Network impact on business models for sustainability: Case study in the energy sector

Highlights

- Sustainability development leads companies to collaborate in networks
- Network impact on participant's business model for sustainability
- Using the resource dependence theory to examine such impact on business models
- Understand the changes in business model due to network participation

Abstract

The production and consumption of energy requires sustainable business models. However, sustainability is a complex phenomenon, particularly in high-technology sectors that require the integration of diverse knowledge for sustainable innovation. Therefore, recent literature on the subject states that business model (BM) innovation based on networks and partnerships is crucial for sustainable development. The literature also calls for further research on how business models change for network adaptability. The resource dependence theory helps explain how different levels of dependencies induce companies to create network linkages, transforming their business models for sustainability.

This study offers empirical evidence on how network participants change the three main elements of their business models: value proposition, value capture and value creation and delivery. The evidence shows that networks help achieve sustainability goals by solving the problem of resource dependency; however, new resource dependencies emerge from network partners and the network itself. Such processes link with the BM dynamics of participants, which expand or adapt according to their involvement in the network.

The results yield implications for practitioners and future research on networks and sustainable business models.

Keywords: Business Model; Network; Green Energy; Case Study

1. Introduction

The focus on environmental problems emphasises action to solve a major challenge faced by humanity: the demand for energy. Companies play an important role in energy demand, as they are the primary consumers of energy and the major contributors of CO_2 in the atmosphere (Baumert et al., 2005; Fourie and Eloff, 2005), especially those operating in high-energy consumption industries, such as transport and manufacturing (Abulfotuh, 2007; Omer, 2008).

Therefore, it is important that all sectors of energy consumption integrate sustainability into their business strategies (Dangelico and Pontrandolfo, 2015; Jeswani et al., 2008) and change the composition of their energy resources portfolio to include renewable energy (green energy), rational use of resources and energy efficiency (Schlör et al., 2015).

However, sustainability is a complex phenomenon (Loorbach et al., 2010), particularly in the energy sector. Such complexity fosters the risk that the BM innovation of a single firm may not lead to significant results in sustainability (Fourie and Eloff, 2005; Mårtensson and Westerberg, 2016). Therefore, recent literature outlines that for sustainable development, BM innovation requires network participation and partnerships (Bocken et al., 2014; Lüdeke-Freund, 2010; Wells, 2008; Stubbs and Cocklin, 2008; Schaltegger et al., 2012).

The resource dependence theory (RDT) helps explain how different levels of dependence on external resources lead companies to develop network linkages toward sustainability (Hillman et al., 2009; Pfeffer and Salancik, 1978, 2003). This approach recognizes the influence of external factors on organizational behaviour and examines how managers can control environmental uncertainty and dependence using different forms of interorganizational arrangements (Breuer and Lüdeke-Freund, 2014; Clarke and Roome, 1995; Zott et al., 2011). Such a theoretical framework examines the creation of a new sustainable BM for energy companies, fed by network relationships and modifying their existing BMs.

This study defines networks as interorganization relationships developed not along the supply chain but among firms operating in complementary activities (Clarke and Roome, 1999; Svendsen and Labarge, 2005; Dangelico and Pontrandolfo, 2015). The extant literature recognises network collaboration as an important form of multi-organizational governance in advancing environmental sustainability (Zander et al., 2016). However, further research on sustainability is necessary, as existing studies ‘benefit surprisingly little from the substantial literature on interorganizational collaboration, alliances, or networks’ (Zander et al., 2016). Thus, a research gap remains on changes in BMs resulting from network participation for sustainability. In particular, resource dependency of energy companies involved in a sustainable development network affects innovation and management of BMs.

This study attempts to bridge this gap by offering empirical evidence through the analysis of a case study. Our empirical evidence examines how companies exploit the opportunities arising from merging different BMs. We as the following research question: *what are the changes in the BMs of companies in the energy sector that belong to a network that focuses on sustainability?*

This paper contains the following sections. We review the existing literature in Section 2 and describe the methodology used in Section 3, explaining the collection and analysis of the empirical evidence. In Section 4, we present the case study and Section 5 includes the major findings. In Section 6, we discuss the results and highlight the contributions and limitations of the study in Section 7.

2. **Literature Review and Research Question**

2.1 Business Model Change for Sustainability

BMs are concerned with a firm's competitive strategy: what it offers to its market, how it charges for it, what it costs to produce, how it differentiates itself from other firms, and how it integrates its own value chain within a value network (Shafer et al., 2005). Generally, the BM is a tool to explain how a firm does business, link its internal operations to outside elements, including customers, suppliers, competitors, and how firms capture value (Baden-Fuller and Mangematin, 2013; Osterwalder and Pigneur, 2005).

In this study, we define a BM from its three main elements in the literature (Bocken et al., 2014; Oswald and Pigneur, 2005; Shafer et al., 2005; Teece, 2010). *Value proposition*, which considers the value embedded in the product/service to generate economic return. *Value capture* considers revenue from sales. Finally, we consider *value creation* and *delivery*, which embrace the exploitation of new business opportunities, new markets, and new revenue streams and the distribution of this value among the stakeholders. These elements are the building blocks of a BM and their analysis allows us to comprehend how a firm does business.

Recently, the increasing focus on BM is due to issues of sustainability. Scholars state that sustainable development occurs through new business ideas and BM innovations (Bocken et al., 2014; Hart and Milstein, 2003; Lüdeke-Freund, 2010; Schaltegger et al., 2012; Stubbs and Cocklin, 2008; Wells, 2008). Literature defines the concept of 'sustainable BM' as 'a business model that creates competitive advantage through superior customer value and contributes to a sustainable development of the company and society' (Lüdeke-Freund, 2010). Thus, sustainable BMs can coordinate technological and social innovations at the firm level, with system level sustainability, valuing the environment and society as key stakeholders (Schaltegger et al., 2012).

The literature also argues that firms must redesign their BM based on networks and collaborative practices to attain sustainable development (Bocken et al., 2014; Lüdeke-Freund, 2010; Roome and

Louche, 2016; Yunus et al., 2010; Svensson and Wagner, 2011). Van Kleef and Roome (2007) assert that sustainable development requires new skills, new resources and capabilities, and new institutional arrangements with external partners. Specifically, increasing pressures of global sustainability foster greater degrees of collaboration between firms (Lowitt, 2013), especially in sectors where sustainable innovation requires the integration of diverse knowledge. In addition, it is not always clear if social and environmental benefits produce economic value and competitive advantage for a firm. Consequently, innovating for sustainability involves a wide set of actors—splitting the risk of BM innovation among several participants—through a BM that enables each member to capture economic profit from the network (Bocken et al., 2014; Clarke and Roome, 1995; Lüdeke-Freund, 2010; Schaltegger et al., 2012).

However, the existing literature remains mostly conceptual in examining the operation of BMs for sustainability. According to Roome and Louche (2016, p. 12), studies investigate some of these new BMs (e.g. Baines et al., 2007; Jones and Levy, 2007; Schaltegger et al., 2012); however, they do not deal with the question of 'how' such new BMs develop and operate. Similarly, Bocken et al. (2014, 43) argue that there is already 'extensive literature on the theory of business models for delivering sustainability'; however, 'there is no comprehensive view of how firms should approach embedding sustainability in their business models'. We want to address this gap and empirically investigate how companies transform their BM toward sustainable practices for green energy and energy efficiency when they act in a network. In particular, this study aims to answer the following question: *what are the changes in the BMs of companies in the energy sector that belong to a network that focuses on sustainability?*

2.2. A Resource-Dependent Approach to BM change

We utilize the Resource Dependence Theory (RDT) to answer our research question. According to Pfeffer and Salancik (1978, 2003), as organizations need external resources and face environmental constraints, they try to control resource dependencies by creating different forms of interorganizational arrangements. Thus, building alliances with other organizations provides a source of information, knowledge, and other resources to help solve complex problems (Gray and Stites, 2013; Provan, 1984; Schnittfeld and Busch, 2015). A central concept in the RDT is the investigation of why and how companies constitute or join interorganizational relationships. Therefore, this theory can help interpret how gaining 'control' of external resources may influence the dynamics of a BM.

Most scholars focus on networks and interorganization relationships among firms operating on the same level of the value chain or by a network of firms that are not necessarily buyers and suppliers to each other nor are competitors (Sullivan and Ford, 2013).

The RDT outlines that attempts to control external dependencies may produce unintended consequences, such as new patterns of dependence and interdependence. According to Hillmann et al. (2009), while networks help in reducing environmental constraints (i.e. dependence on the environment), firms must manage different forms of dependence on other companies belonging to the same network, and on the network itself. For example, to reduce dependence on the environment, firms may participate in a network; however, network participation requires them to manage dependence on the network's other members (Jones et al., 1997). Later, the development of network organization and governance, which usually follows with the increase in number of network members and the extension of its activities, requires partners to manage dependence not only one another, but also on the network (Gulati and Sytch, 2007). Following this approach, studies on network dynamics explain the evolution of networks, as entrepreneurs face emerging resource-dependency challenges (Elfring and Hulsink, 2007; Jack, 2005).

All such dimensions of a firm's dependence allows (or requires) it to adjust strategies, structures and BMs to acquire and develop external resources made available by the partners and the network toward sustainability (Cai and Yang, 2008; Pfeffer and Salancik, 2003).

3. Methodology

We choose a case study analysis to answer the research question for the following reasons. Case study research provides an opportunity for the intensive study of a current phenomenon in which the context might play an important role (Yin, 2009); furthermore, it helps when boundaries are vague (Yin, 2009) or research is still at an early stage and existing theories and models seem inadequate (Eisenhardt, 1989).

Specifically, we use an exploratory case study, as company networks are an under-investigated phenomenon in the context of sustainability and there is a shortage of empirical evidence on its impact on BMs. (Yin, 2009).

We chose this case study from a broader research project investigating the impact of networks on the BMs of participant companies. A public database lists 477 company networks in North Italy, for which we collect qualitative data from a questionnaire survey. We obtain 123 completed questionnaires from the survey, allowing us to identify the main aim of each network, along with other descriptive information on each network (e.g. type of network, structure, and governance).

Therefore, we chose a case study that meets the following three conditions. 1) Networks created with the specific aim of pursuing sustainability, which is one fundamental condition for evidence of its effect on BMs. 2) Networks among companies mutually dependent in deploying their competitive proposition, which is one fundamental condition for evidence that resource dependencies drive the network. 3) Networks in the energy sector, as it is a key industry with substantial impact on economic

sustainability. The Green Energy (GE) network (we use a fictional name for reasons of confidentiality) meets all these conditions.

Following Yin (2003), the GE network represents a 'critical case' in understanding the impact of network participation for sustainability on BMs.

The case study is based on fifteen semi-structured interviews of the most involved actors. We selected interviewees to cover every company in the network, with different roles within the company and the network (Table 1). Consequently, we interview at least two managers from each firm. We interview managers because are in regular contact with other companies in the network and take business decisions that affect the BM. Therefore, managers can determine the impact of network relationships on BMs.

In case of discrepancies, we contacted the interviewees again for clarifications. We conducted four interviews with the president of the network: one at the start of the study to identify key managers in the network, and three follow-up interviews to clarify some aspects noted by other interviewees and request further details. We conducted nine interviews with managers of the companies participating in the network and two with an external consultant. Each interview was individual to avoid reciprocal influences across respondents.

The interview included questions on resource dependency and the impact of network participation on BMs. We used a common research protocol during the interviews, which covered the following questions:

- gathering know-how and experience to pursue sustainability from outside the company, before and after network participation;
- resource dependencies on other companies according to their BM;
- resource dependencies on the network itself;
- changes in the BMs of members (in value proposition, value capture, and value creation and delivery) due to network participation.

We conducted the interviews between January 2015 and February 2016. Each interview lasted about an hour and was tape recorded and transcribed for the post-interview analysis. From the transcribed interviews, we codified patterns of recurring topics on the impact of network participation on different elements of the BM: value proposition, value network, value capture and value creation and delivery. Table 1 presents the details of the interviews.

Table 1. Details of semi-structured interviews

Firms	**Interviewee**

GreenEn	Entrepreneur and current president of the network 'Green Energy'
BetaBoiler	President
Electra	Responsible for strategic development Administrative officer
SavEn	President
Local Bank	Marketing officer
ExConsultancy	External consultant on buildings

We triangulated multiple sources of evidence to improve the quality of the study (Lincoln and Guba, 1985; Hirschman, 1986). We followed Yin's (2009) approach and obtained further information from secondary sources, such as freely available information (e.g. company website publications and press releases) and internal documents. We gathered the following internal documents from the interviewees: network contract signed by the companies, documentation used in board and partner meetings (reporting on discussions and decisions taken by the companies in managing the network), conference and workshop reports (in which the authors participated as observers).

4. Empirical setting: the *Green Energy* network

The GE network is an aggregation of companies that allows its participants to collaborate by making their resources and skills available to the network while guaranteeing the autonomy of individual partners. The network is a contract according to Italian Law 33/2009, which defines a network as an aggregative organization that (i) is governed by a board appointed with the agreement of each company involved; (ii) shares a common set of assets; (iii) gives to each partner equal powers of participation (regardless of the resources invested) in board decisions. The network is an aggregative organization that differs from other interorganizational forms for several reasons. First, it is based on a formal agreement amongst the parties involved. Second, it is not based on ownership, but on interorganization exchange of resources as per the contingent needs of the participants. Therefore, as per the notions of management literature, we can consider this network as a structure involving multiple companies with multiple linkages, working on cross-boundary collaborative initiatives (McGuire and Agranoff, 2011) and leading to more efficient use of resources and increased capacity to deal with complex problems (Marques et al., 2011; Provan and Kenis, 2008).

The GE network was born among four companies that were informally involved in temporary partnerships for specific transactions or events (e.g. participating in regional or national tender notices) and decided to sign the network contract in 2010. The four companies were as follows (names changed for reasons of confidentiality): production companies (BetaBoiler and Electra) that perform

all activities from development to testing, and service companies (GreenEn and SavEn) that provide energy production services. In 2012, a bank (Local Bank) joined the network.

The network governance depends on two boards: *i)* assembly (partner's meeting) represented by the President of each company to take strategic decisions; *ii)* management committee, represented by one member from each company. The board takes decisions on daily activities of the network. The assembly decides the competences of the management committee.

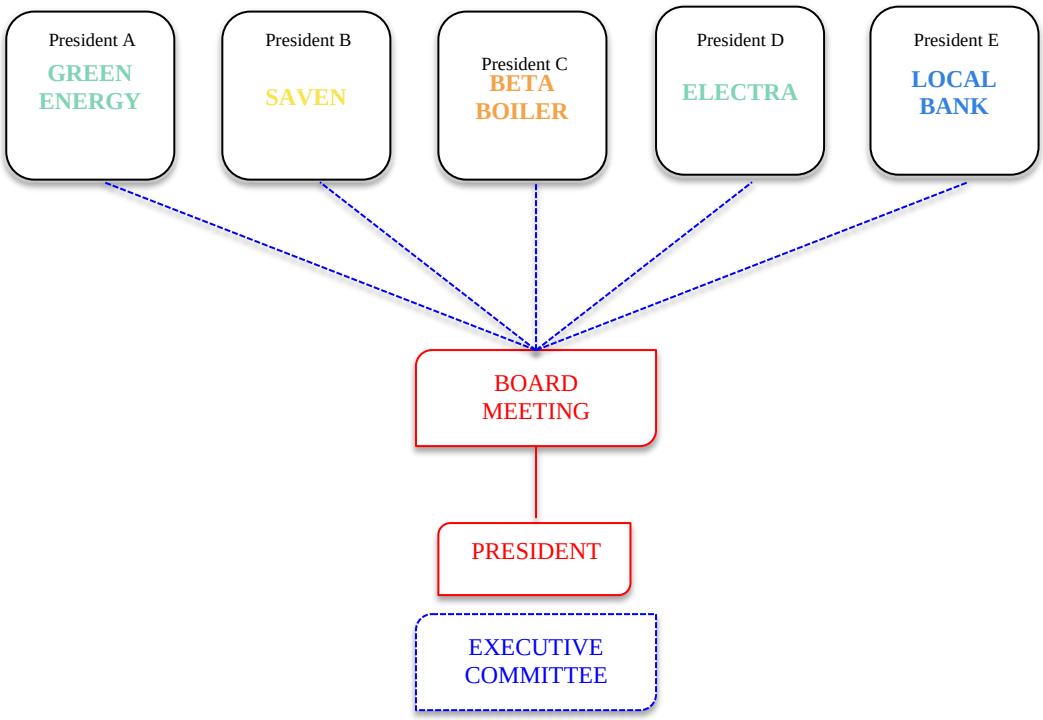
The presidents of each partner firm constitute the assembly. Each committee member has one right-vote and decisions are at majority. The assembly makes decisions on several issues, for example, future projects by the network, admission of new partners, additional rules to coordinate activities, economic report of the network, and the competencies of the management committee. The assembly chair is the president of the network appointed once a year by the assembly and re-eligible for selection. The partner meetings are scheduled once a year to approve the economic report and appoint the president. In addition, the president calls assembly meetings at any time when a member of the management committee requests his opinion.

The representative of each partner (president or a chosen manager) constitutes the management committee. The main activity of the committee consists of managing the network portfolio of skills and competencies useful in improving the products (and services) provided to the market. The committee's meetings are scheduled once a month. In almost every meeting, the committee verifies the resources necessary for such aims and prepares a report on the work in progress along with the budget of resources for the planned activities. The committee proposes the involvement of new partners based on this budget.

The company leader of the network changes with the president of the assembly. The company whose president is the current president of the assembly is the network leader. The company leader takes care of the commercial, administrative, financial, and promotional functions.

Figure 1 shows a representation of GE governance.

Figure 1. GE governance



The rent distribution occurs among partners as per their involvement in each product or project. The network appoints a firm leader for each product or project, which is the company that customers contact. Once the product or the project starts, the firm-leader maintains customer relationships and receives the entire payment. In addition, the firm-leader directs activities within the network and coordinates with partners. The partners split the total price among themselves based on the initial project estimation. In summary, the network works on a commission basis, involving the partners when necessary.

Furthermore, the partners divide the administrative costs of the network in equal parts among themselves.

The network agreement is extremely flexible: they can continue activities outside the network supplying their own customers; however, each member must prioritize the partners in case of a specific requirement.

Table 2 summarizes the activities of each company in the GE network.

Table 2. Green Energy network: companies and their activities

Company	Turnover 2015 (euro ml)	Number of employees 2015	Number of customers 2015	Type of customers	Activities	Contribution to the network

Producing companies	**BetaBoiler**	30	155	100	Wholesalers	Design, manufacturing, installation, and testing of high-performance/efficient boilers in residential and industrial areas.	Production of co-generators that allow the transformation of natural gas into hydrogen to obtain heat and electrical energy.
	Electra	20	66	60	Wholesalers Engineering companies Architect	Design, manufacture, and installation of wind turbines on a compact microturbine for civilian use vertical axis for the production of electricity. Production of LED lamps.	Sharing its technology and handling production, installation and testing of its products.
Service companies	**GreenEn**	2	15	80	SME companies Families	Installation of solar panels and green electricity supply.	Provision of electricity, heat, and managing every aspect of implementation.
	SavEn	1,2	12	500	SME companies Families	Promotion of advanced energy solutions for maximum energy savings.	Diagnosis and energy certification of building-plant systems of clients, installation and financing proposed solutions and managing the customer's plant for as long as necessary to recover the invested capital. From 2010 to mid-2014, it was the lead commercial business for GE, handling customer relations, contracts, and all aspects necessary for the completion of network projects.
	Local Bank	656	3.292	n.a.	Companies Families	Purchase certified ecological paper and recycle where possible, buying about 95% of its electricity from renewable sources, construction of sustainable buildings characterized by a free cooling system, installation of a photovoltaic system, LED lighting system collection and reuse of rainwater, etc. Preparing the sustainability report (GRI).	Integrating and implementing network offers through a financial plan specifically created for the customer. Support the partners in the network with their individual development plans.

5. Findings

We analysed the interview data using a theoretical framework derived from the literature.

The network members (BetaBoiler, Electra, Green Energy, and Saven) decided to pursue sustainability and contribute in reducing energy demand, improve energy efficiency, and produce green energies. Each company aimed to achieve new market shares by leveraging sustainability. However, they lacked the necessary knowledge and competencies and were dependent on external consultants in pursuing sustainability innovation. To diversify operations and gain expertise, in 2010, the companies decided to collaborate in a network for competitive innovation and sustainable development. The officer responsible for strategic development at Electra says:

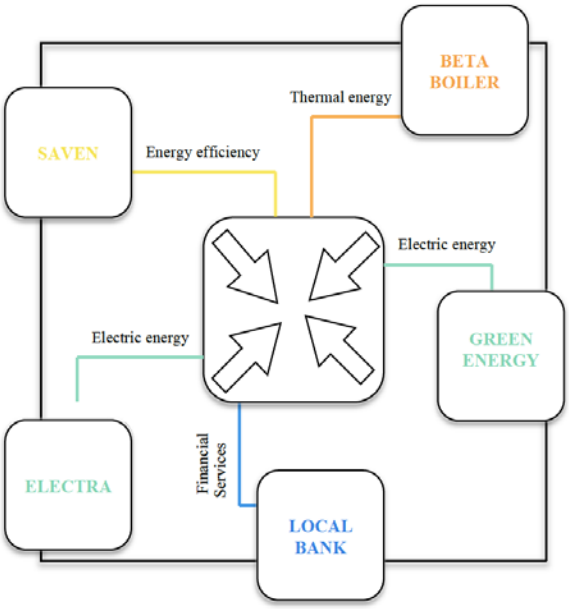
'Each company has know-how, but sometimes what is necessary to develop green energy is an integrated product with the smart integration of such knowledge, which goes beyond the sum of the individual know-how of each company'.

The companies would offer systems for green energy use and energy saving within industrial, commercial, and residential buildings, marketed under the common brand 'Green Energy'. Participants would produce products or provide systems to satisfy energy needs for electricity, heating, and cooling; however, but they would also deploy their competitive proposition, offering such systems in a sustainable manner.

Each company was aware that the network would establish new ways to integrate environmental issues in how they did business, thus modifying the elements of their BMs.

After network creation, several paths of resource dependency from other participants emerge, as represented in Figure 2. First, production companies (BetaBoiler and Electra) primarily need know-how from service companies (GreenEn, SavEn, and Local Bank) on (a) design of products and components to accommodate them in sustainable buildings, (b) engineering for components to maximize energy savings and (c) financial agreements to offer customers some specific financial services. Second, the service companies (GreenEn and SavEn) need technology for sustainable production and supply of energy to offer integrated products that are energy efficient and use renewable energy.

Figure 2 – Resource path dependencies within the network



The combination of skills allows stable and increasing product innovation owing to the extensive involvement of participants in the project, design, production, and installation of technologies. For

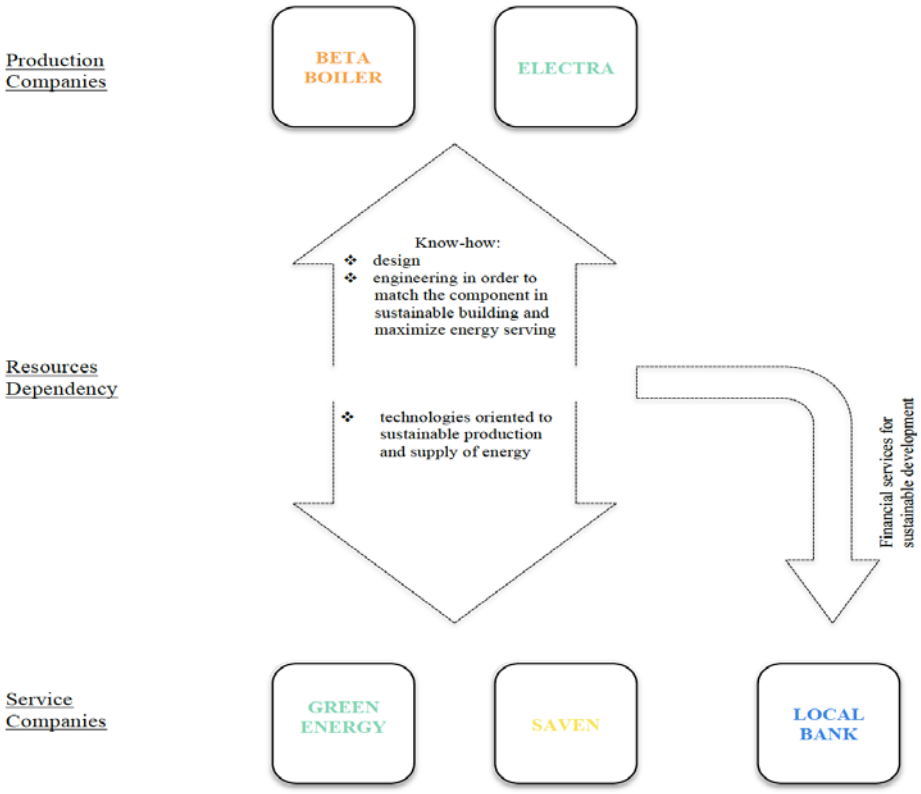
example, Electra, with the help of BetaBoiler, improved its technology to develop a better turbine. This turbine can operate at reduced wind speeds and regardless of direction. Its small size makes it usable in individual homes and for commercial and business centres, rather than in urban areas coupled with lighting systems. Therefore, it is a renewable source accessible to larger segments of the population, helping reduce the energy bill and enabling families to combat pollution. Furthermore, this turbine is very quiet, has great degrees of resistance, and installing it on building roofs will not damage them.

The officer responsible for strategic development at Electra explained:

> *'By combining the Electra's wind turbine with BetaBoiler's boilers, which use energy more efficiently, we certainly get a more powerful solution. Specifically, a boiler with lower consumption will achieve a surplus of energy compared to the production of the turbine; it can be used in other activities'.*

The services companies provide know how on the design and engineering necessary to produce technologies for network members to save energy and use renewable energy. For example, SavEn's know how enabled BetaBoiler to develop tools for optimizing control yields and inducing efficient energy use produced by power stations. Such instruments combine the versatility and the autonomy of independent boilers with the simplicity of management and higher yields of centralized production. With engineering know-how of electricity provided by Green Energy, Electra developed LED technology (Light Emitting Diodes) in which semiconductors generate light rather than a filament or gas. The investments necessary to develop such technologies would be prohibitive for companies without strong partnership and trust with other members. However, network participation makes these risks manageable. Figure 3 shows the resulting interdependency within the network.

Figure 3. Interdependency within the network



Network consolidation and the ability to develop environmentally sustainable products emerge from the increasing number of complex projects that require the support of all members. For example, GE has finalized a project named 'Green Building' to redevelop dated buildings and contribute to the design and construction of new eco-friendly properties in residential (condominiums), services (offices, public administration, schools and hospitals), commercial (shops) and industrial (sheds) areas. In particular, the network aims to replace the obsolete and polluting plants with new efficient and sustainable plants provided by the partners (redevelopment), or install their products in new buildings. The network members have already redeveloped 28 residential condominiums and are working on 13 new construction processes. The president of the GE President states

> *'For energy upgradation, SavEn interfaced with those who represented the condos promoting the replacement of old boilers with more innovative and high-performance boilers from BetaBoiler, combining with the supply of electricity and gas by GreenEn. For new constructions, the network has proceeded to install innovative technology in the new building, with SavEn entering into a contract with the constructor'.*

In both cases, the network analyses the energy consumption to understand the needs of each user, manages financing through Local Bank, installs the technology at its own expense, and in exchange, all users of the building buy electricity and gas from the network for a period of at least three years. Figure 4 shows the technologies integrated in the 'Green Building' project.

Figure 4. Integrated technologies in the ‘Green Building’ project

1. System integrator
2. Small wind turbines
3. Photovoltaic system
4. Hydrogen cogeneration
5. Gas and biogas cogeneration
6. Energy management devices
7. LED illumination

The project shows that participants benefit from the network’s resources and depend on them. Within the network, each participant plays a specific role in developing the product or project. For example, GreenEn provides market support through knowledge of the green energy sector (or narrow sectors), its evolution and future trends and provides network members with insights on the business environment. Management experts confer know-how on the strategic decision process, internal control system and the network organization; in GE, Electra and BetaBoiler provide updated and innovative management systems and mechanisms. Product specialists collect, scrutinize, and enhance knowledge of specific products or production processes. SavEn, for example, is an expert on energy supply, while BetaBoiler is an expert on energy generating systems. Some companies have expertise and knowledge in areas that support the core business. Such companies play a ‘consultant’ role in finance, insurance, law, marketing, public relations, among others. In GE, the bank plays this role and helps provide external legitimacy to the network. Table 4 shows the role of each partner in the network.

Table 4. Support to network functions

Company	Role	Resources

GreenEn	Market Support	Extensive expertise in the competitive environment
Electra and BetaBoiler	Management Expert	Specific knowledge of management systems and mechanisms
SavEn	Product Specialist	Knowledge to promote advanced energy solutions for supplying energy
Local Bank	Consultant	Expertise in finance, insurance, law, marketing and public relations

6. Discussion

Prior research on sustainable BMs has benefited little from existing empirical studies on interorganizational collaboration. Therefore, our study aims to explore the impacts of network participation for sustainability on the BMs of participants, using the RDT. This framework explains how different levels of dependence on external resources induce companies to create network linkages toward sustainability.

From our case study analysis, we can now identify changes in BMs focusing on three main building blocks as mentioned earlier: the value proposition, value capture, and value creation and delivery (Bocken et al., 2014; Oswald and Pigneur, 2005; Shafer et al., 2005; Teece, 2010).

The *value proposition* revises from 'what' participants produce/offer to 'how' they do it. Before network participation, companies were committed to energy delivery through product technologies and services but with different purposes (i.e. boilers in BetaBoiler, alternators and rotating welders in Electra) considering residential and industrial use. After participating in the network, their BMs changed to include sustainability and their value proposition now attempts to reduce the distance between green energy producers and consumers for a sustainable lifestyle (e.g. minimizing the environmental impact of emissions at BetaBoiler or enhancing solar energy use in GreenEn).

The *value capture* revises from focus on costs (in BetaBoiler and GreenEn), price leadership to maximize profit (in Electra), or market niche owing to specific competencies (in SavEn) to new arrangements for gaining new customers and increasing margins from the extant market by addressing environmental issues. Network participation allows participants to share R&D investments and develop new arrangements, such as managing the risks of R&D investment. Therefore, the BMs change to capture value that otherwise would be inaccessible, as a single firm would not have these opportunities (or the resources).

Value creation and delivery extend from merely providing energy using extant technology (i.e. alternators and rotating welders in Electra, photovoltaic panels in GreenEn) to creating and delivering value through new arrangements, which allow (a) producers and suppliers to enlarge market share and profit from market positioning in the sustainable segment (Electra extended production to LED

technologies and improved the efficiency of rotating welders) and (b) consumers to reduce environmental impact and save energy (SavEn now offers innovative systems that save energy).

Table 5 presents the changes within each BM. We do not show the changes in BM of the Local Bank, as it is less relevant.

All the companies changed their BM due to an in-depth review of their activities and a rigorous section of partners. The network forced its participants to widen their definition of value (Stubbs and Cocklin, 2008) and include value creation for both company and society as a goal in the BM (Schaltegger et al., 2012). The network allows for the introduction of new concepts, knowledge and practices, creating and reinforcing a different approach to capturing value (Breuer and Lüdeke-Freund, 2014; Zott et al., 2011), which are based on new links within the firm to outside actors participating in the network. After these changes to their BMs, the participants became aware of the different roots of their value creation and delivery processes; consequently, a new commitment for learning and innovation to pursue sustainability emerged.

Table 5. Changes in BMs of participants –Production companies

BUSINESS MODEL	BETABOILER		
	Before network participation	**Changes**	**After network participation**
Value proposition	Production of boilers for residential and industrial use	R&D devoted to refining technologies to improve efficiency of products, low noise and maximum security	Production of high quality sustainable boilers suitable for (i) producing energy from renewable sources and (ii) minimizing the environmental impact of emissions
Value capture	Cost control for production and pricing its customer service	Partnership to develop technologies for modulating energy delivery and offer a high quality sustainable product	Premium price for the boilers related to their ability to use of green energy and to minimize emissions and energy waste
Value creation and delivery	Production using extant technology know-how and minimizing production costs	Knowledge acquisition to produce sustainable value, delivered along the value chain, as it involves both input and output resources	Products developed that have sustainable input (renewable resources) and output (electrical and thermal energy)

BUSINESS MODEL	ELECTRA		
	Before network participation	**Changes**	**After network participation**
Value proposition	Production and sale of high quality alternators and rotating welders	Products that use renewable resources and produce clean energy	Production of the best electric rotating machines and the most efficient solutions in energy transformation
Value capture	Leadership position in the production of alternators and rotating welders	Joint engineering with partners leads to technology suitable for renewable resources. Partnership for production of LED technologies	Repositioning of leadership, gaining market share in sustainable energy (wind turbines and LED lamps), where profit margins are growing
Value creation and delivery	Premium price position in the market for rotating welders	Network project design to match sustainability needs and minimize environmental impact gaining acceptance from communities sensitive to green energy	Economic value is created for the company, which benefits from increasing profit margins, while environmental value is created and delivered to communities through reduction in environmental impact

Table 5. Changes in BMs of participants – Service companies

BUSINESS MODEL	GREENEN		
	Before network participation	**Changes**	**After network participation**
Value proposition	Production and delivery of electricity from renewable sources (solar energy) for residential and industrial use	Installation of photovoltaic panels in new buildings	Delivery of solar energy and installation of photovoltaic panels extends to new sites regardless of the annual solar radiation
Value capture	Pression on the cost of production; capturing value by minimizing the cost of solar energy delivery	Integration of photovoltaic panels with technologies of other partners to expand the market and encourage the installation of photovoltaic panels	Value captured from installation of photovoltaic panels at new sites owing to special software that drives the module orientation to maximize efficiency
Value creation and delivery	Purchasing solar energy from small and medium producers and selling it to the final consumer	Geographical market enlargement for use of solar panels	Increase in potential customers for the company and greater efficiency in solar energy consumption for society

BUSINESS MODEL	SAVEN		
	Before network participation	**Changes**	**After network participation**
Value proposition	Implementation and certification of energy delivery technologies in private and industrial buildings	Changes in implementation to induce efficient energy use	Optimizing the energy consumption of all users in a simple, intuitive, and versatile manner
Value capture	Specific competencies of installation and certification of complex and integrated energy technologies	Development of competencies to meet network needs of certification	New acquired ability to install and certify sustainable technology increases customer attraction and consolidates premium price position
Value creation and delivery	Value created through joint commission with constructors by providing specific competencies of energy technologies	Partnership useful in allowing the extension of its business using technologies based on renewable energy	Construction features and sustainability reach high-end market position and higher level of prices. Consumers receive their cost of investment in energy savings, with positive environmental impact

We can interpret such changes in each BM according to the archetypes of BM dynamics identified by Cavalcante et al. (2011) as follows. BM *creation* is what occurs with the implementation of the initial processes for business operations due to a new business idea. BM *extension* is what emerges with addition and/or expansion of activities or existing core processes of an extant BM. BM *revision* is what occurs when a new BM replaces the older one. BM *termination* involves the abandoning of an existing BM and the closure of a business unit or the company itself.

In some cases (Electra, GreenEn and SavEn), network participation implies an *extension* of existing BMs due to the knowledge combination arising within the network, which allows each partner to maintain its previous BM, while developing a new approach to complete or complement it. For example, network participation enables Electra to extend its production from alternators and rotating welders to LED lamps. This extension of BM requires change in previous production and commercial activities, resulting in an evolution of the business practices of the company.

For BetaBoiler, its existing BM undergoes a *revision* due to innovations from the acquired resources within the network. BetaBoiler substitutes its production of traditional boilers with high quality sustainable boilers (and related services) suitable for (i) producing energy from renewable sources and (ii) minimizing the environmental impact of emissions. Such changes, based on an innovative technology (the hydrogen cogenerator), allows the company to offer a new product reaching a different target customer who is sensitive to issues of sustainability. Revising the BM involves more substantial changes than BM extension: for BetaBoiler, transitioning to the new technology involved several significant challenges, requiring not only evolution but also a radical transformation of core production and commercial processes, increasing its dependence on the network.

Cavalcante et al. (2011) opine that such changes may be uncertain in results and ambiguous in pattern, also because the companies did not follow a blueprint for BM innovation (Roome and Louche, 2016).

The GE case study shows that new forms of interdependencies arising within the network and are strong drivers of BM extension that affect BM dynamics. Once a company participates in the network activities, the gradual increase in mutual dependence binds them to each other, and consequently, they must follow the evolution of the network. Such a dynamic requires firms to manage their BM dependence on that of other network members, which results in further changes to the way they do business, influences their vision, commitment to innovate, and seeking opportunities.

7. Conclusion

Drawing on the RDT, the study contributes to the literature by offering empirical evidence into the impact of network participation for sustainability on the BMs of participants.

We investigate these impacts are as changes in the three main elements of the BM concept: value proposition, value capture and value creation and delivery.

The evidence shows that networks enable the achievement of sustainability aims, solving resource dependency on the environment. However, new resource dependencies emerge on the network partners and on the network itself. Therefore, a new dependency substitutes the current one but at a much higher level. Such processes link with the dynamics of the participants' BMs, which extend of or revise as per their involvement in the network and its scope of sustainability.

7.1. Implications for practice

The analysis offers some interesting practical insights.

Companies involved in partnerships for sustainability need to be aware that network participation may result in significant consequences for the design and functioning of their BMs; in particular, they should have the ability to extend and even to revise it to pursue sustainability.

Furthermore, network participation fosters new dependence patterns that evolve over time according to network goals. Therefore, managers should be ready to handle new dependencies on other partners and from the network itself, which requires different arrangements and mechanisms from those implicit in relationships with external subjects.

When partners must collaborate closely, they must address their selection process and network governance. Our case study shows that the network management committee reserves constant attention for these vital issues. Scouting for new suitable partners and selecting them is relevant for orienting the value proposition of the network toward sustainability and meeting eventual resource dependency on the environment.

7.2 Study limitations and suggestions for further research

This study suffers from two main limitations: although our case study is a ‘critical case study’ (Yin, 2003), it remains a single example. We hold that case studies in different contexts in different industries and network types are necessary for further validation.

First, our case study considers the energy sector, in which sustainability is a core topic due to environmental issues resulting from increasing energy demand. Future research could extend this analysis to other industries.

Second, this study examines a type of network in which companies attempt to satisfy specific resource dependencies (technology know-how, market competencies and financial skills). Different type of networks, for example, among competitors (in business to business or in business to consumer), could reveal different dynamics and impacts on BMs. Further research could then extend this analysis to different types of networks.

References

Abulfotuh F. 2007. Energy efficiency and renewable technologies: the way to sustainable energy future. Desalination. 209(1), 275–282.

Baumert, K.A., Herzog, T., Pershing, J., 2005. Navigating the Numbers: Greenhouse Gas Data and International Climate Policy. World Resources Institute.

Baden-Fuller, C., Mangematin, V., 2013. Business models: A challenging agenda. Strateg. Organ. 11, 418–427.

Baines, T., Lightfoot, H., Evans, S., Neely, A., et al., 2007. State-of-the-art in product service systems. Proc. Inst. Mech. Eng. J. Eng. Manuf. 221, 1543–1552.

Bocken, N., Short, S., Rana, P., Evans, S., 2014. A literature and practice review to develop sustainable business model archetypes. J. Clean. Prod. 65, 42–56.

Breuer, H., Lüdeke-Freund, F., 2014. Normative Innovation for Sustainable Business Models in Value Networks. Paper presented at the 25th ISPIM conference ‘Innovation for Sustainable Economy and Society’, Dublin, Ireland.

Cai, S., Yang, Z., 2008. Development of cooperative norms in the buyer–supplier relationship: the Chinese experience. J. Supply Chain Manag. 44(1), 55–70.

Cavalcante, S., Kesting, P., Ulhøi, J., 2011. Business model dynamics and innovation: (Re)establishing the missing linkages. Manag. Dec. 19, 1327–1342.

Clarke, S., Roome, N., 1995. Managing for environmentally sensitive technology: networks for collaboration and learning. Tech. Anal. Strateg. Manag. **7**, 191–206.

Clarke, S., Roome, N., 1999. Sustainable business: learning-action networks as organizational assets. Bus. Strateg. Environ. 8, 296.

Dangelico, R.M., Pontrandolfo, P., 2015. Being 'green and competitive': the impact of environmental actions and collaborations on firm performance. Bus. Strateg. Environ. 24, 413–430.

Eisenhardt, K.M., 1989. Building theories from case study research. Acad. Manag. Rev. 14, 532–550.

Elfring, T., Hulsink, W., 2007. Networking by entrepreneurs: patterns of tie-formation in emerging organizations. Organ. Stud. 28, 1849–1872.

Fourie, A., Eloff, T., 2005. The case for collective business action to achieve systems change. *J* Corp Citizsh Summer. 2005, 39–48.

Gray, B., Stites, J.P., 2013. Sustainability through partnerships: Capitalizing on collaboration. Network for Business Sustainability.

Gulati, R., Sytch, M., 2007. Dependence asymmetry and joint dependence in interorganizational relationship: Effects of embeddedness on manufacturer's performance in procurement relationships. Admin. Sci. Quart. 52, 32–69.

Hart, S.L., Milstein, M.B., 2003. Creating sustainable value. Acad. Manag. Exec. 17, 56–69.

Hillman, A.J., Withers, M.C., Collins, B.J., 2009. Resource dependence theory: A review. J. Manag. 35, 1404-1427.

Hirschman, E.C. 1986. Humanistic inquiry in marketing research: Philosophy, method, and criteria. J. Market. Res. 23, 237–249.

Jack, S.L. 2005. The role, use and activation of strong and weak ties: A qualitative analysis. J. Manag. Stud. 42, 1233–1259.

Jeswani, H.K., Wehrmeyer, W., Mulugetta, Y., 2008. How warm is the corporate response to climate change? Evidence from Pakistan and the UK. Bus. Strateg. Environ. 17, 46–60.

Jones, C., Hesterly, W.S., Borgatti, S.P., 1997. A general theory of network governance: exchange conditions and social mechanisms. Acad. Manag. J. 22, 911–945.

Jones, C.A., Levy, D., 2007. North American business strategies towards climate change. Europ. Manag. J. 25, 428–440.

Lincoln, Y.S., Guba, E.G., 1985. Naturalistic Inquiry. Sage Publications, Newbury Park, CA.

Loorbach, D., van Bakel, J.C., Whiteman, G., Rotmans, J., 2010. Business strategies for transitions towards sustainable systems. Bus. Strateg. Environ. 19, 133–146.

Lowitt, E., 2013. The Collaborative Economy. Jossey-Bass (Wiley), San Francisco.

Mårtensson, K., Westerberg, K., 2016. Corporate environmental strategies towards sustainable development. Bus. Strateg. Environ. 25, 1–9.

Marques, L., Ribeiro, J. A., Scapens, R.W., 2011. The use of management control mechanisms by public organizations with a network coordination role: A case study in the port industry. Manag. Acc. Res. 22, 269–291. http://dx.doi.org/ 10.1016/j.mar.2011.09.001.

McGuire, M., Agranoff, R., 2011. The limitations of public management networks. Pub. Admin. 89, 265–284.

Omer, A.M. 2008. Energy, environment and sustainable development. Renew Sustain. Energy Rev. 12, 2265–2300.

Osterwalder, A., Pigneur, Y., 2005. Clarifying business models: Origins, present, and future of the concept. Communications of the Association for Information Systems. 16, 1–25.

Pfeffer, J., Salancik, G.R., 1978. The External Control of Organizations: A Resource Dependence Perspective. Harper & Row, New York.

Pfeffer, J., Salancik, G.R., 2003. The External Control of Organizations: A Resource Dependence Perspective. Stanford University Press, Stanford, CA.

Provan, K.G., 1984. Interorganizational cooperation and decision-making autonomy in a consortium multi-hospital system. Acad. Manag. Rev. 9, 494–504.

Provan, K.G., Kenis, P., 2008. Modes of network governance: structure, management, and effectiveness. J. Public Adm. Res. Theory 18, 229–252. http://dx.doi.org/10.1093/jopart/mum015.

Roome, N., Louche, C., 2016. Journeying toward business models for sustainability: A conceptual model found inside the black box of organizational transformation. Organ. Environ. 29, 11–35.

Schaltegger, S., Lüdeke-Freund, F., Hansen, E.G., 2012. Business cases for sustainability: The role of business model innovation for corporate sustainability. Int. J. Innov. Sust. Dev. 6, 95–119.

Schlör, H., Fischer, W., Hake, J.F., 2015. The system boundaries of sustainability. J. Clean. Prod. 88, 52–60.

Schnittfeld, N.V., Busch T., 2015. Sustainability management within supply chains – A resource dependence view. Bus Strateg. Environ. 25, 1–18, doi: 10.1002/bse.

Shafer, S.M., Smith, H.J., Linder, J.C., 2005. The power of business models. Bus. Horizons. 48, 199–207.

Stubbs, W., Cocklin, C., 2008. Conceptualizing a sustainability business model. Organ. Environ. 21, 103–127.

Sullivan, D.M., Ford, C.M., 2013. How entrepreneurs use networks to address changing resource requirements during early venture development. Entrep. Theory. Pract. 1042–2587.

Svendsen, A.C., Laberge, M., 2005. Convening stakeholder networks. J. Corp. Citizsh. 2005, 91–104.

Svensson, G., Wagner, B., 2011. Transformative business sustainability: multi-layer model and network of e-footprint sources. Europ. Bus. Rev. 23, 334–352.

Teece, D.J., 2010. Business models, business strategy and innovation. Long Range Plan. 43, 172–194.

Van Kleef, H., Roome, N., 2007. Developing capabilities and competence for sustainable business management as innovation: A research agenda. J. Clean. Prod. 15, 38–51.

Wells, P. 2008. Alternative business models for a sustainable automotive industry, in: Tukker, A., Charter, M., Vezzoli, C., Stø, M. A. E., (Eds.), Perspectives on Radical Changes to Sustainable Consumption and Production. Greenleaf, Sheffield, England, pp. 80–98.

Yin, R.K. 2003. Case Study Research: Design and Methods, 2nd ed. Sage, Newbury Park, CA.

Yunus, M., Moingeon, B., Lehmann-Ortega, L., 2010. Building social business models: Lessons from the Grameen experience. Long Range Plan. 43, 308–325.

Zander, S., Trang, S., Kolbe, L. M., (2016). Drivers of network governance: A multitheoretic perspective with insights from case studies in the German wood industry. J. Clean. Prod. 110, 109–120.

Zott, C., Amit, R., Massa, L., 2011. The business model: Recent developments and future research. J. Manag. 37, 1019–1042.