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Promoting circular innovation through innovation networks: the case of cradle to cradle certified products

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Abstract
As advancement of sustainability-oriented innovation, circular innovation addresses not only the lacking environmental challenge integration but adopts a life cycle perspective. As a product design concept for the circular economy, Cradle to Cradle promotes closed biological and technical loops. We make use of the promotor network theory for understanding how companies collaborate in an innovation network for overcoming innovation barriers and successfully developing circular products. By conducting a longitudinal in-depth case study on a cradle to cradle pioneer company in the consumables industry, we find that cradle to cradle innovators collaborate tightly on the company, supplier and linking levels. Furthermore, these companies are characterised by excellent communication structures between the various promoters in the innovation network.

Introduction

Today's linear economic system fails to account for resources scarcity, the allocation of waste in the ecosystem, and environmental pollution more broadly thus threatening the livelihood of future generations. In the last decades several concepts have been developed that aim at decoupling economic growth from environmental pressure, such as Stahel's loop economy (Stahel, 1984; Stahel, 2010), biomimicry (Benyus, 2008), the blue economy (Pauli, 2012), and cradle to cradle (Braungart, McDonough, & Bollinger, 2007). The Ellen MacArthur foundation (2013) integrated these overlapping perspectives under the umbrella term of circular economy (see also Blomsma & Brennan, 2017) . For systematically basing and advancing the scientific debate on the circular economy, several authors conducted literature reviews and identified innovation and collaboration as critical elements for implementing the circular economy (Blomsma & Brennan, 2017; Geissdoerfer et al., 2017; Ghisellini, Cialani, & Ulgiati, 2016; Lieder & Rashid, 2016). Geissdoerfer et al., (2017). Innovation and collaboration go hand in hand, as circular innovation, endeavours need a close collaboration with company external parties to fulfil the criteria for closed loops products.

In order to systematically understand the immanent collaboration structures of circular innovation processes and how company level barriers to circular innovation can be overcome, this paper suggests applying the theory of promotor networks (Fichter, 2009) on cradle to cradle innovation. This aims at answering the research question: How do companies collaborate in an innovation network for successfully developing circular products?

In the remainder of this paper, we first concisely review literature on circular innovation before we present our theoretical lens 'promotor networks'. Afterwards, we apply it to analyse a longitudinal single case study on a successful cradle to cradle pioneer company in the consumables industry.

Literature Review: Circular Innovation

Coming from an innovation management perspective, Hansen et al. (2009) specified sustainability-oriented innovation as based on the full product life cycle from resource extraction to end-of-life. In more recent advances under the label of 'circular' innovation, Bocken et al. (2016) have emphasized the importance of closing these life cycles. One very recent branch of circular innovation studies looks at the phenomenon of cradle to cradle (Braungart et al., 2007) – a product design concept that has been formalised into what can be considered the first product certification standard for the circular economy. The product certification standard supports companies when implementing circular innovation by making the concept tangible. Cradle to cradle differentiates between biological and technical loops. Products with inherent dissipative losses (materials of consumption) shall be designed for being biodegradable; other products (materials of service) shall be designed for continuous and safe cycling without material downgrading (Braungart et al., 2007). Thus, the product certification not only certifies

the materials that can be cycled, but also focuses on health effects of the materials by banning hazardous substances (further certification criteria are water stewardship, use of renewable energies, and social fairness, but are not investigated in detail here). The standard also differs from other product certifications by its five-level certification system ranging from 'basic' to 'platinum' stimulating companies' level of ambition and animating for continuous improvements.

First studies show that the strict specifications and the resulting necessary collaboration with value chain partners make circular innovation processes very complex (Drabe & Herstatt, 2016; Smits, Drabe, & Herstatt, 2016). These studies discovered that interactions between individuals and groups in and outside the firm are important to connect disparate "knowledge assets" (Staber, 2004). Taking into account the close collaboration for developing cradle to cradle products, the circular innovation environment can be understood as an innovation network with the joint goal of developing cradle to cradle certified products. However, as developing or changing suppliers and business models, product developers of circular products often do not have the authority for deciding to implement closed loop production systems (Bakker et al., 2010). This is an important barrier to circular innovation. In the following sections, we will first explain the promotor roles, who push forward circular innovation in the company and its innovation network, and consecutively analyse the case of a successful cradle to cradle pioneer company with regard to the promotor roles

Theoretical Perspective: Promotor Networks

Originally introduced by Witte (1973), Fichter merged the promotor concept into the discussion on open innovation in the sustainability context by combining both concepts in a multi-level concept of innovation systems (Fichter, 2009). According to the promotor theory, companies need different types of promotors in their innovation processes to overcome innovation barriers. Promotors are defined as 'individuals who actively and intensively support the innovation process' (Witte, 1973, p.15). There are four types of promotors, which contribute to the innovation process by different competences:

- Power promotor: hierarchical power
- Expert promotor: expert knowledge
- Process promotor: organizational knowledge
- Relationship promotor: relationships inside and outside the company.

These promotors can even be combined in one person – the universal promotor (Fichter, 2009). In a successful innovation process, all types of promotors work together closely. The promotors aim at helping a specific innovation to a break through (Fichter, 2009). These promotors must not necessarily be part only of the focal firm (company level) but also act within the company's innovation network on the value chain as well as the framing and linking levels (Fichter, 2009). The latter spans firms that facilitate other firms' innovation (Winch & Courtney, 2007).

We are going to apply this framework for analysing the power structures that promote circular innovation and to understand success factors that help to overcome innovation barriers.

Methodology

We will answer the research question by an abductive longitudinal case study. Case study research leads to propositions deeply grounded in empirical evidence, thus providing a strong basis for theory building (Eisenhardt & Graebner, 2007; Yin, 2014). Therefore, this approach is particularly suitable for analysing newly emerged phenomena such as circular innovation. Our study focuses on a large family-owned environmental pioneer in the consumer goods industry (in the following 'Consumables Ltd.') that optimises its products for the biological and technical loops. We chose Consumables Ltd. due to its catering to both loops, its long legacy of environmental innovation and its respective market positioning as eco-pioneer.

Well-grounded on desk research we are currently conducting semi-structured interviews with internal and external experts of the firm involved in the innovation process. Following the strategy of interviewing a broad set of actors, we started with the Cradle to Cradle Officer. Afterwards, we questioned the experts in the departments and consecutively a member of the management board, followed by relevant external agents, such as EPEA (Environmental Protection and Encouragement Agency), selected suppliers, and value chain partners (see Figure 1).

This allows us to capture the whole innovation network. This method, based on data triangulation (Yin, 2014), allows profound insights into all facets and stages of the innovation process. We follow a recursive process of data generation and analysis (Charmaz, 2014) and are currently at the progressed beginning of the interview and analysis phase. Table 1 provides an overview of the current research status.

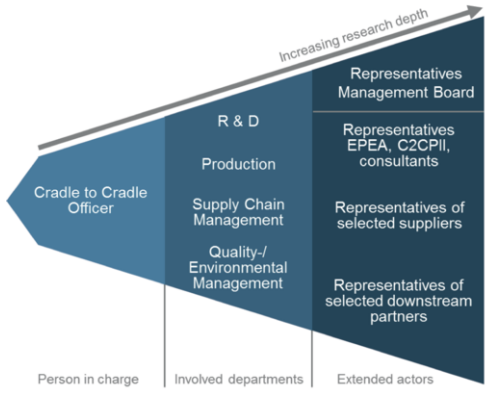

Figure 1. Interview strategy.

Data Categories	Consumables Ltd.
Interviews	**4 (8)**
Focal firm	3 (5)
Assessor, certification body, consultants	1 (1)
Suppliers and partners	1 (2)
Site visits	**2 (2)**
Publicly available information	**20 (20)**
Corporate documents (e.g. sustainability reports, environmental policy)	4 (4)
Press releases	6 (6)
Press articles	10 (10)
x = conducted, (x) = planned	

Table 1. Data collection status.

The interviews are transcribed, coded, and analysed using the software for qualitative text analysis, MAXQDA. The derived tentative theoretical categories will be presented in the following sections.

Preliminary Findings

Consumables Ltd. has been considered as an eco-pioneer in the chemical industry as early as the 1980s. They specialised in products, which, after their application, are fully biodegradable in the water system. When starting their cradle to cradle project in 2012 they had already optimised the formulation of the products, but as they are taking a holistic approach, they went on with optimizing the packaging of their products, too. In the course of developing the core product and packaging consistent with the cradle to cradle philosophy, an extensive innovation network has developed. Figure 2 depicts the innovation network on three levels: organisation, value chain network, and overarching linkages. It includes the different promotor types that we identified within the case study and their relationships.

Company Level

At the company level, three promotors were significantly driving the cradle to cradle project. First, the Head of Product Development served as an expert promoter. He joined the company with previous experience in developing products optimised for the biological cycle. Consequently, he applied this thinking to the products of Consumables Ltd. and started to demand detailed material passports from the suppliers. In 2011, he introduced the cradle to cradle concept to the company at a point of time when the CEO was looking for concepts on sustainable packaging which, given his scepticism due to food competition, would not use bio plastics. Cradle to Cradle would allow the company to argue the use of renewable materials for their core products, which are products of consumption that will be dissolved in water and therefore need to be biodegradable. At the same time, they can reason for the use of recycled plastic from the public collection system for the packaging. The CEO became a strong supporter of cradle to cradle in the company and acted as a power promotor. He entrusted the Head of Product Development to have a product certified as a trial. "Without our CEO Cradle to Cradle would not have been possible" (Sustainability Manager, Consumables Ltd.). Short before the Cradle to Cradle kick-off meeting took place, the company additionally hired a Head of Packing Development, who developed into an expert promotor himself.

Consecutively, the Head of Product Development had the first product and production site assessed by EPEA. They had their first product cradle to cradle certified in 2013. The cleaning product itself reached the material health Platinum level straight away, the overall cradle to cradle score summed up to gold. Although not having been part of their core value creation so far, the packaging managed to get the bronze certification. A success factor was the fast and direct communication with the CEO. On the one hand, he supported and challenged his experts by leaving them room for innovation and accepting intermediate steps to get to the market quickly and, on the other hand, challenging them regarding the progress in regular

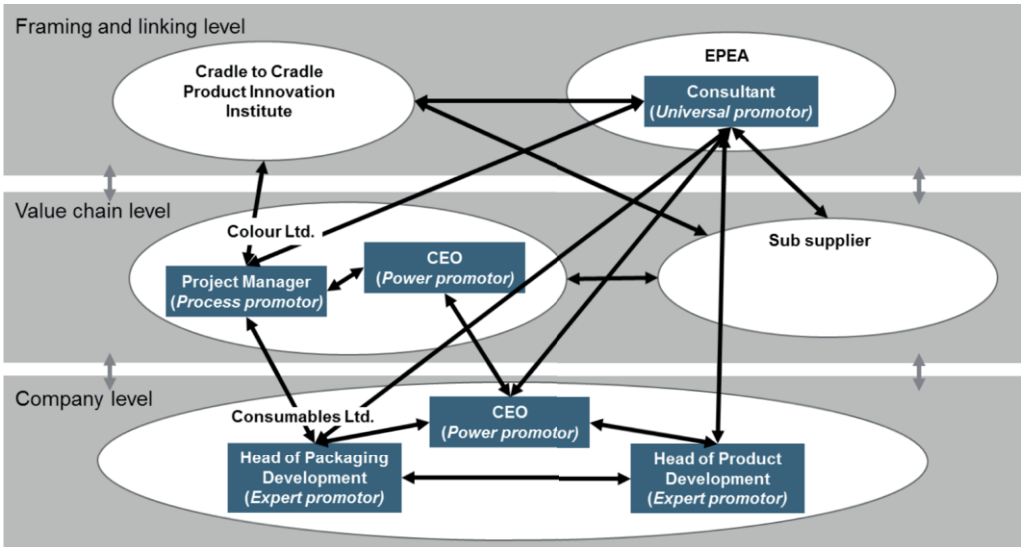

Figure 2. Preliminary framework: Cradle to cradle innovation network with promotors (based on Fichter, 2009).

meetings. He also backed them against team members with a more reactive stance towards environmental management. Especially the communication ties between the expert promotor Head of Packaging Development and the CEO of Consumables Ltd. were strong and direct. Whereas the expert promotor Head of Product Development developed tight linkages with EPEA.\

Value chain level

An important supplier to Consumables Ltd. in the area of packaging is Colour Ltd., supplying the inks for the labels of the packaging. They had already been contacted by EPEA a couple of years before if they were interested in developing a gold-level printing colour, but there was not much commitment then. Later, in 2014, with Consumables Ltd. as a prospective customer, EPEA convinced a project manager at Colours Ltd. of the demand and future profitability of cradle to cradle colours. The project manager used his direct contact with the CEO of Colour Ltd. to get permission for the cradle to cradle colour development project. "I knew that the second hierarchy level would kill the project right away again, so I directly asked our CEO for permission." (Project Manager, Colour Ltd.) Thus playing the role of a process promotor. Without the joint initiative on all three levels by the universal promotor, the expert promotor (Head of Packaging Development) and the process promotor, the project would not have been conducted. During the joint development process, strong ties and trust have developed.

Framing and linking level

On the framing and linking level, we locate the innovation intermediary EPEA. Its Managing Director, also working as an operative consultant, acts as universal promotor. He disposes over cradle to cradle expert knowledge, has the process knowledge on how to conduct all necessary assessments and the certification, and has direct influence on the EPEA headquarter. Furthermore, he has important relationship knowledge as he is well connected in many companies in the cradle to cradle sphere, so that he can broker knowledge and bridge the needs of companies through matchmaking. His persistence and commitment was central to the development of the strong ties within the network. Based on the successful first certification, Consumer Ltd. further opened up their innovation process to integrate an EPEA representative early on in the innovation project. The universal promotor and the expert promoter (Head of Product Development) developed even a weekly call for pushing forward cradle to cradle innovation.

Discussion

We find that successful cradle to cradle innovators are characterised by excellent communication structures between the various promoters in the innovation network. The innovation network is characterised by close relationships between the actors and open and direct communication. The power promotors play a central role in levelling out the way for circular innovation and pushing forward innovation projects that would otherwise risk to be stopped at a middle management level. A process promoter can overcome such barriers. The expert promotors developed their existing suppliers or developed new ones together with the intermediary organisation's universal promoter. They were given the support of the top management, who had a very strong interest in improving the environmental performance of their products. Leaving the experts free rein, the permission to develop the supply network, and the frequent milestone meetings facilitated swift decision-making and relatively fast market entry.

Overall, all promotors, through their tight collaboration, jointly contribute to overcoming company-internal innovation barriers and set aside structural constraints through their network integration.

Conclusions

Applying the promotor networks framework to cradle to cradle allowed us to get a better understanding of a circular product innovation processes. With regard to its linkages to its external partners and the roles that facilitated circular innovations in form of improved cradle to cradle products. We contribute to understanding how promotors manage to overcome innovation barriers. Our findings imply that companies wishing to implement successfully circular innovation need to build up a strong network with their suppliers and partners on the framing and linking level that are characterised by a long-term orientation, trust, and open communication.

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