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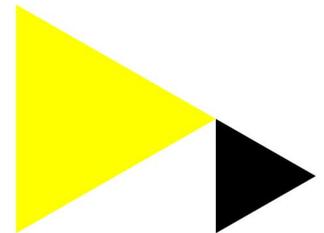
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The interaction between business modelling and networking across the life cycle of eco-sustainable innovations

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Interfirm networks play an important role in technological innovation and in development of new business models. Especially sustainability-oriented innovations need fundamental business model redesign and involvement of new partners. Building on two cases, we explore how business modelling and networking interact from development to implementation of a new eco-sustainable technology. A life cycle stage model is created distinguishing five successive stages of interaction between business models and networks. The model shows what changes in both network ties and business model take place from ideation to continuous growth of the business. The central phenomenon found is 'value shaping', showing how the value created with the eco-sustainable technology changes over time through interaction with network partners. The model shows that after path-dependent behaviour a cognitive shift takes place when the market proves to be reluctant towards the technology. This paper connects network theory to business model theory and by doing so we improve our understanding of the process of business modelling. We show that this process is not exclusively internal to the firm, but is strongly influenced by the firm's external network. The model may guide practitioners to actively use their ties to create a viable business model with eco-sustainable technology.

1. Introduction

Interfirm networks play an important role in technological innovation and in the development of new business models (Doganova & Eyquem-Renault, 2009). Especially radical innovations such as sustainability-oriented innovations need fundamental business model redesign (Boons & Lüdeke-Freund, 2013; Boons, Montalvo, Quist, & Wagner, 2013; Schaltegger, Lüdeke-Freund, & Hansen, 2012) and changes in the supply and demand side of the value chain (Boons & Lüdeke-Freund, 2013; Kemp, Schot, & Hoogma, 1998). There is a clear connection between business modelling and collaboration partners. Partners in the network play an important role in (re)designing the business model and the business model can influence the network ties with (potential) partners necessary for innovation (Boons & Lüdeke-Freund, 2013; Doganova & Eyquem-Renault, 2009; Iles & Martin, 2013). Network dynamics at the level of a focal firm is an area that is not well researched (Dittrich, Duysters, & Man, 2007) and a gap seems to exist in how the interaction between networking and business modelling actually takes place. In this paper we focus on this gap, elaborating on the literature of business modelling, especially sustainable business modelling and connecting it to insights from network theory. This lays the foundation for an improved theoretical understanding of business model innovation. The research question we seek to answer is: How do networking and business modelling interact from development of a new sustainable technology to growth of the business?

Two cases in which SMEs develop and realise applications of bio-based plastics serve as empirical material providing a detailed insight into the development of both business model and network, from origination of the idea and development of the sustainable technology, to introduction of the product in the market, and growth of the business. For SMEs networks are of extra importance to complement limited internal R&D capacity with knowledge generated by external actors, to help overcome liability of smallness and to gain access to other sources of knowledge (Colombo, Laursen, Magnusson, & Rossi-Lamastra, 2012).

This paper is structured as follows: In section 2, we summarize the literature of business modelling, especially sustainable business modelling, and define the network aspects that are embedded within this concept. Then we discuss insights from network theory regarding network and tie characteristics that may prove valuable for studying the interaction between network development and business modelling in sustainable innovation. In section 3, we explain the research approach and introduce the case study characteristics. In section 4, we present the findings and a life cycle stage model, derived from the results. The paper ends with conclusions in section 5, containing directions for further research, and implications for practitioners.

2. Summary of previous work

In this paper we build on the business model literature. First we introduce the business model concept and determine the network ties that are embedded within this concept. Next we explore the role of business modelling in sustainable innovation. We end this section with an exploration of network development literature that may provide valuable insight for the interaction between networking and business modelling.

2.1 The business model concept

The business model is a conceptual representation of the organizational and financial ‘architecture’ of a business (Teece, 2010). The business model is often defined by three elements (Bocken, Short, Rana, & Evans, 2014; Boons et al., 2013; Richardson, 2008) each involving different actors of the company’s network. In this paper we define the three elements of a business model as:

- Value proposition: the value being delivered embedded in the new product or service and to whom.
- Value creation and delivery: the way value is created in relationships with suppliers, customers and other partners.
- Value capture: the distribution of costs and revenues across all actors involved.

The business model is not limited to the internal organization but spans firm boundaries and can include suppliers, distribution channels and other partners that extend the company’s resources (Doganova & Eyquem-Renault, 2009; Zott, Amit, & Massa, 2011; Zott & Amit, 2010). The business model element ‘value proposition’ connects primarily to the customer or user as the target group to whom the value is being delivered. The second element ‘value creation and delivery’ has a direct relation with the network of the company necessary for the innovation. To stress the importance of the connection to the customer groups, ‘value creation and delivery’ is sometimes split in two separate elements: ‘supply chain’ and ‘customer interface’ (Boons & Lüdeke-Freund, 2013; Osterwalder, Pigneur, & Tucci, 2005). Disadvantage of this dichotomy is the focus on upstream and downstream relationships. In this study we choose to use the combined perspective, making it possible to include lateral and horizontal relationships next to vertical relationships and to explore their role within the value creation and delivery process. The third element ‘value capture’ involves the network as well, while it is important for a viable business model to have a fair distribution of costs and revenues for all actors involved (Boons et al., 2013).

2.2 The role of business modelling in innovation

Business model innovation is regarded as an important instrument for commercializing new ideas and technologies (Chesbrough, 2010) and is seen as important to create viable business cases for sustainable innovations (Boons & Lüdeke-Freund, 2013; Schaltegger et al., 2012). In recent years a large, but dispersed contribution has been made by scholars from various disciplines to the business model literature (Baden-Fuller & Morgan, 2010; Magretta, 2002; Osterwalder et al., 2005; Zott et al., 2011). According to Doganova & Eyquem-Renault (2009) some scholars take an essentialist view on business models and regard business models as a description or representation of an objective reality such as an existing firm. Others have a functionalist view on business models and see them as conceptual models to envision a future venture or innovation (Boons et al., 2013; Teece, 2010; Zott et al., 2011). According to Baden-Fuller & Morgan (2010) business models can play different roles at the same time: business models can serve as a

classifying device for ideal types (role models), instruments for scientific inquiry (scientific models) and practical models for demonstration and copying (recipes). Many scholars agree that business modelling is not a linear process, but an activity system (Doganova & Eyquem-Renault, 2009; Zott & Amit, 2010) that involves an iterative design process in which business models are selected, adjusted and/or improved (Teece, 2010).

For this study we adopt the viewpoint by (Doganova & Eyquem-Renault, 2009) that takes a pragmatic perspective combining both the essentialist view and the functionalist view on business models. Doganova & Eyquem-Renault (2009) describe business models as devices for collective exploration "to explore a market and to bring their innovation – a new product, a new venture and the network that supports it – onto existence" (p.1560). They see business models as a scale model of the new venture that is aimed "at demonstrating its feasibility and worth to the partners whose enrolment is needed" (p.1568). By using it as a market device and with encounters with possible partners it helps to gradually build the network of the new venture (Doganova & Eyquem-Renault, 2009). Zott et al. (2011) call this the 'networked nature of value creation' stating that "value creation through business models involves a more complex, interconnected set of exchange relationships and activities among multiple players" (p.1031). A gap seems to exist in how the interaction between the network and business modelling actually takes place in the attempt of companies to successfully introduce a sustainable innovation in the market.

2.2 Network development in relation to business modelling

This paper wants to contribute to the business modelling literature by connecting it to insights from the literature of network development. Networks tend to be dynamic (Gulati, 1998) and inter-organizational relationships emerge, evolve and dissolve over time (Ring & Ven, 1994), their function changing with the development of the organization (Butler & Hansen, 1991). The literature identifies different patterns of network development (Elfring & Hulsink, 2007; Hite & Hesterly, 2001; Jack, Dodd, & Anderson, 2008; Larson & Starr, 1993; Steier & Greenwood, 2000). Most of this research on patterns of network development differentiate only between the emergence and growth stage of a company. A more detailed look at the development process using a qualitative longitudinal approach can be useful to develop an in-depth understanding of how entrepreneurs use their network and the ties they are composed of in sustainable business model development and implementation (Jack et al., 2008).

The composition of a company's network can be assessed by a number of characteristics of both dyadic ties (i.e. two-way relationships between two actors in the network) and the network as a whole. A tie characteristic that is often taken into consideration in literature on network process is tie strength (Slotte-Kock & Coviello, 2010), an important characteristic of networks because of its connection to innovation, innovation diffusion and adoption of ideas (Granovetter, 1973). Tie strength of an interpersonal relationship is defined by Granovetter (1973) as a combination of the amount of time put into the contact, the emotional intensity of the contact, the intimacy, and the reciprocal commitments between the partners involved. Because the value of strong and weak ties strongly depends on the type of learning or purpose, and on the (external) environment (Dittrich et al., 2007; Rowley, Behrens, & Krackhardt, 2000) we also look at purpose of ties building on the classification used by Lechner & Dowling (2003) consisting of social, reputational, co-opetition, marketing, and knowledge, technology and innovation networks. They emphasize the importance of a mix of different types of networks and the changes of this mix on firm development (Lechner, Dowling, & Welp, 2006). Further we distinguish three types of ties for collaboration: horizontal ties with competitors, vertical ties with the supply chain (i.e. upstream relationships) and partners for marketing and distribution (downstream relationships), and lateral ties with firms from other industries (Nooteboom, 2004).

3. Research design

3.1 Methodology

For this research we use a case study methodology to capture as much detail as possible and create an in-depth insight in the phenomenon of network structured, sustainable business model innovation (Eisenhardt, 1989; Huberman & Miles, 1994; Yin, 2003). The units of analysis are two cases involving the introduction of a new technology that radically improved the environmental performance or creation of new market needs, by Noci & Verganti (1999) called an innovation-based 'green' strategy. The new sustainable technology in the selected cases concerns bio-based and biodegradable plastics, successfully applied in a sustainable product and commercialized in the market. A design that consists of two cases enables within-case analysis and a cross-case comparison and analysis of the empirical results (Yin, 2003). This research design is a first step in developing an insight that is analytically valid for comparable cases and a first step in the development of theory about the phenomenon (Eisenhardt & Graebner, 2007; Yin, 2003).

3.2 Introduction of the cases

In recent years fundamental and applied research into bio-based plastics has increased because of their potential to contribute to a circular economy. Larger plastics companies focus their research on drop-ins, i.e. bio-based equivalents of conventional known petroleum-based plastics (PE, PP, etc.) with the same characteristics (Iles & Martin, 2013). New bio-based plastics not only can substitute existing plastics, but appear to provide new application possibilities based on unique material characteristics. Examples are the water solubility of starch plastics (TPS), suitable for applications such as drug delivery and mulch films, the compostability, barrier properties and transparency of Polylactic acid (PLA), known for its application in packaging, and the biocompatibility and absorbability in human tissue of Polyhydroxyalkanoates (PHAs), applicable as biomedical implant materials (Babu, O'Connor, & Seeram, 2013). These materials and their applications need further research and development. This is a typical example of radical innovation, asking for the development of niches for application, a type of innovation often unattractive for larger companies that target on direct large-scale commercialization (Iles & Martin, 2013). Recently some successful niche applications of new bio-based plastics have been developed by SMEs collaborating in inter-firm networks. We selected two of such Dutch cases as the basis for this study, one initiated by a (serial) entrepreneur and one by an incumbent SME, both active in a business-to-business environment. Both cases are shortly introduced by an introduction of the company, a description of the innovation, and why it was initiated.

3.2.1 Keeper system: underground tree anchoring system of Natural Plastics

Natural Plastics designs, produces and markets products for sustainable gardening and landscaping with an ecologically sustainable philosophy. The mission of Natural Plastics is to develop products that do not take precious resources from our earth and are not meant to leave any damaging or polluting residual after serving their purpose. Natural Plastics designed a unique, patented system, called Keeper system, for underground tree anchoring supplemented with additional bio-based plastic products such as venting and watering, lawn mowing protection, root protection, bamboo protection, etc. The products that are part of the Keeper system are made of Cradonyl and are 100% biodegradable and completely renewable. The development of the Keeper system started in 2009. The entrepreneur with a background in civil contracting, saw how the plastics used around roads polluted the soil and was motivated to find a sustainable solution using bio-based plastics. He started a new company to develop and market the sustainable innovation.

3.2.2 D-grade: biodegradable horticultural products of Desch Plantpak

Desch Plantpak produces thermoform pots, containers and trays for professional horticulturalists, aimed at improving the growers' production results and optimizing returns. Sustainability is part of the mission of the company, visible in their efforts to reduce material- and energy usage, use recycled materials and improve the wellbeing of employees. In 2009 Desch Plantpak introduced D-grade, a product line containing a range of thermoform pots, packs, and trays that are 100% biodegradable and compostable. The products are made of Ingeo, a biopolymer based on corn, and are completely free from oil components and 100% renewable. The idea for this innovation originates from the mid 1990's when attention for sustainable solutions grew. The actual development started in 2004 when new bio-based plastics became better available and demand for bio-pots grew.

3.3 Data collection and analysis

Firstly, eight in-depth retrospective interviews, covering the whole development process from ideation until current state of affairs, are conducted with key persons of the company, responsible for the sustainable innovation trajectory and with main collaboration partners. For triangulation purposes additional data are studied, consisting of 46 documents (e.g. news bulletins, professional publications and presentations) and other data such as video's, websites and field notes made at company visits. Table 1 shows the data sources per case.

The research approach that was followed, started from raw data. Units of observation for this study were 'events', 'key actions' and 'pivot points'. Raw data was structured by positioning events, key actions and pivot points in the sustainable innovation development trajectory, a process that starts with an idea and moves towards growth of the business. In this trajectory there is a focus on the concepts of networking and business modelling. The analytical process started with creating a timeline for each case, describing the steps that were taken and events that took place from ideation to growth of the business. Next, a coding strategy was followed, using software for qualitative data analysis (Atlas.ti) to manage the volume and variation of the data material.

The material was coded for the different ties the network consists of, and for the three elements of the business model (value proposition, -creation & delivery, -capture). A cross-case comparison was conducted for both network development and business model development looking for co-occurring codes and patterns across the cases and making data displays and tables in iterative cycles. This resulted in a detailed description of the network ties development process and business model development process apparent in both cases.

Next a process of open coding was started to explore emerging patterns in the interaction and relationships between networking ties and business modelling, and the influence of ties on the various business model elements and vice versa. Different coding techniques were used, such as writing memo's and making data displays and tables in iterative cycles. Finally first-order and second-order concepts were created showing what interaction takes place in each stage of the development process, resulting in a life cycle stage model for value shaping.

Table 1. Data sources per case

		<i>Case: Keeper system</i>	<i>Case: D-grade</i>	<i>Total</i>
Interviews	With company representative responsible for the innovation	2 (entrepreneur)	2 (marketing manager)	4
	With key collaboration partners	3 (launching customer, consultant, product partner)	1 (knowledge partner)	4
Documents	Professional publications (report, case description)	5	8	13
	News bulletins	14	14	28
	Presentations	3	2	5
Other data	Videos	3	0	3
	Websites	1	2	3
	Field notes	0	2	2
	Total of data sources	31	31	62

4. Findings

In each case five successive development stages were recognized: ideation, conception, business start-up, early growth and continuous growth of the business. Based on a within cases analysis of both cases and comparison between the two cases, the similarities are described for the development of the business model, and for the development of the network. The interaction between business modelling and networking is described in a life cycle stage model introducing the concept of value shaping, explaining how the interaction takes place.

4.1 Development of the business model

During the innovation process from ideation to continuous growth of the business, the business model and the three elements it contains is altered several times.

4.1.1 Stage I. Ideation

In both cases the lead companies start the ideation stage with the idea to substitute an existing product, currently made with oil-derived plastics, by a sustainable alternative using biodegradable and bio-based plastics. In this stage the sustainable technology is explored, focusing on whether the desired functionality is met by the new technology. In the case of D-grade the idea originated from the rise of attention for bio-based plastics and emerging demand from the market. The company performed an explorative test with a lab scale batch of a new bio-based plastic, but at that time the material was not available in sufficient quantities to proceed the development. In the case of the Keeper system the entrepreneur realised that the plastic products he used in his civil contracting business would benefit from a bio-based and biodegradable alternative. A test with biodegradable plastics was performed to explore the possibilities.

4.1.2 Stage II. Conception

In the conception stage a functional product concept is developed by adapting the sustainable technology to the product and its envisioned end-of-life scenario. In this stage the R&D effort is aimed at translating the sustainable technology to fit the specific requirements for functionality, manufacturability and reproducibility. For both cases a dedicated material recipe is developed and the sustainability of the product is proved focussing on biodegradability and bio-based content. The value proposition is aimed at the same direct customers of the current product (i.e. growers for D-grade and gardeners for the Keeper system). Value capture is based on a classic products sales revenue model focussing on price-per-unit, while adding the sustainable quality aspect that the material is bio-based and biodegradable. The business element value creation and delivery is focussed on organising the supply chain.

4.1.3 Stage III. Business start-up

In the business start-up stage the focus shifts towards organising the distribution channel for value delivery. The value proposition is still a product concept targeted at the direct customer, but it stresses the added value for the whole value chain. Instead of price-per-unit the value capture is now focussed on the costs and revenues throughout the lifecycle of the product, both economically and environmentally. For example by stressing the lower costs for waste disposal or maintenance and the potential for CO₂ reduction, the higher product costs are made more acceptable. In this stage the adoption of the product by the market (distribution channel and direct customers) lags because the channel is reluctant, and potential early adopters fail in selling the added value to their client.

4.1.4 Stage IV. Early growth

In the early growth stage the focus shifts towards the decision maker, often the end client, that determines what solution is used or prescribed. The target group for the value proposition is redirected from the direct customers of the companies towards the end clients or users, asking for changes in the way value is delivered and captured as well. The value delivery is aimed at creating a pull-effect from the end client by improving credibility and visibility. Value capture is altered by improving the sustainability claim, stressing the sustainability of the solution in terms of CO₂ reduction and by addressing the ethical-sustainable value of the concept.

4.1.5 Stage V. Continuous growth

At this moment, both companies are in an early stage of the continuous growth stage. The value proposition is extended with products and services in collaboration with lateral partners, thereby creating total solutions for the end client. A value network with lateral partners and key customers is created for endorsement and market development. Creating awareness for the sustainability and market value of the solution is part of the way value is captured.

4.2 Development of the network

Looking at the network development from ideation to continuous growth of the business, the following changes are found with regard to type, purpose and strength of ties.

4.2.1 Stage I. Ideation

The sustainable innovation process starts with involvement of some strong ties, primarily from the existing network of the company or social network of the entrepreneur. These ties are lateral relationships involved to explore the sustainable technology. In the case of D-grade the research and development partner is a knowledge institute and a material supplier. In the case of the Keeper system the knowledge partner is an informal tie of the entrepreneur who is active in the production, application and sales of plastic products and intermediate products.

4.2.2 Stage II. Conception

During the conception stage the social network is extended with a few new ties for R&D purposes. It consists of upstream relationships in the supply chain (e.g. material suppliers and production partners), and key customers. The tie strength is primarily strong although ties with the upstream partners are weak. Both companies are not dependent of a specific production partner. In the case of D-grade different customers are involved. The launching customer at the end of the conception stage is a grower with a large retailer as client expressing the demand for the product. The knowledge

partner involved plays an important role in developing the material and field-testing the products. In the case of the Keeper system the two key customers are gardeners originating from the social network of the entrepreneur, one for the business market and one for the consumer market. Both customers are involved in developing and testing and are launching customers of the system.

4.2.3 Stage III. Business start-up

During the business start-up stage the network changes towards a more business-like network. The network is actively expanded with new (weak) ties focussed on potential direct customers (downstream relationships). Lateral ties, for example with independent bodies and consultancy firms, are involved to prove sustainability and show the value for the whole value chain. In the case of D-grade, the existing channel is deployed for marketing and distribution of the product. For the Keeper system, the two launching customer are involved for this role.

4.2.4 Stage IV. Early growth

In this stage the network changes towards a more strategically managed network, consisting of upstream relationships already established during earlier stages, and expanded with downstream relationships. It constitutes a focussed expansion of weak ties, especially with end clients or decision makers, and mainly for marketing purposes. Some of these ties turn into strong ties and play an important role in showing the value of the product to others. In the case of D-grade the new downstream relationships that are being built consist of retailers that appraise sustainability and appreciate the added value of a bio-based product. For the Keeper system the network is extended with weak ties with decision makers, such as municipal officers and contractors that have the ability to prescribe the product to be used by gardeners.

4.2.5 Stage V. Continuous growth

At the time of analysis, both cases find themselves at an early stage of the continuous growth stage. In this stage some strong lateral relationships are found, for example with product partners for marketing and reputation purposes. In the case of D-grade the company extends the network by strong relationships with other product companies. Together with these partners combinations of products are made to develop total solutions for retail. In the case of the Keeper system the entrepreneur builds a strong relationship with a fellow entrepreneur also active with bio-based products. Together they develop total concepts with partner products and services, targeted at the end client.

4.3 Interaction between networking and business modelling

Based on the development of both the network and the business model, and the analysis of the co-occurrence of events, a life cycle stage model is created. Looking closely at the interaction that takes place between networking and business modelling a central phenomenon emerges that is apparent in all stages and what we call 'value shaping'. We define this phenomenon as 'the transformation of the value being delivered and the group it is targeted at, through interaction with partners in the network'. Five successive concepts were found that clarify the phenomenon for each stage: exploring value, developing value, framing value, redirecting value and extending value. Figure 1 shows for each successive stage what type of network partners are involved and how the business model is altered for each form of 'value shaping'. In table 2 each form of value shaping is explained and illustrated with exemplary quotes from the interviewees for both cases. The trigger for the transformation to the next successive form of value shaping is also marked.

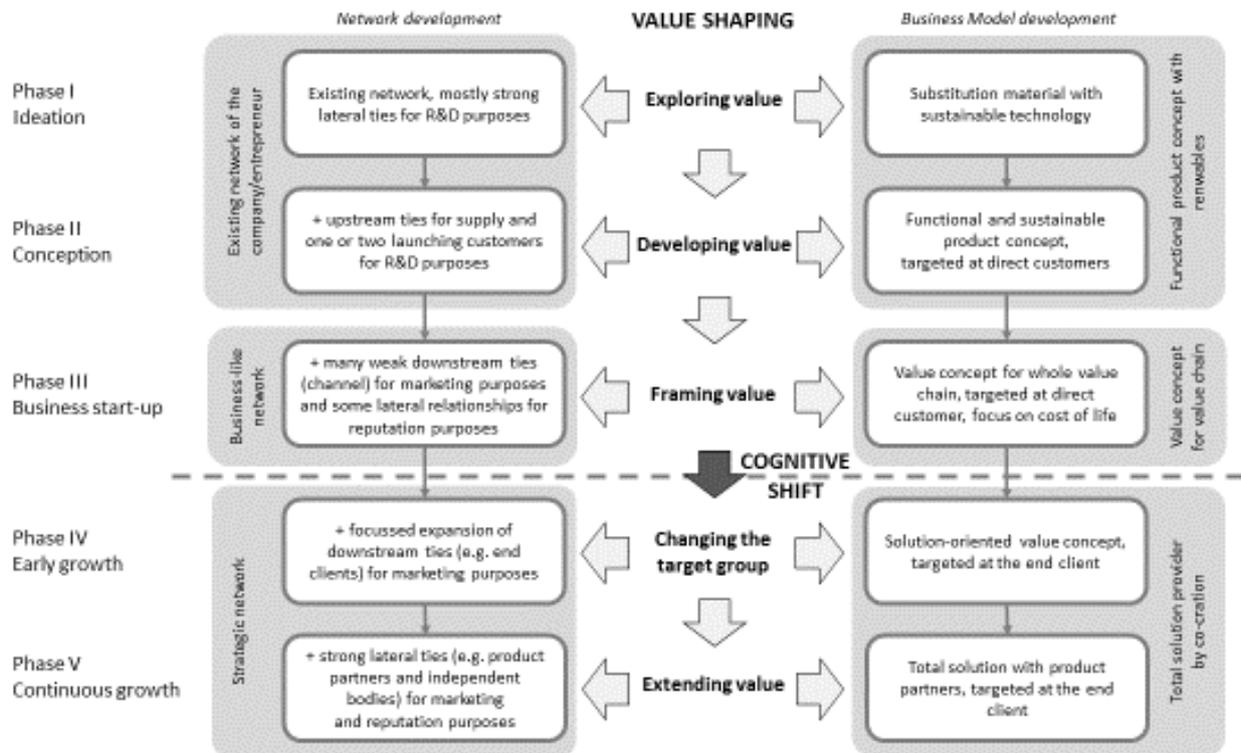


Figure 1. A life cycle stage model for value shaping

Table 2. Value shaping in five successive forms: definitions, exemplary quotes and triggers

	Exemplary quotes case D-grade	Exemplary quotes case Keeper system
<p>I. Exploring value: collaboration with existing ties to explore the functionality and readiness of the technology</p>	<p>Company: “At a certain time there was a contact with a material provider and a test was performed. Then for years nothing happened, because the material was not available and sufficient quantities could not be made.”</p>	<p>Entrepreneur: “I got to know someone from a plastic processing company. We came to talk about our mutual concern about the plastic soup. He had access to some examples of bio-based plastics and that was the moment we started experimenting.”</p>
<p>Trigger for shift: technology readiness and actual market demand for the value added by the sustainable technology</p>		
<p>II. Developing value: collaboration with launching customers and other research partners to translate the sustainable technology into a viable product concept, by testing and proving the functional and sustainable value of the technology</p>	<p>Knowledge partner: “There was a test at the grower, wherefor really thousands of pots were made. Because one of the first things to know is: what if I put a plant in it, but the pot starts to degrade and the plant dies. That has to be tested first.”</p>	<p>Launching customer: “We have planted some trees, in deliberation with municipalities and they have monitored what is happening to the material. We have made adjustments until you can say: we have a product.”</p>
<p>Trigger for shift: product ready to be introduced in the market</p>		
<p>III. Framing value: interaction with downstream and lateral ties to change the message towards stressing the value for the whole value chain in order to help direct customers persuade their clients</p>	<p>Company: “It is important to inform our clients, both the channel and individual growers, for example about the reduction of CO₂ emissions and the lower energy consumption at production.”</p>	<p>Entrepreneur: “We have been innovative in technology, in sustainability, but what lacks is the social innovation, the implementation of the product in the market.” “We were surprised: we have developed a good product, why is not applied? It is better for people, planet, profit and all, but it is not being used.”</p>
<p>Trigger for shift: market failure by reluctance of the channel</p>		
<p>IV. Redirecting value: redirection of the value proposition towards another target group, the end clients or users</p>	<p>Company: “We have been very active in making contacts. At the start we did not know how to do this. The product went to growers and they were enthusiastic about the product, but didn’t want it because it was too expensive. Until we came with the idea: we should not go to the grower, but to the client of the grower. He will create a sort of attracting power and then the grower will come automatically.”</p>	<p>Consultant: “Instead of ringing doors he started giving presentations and trainings about biodegradable plastics and how this could offer a sustainable solutions when applied for planting trees. He presented that proposition to government officials, provincial administrators and civil servants. What he did was collectively engage the market with his project instead of deploying an individual approach. This made that his product got prescribed.”</p>
<p>Trigger for shift: apprehension of the needs of end clients / users</p>		
<p>V. Extending value: collaboration with lateral partners to build total solutions that provide multiple value for the end client or users</p>	<p>Company: “Above all our sales manager aims to reflect our added value one way or the other, not by showing ‘what a nice product we have’, but by looking for companies that want to make a combined offer with us, that creates some sort of synergetic effect.”</p>	<p>Entrepreneur: “We started cooperating with other companies, so we can offer around 30 products, from soil improvement to all sorts of things. So you have a whole range of products that can be used around trees, and we started giving advice.”</p>

5. Discussion

The life cycle stage model for value shaping shows how networking and business modelling interact for value shaping, giving detail on how the network changes and how the business model is altered.

The study reveals that SMEs successful in developing and introducing new sustainable technology adapt their business model and network continuously and in interaction with each other, throughout the development process from ideation to growth of the business. Through interaction with the network the value being delivered and the group it is targeted at is transformed, a process we call ‘value shaping’. The five successive forms of value shaping show how different type of ties are involved for different purposes and causing alterations in not only the value that is created, but also how the value is framed and the customer group it is targeted at.

In the first three stages an evolution can be seen of the value that is created, following a path dependent behaviour. In both cases initially a business model is envisioned that only differs from the existing model by the environmental value created through substitution with a renewable and biodegradable material. The business model consists of a classic sales revenue model, known to the companies involved, with a value proposition targeted at the direct customers. Value shaping evolves from exploring the value that can be delivered with existing ties to actual development of the value by creating products with the sustainable technology together with launching customers. In the business start-up stage the value is framed differently in order to assist direct customers to persuade their clientele and help adoption of the product in the market. Up to this stage the original business model is not altered substantially.

The model shows that after path-dependent behaviour in the first three stages, a cognitive shift takes place when the market proves to be reluctant towards the sustainable technology. The companies realise that they should not target the direct customer but should redirect the value shaping towards the end clients and decision makers that prescribe what products are to be used. The shift towards another target group proves to be essential for the adoption of the sustainable technology by the market and growth of the business.

The study adds to the literature on (sustainable) business models by showing how the interaction between the external network and the business model actually takes place, and underlines the view of Doganova & Eyquem-Renault (2009) of the business model as a device for market exploration. It adds in-depth understanding on how the entrepreneurs use their network in business modelling as proposed by Jack et al. (2008). The results reveal that development of the business model strongly depends on interaction with the external network. This occurs path dependent in the early stages of the development process and ‘path breaking’ when encounters with the market demands changes in both network and business model. The interaction with the external network is especially apparent in value shaping, at first strengthening existing cognitions on value perception by the market, and helping to frame it, later disrupting the cognition and radically changing the value and its target group.

The data shows that type and purpose of ties are important aspects for explaining the interaction between networking and business modelling. The results make clear that when looking at type and purpose of ties in relation to sustainable business modelling, a distinction between vertical and lateral relationships and between upstream and downstream relationships adds to our understanding of the influence of ties on the business model. The data reveals that different types of ties have different purposes, also varying for the development stage of the business modelling the company is in.

We acknowledge several limitations to this research. This qualitative study was based on two cases, limiting the generalisability of the results. Both cases concern a sustainable technology that was implemented in products aimed at business to business markets. Specific for these cases is the existence of a ‘client chain’, with direct customers buying and using the products and end clients that have a large influence on what products are to be used in the value chain. Whether the model holds for other client chains or single client situations needs further exploration. Another specific characteristic of the cases studied is the fact that the sustainable technology concerns a bio-based and biodegradable material. Whether the model holds for other sustainable technologies is also subject for further research.

6. Conclusions and implications

Overall the life cycle stage model gives us more insight in how the development of the business model actually takes place from ideation to growth of the business and the determining mechanisms in relation to value shaping. We define value shaping as ‘the transformation of the value being delivered and the group it is targeted at, through interaction with partners in the network’. A cross-case analysis will be executed to further develop the model for value shaping. Another subject that needs further exploration is the cognitive shift that occurs in value shaping. This phenomenon asks for further exploration by academics, for example in studying what the activities are that make this shift in cognition successful in overcoming a market barrier for sustainable technology.

For practitioners active in developing and implementing a new sustainable technology, the life cycle stage model may provide valuable insight in how development of the network and the ties it is composed of and business modelling interact. Their task is to timely adapt the value to accommodate possible reluctance of the market towards the new sustainable technology. The model may serve as a guideline to pro-actively build their network and use specific ties to develop and evaluate various aspects of the business model and enable the successful implementation of new sustainable technologies.

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