create shared meaning as well as translate and transform knowledge between collaborators.

The next activity engaged collaborators to think about why, where and how a company should be transparent. By first ideating individually, the group then worked together by listing on posters the reasons for transparency (Why?) and the places and phases of the value chain where transparency should occur (Where?). Participants formed teams and chose an idea from the posters to focus on in order to develop a concept that would answer the question of how the company should implement transparency.

One of the developed ideas followed the lifecycle model of the product. The idea was that the company would disclose information of each phase in the value chain: selection of materials, design, production, logistics, product, sales and use as well as give information on how to reuse or recycle the product.

The second phase of the workshop was concluded with feedback and discussion of the process. All the participants expressed positive feelings about the intensive two days of workshopping.

7.1.3 PHASE 3: DELIVER

The group got together after two weeks for the third phase of the EcoDesign Sprint. After developing the concepts further based on the collaborative work conducted during the first two days of the sprint, the design agency presented the two concepts for the rest of the group.

Presenting the concepts and prototypes

The design agency presented both the second-hand concept and the transparency concept in the form of presentation slides and prototypes. Through the prototypes, participants were able to experience the abstract concepts in a tangible manner. They allowed the design agency to demonstrate the ideas in practice and enabled exchange of feedback between participants. Thus, the prototype served as a boundary object that translated and transformed knowledge between participants in order to explore and create shared understanding of the developed concepts which served as epistemic objects.

Discussion and feedback

After presenting the two concepts, workshop participants discussed the practicalities and future development possibilities of the concepts. All in all, workshop collaborators expressed feelings of content and satisfaction towards the collaboration and the results of the sprint. The positive feelings become apparent in the following quotes:

> ***From our perspective, EcoDesign Sprint has brought us to a greater understanding on the significant potential of design in enabling and advancing the circular economy. It is a great tool for creating solutions to complex problems. (D1, quote from the workshop)***

> ***We were encouraged to think outside the box and generate crazy ideas, which does not happen in the comfort zone. We were able to develop the concepts together quite far in just two days. (C3)***

7.2 ENABLERS OF KNOWLEDGE CO-CREATION

This chapter covers the identified elements that enabled and supported knowledge co-creation in EcoDesign Sprint. The key enablers of knowledge co-creation were divided into four categories: Atmosphere, People, Teamwork and Workshop Structure.

7.2.1 ATMOSPHERE

The first category of enablers of knowledge co-creation in EcoDesign Sprint relates to the atmosphere during the workshop. Mutual trust and openness was identified as subcategories. Participants expressed that trust towards other participants and openness towards the process created a pleasant atmosphere for collaboration.

Mutual trust

In the interviews, mutual trust was referred to as one of the core elements that advanced co-creation in the sprint. All the interviewees stated that they felt like EcoDesign Sprint was a trustworthy environment. Right from the beginning of the workshop, the organizers made clear the schedule and goals of the sessions as well as ensured confidentiality of sensitive information shared during EcoDesign Sprint. In addition, open discussion was encouraged throughout the process for example by enabling everyone to introduce themselves at the beginning.

> ***One of the reasons why the co-creation went so smoothly was because we started the workshop by talking to each other, like people talk to each other. We did not build walls between 'we' and 'them.' We were just sitting around the same table, drinking the same coffee and asking each other what's up. (D1)***

> ***Right from the start, it was made clear what the sprint was about and what was going to happen. I did not feel any kind of mistrust, it was easy to take part and jump in. (C1)***

An interviewee also pointed out that the novelty of the workshop situation created tension which might have had impact on the participation in the activities. The following quote illustrates the significance of building trust in a workshop setting where the working environment is new, and participants meet each other for the first time.

I noticed tension in some situations which might have affected participation. Maybe it was because of the unfamiliar environment and people. (C3)

Participants listed that the size of the group, open and genuine conversation as well as prior knowledge of the topic contributed to building trust inside the group. The small group enabled dialogue, which in turn, built trust between participants. An interviewee also pointed out that background knowledge of the circular economy created a trustworthy atmosphere.

The small group and dialogue built up trust. (C1)

Everyone had some kind of background knowledge of the circular economy, which created a trustworthy environment. (C3)

Openness and enthusiasm

An open and enthusiastic mindset was an essential contributor to creating an atmosphere suitable for knowledge creation. Participants expressed that they came to the sprint open-minded and without expectations. According to interviewees, enthusiasm of other participants encouraged participation and ideation. Hence, it can be interpreted that openness and enthusiasm of participants had a positive influence on others and on the process. The following quotes reflect the openness and enthusiasm towards collaboration and the co-creation process.

We came to the sprint with an open mind and with curiosity. Everything that happened there was a possibility and a great experience. (C1)

I was surprised of how open-minded we were as a company. We worked towards the goals and objectives without putting brakes on. (C3)

I came to the workshop and took part in the activities with an open mind. (C2)

I did not know what to expect so I approached the workshop with enthusiasm and a "let's see" attitude. (D1)

Everyone was excited and energetic. It gave a lot [to the process]. (D2)

As the quotes of participants reveal, optimism and enthusiasm of participants affected greatly the atmosphere in the workshop. Through their encouraging attitude and behaviour, collaborators supported each other and advanced co-creation.

When someone expressed their opinion, I encouraged them by complimenting and showing appreciation of their idea. (C2)

The client's open and enthusiastic attitude towards the topic affected [the process] a lot. (D2)

Participants were uplifting and encouraging. (C3)

7.2.2 PEOPLE

The second category of enablers of knowledge co-creation relates to people. Elements such as motivation to learn and expertise were identified to give support to the process. Participants expressed strong motivation towards acquiring knowledge on the circular economy in order to use it to develop their business. Hence, motivation to learn seemed to be key in the knowledge creation process. In addition, many emphasized that the expertise of all participants in their respective areas helped to approach the problem from new perspectives.

Motivation to learn

Participants were highly motivated to acquire knowledge on the circular economy, circular business models and design principles, as well as discover the business possibilities for the client company to take part in the transition to a circular economy. When introducing themselves in the beginning of the workshop, participants expressed the significance of sustainable values and ecological principles in their work and personal lives. In the interviews, people expressed that the desire to develop the business towards a more sustainable and responsible way of operating was one of the key motivators for participating in the workshop.

Sustainability and the desire to take part in the circular economy is at the core of our company values. We thought that this would be a great opportunity for learning, networking and really getting inside the topic of circular economy. (D1)

We want to increase sustainability efforts in the company and develop concepts that promote the circular economy. Responsibility in the clothing industry is close to my heart. (C3)

Even though we have always invested in sustainability and responsibility, we need support and guidance in making our business more responsible. That was something I hoped to get from the sprint. (C2)

We want to learn about the circular economy in order to utilize the knowledge to develop our business. (C1)

Expertise

Sprint participants represented different organizations and practices. Everyone was able to contribute through their own expertise and knowledge, thus bringing new perspectives to the dialogue and collaboration activities. An interviewee pointed out that since participants had all expertise in a certain area and were chosen to participate in the workshop because of it, their opinions were convincing. The significance of multidisciplinary backgrounds and expertise in knowledge co-creation becomes apparent through the following quotes:

> ***All the participants were chosen to take part in the workshop because of what they do. I was convinced about everyone's opinions and expertise. Everyone was there for a reason. (C2)***

> ***I am certain that participants' different backgrounds and expertise brought new perspectives. (C3)***

7.2.3 TEAMWORK

The third category of enablers relates to teamwork. Having a common starting point and goal, working in a small group and keeping an open and ongoing dialogue between participants were found to be key factors that supported teamwork and advanced knowledge creation. The common starting point enabled participants to establish common grounds to build up knowledge and the shared goal gave motivation and meaning to the activities. The small group allowed participants to get to know each other and permitted everyone to express their opinions and be heard. Keeping an open dialogue throughout the workshop made knowledge creation possible as new knowledge arises from communication and social interaction.

Common starting point and goal

The first phase of the workshop aimed at creating shared understanding of the client's current situation as well as on the circular economy and its business implications. It served as a common starting point among collaborators for further concept development and knowledge creation. Hence, the results of the Ideate phase depended on the knowledge acquired in the first phase of the workshop. As interviewees noted, building shared understanding of the circular economy was a crucial element in the co-creation process, which is manifested in the quotes below:

> ***It was important to first go through the principles and foundations rather than jumping straight into developing a solution. We first built a basis and common understanding of what we are doing and where we are doing it. And only after that did we start to think about how it should be done. (D1)***

> ***Learning about the basics of the circular economy at the beginning of the workshop was crucial. (D2)***

According to the interviewees, having the same objective and goal advanced the process. As an interviewee stated, working towards the same goal emphasized the importance of everyone's input and strengthened the collaboration. Another interviewee pointed out that all participants showed commitment towards ideating and developing the best possible concepts. Having a common objective gave meaning to teamwork.

> ***We had a concrete case company that we were working with. We talked about the same thing and tried to find solutions together. We had the same cards on the table, the same goal. (D1)***
>
> ***I feel like we were working towards the same goal. Everybody was excited and devoted to develop and ideate [new concepts]. (C3)***
>
> ***Everyone's opinion was important and relevant, and together we tried to find a consensus. (D1)***

Dioalogue and communication

Participants kept an open dialogue throughout the process by discussing, listening, asking each other questions, suggesting new ideas and ensuring that everyone was always onboard. Through dialogue, participants were able to build upon each other's ideas and create new meaning. Communicating with others and listening to their opinions clarified participants' own ideas and the bigger picture. One participant stated that asking the question "Why" was essential in order to stimulate the discussions. The following quotes from interviewees show that dialogue was recognised as an essential support of co-creation.

> ***Through interacting with others, my own thoughts and ideas got clarified. Sometimes I felt like I did not quite get an activity or exercise but when I listened to other participants, I could get new ideas by building upon theirs. (C1)***
>
> ***I tried to consider everyone's different viewpoints. Through my own actions, I tried to show that there are no ready-made solutions. Rather, I find it's important to start with thinking why things are the way they are. Asking the question 'Why' is one of the most important things. (D1)***
>
> ***I advanced co-creation by participating in the discussion and expressing my opinions. (C2)***
>
> ***Participants let others talk and listened. (C3)***
>
> ***EcoDesign Sprint provides a possibility to engage in dialogue with companies on trendy topics in a way that everybody understands each other. (D1)***

Small group

Interviewees stated that the number of participants was suitable for this particular type of co-creation workshop. It created a relaxed atmosphere, where it was easy to communicate and create dialogue. The compact group of eight people allowed everyone's opinions to be taken into account but still enabled the division into smaller teams.

> ***The number of participants in the workshop was pretty close to the ideal as there was enough time to explore the results of different teams. If there are too many attendees in a workshop, it can easily feel like running through different activities. (D1)***
>
> ***There was an appropriate number of attendees. I get nervous if there are too many people, but it was easy to relax in this workshop. (C2)***
>
> ***I think the size of the group was good, at least I would not have wished for more people to take part. It was more important that the participants were encouraging and uplifting. (C3)***
>
> ***The small group allowed dialogue to emerge. (C1)***
>
> ***The group was compact and worked well. (C1)***

7.2.4 WORKSHOP STRUCTURE

The fourth and last category is the workshop structure, which manifests the significance of the workshop process and structure in facilitating collaborative creation of knowledge. The identified sub-categories are activities and facilitation as well as the use and creation of artefacts. Activities and facilitation played a key role as they guided the process forward and supported the ongoing dialogue and collaboration. The use and creation of artefacts in various activities supported the creation of knowledge as participants were able to visualize and communicate abstract ideas, learn by doing as well as engage in creative activities.

Activities

According to interviewees, activities supported the creation of knowledge for the circular economy and facilitated the development of circular concepts. The activities proceeded in a logical manner, always contributing to the bigger picture. The versatility of activities was perceived to contribute positively to the creation of a relaxed and inspiring atmosphere. The significance of teamwork got emphasized through the activities as everyone's ideas contributed to the bigger picture. The importance of the workshop activities is emphasized in the following quotes:

The activities supported co-creation. (C3)

The activities as a whole facilitated co-creation. (D2)

The activities supported each other and the whole process. (C1)

All the activities were important, and they moved forward at a good pace. At first, a task might have felt challenging but when you saw that others had a lot of thoughts, the posters and models suddenly filled up with ideas. (C1)

Sometimes I felt a bit of prudence towards some activities, but then there were also activities that lightened up and relaxed the atmosphere, such as the ones during the second day that gave permission to come up with crazy and unrealistic ideas. It reminded me that everything does not have to be taken too seriously. (C3)

The activities allowed alternating between individual, pair and group work. Some tasks required individual thinking, while others supported collaboration. According to the interviewees, changing pairs and teams built up trust, created a sense of community and encouraged dialogue. By working with different people, participants gained new perspectives to the topics.

We were not always working with the same people as we switched pairs and teams in each activity. In that way we were able to build trust inside the group. By being able to do one short activity with everyone. (C2)

The methods that allowed independent thinking before collaboration worked well. We were first given time to come up with ideas and write them on sticky notes. After that we collected the sticky notes to put them on a poster and voted for the best ones to be developed further together. In this manner, we were able to consider individual ideas but also decide together on the most important ones to develop. (C3)

Dividing the group from time to time created a sense of community and enabled collective learning. Sometimes we worked together as a group and sometimes in smaller teams in a way that everyone had the chance work with different people. (D1)

All the activities that we did in pairs and in groups were very good. (D2)

Since there was a considerable amount of material and content to go through in a limited time frame, the working pace was quite fast. Participants noted that the time limit set pressure and challenges. However, as emphasized in the first quote below, keeping the big picture in mind facilitated coping with fast-paced working.

The fast-paced working method [was challenging]. But when you saw what the group achieved as a whole, the results were really good. If a task did not unfold immediately to everyone, it did not matter at all. (C1)

When you did not immediately understand a task and the schedule was pretty tight to carry out the activity, it created some kind of pressure and challenge. (C3)

Through exercises that encouraged participants to think "outside the box", the purpose was to create a supportive environment for sharing and exchanging ideas. Self-reflection and feedback was also advocated through open discussion. Participants reflected on their own behaviour throughout the sprint, which is exemplified in the following quote:

I am often too quick in these kinds of activities. I should give more time for thoughts and ideas to emerge and not start to analyse the realities too early on [in the process]. Brainstorming as a working method does not come naturally to me. When in the ideation phase, one should just let the ideas flow freely. (C1)

Facilitation

Facilitation played a key role in guiding the process forward. EcoDesign Sprint workshop was particular in the way that the first and second phases were facilitated by two different people; the facilitator in the first phase was the circular economy consultant and the one in the second phase was the design agency. Interviewees indicated that facilitation especially encouraged the generation of new ideas and moving forward despite challenges as well as helped in the selection of concepts.

Facilitation was good. The process kept on flowing because if there was a situation where we got stuck, we were guided forward. (C3)

An interesting challenge from the facilitator point of view was to find the concepts to develop, to somehow find common grounds after ideating and producing a lot of material. (D1)

We are dealing with such broad entities and so many possibilities which makes it challenging to select ideas to develop. I was surprised of how much material and possibilities there are. But which way to go... well, that sorts itself out through the process. (C1)

Use and creation of artefacts

As mentioned earlier in this section, the use and creation of objects of collaboration was a central support in the co-creation process. The artefacts acted as support in the process by facilitating

collaboration and communication. Through these objects, participants were able to communicate abstract ideas through visualization. The significance of learning through drawing and writing was emphasized in the interviews. In this paper, the objects of collaboration are categorized under material infrastructure, boundary objects and epistemic objects.

> ***Sticky notes, papers, maps and posters helped a lot. I learn better by doing than by reading from a book and writing notes. For me the best way to learn is by discussing, visualizing and working together with people. (C2)***

> ***The Circular Roadmap, which we started to fill out during the first day, [was helpful]. It was next to me, so I looked at it often as it helped me to see the bigger picture. It showed the concrete steps that we had taken. For example, the small activities that we did sometimes felt strange at first but when you could see on the map what we were developing and why, it was good. (C2)***

> ***The use of sticky notes visualized clearly the amount of generated ideas and that the path led somewhere. (C1)***

Interviewees acknowledged the significance of real-life examples and cases in learning. Case examples from the textile and clothing industry were presented and discussed in the workshop, however, some participants pointed out that they would have been interested in having more of them.

> ***Concrete cases like the ones that show how someone has already done something, are always helpful. And I definitely think that you learn by doing. (D1)***

> ***It would have been good to have more concrete examples right at the beginning. (C2)***

7.3 IMPACT OF ECODESIGN SPRINT

This chapter discusses the impact of EcoDesign Sprint on participants and their companies. Participants reported that the sprint positively affected both their personal mindset as well as their organizational and strategic operations. Hence the chapter is divided into impact on organization and strategy and impact on personal attitude and mindset.

7.3.1 IMPACT ON ORGANIZATION AND STRATEGY

Interviewees reported that the sprint strengthened their understanding of the circular economy and its business potential as well as opened their eyes on the urgency of transforming their business operations according to circular economy principles. Representatives of the client company described that the workshop inspired them to adopt circular principles in their activities and pursue a more sustainable way of making clothes. Representatives of the design agency noted that the sprint crystallised the power of design as a tool in complex and systemic problem solving. All in all, participants reported that EcoDesign Sprint gave them new ideas on how to develop their businesses forward. Thus, both parties reported that the circular economy will play an important role in their businesses in the future. The following quotes reflect how the sprint affected the business:

> ***We had already been inquiring for organic cotton and recycled fabrics before the sprint. But now [after the sprint], when we are deciding on the fabrics for the next collection, there are no other alternatives. They [sustainable alternatives] have to be found. (C2)***

> ***The sprint gave us a lot. Through the sprint, we realized that design has a lot to give to these kinds of challenges. Companies should utilize it more. (D2)***

> ***Even though I thought I have always been aware of environmental issues and ecological values have always been important for me, the sprint opened my eyes. Especially regarding the realization that it could be present in everything I do. From now on, I will take these topics into consideration even more in my work. (D2)***

> ***I think that a huge thing was to become aware of the significance of the circular economy and especially on how it can create new business opportunities for design agencies. Kind of combining circular economy with design. After all, design is such a great tool to create new concepts, processes and alternatives models. So, this has definitely made me realize the business potential of developing circular products and services for companies. (D1)***

Through EcoDesign Sprint, participants learned about the ways in which circular economy principles could be implemented at the strategic level. Interviewees reported that the workshop helped them to understand how they could use circular economy as a strategic advantage.

> ***I see a possibility for us to start developing a service that provides solutions for challenges relating to circular economy through design. The circular economy could serve as the foundation for creating dialogue with companies in a way that we all understand each other as well as the benefits of using design in the process. So, I feel that the sprint helped us realize how to create more business. (D1)***
>
> ***Both in the short and long term we will definitely take the circular economy into consideration and, if not completely focus, at least make it an essential part of our range of services. I am eager to explore what kinds of new partnerships and customerships will emerge. (D1)***
>
> ***In decision-making, it [sustainability] is part of our value base. But now that we have gained more knowledge of the circular economy, it will surely affect even more. These are important learnings to apply in the development of business operations. (C1)***
>
> ***The knowledge gained from the sprint will affect our strategy. Changes regarding the responsibility of the company will be made in the short term and long term. Our objective is to become a more responsible company. (C2)***

One stated objective of the EcoDesign Sprint is to facilitate the creation of new partnerships and networks. According to interviewees, one of the main benefits of participating in the training programme was the possibility to build new partnerships. The client company and design agency were eager to continue collaboration after the sprint.

> ***It is great that collaboration with the client company might continue and we got an opportunity for a new partnership. Of course, it was what we wished for. (D2)***
>
> ***Since the design agency is already well acquainted with our situation, they could help in implementing the concepts and communicating them to the public. (C2)***
>
> ***It is important to have the possibility to continue collaboration with the design agency for developing the strategies further. (C3)***

7.3.2 IMPACT ON PERSONAL ATTITUDE AND MINDSET

In addition to the impact the sprint had on business activities and strategies, participants experienced a personal change in their attitude and mindset towards the circular economy. All the participants expressed their interest in sustainability and responsibility at the beginning of the workshop. However, the findings from the interviews show that the increased knowledge on the circular economy gained from the workshop had an important impact on individuals and their mindsets. The workshop opened their eyes and encouraged them to consider environmental issues also in their daily life.

> ***I have noticed that I became even more devoted towards sustainability through the workshop. It encouraged me to really take action. (C2)***
>
> ***I find it really important for me to become, in a way, an ambassador for circular economy. (D2)***
>
> ***The sprint surely had an impact on all our mindsets both in the short and long term. I hope it will also influence action. (C3)***
>
> ***These kinds of workshops open your eyes. (C2)***

As EcoDesign Sprint is a training programme, one of the main objectives was to enhance participants' understanding of the circular economy and its business opportunities. Design proved to be a suitable method for achieving this objective. Interviewees also pointed out that in addition to learning about the topics, they also received links and channels to explore the topics further.

> ***The guidance provided by the circular economy consultant helped in organizing thoughts and strengthened the foundations. My understanding [of the circular economy] definitely increased through the workshop. (D1)***
>
> ***The sprint was beneficial also because now I know where to seek for more information. (C1)***
>
> ***We designers are of course familiar with design but not necessarily so much with the circular economy. Now that the we started to explore the topic through and with the help of design, we learned a lot about the circular economy. (D1)***

Interviewees reported that the sprint helped them to understand the bigger picture. Many participants were stunned by the broadness and all-encompassing nature of the circular economy. Circular economy is a topic that all participants were familiar with to some extent before the sprint, but the three days of intensive workshopping enabled them to gain deeper knowledge.

The big picture became clearer. I have not thought about these topics to such a large extent or focused on them for so many hours before. (D2)

I learned a lot of new things. Of course, the information has been available, but it is not something I have explored in my daily life. We aim to take into account these topics in our work and decision-making but since the circular economy is such a broad topic, I did not know about all of it. (C1)

I learned a lot about the circular economy in general. Also, about the textile and clothing industry, even though I had a good understanding of it already. But I got deeper in the topic. Regarding the circular economy, there was a lot of information that I thought I knew but actually didn't. (D2)

The sprint clarified the all-encompassing and systemic nature of the circular economy; how much it affects all elements of the supply chain and business activities. (C3)

8

DISCUSSION

8. DISCUSSION

This chapter discusses the findings of the research in relation to the main theories introduced in the literature review. The findings of the study, which derive from participant observation of a co-design workshop as well as interviews with workshop participants, indicate that collaborative design methods and design thinking facilitate knowledge creation for the circular economy. The following four categories of enablers of knowledge creation were identified: a) Atmosphere, b) People, c) Teamwork, and d) Workshop Structure. The positive impact of EcoDesign Sprint workshop on developing the capacity of individuals and their organizations to advance the transition to the circular economy was evident leaning on the research data.

Based on the research questions and findings, the discussion section is threefold. First, this chapter discusses how the collaborative design process of EcoDesign Sprint supported knowledge creation for the circular economy. Second, the identified enablers of knowledge co-creation are reviewed, and lastly, the impact of the co-design workshop on the capacity-building of individuals and their organizations in taking part in promoting a more circular future is reflected upon.

8. 1 CREATING KNOWLEDGE FOR THE CIRCULAR ECONOMY THROUGH CO-DESIGN

How does the collaborative design process facilitate knowledge creation?

The first research question of the thesis deals with the potential of the collaborative design process to facilitate knowledge creation. Participants of the workshop came from various fields and organizations, thus, they all had discipline-specific, company-specific and industry-specific knowledge. Nonaka (1994) refers to the notion of tacit knowledge to define knowledge that is not easily transmittable verbally to another individual. Hence, tacit knowledge can be transferred only through experience. The design process of EcoDesign Sprint allowed participants to acquire knowledge through experience, activities and dialogue. In order to fulfil the goal of the workshop, which was to develop innovative circular economy concepts for the client company, participants had to engage in a process of learning from and with each other.

As Carlile (2004) describes in his theory of knowledge transformation; difference, dependence and novelty of knowledge foster innovation. However, as the difference in the amount and type of knowledge, the amount of dependencies between actors and the novelty of knowledge increase,

knowledge creation becomes more complex (Ibid). EcoDesign Sprint brought together participants across various specialized domains to learn and co-create solutions for the circular economy. Since knowledge had to be transformed in order to foster innovation, participants were faced with a pragmatic boundary. According to Carlile (2004), transformation of knowledge at the pragmatic level requires first the transfer and translation of knowledge. EcoDesign Sprint tackled these boundary complexities through the design process comprising the following three phases: Understand, Ideate and Deliver. Each of them advanced and supported the collaborative creation of knowledge and development of circular economy concepts in different ways. The figure below illustrates how EcoDesign Sprint facilitated the transformation of knowledge between participants.

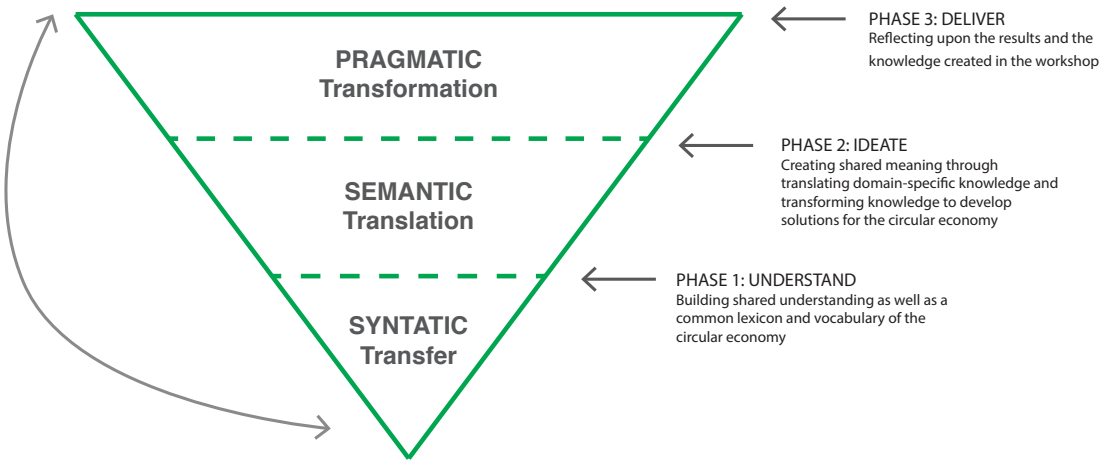

Figure 15: EcoDesign Sprint process supporting knowledge transformation (Adapted from Carlile, 2004)

In the Understand phase, the foundations for knowledge co-creation were set by building shared understanding of the current situation, potential future scenarios as well as circular economy principles. Knowledge was transferred between individuals through building common lexicon and vocabulary and shared meaning was created through dialogue and activities. Hence, the Understand phase supported both knowledge transfer and translation, which occur at the syntactic and semantic levels according to Carlile's (2004) theory.

In the Ideate phase, two concepts were developed in collaboration based on the knowledge acquired in the Understand phase. Through various co-design activities facilitated by the design agency, participants had the opportunity to apply in practice what they had learned in the previous phase. In the Ideate phase, shared meaning was created, and domain-specific knowledge was transformed to serve the common goal of developing circular concepts. Hence, it supported both the translation of knowledge at the semantic level and transformation of knowledge at the pragmatic level. (Carlile, 2004.) The ideation facilitated proposing, negotiating and transforming knowledge, which according to Carlile (2004) are fundamental in problem solving at the pragmatic boundary.

The last phase, which was about the delivery of concepts, allowed participants to reflect upon the results and the new knowledge created in the workshop. Thus, it supported the transformation of knowledge and finalized the knowledge co-creation process. As Carlile (2004) emphasize, the capacities of the boundaries in lower levels support the ones at the higher levels. In EcoDesign Sprint, each phase supported the next one and advanced knowledge co-creation. Finally, it is important to note that the process of knowledge creation is iterative, hence, transfer, translation and transformation occurred in all phases of EcoDesign Sprint. Figure 15 aims to show that each phase laid foundations for the next one and contributed to addressing the complexities in collaborative work.

According to Carlile (2004), boundary objects, such as drawings and prototypes may facilitate the transformation of knowledge between boundaries. Since design thinking is a process of thinking-by-doing (Hassi & Laakso, 2011), drawings, posters, sticky notes and prototypes among other artefacts were used to transfer, translate and transform knowledge in EcoDesign Sprint. The various objects of collaboration used in EcoDesign Sprint to advance knowledge co-creation are discussed in the next subchapter.

8. 2 ENABLERS AND SUPPORT OF KNOWLEDGE CO-CREATION

What can be seen as the enablers of the knowledge co-creation process?

The second research question relates to the factors that enabled and supported the process of collaborative knowledge creation. Central enabling conditions and supporting elements of knowledge creation were discussed in the literature review and summarized in the theoretical synthesis. Based on the empirical research, four categories of enablers of knowledge co-creation were recognized: a) Atmosphere, b) People, c) Teamwork and d) Workshop Structure. Next, each category will be further discussed by combining findings with the relevant literature.

Atmosphere

As Nonaka et al. (2000) argue, knowledge creation occurs in context and place, in *ba*. *Ba* provides a shared context for individuals to share and create knowledge. EcoDesign Sprint can be defined as the *ba* in this case as it provided the context and place for knowledge co-creation. An open and caring atmosphere where individuals trust each other was identified as a crucial enabler of knowledge creation in EcoDesign Sprint.

Participants acknowledged that being able to *trust* each other and the process played a key role in advancing knowledge creation in the workshop. Many authors (Nejatian et al., 2013; Nonaka et al., 2000; Blomqvist & Levy, 2006; Esterhuizen et al., 2011) claim that trust is essential in creating a knowledge-friendly culture. Nejatian et al. (2013) note that trust decreases the fear of risk and uncertainty and Nonaka et al. (2000) state that it forms the foundations for creating an atmosphere in

which participants feel safe and motivated to share knowledge. Building trust is particularly important in activities involving cross-functional and inter-organizational groups (Nejatian et al., 2013), such as in the case of EcoDesign Sprint where participants come from different organizations and practices. According to interviewees, they did not feel any kind of mistrust towards the process and other participants because organizers made the purpose and goals clear from the very start of the workshop. The organizers also ensured confidentiality of information shared in the workshop, which created a safe atmosphere for sharing sensitive information. In addition, the small group size was identified as another means to strengthen trust inside the group as it enabled open and genuine conversions to emerge.

All participants reported that they attended EcoDesign Sprint with an *open mindset* - enthusiastic about having the opportunity to interact with others and learn. The open and positive atmosphere encouraged participants to be active in the co-creation activities by expressing their thoughts and ideas. Esterhuizen et al. (2011) emphasize that a culture of trust, empathy and openness is central especially at the beginning of the knowledge creation process when individuals share tacit knowledge between each other.

People

According to Nonaka and Takeuchi (1995), even though knowledge creation occurs through social interaction; individuals play a key role in the process. This study supports the view of Nonaka and Takeuchi by identifying "people" as one of the four categories of enablers of knowledge co-creation. Participants' high motivation towards learning as well as their multidisciplinary backgrounds were found to support knowledge creation.

A central element and enabler in creating a knowledge-friendly atmosphere was the *motivation of participants to learn* and acquire knowledge. Participants of EcoDesign Sprint were all eager to learn about the circular economy in order to apply the knowledge in their own work and personal lives. Nejatian et al. (2013) emphasize the importance of encouraging learning as the time spent on learning correlates positively with the amount of knowledge created. Learning is a crucial element of internalization, which is the last phase of Nonaka's (1994) knowledge spiral. Thus, Esterhuizen et al. (2011) argue that creating a culture of learning is essential to support the process of knowledge creation. At the beginning of the workshop, all participants expressed that sustainability is part of their core values, which supports the argument of Esterhuizen et al. (2011) about shared values being an essential supporting requirement in the knowledge creation process.

According to Jones (2014), design dealing with high complexity and social transformation requires broad representation of disciplines and organizations. Developing solutions for the circular economy is a design challenge of high complexity that deals with systemic change in economic and social systems. Nonaka and Takeuchi (1995) also argue that requisite variety of knowledge enables individuals to address complex problems, which advances the creation of knowledge. Participants of EcoDesign Sprint represented different organizations and disciplines. The wide scope of *expertise* enabled diverse perspectives to arise and stimulated dialogue and communication.

Teamwork

The third category derived from the empirical research is teamwork. According to Scheer et al. (2012), teamwork is one of the three core elements of design thinking that enhance learning and knowledge creation. Recognising that everyone is creative and capable of expressing their ideas if they are provided with the right tools and methods are the core building blocks of collective creativity (Sanders and Stappers, 2008). EcoDesign Sprint brought together eight professionals from different backgrounds to solve a problem through collective creativity. Hence, teamwork played a crucial role in the process.

Forming a *common basis* as well as determining *a goal* for the collaboration was recognized to advance knowledge co-creation in EcoDesign Sprint. The objective of the first phase was about creating shared understanding on the topic and the current situation of the client. As Carlile (2004) argues through his theory of knowledge transformation, building a common lexicon is a prerequisite for translating and transforming knowledge across boundaries. Through the first phase of EcoDesign Sprint, participants were able to learn about the principles of circular economy and create common vocabulary to use throughout the co-creation workshop. Furthermore, determining clear goals for the workshop supported the process as Nonaka and Takeuchi (1995) confirm by stating that intention, the source of collective commitment, builds the capabilities of a group to acquire, share and create knowledge. Conklin (2006) follows the same thread of thought by emphasizing the significance of building shared understanding and commitment between individuals in collaboration activities. Participants stated that collaboration went smoothly because they felt like they were working towards the same goal.

According to Nejatian et al. (2013), collaboration and open discussion play a crucial role in advancing knowledge creation. The findings of the study support the argument of Nejatian et al. (2013) as *dialogue and communication* were identified as key enablers of knowledge creation in EcoDesign Sprint. Through dialogue, participants were able to express and get feedback on their ideas, ask further questions and clarifications as well as develop common concepts and meaning. An interviewee pointed out that asking questions was essential in order to get deeper understanding on participants' ideas. Leifer & Steinert (2011) state that design is actually a question driven process where the number of questions asked correlate positively with the team's performance. Interviewees also emphasized that the *small group* created a trustworthy environment where dialogue and ideation felt natural.

Workshop Structure

Stemming from the findings, workshop structure was identified as the fourth category of knowledge co-creation enablers, which comprises activities and facilitation as well as the use and creation of artefacts. Scheer et al. (2012) state that the design thinking process itself, which they define as an iterative process of six phases, support collective learning.

According to interviewees, *activities* that stimulated outside the box thinking advanced co-creation. Furthermore, switching teams and pairs and alternating between individual and group work allowed

participants to get new perspectives on the topics and supported both individual and collective thinking. Nonaka and Takeuchi (1995) claim that autonomy increases the chances for individuals to find valuable information and motivates them to create new knowledge. In EcoDesign Sprint, autonomous thinking and learning was supported through activities that required individual work. Interviewees confirmed that working alone helped to generate ideas and organize thoughts, which in turn strengthened collaboration. Switching pairs and groups, on the other hand, enabled redundancy, which according to Nonaka and Takeuchi (1995) supports and enables the creation of knowledge. In addition to activities, *facilitation* had a central role in stimulating the generation of ideas and guiding the co-creation process forward. Planning and facilitating activities that generated divergent thinking allowed the posters and sticky notes to fill up with ideas while activities that supported convergent thinking helped collaborators to make decisions between different alternatives and drive the process forward (Brown, 2009).

Activities allowed participants to collaborate through experience and complex problem solving, which according to Scheer et al. (2012) are the reasons why design thinking is particularly suitable as a learning method. Indeed, supporting learning-by-doing (Conklin, 2006) and thinking-by-doing (Hassi & Laakso, 2011) through the *use and creation of tangible and conceptual artefacts* was at the core of the co-design methods employed in EcoDesign Sprint. As mentioned in chapter 7.1, artefacts were utilised in various stages of the process to support co-creation activities. According to interviewees, the use of sticky notes, papers, models and posters allowed visualization of ideas, which contributed positively to knowledge co-creation. Leifer and Steinert (2011) and Rylander (2009) support the idea by claiming that visualization can serve as a suitable method to express abstract ideas.

This thesis follows the categorization by Nicolini et al. (2012) of objects of collaboration. Material infrastructure, which is categorized under tertiary objects, gives the basic infrastructural support and serves as an enabling element of collaboration. Boundary objects, which are considered as secondary objects, support the translation of knowledge between different knowledge boundaries. Finally, activity objects and epistemic objects serve as the objective and motivation for collaboration, hence, they are referred to as primary objects. The table on the next page summarizes the three types of objects of collaboration utilized in EcoDesign Sprint workshop.

Table 3: Objects of collaboration in EcoDesign Sprint

OBJECTS OF COLLABORATION	ARTEFACTS USED IN ECODESIGN SPRINT	PURPOSE	PHASE
Tertiary objects: Material infrastructure	Space for workshop	Provided the basic infrastructural support	All phases
Secondary objects: Boundary objects	Circular roadmap	Served as the main boundary object throughout the workshop as it showed the progress of the group and the results of activities	All phases
	Results of EcoDesign Audit	Facilitated discussion and created a common starting point	Phase 1 / Understand
	Megatrend cards and PESTEC model	Facilitated the negotiation of the most relevant megatrends for the company	Phase 1 / Understand
	Lifecycle model	Built shared understanding of how circular principles affect various elements of a product's lifecycle and facilitated idea generation	Phase 1 / Understand
	"360" questions developed by participants	Supported ideation of concept B	Phase 2 / Ideate
	Ideation cards	Supported ideation of concepts A and B	Phase 2 / Ideate
	Ideas explicated and visualized on sticky notes, papers and posters	Facilitated the communication and translation of ideas between participants	All phases
	Prototypes	Demonstrated the concept in practice and stimulated discussion	Phase 3 / Deliver
Tertiary objects: Epistemic objects	Concept A: Second hand clothing concept	Served as the objective of collaboration and motivated participants to engage in co-creation	All phases
	Concept B: Concept enhancing transparency	Served as the objective of collaboration and motivated participants to engage in co-creation	All phases

As demonstrated in Table 3, material infrastructure, boundary objects and epistemic objects supported the collaboration activities and advanced knowledge co-creation. Material infrastructure is often taken as granted since it is not the focus of the activity (Orlikowski, 2007; Nicolini et al., 2012). The space of the workshop was obviously a crucial enabler of collaboration and knowledge co-creation; however, it did not contribute directly to the co-creation. Hence, it was categorized as material infrastructure. Boundary objects are used as means of translating and transforming knowledge across boundaries (Carlile, 2002). The boundary objects presented in the table are all tangible objects that supported collaboration either in a single activity or in different activities throughout the workshop. Epistemic objects drive collaboration by providing an objective and goal for participants (Nicolini et al., 2012). Concepts A and B served as the epistemic objects in EcoDesign Sprint since the goal of the workshop was to develop two circular economy concepts for the client company.

8. 3 CAPACITY-BUILDING FOR TRANSITIONING TO THE CIRCULAR ECONOMY

How does collaborative design support the transition to a circular economy?

The main research question explores the impact of the co-design workshop on the personal and organizational capabilities to advance the transition to a circular economy. Circular economy promises to create wellbeing and prosperity without jeopardizing the environment through the implementation of new innovative business models and the sustainable use of natural resources (EMF, 2012). Thus, a circular economy requires restructuring the economy in relation to consumption and production practices (Yuan et al., 2006; Preston, 2012) as well as developing radically innovative solutions to improve business-as-usual (Ghisellini et al., 2016). According to Accenture (2014), circular economy delinks value creation from the use of natural resources through business models that are based on longevity, renewability, reuse, repair, upgrade, refurbishment, capacity sharing and dematerialization. Coming up with new ways of generating profit through circular business model innovation necessitates collaboration and partnership-building (EMF, 2012; Preston, 2012). Based on the literature review and the empirical findings, I argue that knowledge creation is a precondition for circular economy innovation and collaborative design can serve as a suitable method to support the process. This study follows the definition of collaborative design given by Sanders and Stappers (2008, p. 6) who state that co-design is “the creativity of designers and people not trained in design working together in the design development process”. EcoDesign Sprint is a co-design workshop that aims to enhance participants knowledge on the business opportunities in the circular economy and facilitate the development of two business and/or design concepts that follow the principles of the circular economy. According to interviewees, learning and developing new concepts for circular economy together in a multidisciplinary and cross-organizational group contributed positively to their capability and desire in taking part in advancing the transition to the circular economy.

EcoDesign Sprint had a positive impact on participants both on the personal and organizational levels. Regarding the impact on organization and strategy, the workshop helped participants to acquire knowledge on the circular economy and its business opportunities as well as provided them with tools to apply the knowledge in practice. In the workshop, participants were guided through different phases that supported learning, problem-solving and concept ideation. The client company reported that the knowledge acquired in the sprint is beneficial to developing their business and strategy in the future. Even though the company operated already in a responsible way, EcoDesign sprint inspired them to apply circular principles in their business through new innovative solutions developed in the workshop. The design agency stated that EcoDesign Sprint clarified the important role design can play in solving sustainability-related business challenges. According to Jones (2014), design dealing with high systemic complexity requires participatory methods and transdisciplinary collaboration, which is consistent with the methods employed in EcoDesign Sprint. Representatives of the design agency reported that the workshop encouraged them to consider the possibility of updating their service portfolio to also include circular design services in addition to their current service offerings.

In addition to the impact the sprint had on organization and strategy, interviewees stated that it affected their personal attitude and mindset towards sustainability and the circular economy. Participating in the workshop opened their eyes on the urgency of finding new alternatives to the current consumption and production practices as well as encouraged them to take action in their own every-day lives. According to interviewees, gaining understanding of the circular economy was one of the biggest benefits of EcoDesign Sprint. It helped them to realize the complex and systemic nature of the concept and created a basis for further exploration. As many authors have stated (see e.g. EMF, 2012; Preston, 2012), the transition to a circular economy necessitates large-scale changes in how our economies and societies are organized, from production economics to regulation. The shift of mindsets is key in the change, which is why EcoDesign Sprint contributed to advancing a circular future by providing a platform for individuals to explore in practice the possibilities beyond linear business-as-usual and facilitate the reframing of mindsets.

To sum up the discussion chapter, figure 16 on the next page summarizes the answers to the three research questions.

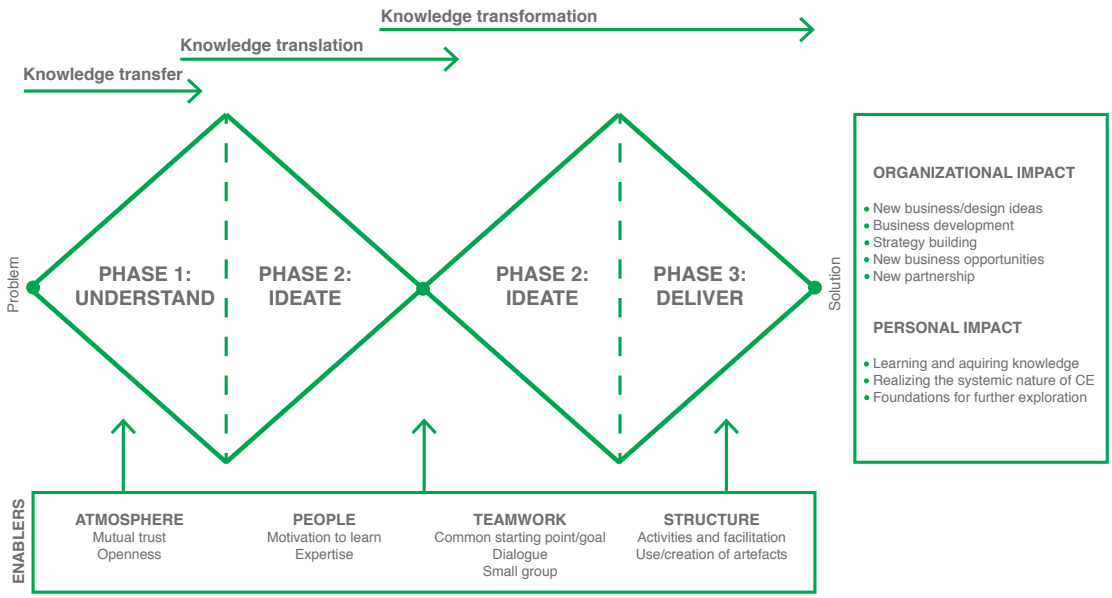

Figure 16: EcoDesign Sprint as a platform for knowledge co-creation

As illustrated in the figure above, the three phases of the design process of EcoDesign Sprint facilitated knowledge co-creation by supporting knowledge transfer, translation and transformation between participants. The enablers of co-creation are presented at the bottom of the figure. Various elements categorized under atmosphere, people, teamwork and workshop structure were found to enable and support knowledge co-creation throughout the workshop. By attending EcoDesign Sprint, participants acquired knowledge and designed solutions for the circular economy. Their personal and organizational capabilities to address the changes posed by a circular economy strengthened through the co-creation activities, as can be seen from the figure.

9

CONCLUSION

9. CONCLUSION

The idea of a circular economy has recently attracted significant attention as it proves to offer a solution to environmental and social despair around the world caused by the current forms of production and consumption. The circular economy promises to create wealth and wellbeing, by not only minimizing negative impact, but also by regenerating and restoring the environment. However, the transition calls for large-scale changes from business operations to regulation and consumer behaviour.

This study aimed to shed light on the use of collaborative design in innovation activities for the circular economy. Since knowledge creation is seen as a source for innovation, I examined how design thinking and methods facilitate the collaborative creation of knowledge and influence the participants to foster circular change. Despite an increasing amount of literature focusing on circular business model innovation, there is a lack of studies focusing on the role of design in facilitating the innovation practices in cross-disciplinary and collaborative settings. Hence, the study aimed to answer the following main research question:

> ***How does collaborative design support the transition to a circular economy?***

The research question was approached through the following sub-questions:

> ***How does the collaborative design process facilitate knowledge creation?***
>
> ***What can be seen as the enablers of the knowledge co-creation process?***

To address the research gap and answer the research questions, I conducted a case study on a co-design workshop, EcoDesign Sprint, that aimed to enhance participants' knowledge on the circular economy and facilitate the development of business and design solutions for the circular economy. The data for this study was gathered through participant observation and semi-structured interviews with participants of the workshop.

The findings of the research indicate that collaborative design methods supported the process of knowledge co-creation in different ways. It was found that the collaborative design process in EcoDesign Sprint, which was divided into three phases (Understand, Ideate, Deliver), facilitated knowledge transfer, translation and transformation between collaborators. The Understand phase provided participants with a common lexicon and vocabulary on the circular economy as well as set

the foundation for knowledge creation. Furthermore, the Ideate phase supported the translation and transformation of knowledge through co-design activities which enabled the development of shared meaning and established common interests. Finally, the Deliver phase allowed collaborators to reflect upon the knowledge created in the workshop through discussions on the developed concepts.

The study identified various supporting and enabling elements that were categorized under atmosphere, people, teamwork and workshop structure. The open and trustworthy atmosphere as well as participants' expertise and motivation to learn were found to create a suitable environment for knowledge creation. Furthermore, having a common starting point and goal, a small group in addition to continuous open dialogue were identified to drive the process forward. Regarding the structure of the workshop, activities and facilitation as well as the use and creation of artefacts were proven to advance co-creation and support communication. Design uses and generates artefacts, which were found to facilitate learning, communication and collaboration as participants were able to create shared meaning by generating and visualizing ideas. Stemming from the findings of the research, the collaborative design workshop had significant impact on participants and their organizations. The workshop allowed collaborators to acquire deeper knowledge on the topics, gain skills to apply the knowledge in practice as well as build a new partnership for implementing the developed circular solutions. Hence, the study has shown that collaborative design enables the creation of new ideas, meaning and concepts and strengthens the capabilities of participants to take part in creating a more circular future. In this way, this study has provided support to prior research indicating the significant role of design in tackling complex societal issues and has continued the dialogue on the role of design in promoting the circular economy.

To this end, this study has demonstrated the relevance of collaborative design in addressing issues of high complexity. Albeit this study does not give a step-by-step guide to follow, certain enabling and supporting elements have been identified that facilitate the collaborative development of solutions for the circular economy. Therefore, this study is expected to help innovators across domains to engage in collaborative design activities that aim to explore alternative paths and create new mindsets for shifting to circularity.

Since the framework was created based on a single case study with a limited sample size, the findings and framework should be tested and further developed in the context of other organizations and industries. In addition, exploring the topic by using alternative methods of gathering data would be beneficial as the methodology employed in this study has its own limitations. Participant observation has the risk of giving biased data, especially since video-recording was not possible in this particular case. To tackle the limitations posed by participant observation, semi-structured interviews were used as the other main method to collect data. Through interviews, participants were able to express their views of the co-creation experience with their own words. Hence, the combination of the two data collection methods was proven to work well in this case. However, recognising these aforementioned limitations in the methodology of this study is essential for future researchers examining similar phenomena.

Consumer behaviour and policy have been acknowledged to play a central role in the successful shift to a circular economy. Thus, exploring the wider engagement of sectors in co-creation, including consumers, communities, legislators and companies, could represent an avenue for future research. The long-term impact of collaborative design on circular business development and innovation was not assessed in this research, however, it provides a pertinent approach for further research. Cross-sectoral dialogue on the best practices for moving from a linear economy to a circular one has just started. Hence, future avenues of research remain open and full of possibilities.

10

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11

APPENDIX

11. APPENDIX - INTERVIEW QUESTIONS

BEFORE THE SPRINT

Why did you sign up for EcoDesign Sprint?
What were your expectations from EcoDesign Sprint?
How were you prepared for the workshop?

DURING THE SPRINT

What do you think about the amount of participants in the sprint?
What do you think about the structure of the sprint?

Did you learn anything new or meaningful during the sprint?
How did your know-how of circular economy develop during the sprint?
What elements assisted the learning process in the workshops?
How was the collaboration with other participants?
How was the communication with other participants?
What do you think advanced co-creation in the sprint?
How did you try to help advance the collaborative thinking?
Which things built up trust between participants?
If you would participate in the workshop again, would you do something differently?

Which activities do you especially remember? Why?
Which methods most helped progress co-creation and learning? Why?
What was challenging regarding learning and co-creation?

AFTER THE SPRINT

Were you satisfied with the results of the sprint?
Could something have been done differently?
How should the organizer develop the sprint?
Could you tell about the impact that the sprint has had on your company in the short term and in the long term?
How could the teachings from the sprint be brought into one‘s own company?