Sustainable Business Model Innovation for the Agroindustry

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Abstract: Research about business models, business model innovation and sustainability in business model innovation in the agroindustry in general has received little attention. Nevertheless, in other sectors, models like cradle-to-cradle and product stewardship have proven to be successful for ensuring the economic and environmental sustainability of industries. This paper aims to fill this gap by addressing the following research question: what value can cradle-to-cradle and product stewardship create to integrated biomass logistics centers? For this, a systematic literature review based on the archetype on sustainable business models "create value from waste" provided by Bocken et al. (2014) was carried out. After the analysis process a total of 14 papers were selected and the "value proposition", "value creation and delivery" and "value capture" in each business model was identified. The extracted knowledge from the analysis was used as a basis for the definition of a business model innovation in the agroindustry.

Keywords: Business Model Innovation; Agroindustry; Cradle-to-cradle; Product stewardship; Systematic literature review.

1 Introduction

Nowadays, agro-industries are facing several barriers that difficult their competitiveness. Some of them include the seasonal nature, which imply low activity, and underuse of the existing resources, such as residues arising from the exploitation of the business activity. Agro industries are usually located in rural areas with scarcity of opportunities in terms of business activity in other industry sectors. This implies a problem for the consolidation of these areas in terms of population growth and employment. Given these challenges, existing business models have proved to be difficult to apply.

Increasing concerns about the depletion of natural resources have boosted the commitment of governments and firms towards a sustainable development. Sustainability in a business context is generally linked to the Triple-Bottom-Line, i.e. three pillars:

economic, environmental, and social[1]. In addition, sustainability can be based on considering the entire lifecycle of a product during the planning stage, and is affected by several factors (Salonitis and Stavropoulos, 2013): raw materials, supply chain considerations, manufacturing operations, usage, service and decommissioning.

In this context, an innovative business model (BM) for the agroindustry is proposed by means of the transformation of the traditional model into a new concept, the integrated biomass logistics center (IBLC). The transformation of the business model supposes a transformation in the supply chain. The concept is based in taking advantage of the unexploited resources and knowledge with the objective to diversify the activity in both the input (feedstock typology) and output of the supply chain (product typology). The IBLC is defined as (Annevelink et al., 2017):

> "A business strategy for agro-industries to take advantage of unexploited synergies in terms of facilities, equipment and staff capabilities, to diversify regular activity both on the input (food and biomass feedstock) and output side (food, biocommodities and intermediate bio based feedstocks) thereby enhancing the strength of agro-industries and increasing the added value delivered by those companies".

In this definition, the BM is linked to the strategy of the agro-industry. According to Annevelink et al. (2017), four typical characteristics can be associated to an IBLC: (i) integrated value approach towards food and bio based markets; (ii) regional availability of biomass; (iii) logistics, storage operations and pre-treatment; and (iv) exploiting the central position.

Research about BMs, business model innovation (BMI) and sustainability in BMI in the agroindustry in general has received little attention (Ulvenblad et al., 2014). Nevertheless, it is well known that in other sectors, cradle-to-cradle and product stewardship models have been successfully applied to run circular economy businesses (e.g. Wiel et al., 2012; Keith and Silies, 2015). Cradle-to-cradle asserts that economic growth can be achieved sustainably by designing and manufacturing products in a clean industrial ecosystem and using them within a closed loop that ultimately returns them to their source (McDonough and Braungart, 2002).Product Stewardship is about reducing environmental burden with less use of hazardous and non-renewable materials in products development, considering the environmental impact in the design, packaging and use of material (Wong et al., 2012). Hence, this paper aims to address the following research question: what value can cradle-to-cradle and product stewardship create to IBLCs?

The structure of the paper is as follows: after the introduction a literature review on BM, BMI, sustainable BM and sustainable BMI is presented; Section 3 shows the methodology used and explains in more details the cradle-to-cradle and product stewardship models; Section 4 focuses on the results obtained; and Section 5 discusses and concludes the main outcomes of the research.

[1] Cited in Bocken et al. (2014)

2 Background

Business Model and Business Model Innovation

The term "business model" has gained popularity in recent years, however there is still a lack of agreement on how to define it (Zott et al., 2011). For Saxena et al. (2017), the BM is a multipurpose concept, it has a diverse utility, and presents three main functions within an organization: (i) a conceptual tool, to fill the gap between an organization's strategy and business processes; (ii) an interceding framework between technology and the fulfilment of strategic goals and objectives; and (iii) a strategic-oriented knowledge capital which portrays the logic of a business system. BM can also be linked to the competitive advantage of a firm by meeting certain customer needs, in addition to difficulty in replication and imitation (Teece, 2010). A successful BM should be dynamic, and change with the environment or make the environment change (Saxena et al., 2017). A definition that has grown in use in the recent years is that provided by (Osterwalder et al., 2010) which define a BM as "the rationale of how an organization creates, delivers and captures value". Furthermore, the authors create a framework, the well-known "Business Model Canvas" in which nine blocks are used to describe it: customer segments, value propositions, channels, customer relationships, revenue streams, key resources, key activities, key partnerships, and cost structure. Other definitions are based on one or several components of the firm (Wirtz et al., 2016): strategy, resources, network, customers, market offering (value proposition), revenues, service provision, procurement, and finances.

Changes to BMs are recognized as a fundamental approach to realize innovations for sustainability (Evans et al., 2017). BMs and BMI have received substantial attention in literature, presenting different perspectives, e.g. technological, strategic and organizational (Boons and Lüdeke-Freund, 2013). Some common elements of a BM include (Richardson, 2008; Bocken et al., 2014): value proposition, value creation and delivery, and value capture. Value proposition is linked to the product and service offering, the segments of customer and its relationships. Value creation refers to the identification of new business opportunities, new markets and new revenue streams. Value capture refers to the earning of revenues from the provision of good, services or information to customers.

BMI can be understood in terms of the adoption of a novel approach (Gambardella and McGahan, 2010). It usually involves changes to the foundational values of a firm, and is often transformative with profound implications (Long et al., 2018). In addition, it has been identified a link between BMI and firm performance (Zott et al., 2011). BMI can occur in a number of ways (Amit and Zott, 2012): (i) by adding novel activities; (ii) by linking activities in novel ways; and (iii) by changing one or more parties that perform any of the activities. According to these authors, key aspects are novelty, lock-in complementarities and efficiency. Barriers to BMI in existing firms are linked to (Chesbrough, 2010): (i) the configurations of assets and processes, which may be subject to inertia, and (ii) the cognitive inability of managers to understand the value potential of a new business model. In an IBLC, barriers are mainly related to technological and economical aspects in the supply of the raw material. In addition, the transformation of organizational processes is difficult, and the acceptation of the new scheme over the traditional is needed.

Sustainable business model and sustainable business model innovation

BMI for sustainability is defined in terms of the impact for the environment and/ or society through changes on how the organisation creates, delivers and captures value (Bocken et al., 2014). It involves inter-organizational networks and wider societal systems (Boons and Lüdeke-Freund, 2013). BMI for sustainability tend to be ad hoc and neither systematic nor systemic (Stubbs and Cocklin, 2008). In this regard, Bocken et al. (2014) describe eight sustainable BM archetypes classified according to the main type of BMI: technological, social, and organizational. Technological archetypes include "maximize material and energy efficiency", "create value from waste" and "substitute with renewables and natural processes". One of the archetypes more related to the agroindustry is the creation of value from waste, which implies the valorization of by-products such as emissions through re-processing or product take-back schemes, cradle-to-cradle thinking, closed-loop supply chains, and circular economy.

The consideration of sustainability in the BM definition for the agroindustry should take into account additional aspects regarding the three elements previously presented. Thus, Barth et al. (2017) consider traceability for products and standards for safety and quality should be included in the 'value proposition' block. For 'value creation and delivery', aspects should include key activities, resources, channels, partners, and technologies focus on sustainability aspects. Last but not least, 'value capture' should include sustainability considerations.

Slowak and Regenfelder (2017), within the circular economy context, introduce the use of three different logic layers: new process technology, new BMs for the re-use and materials recovery, which translates innovation into economic practice, and new innovation logic to underline the nature of innovation itself. The objective is to show how sustainable innovation can utilise overlapping lifecycles in order to save processed materials and/or re-use components.

Some literature reviews on the BM concept are provided by Zott et al. (2011); Boons and Lüdeke-Freund (2013) and Bocken et al. (2014).

3 Methodology

This section describes the methodology followed to respond to the research question posed in Section 1. Considering the characteristics of an IBLC within a context of circular economy, a methodology in three steps was applied:

- Step 1: A systematic literature review based on the archetype of sustainable BMs "create value from waste" provided by Bocken et al. (2014) was carried out. Two typologies that fit the IBLC concept within the archetype were selected: cradle-to-cradle and product stewardship. Although firstly introduced in the 1980's, the cradle-to-cradle (C2C) current concept was designed and developed by McDonough and Braungart (2002). The C2C is a sustainable business strategy that imitates the regenerative cycle of nature in which waste is reused, i.e. the waste becomes a "nutrient" for another process, creating a cyclical process. On the other hand, according to the Product Stewardship Institute, the concept of product stewardship (PS) is defined as[2]:

[2] http://www.productstewardship.us/

> "the act of minimizing the health, safety, environmental, and social impacts of a product and its packaging throughout all lifecycle stages, while also maximizing economic benefits. The manufacturer, or producer, of the product has the greatest ability to minimize adverse impacts, but other stakeholders, such as suppliers, retailers, and consumers, also play a role".

PS includes Extended Producer Responsibility where the manufacturer's responsibility for its product extends to post-consumer management of that product and its packaging.

- Step 2: An analysis of the BMs was performed on the following elements: value proposition, value creation and delivery, and value capture.
- Step 3: A proposal of an IBLC BM based on the findings of this study is put forward.

Literature review- cradle to cradle and product stewardship BMs

Figure 1 summarizes the process performed for the literature review. Two academic databases were used for the literature search: Web of Knowledge and Scopus. They were selected because they provide a broad coverage of management journals. The following string was used for the search: ("Product stewardship") OR ("Cradle to cradle") OR ("cradle-to-cradle") OR ("extended producer responsibility") AND ("Business model"). The search in Scopus produced a total of 30 articles. The Web of Knowledge provided 436 results. After the search some exclusion criteria were applied. The first criterion was related to the time span. It was decided to include the last 10 years. The second criterion was related to the typology of articles to be included, only those from peer review journals and book chapters were considered. In addition, duplicates were filtered. After reading the title and abstract some papers were excluded (123). Next, full papers were read and a total of 57 papers were excluded. Finally, a total of 14 papers have been considered.

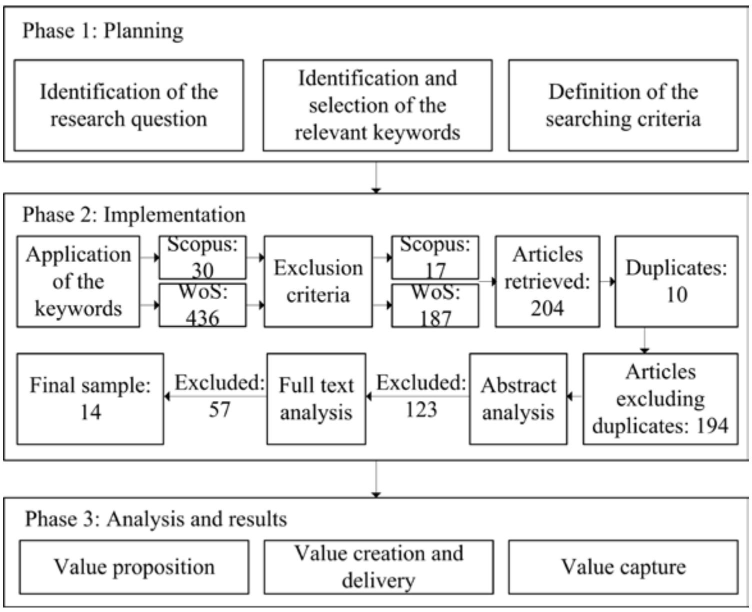

Figure 1 Systematic literature review process.

4 Results

Table 1 gathers the characteristics of the BMs analysed regarding the "create value from waste" archetype. This archetype was chosen as it fits the characteristics of the agroindustry. The results have been structured along the typical elements of a BM: value proposition, value creation and delivery, and value capture.

Table 1 Value proposition, value creation and delivery, and value capture of cradle-to-cradle and product stewardship BMs

Scope; Reference; Typology	*Value proposition*	*Value creation and delivery*	*Value capture*
Scalable solutions for accelerating product reuse and recycling (Antikainen and Valkokari, 2016); cradle-to-cradle	Radical increase in the usage of goods with the easy digitalisation concept and platform.	Recycling centres, other sellers for used products, both value the easiness and accessibility.	Buyer: pay-per-product, future: monthly fee, seller: commission-based fee for quality products.
Luxury textile brands (Keith and Silies, 2015); cradle-to-cradle	Designing with Scottish heritage textile surplus (pre-consumer waste), transforming it into fabric suitable for fashion and accessories.	Return discarded materials back into the textile lifecycle and transform them with the aid of design. Partnerships to source the material.	Economic and environmental costs are reduced by turning otherwise "wasted" resources into new value added products (mixture of high quality materials).
Textile materials (Franco, 2017); cradle-to-cradle	Recycling post-consumer textile waste while maintaining the quality of the fibers.	The supplier-buyer establish collaboration at different levels (i.e., supply chain position, power balance, and a shared vision) coupled with complex aspects in product design (i.e. basic materials, architecture, and functionality), combine to determine the output speed and quantity of circular products to be sold, taken back, and ultimately regenerated.	The product's frequency of use and maintenance as well as the tracking and recovery technologies available, determine the mix, quantity, and quality of products recycling parties received to be regenerated in the technical cycle or disposed in the biological one. This affects the cost reductions and the new forms of value to be obtained.
Electronics manufacturers (Wong et al., 2012); product stewardship	New product design, use of recyclable containers for transportation, redesign of packing, and sourcing of ecological materials.	Introduction of new partnerships (e.g. recycling firms) for collecting and recycling returned products, to mitigate environmental pollution and to attract and retain environmentally conscious customers. Customer involvement	Economic and environmental costs are reduced. Positive contribution to society and environment through reduced footprint, reduced waste and reduced virgin material use.

		necessary.	
Electronics equipment (Wang *et al.*, 2017); product stewardship	Fusion of Extended product responsibility with eco-design.	Producers are responsible for providing relevant information for recovery and recycling and to dispose the waste electrical and electronic equipment.	The transportation cost from the consumer to the retailer and from the retailer to the distribution center is determined based on the retailer's own fee standards and paid by the consumer separately (in the Japanese model).
Electronic industry (Tong, Tao and Lifset, 2018); product stewardship	Community-based programs targeting the garbage sorting behaviour of consumers for all household waste, reverse logistic systems with automatic vending machines attached to traditional commercial chains, and pure internet solutions to bridge the transactions between the consumers and recyclers.	Introduction of new partnerships (e.g. recycling firms) for collecting and recycling returned products, to mitigate environmental pollution and to attract and retain environmentally conscious customers. Customer involvement is necessary.	Economic and environmental costs are reduced. Positive contribution to society and environment through reduced footprint, reduced waste and reduced virgin material use.
Panel industries AU Optronics (Yang, Wei and Lin, 2014); product stewardship	Implementation of industrial ecology approaches (carbon footprint management and dematerialization).	Collaboration systems at different levels in the company. Connections between groups with different functions to make communication easier.	Increment of the total revenue from all AUO products (2.7 % in 2012, 4.2 times the figure obtained in 2008).
Cradle-to-cradle modelling of steel flow (Wang and Kara, 2017)	Manufacturers obtaining steel production from home, new and old scrap. Consumer gets a product obtained in a different way from the traditional smelting.	Collaboration systems are established with logistics companies and collection points from construction waste, end-of-life vehicles, household waste, industrial equipment waste, and other waste.	Wasted resources are turned into a new form of value (extraction of raw material) that can be used in the manufacture of new products.
Waste reduction in cradle-to-cradle firms of the metal industry (Wiel, Bossink and Masurel, 2012); cradle-to-cradle	Existing waste streams are turned into inputs to other production.	Companies are dependent on their suppliers, third parties and on other players in the supply chain. Good communication is needed.	Value of used products is recovered and costs of raw materials and assembly are reduced.
Reuse, recycling and disposal of used reverse osmosis membranes (Lawler et al., 2012); product stewardship	Direct application of the old membranes within lower throughput systems and chemical conversion into porous, ultrafiltration-like filters. Other options include, direct recycling of the various module	Obligations are imposed on key stakeholders regarding the avoidance, reduction and management of waste from products. Under the scheme, liable parties will meet their obligations by becoming a member of an approved product	Producers are responsible for the costs of implementing the scheme including the collection infrastructure, recycling, awareness and education programs, governance activities, and development and

	components, and energy recovery through incineration.	stewardship arrangement.	provision of information used to identify relevant products.
Oil and gas industry (Wan Ahmad et al., 2016); product stewardship	Eco-design programs. It is necessary to identify and monitor risk factors that could cause adverse social and environmental impacts, disrupt supply chain activities and affect its reputation.	Utilization of in-house knowledge to develop processes and technologies, and partnering with international companies and experts through open innovation programs. Close cooperation with suppliers to improve the environmental performance of logistics operations.	Close cooperation with suppliers in eco-design programs facilitates better communication, improves efficiency and reduces costs. This could result in better environmental performance because fewer resources are consumed and less waste is discarded.
Silicon solar photovoltaic panels (PV) (Contreras-Lisperguer et al., 2017); cradle-to-cradle	PV modules' materials at the end of their life, become in primary resource, to manufacture the same or a different product, the overall process can be regarded as “upcycling”.	New collaborations and take back systems need to be established to collect materials. Panel re-cycling could open a new market, using effective technology and economically viable methods to separate the materials embedded in the PV panel.	In addition to reducing waste and toxins, new forms of value are obtained from “waste” resources.
Automobile industry (Cristina De Stefano, Montes-Sancho and Busch, 2016); product stewardship	Redesign products using lighter materials, such as plastic, aluminium and magnesium. Lighter materials reduce the weight of vehicles, improving their fuel economy and reducing CO2 emissions. Development of new “clean” technologies.	Companies must cooperate not only with their component suppliers, but also with other stakeholders (e.g. institutions) for its development. In addition, new collaboration mechanisms with the Administration to re-educate consumers about new vehicle concepts.	The automobile industry can provide new forms of value through reduced material costs and new forms of energy.
Recycling industry (Schroeder, 2012); product stewardship	Use of enterprise information systems to generate up-to-date and accurate information needed to manage the business.	Establishment of collaboration mechanisms to: collect product sales data from retailers and use this to set performance targets and steward fees; operational data from service providers will be used to determine payments; performance data will need to be collected from across the supply chain for use in producing business and compliance reports.	Manufacturers are required to fund the cost of recycling or disposal, by implementing their own product take-back programmes or by paying fees to a third party to administer an e-waste management scheme on their behalf.

Source: Own elaboration

5 Discussion and conclusions

The “value proposition” of the BM analysed is based on exploiting the residual value of resources, making a more appealing product (e.g. textile), the use of new technologies for tracing the product (e.g. digitalisation and platforms, information systems), the introduction of eco-design concept, redesign of the product, and sourcing of materials, and use of ecology approaches. In addition, energy recovery through incineration is proposed.

The “value creation and delivery” is mainly related to the creation of collaboration mechanisms between the different stakeholders involved in the process, and also at different levels in the company. In addition, the possibility of creating new partnerships arises. In some BMs, producers are responsible for providing relevant information for recovery and recycling.

The “value capture” stems from established fees for the buyer-seller, the reduction of economic and environmental costs by turning “wasted” resources into new value added products. A positive contribution to society and environment through reduced footprint, reduced waste and reduced virgin material use. In addition, the value of used products is recovered and costs of raw materials and assembly are reduced. Producers are responsible for the costs of implementing the scheme. This includes the infrastructure of waste collection, recycling, awareness and education programs, governance activities, and development and provision of information used to identify relevant products. Furthermore, a close cooperation with suppliers in eco-design programs reduces costs.

The analysis shows that the selected BMs belonging to the “create value from waste” archetype (Bocken et al., 2014) are not related to the agroindustry. However, some of the characteristics can be adapted to the IBLC concept. Thus, an IBLC BM can be defined as:

- Value proposition: exploiting residual value of resources (agro-residues of different nature, e.g. crops, prunings) by providing new bio-commodities (e.g. pellets, construction materials, biofuels) or intermediate bio-commodities (e.g. chemical products). Use of information systems to measure the transport flows. Comply with standards to ensure the quality and safety transport of the raw material from the field to the warehouse or transformation process.
- Value creation and delivery: creation of collaboration mechanisms between the stakeholders involved in the process (e.g. farmers, logistics service providers, technology providers) and definition of different contracts typologies. In addition, conditions of raw material supply should be established. Key activities are related to those necessary for measuring the technical feasibility of the new products. For this, some resources are needed (e.g. raw material, technology, human resources). In addition, a marketing strategy will be necessary to bring the new products to the markets (e.g. through a marketing department, demonstration activities). Partnerships between different stakeholders can arise (e.g. cooperative). Technologies will vary according to the typology of product to be obtained due to the necessity of using different production processes.
- Value capture: a reduction of environmental costs by turning “wasted” resources into new value added products are obtained. Economic feasibility of the transformation process will depends, among others, on the logistics costs in both the upstream and

downstream part of the supply chain. In addition, a positive contribution to society by means of the creation of new jobs, and to the environment through reduced waste is obtained. Costs of raw materials are low or even inexistent. The costs of implementing the scheme consider the use of machinery and equipment in idle periods, and the necessity of some investment for the adaptation or acquisition of new machinery. This includes infrastructure for waste collection, performing tests for the transformation process, awareness and education programs, and development and provision of information used to identify relevant products.

The definition has taken into account sustainability in the BM definition by introducing those aspects proposed by Barth et al. (2017) in the three value blocks. For more detail see Section 2.

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