

Upscaling of circular business models to reduce plastic pollution

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Abstract

Circular business models (CBMs) have emerged to tackle the growing challenge of plastic pollution, however little research to date has focused on how to scale up these business models. This paper seeks to answer the question: What role do stakeholder relationships play in upscaling circular business models? Preliminary results suggest that CBMs create value for a range of stakeholders, and that these stakeholders in turn contribute to CBM upscaling.

1 Introduction

Plastic pollution is a global threat that remains largely unaccounted for and poorly managed. Considering microplastics in the world's oceans, which are ubiquitous and irreversible, researchers have advocated classifying marine plastic pollution as a planetary boundary threat. However, questions still remain on the effects of such concentrations of plastic and microplastics on biota and earth-system processes (Koelmans et al., 2017; Villarrubia-Gómez et al., 2018). Regardless of the uncertainties, it is generally accepted by the scientific community that plastic pollution is a problem that should be mitigated, though efforts to do so have been widely ineffective (Dauvergne, 2018). One reason that plastic pollution remains a problem is the limited economic value of plastic waste. Many plastics are not economically feasible to recycle, and even those that are, mainly PET and HDPE, lose their material quality as they are mechanically recycled (Hahladakis et al., 2018). The circular economy is an economic structure that, by design, maintains resources and materials within 'loops' and seeks to minimize or even eliminate waste from the economy (Lüdeke-Freund et al., 2018). For plastic, the economic and technological barriers of recycling and recovering waste have been obstacles to achieving circular economy goals (Hahladakis et al., 2018; ten Brink et al., 2016). Innovations in technology and novel business model structures have emerged to tackle these obstacles, adding value to what was previously determined to be waste. However, for these business models to truly be impactful, they must not only be effective, but also adopted by a large proportion of the market. This short paper presents the first steps in answering the question: **What role do stakeholder relationships play in upscaling circular business models?** The research question is answered by studying five circular businesses models targeting plastic pollution and engaged in upscaling.

2 Problem framing

The circular economy (CE) is a promising avenue to achieve sustainability goals as it promotes regenerative practices for both organic and inorganic resources, conserving energy and reducing waste and pollution. The circular economy has increased in popularity, at the institutional level, for example the EU's Circular Plastic strategy, and at micro levels for example the rise of circular entrepreneurship (Henry et al., 2020). In order to be more than just a buzzword, circularity must be adopted within societal and economic structures,

which requires changing legislation, moving away from traditional 'take-make-waste' business models and adopting new consumer behaviors.

Considering plastic, one major barrier to circularity is the long value chain comprised of siloed agents who may not collaborate. Supply chain agents have different economic motivations which has led to divergence and design flaws detracting from sustainability (Hahladakis et al., 2018; Vermunt et al., 2019). A second issue with plastic is the growing amount of plastic waste and the ineffective technological options to treat this waste. A recent survey of all recycling plants in the United States by Greenpeace found that only two types of plastic are effectively recycled, PET and HDPE, with the rest incinerated or landfilled. In some developing countries such as in India, extensive networks of waste pickers contribute to high recovery rates for plastics. However the focus remains on high-value plastics with the rest burned or landfilled (Nandy et al., 2015; Pandey et al., 2018). It should also be noted that Western countries, such as the USA, contribute to significantly more plastic waste generation than developing countries, such as India (Clapp, 2002; Dauvergne, 2018). These technological limitations mean that even with effective waste collection and separation, a high percentage of the world's plastic ends up as waste (Geyer et al., 2017). These challenges have prevented plastic from becoming a truly circular material (Vermunt et al., 2019). Circular business models (CBMs) have emerged to tackle these plastic challenges, and there is growing research into the potential of innovative business models to create financial value and increase the circularity of the markets they inhabit (Ranta et al., 2018). However, if these CBMs are to have significant impact, they must be able to scale (Hockerts and Wüstenhagen, 2009; Schaltegger et al., 2016).

3 Theoretical background

Circular business models

Business models are frameworks that can be used to understand and communicate how a firm operates and creates value by breaking down a business into key functions and elements (Bocken et al., 2014; Osterwalder et al., 2005). The business model concept was developed to describe new business structures that emerged with the rise of e-business, but has since been widely applied to companies involved in sustainability and circular economy. Circular business models (CBMs) are business models that focus on closing material loops or extending resource lifetimes through reducing, reusing, recycling or recovering (Henry et al., 2020; Kirchherr et al., 2017). Research into CBMs include studies mapping best practices and industry examples, exploring theoretical dimensions of CBMs and analyzing drivers and barriers (Bressanelli et al., 2018; Diaz Lopez et al., 2019; Lüdeke-Freund et al., 2018; Rosa et al., 2019). Often this research has focused on circular startups and entrepreneurs, but less attention has been paid to how these CBMs can be successfully upscaled.

Upscaling and replication

Upscaling is the process of a company growing to take up a larger market share and integrate with mass markets. Schaltegger and colleagues have proposed a model of upscaling for sustainable entrepreneurs inspired by concepts from evolutionary economics (Schaltegger et al., 2016). This model proposes three elements that are needed for a startup to upscale: variation (unique characteristics of the business model), selection (acceptance by market) and retention (maintenance or growth of company). Retention was found to follow four pathways, defined as growth, replication, mergers and/ or acquisition and

mimicry. These pathways are described in terms sustainable entrepreneurship (SE) but they can also be relevant for circular economy business models, See Table 1.

Table 1 Sustainable entrepreneurship upscaling pathways from Schaltegger et al. 2016. Replication is highlighted as the subject of this study

Upscaling pathways	Description updated for circular business models
Growth	A single organization scales to take over more market share, replacing conventional offerings with circular options.
Replication	Circular characteristics pioneered by a single organization are adopted by multiple organizations. This can be facilitated by strategic partnerships
Mergers and/ or acquisition	Incumbents can purchase circular companies in order to integrate the circular products or services within their existing organization
Mimicry	Incumbents copying circular products or services (often with less sustainable modifications) to compete with circular businesses

This study investigates two groups of CBMs utilizing replication as a means to scale circularity to analyze how this process functions in practice, and to assess the role of stakeholders in replication. Replication is an interesting pathway to study as it involves the multiplication of a successful CBM and its associated benefits, but it also invites competition from others, which can threaten financial viability.

The role of stakeholders

Research has shown that collaboration and partnerships are key aspects to success in sustainable and circular business models (Brown et al., 2019; Veleva and Bodkin, 2018) (Kishna et al., 2017; Long et al., 2018). Stakeholder theory posits that firms do not exist in isolation, but are embedded in networks and ecosystems with other agents (Freeman, 2010; Freudenreich et al., 2019). These agents are described as different stakeholder groups such as employees, business partners, customers, financial and societal stakeholders. Stakeholder relationships are seen as necessary for value creation and previous work has emphasized the importance of defining these relationships as active and multi-directional. As shown in Table 2, value is provided to stakeholders, but also created with stakeholders (Freudenreich et al., 2019).

Table 2 Multi-directional value creation for various stakeholder groups based on Freudenreich et al. 2019

Stakeholder group	Value creation (for stakeholder)	Value creation activity (with stakeholder)
Societal stakeholders	Contributing to sustainable (or circular) solutions	Appreciating business contributions (e.g. legitimacy)
Financial stakeholders	Creating profit	Financing
Customers	Appreciating proposed value through sales	Proposing customer value through solutions
Business partners	Supplying	Co-creating (e.g. contracts)
Employees	Employing	Working

Little research to date has studied how stakeholder relationships can contribute to upscaling of circular business models. This paper will describe how stakeholder relationships

contribute to or detract from a CBMs ability to scale. The research will eventually propose a cohesive framework integrating the concepts of upscaling through replication and stakeholder relationships.

4 Methodology

This paper utilizes an illustrative multi-case study design (Yin, 2003). The cases were identified during the course of PhD research into private sector contributions to plastic sustainability as part of the Horizon 2020 project CLAIM (Cleaning litter by developing and applying innovative methods in European Seas). The cases were chosen as representative examples of circular business models engaged in replication pathways for upscaling. Once selected, the cases were described using a business model framework in order to compare and understand the underlying business logic, and key relationships with stakeholders were identified. Data was gathered from online public sources, such as company websites, social media (LinkedIn, Twitter, Crunchbase), news articles and blog posts. Additionally, three semi-structured interviews were conducted with agents active in the stakeholder networks. The interviews were transcribed and coded for information to validate business models and provide more in-depth understanding of the upscaling processes and critical stakeholder relationships. This paper presents preliminary results, which will later be extended to include more upscaling pathways and involve more interviews.

5 Preliminary Results

Joint ventures for recycling fishing nets

The first group of CBMs studied involve recycling of collected fishing gear into textiles or products. The business model of the three examples found is shown in Table 3. These initiatives tackle one of the most insidious marine plastic issues, namely derelict fishing gear (DFG). DFG is abandoned, lost or otherwise dumped fishing gear that remains in the marine environment and can trap and harm fish and other biota long after the fishermen stop using the gear (NOAA, 2016). These businesses support collection of DFG through partnerships with NGOs, and recycle the collected material into textiles, clothing and other products.

Table 3 Business model and examples of joint ventures for recycling fishing nets. B2B = business to business, B2C = business to consumers

Business model component	Description
Value proposition	Textiles, clothing or other products created with recycled fishing nets
Key activities and processes	Partnerships with NGOs, fishermen and fishing industry. Recycling infrastructure to transform the nets
Customer segments and relationships	Increasing number of partnerships with brands and retailers to create and market products to eco-conscious consumers
Financial infrastructure	B2B sales of textiles and raw materials, B2C sales of products at a price premium. Distribution of profits to NGOs, fishermen or communities supplying nets

Examples include:

Healthy Seas Initiative – Ghost Diving (NGO) leads dives to recover ghost nets which are recycled by Aquafil Group and made into products by Star Sock and other brands.

Parley for the Oceans – Environmental organization network that organizes beach cleanups and advocacy efforts, partners with brands like Adidas to make ocean plastic products.

Net-Works – Connects small scale fisherman with market for nets, Zoological Society of London (NGO) works with Aquafil Group for recycling and Interface makes ocean plastic carpeting.

These three CBMs can be classified as joint ventures. A joint venture is a new entity created by existing organizations, and can be a tool to share resources, markets and capacity using a partnership. They may be created to tackle a unique problem or spearhead an initiative that does not fit within the existing organizations' structures. Numerous joint ventures have emerged to tackle plastic sustainability problems, often engaging upstream and downstream agents in order to overcome supply chain barriers (Beulque and Aggeri, 2016).

These joint ventures utilize partnerships to replicate the CBM by increasing the number of downstream partners, which in turn increases the demand for collected DFG. This demand is met by financing more beach cleanups, dives or community net collections. The access to finance can scale up the positive environmental impacts of NGOs, which may struggle with stable funding. The manufacturers and brands reap the benefits of labeling their products as containing ocean plastic and accessing sustainable branding opportunities. Other important stakeholders include customers who purchase the circular products and contribute to increasing demands, and society at large which benefits from reduced marine pollution and can contribute to growing societal awareness, for example by sharing information with their social networks. The value created for key stakeholders, and the contribution to upscaling by stakeholders, is summarized in Table 4.

Table 4 Stakeholder value and contribution to upscaling for joint ventures

Stakeholder	Value created (for stakeholder)	Value creation activity (contribution to upscaling)
Downstream business partners: brands and retailers	Recycled textiles, sustainable branding	Multiplying demand, marketing of products, price premiums for recycled materials
Upstream business partners: NGOs, civil society organizations	Compensation and/or support (for nets, for dives, for cleanups)	Multiplying supply, awareness raising
Customers	Sustainable, circular products	Increasing demand
Societal stakeholders	Reduced marine pollution	Engagement

Diffusion of low-tech solutions

The second group of CBMs involve the development and promotion of decentralized technology solutions. These CBMs provide accessible and flexible solutions that are designed to be used in many different global contexts to tackle local problems. The two business models studied are described in Table 5. Precious Plastic has designed open source plastic recycling machines that can be made at low cost and used to create objects such as keychains, furniture and other design and home goods. Toolkits and videos showing how to make the machines and products are freely available online, and there is an active support

community. Ecobricking is a process for turning PET liter bottles and plastic films and bags into a building brick by stuffing the light plastic into the bottles (Valinejadshoubi et al., 2013). This low-tech process was not widely known or practiced before a few organizations began educating and training communities to make these bricks. The Global Ecobrick Alliance is a self-proclaimed 'Earth Enterprise' founded in Indonesia that champions the technique with a broad network of practicing 'ecobrickers'.

Table 5 Business model and examples of technological diffusion

Business model component	Description
Value proposition	Open source processes for bottom-up waste management and plastic valorization
Key activities and processes	Research and development to define and improve processes and technology. Trainings (online or in-person)
Customer segments and relationships	Micro-entrepreneurs interested in reducing local plastic pollution
Financial infrastructure	Philanthropy and grant-based funding. No costs for users / entrepreneurs to access information
Examples include: Precious Plastic – open source plastic recycling machines that can be made with tools and materials readily available around the globe. The Global Ecobrick Alliance - develops training guides and toolkits to support groups, trainers and individuals in ecobricking for bottom-up waste management.	

Both of these initiatives provide micro-entrepreneurs and communities with free and adaptable solutions to tackle local plastic pollution problems, and the stakeholder relationships are shown in Table 6. Replication occurs when users implement the solutions locally, multiplying the number of CBMs at a global scale. These initiatives create a network of people using pre-developed techniques to manage plastic, significantly scaling the amount of plastic managed and the number of users engaged. The employees in these organizations focus on refining their procedures - doing research, development and testing - and finding ways to increase their network of users. Ecobricks does this by training guides who can then educate within their community and distribute information. Precious Plastic produces updated instruction manuals and videos and provides a marketplace for users to sell their recycled plastic products. Financial stakeholders are needed to provide grants that allow these organizations to run, and in return they contribute to wider societal goals of improving the circularity of plastic and reducing plastic pollution.

Table 6 Stakeholder value and contribution to upscaling for technological diffusion

Stakeholder	Value created (for stakeholder)	Value creation activity (contribution to upscaling)
Users (entrepreneurs, communities)	Open source technology and support	Entrepreneurial activity, multiplying BMs
Employees	Employment, development of technical skills	Knowledge, entrepreneurial activity
Financial stakeholders	Contributing to circular solutions, reducing plastic pollution	Financing through grants and donations
Customers	Circular products and materials	Increasing demand

6 Preliminary conclusions

This short paper is the first step towards analyzing how stakeholder relationships contribute to replication of CBMs for plastic pollution management. The initial results suggest that different stakeholder groups gain value from CBMs, but that they also contribute to the ability of CBMs to upscale. The CE initiatives utilized partnerships and user networks in order to involve more actors and stakeholders and increase the scope of impact. Further research will dive deeper into the nature of replication through joint

ventures and user networks, and develop an empirically validated framework that integrates stakeholder theory with upscaling processes. Interviews with representatives of the CBMs studied, as well as agents in their stakeholder networks, will be further conducted. The analysis will also be extended to include a discussion of the financial and environmental implications of engaging in replication to upscale.

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