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Research article

Towards territorial product-service systems: A framework linking resources, networks and value creation

Estephania Delgadillo[a,*], Tatiana Reyes[a], Rupert J. Baumgartner[b,c]

[a] InSyTE, University of Technology of Troyes, 12 rue Marie curie 10004, Troyes, France
[b] Institute of Systems Sciences, Innovation and Sustainability Research, University of Graz, Merangasse 18/I, 8010 Graz, Austria
[c] Christian Doppler Laboratory for Sustainable Product Management, University of Graz, Merangasse 18/I, 8010 Graz, Austria

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ABSTRACT

While many models for sustainable product-service systems (PSS) integrate the multi-actor perspective, few provide insights on how the territory in which actors implement the system influences its sustainability. This paper explores the implementation of a territorial PSS at a city or regional scale as a means to structuring value networks and enhancing its sustainability potential. The research combines a multidisciplinary literature review with two exploratory sustainable PSS cases in packaging and cloth baby diapers. The paper proposes a framework explaining how sustainable PSS providers develop territorial networks that consider a diversity of actors from civil, industrial, and public spheres to mobilize resources for value creation at organizational, network, and territorial levels. It identifies contextual factors, such as proximity, social embeddedness of relations, and the visions that influence the consolidation and sustainability of the territorial PSS networks. The empirical cases show the development of territorial networks enhances embed social relations among actors and enables the sustainable PSS concept to adapt to locally articulated sustainability principles and priorities. The paper discusses the implications of this approach for PSS for sustainability managers and designers. The study fills a gap by showing the importance of integrating a diversity of territorial actors as a pre-condition for PSS to contribute to the sustainability transitions and resilience of territories. Future research may validate the proposed framework and focus on identifying opportunities and barriers for the territorial PSS approach in different contexts such as industries and company sizes.

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1. Introduction

Sustainability has become increasingly crucial for long-term business success (Bertoni, 2019; Metz et al., 2016). Product-service systems (PSS) are integrated offerings of products and services which can bring innovative potential, securing competitiveness while at the same time allowing companies to address environmental concerns (Annarelli et al., 2020). PSS are value propositions oriented towards satisfying users through the delivery of functions or performance instead of products (Ceschin and Gaziulusoy, 2016), e.g., from selling cars to selling mobility solutions, from selling light bulbs to selling lighting solutions. Since manufacturers retain the ownership of the products and deliver performance to their customers, they are economically incentivized to optimize their resource utilization: improving resource efficiency; increasing product lifetime, or reducing the total number of products needed to provide that performance (Tukker, 2015, 2004; Vezzoli et al., 2015).

Despite the sustainability potential of PSS, recent studies highlight that these offerings are not always sustainable (Boucher et al., 2016; Doualle et al., 2016; Pigosso and Mcaloone, 2016). Companies might adopt the business model for their economic interest, without internalizing environmental or social concerns. Thus, for PSS to contribute to the transition towards sustainability, they need to be carefully designed, developed, and delivered for this purpose (Bertoni, 2019; Boucher et al., 2016; Ceschin, 2013).

Sustainability within the PSS field is primarily associated with resource efficiency and lifecycle assessment (Cook, 2014). While gains in resource productivity are essential for the sustainability of the offering, sustainable PSS design should integrate a systemic approach including multiple stakeholders to attain a range of environmental and social performances (Kristensen and Remmen, 2019; Reim et al., 2015; Vezzoli et al., 2015). At present, stakeholder integration in PSS design and development focuses on customers, providers, and other value chain actors, such as suppli-

* Corresponding author.
E-mail address: estephania.delgadillo@utt.fr (E. Delgadillo).

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ers (Sassanelli et al., 2019, 2021; Pezzotta et al., 2018). To maximize sustainability benefits, however, stakeholder integration needs to extend beyond value chain actors and incorporate, governments, communities, and society at large (Ceschin, 2013; Costa Fernandes et al., 2020; du Tertre et al., 2017). Therefore, we assume that companies must question their territorial anchorage for PSS to develop its social and environmental benefits and integrate a more diverse range of stakeholders in the design and implementation (Buclet, 2014).

In this paper, the authors investigate PSS for territorial sustainability in which the PSS works as an innovation for territorial enhancement. PSS innovations have an high potential for driving the territorial sustainability transitions. They can enhance the creation of territorial cooperative systems in which the actions of economic actors can converge with the interests of public actors and communities (ADEME et al., 2019; Hofmann, 2019). This approach assumes that PSS sustainability cannot be separated from the sustainability transitions of the territory(ies) where they are implemented. In this study, territories are not only "neutral" locations where economic activities are developed; they are considered as PSS co-constructors and resource providers (Allais and Gobert, 2019). The territory is an organization inscribed in space and socially constructed (Pecqueur, 2014). It is a socio-cultural construct maintained and renewed through history (François et al., 2006) in which social, cultural, ecological, productive, and technological dynamics occur (Pereno and Barbero, 2020). Thus, the territorial anchorage of a PSS approach studies the interactions of stakeholders collaborating in the design and implementation of a project as part of a larger socio-spatial and temporal process, which have not been seriously considered in most PSS for sustainability studies so far. Although a PSS for territorial sustainability can be designed and implemented at different scales (from a local to global scale, from a regional to a national and interregional scale), in this study we focus in the development of PSS at a city or regional scale. To this end, we aim to understand how stakeholder relations are orchestrated to respond to locally constructed sustainability issues and generate sustainable value for them and their territory. The territorial approach of our work is important as it represents the shift towards a more strategic vision of design, which highlights the need to foster a systemic approach, which does not replace the product and service dimensions but integrates it to overcome the insular concept of innovation (Brown et al., 2021; Ceschin and Gaziulusoy, 2016; Pereno and Barbero, 2020).

Some approaches to applying the territorial approach and the importance of situatedness in the design and development of PSS can be found in the literature. Allais and Gobert (Allais and Gobert, 2016a; Gobert and Allais, 2017), show that the integration of territorial resources played a crucial role in the design and implementation of sustainable offerings. At the same time, Buclet (2014) develops a typology of PSS which responds to the consequences of the PSS in regard to the sustainable development of the territory. Cook (Cook, 2018, 2014) explores how the process of introduction and embeddedness of the PSS takes place in specific spaces and its plurality of meanings, as different actors encounter it. Vezzoli et al. (2018) explore the development of localized PSS to create local value and employment through decentralized production and consumption systems. Du Tertre et al. (2017) study the development of cooperative territorial ecosystems through PSS and the creation and sharing of the value benefits at a territorial level.

The territorial approach for PSS is highlighted as important for implementing offerings that contribute to the sustainability transitions of territories. However, there is no formalized framework that provides insights into how PSS providers develop relations between stakeholders in a territory and how they mobilize and create resources and generate sustainable value in different levels. A majority of PSS approaches addressing multi-stakeholders perspectives focus on the study of dyadic relationships, higher levels of analysis such as the network and the territorial systems levels have not been completely explored (Garcia Martin et al., 2019). Thus, our research and approach contributes to the understanding of stakeholder interactions from a multi-level perspective while providing insights on the socioeconomic factors that influence the process of creating a territorial network. We assume that providing PSS network designers with an initial descriptive framework can lead to higher reflections on how can they trigger territorial synergies and value creation at different levels that influence the success of the innovations.

Accordingly, the research question of this paper is:

- How can PSS providers develop territorial networks to mobilize and create resources for generating sustainable value?

We propose a conceptual framework, built from concepts on strategic management, geography, social sciences, and systems innovation literature. First, theoretical discussions on theories' key elements and their interaction for understanding the implementation of a territorial PSS innovation are summarized. Second, the analytical elements from the literature are further explored through the study of two PSS cases and a final conceptual framework is then synthesized into a proposal.

Following this introduction, the paper includes the following sections: Section 2 presents a literature review on the concepts of territory, embeddedness, actor networks and value creation related to PSS discipline. Section 3 presents the methods used on the research. Section 4 presents the first version of the framework retrieved from the literature review and the results of the exploratory territorial PSS studies. Section 5 discusses the main findings and presents a refined version framework, while Section 6 provides concluding along with some suggestions for future work.

2. Literature review

In the following section, the theoretical background used in this study is presented to position our research. The literature review introduces the territorial approach to PSS for territorial sustainability, sustainable value creation concept and the resource concept in the literature. It was conducted through a multidisciplinary focus.

The main theoretical foundations in this study include the theory of competitive advantage of interconnected firms, the French school of the territory, the theory of social embeddedness and the innovation systems perspective. The competitive advantage of interconnected firms theory allows an understanding of the need of companies to connect with other actors to create value (Lavie, 2006). Moreover, scholars highlight that inter-organizational relations are influenced by social and geographical factors (Köhler et al., 2019). Thus, we use Granovetter's (Granovetter, 1985) theory of embeddedness and the territory (Pecqueur, 2006) to explain how relations in a sustainable PSS are influenced by the different social interactions (socioeconomic, socio-political, etc.) that happen in particular spaces, which are often overlapping and intertwined (Murphy, 2015). Within the paradigm of systems innovation, PSS for sustainability is understood as a non-linear and iterative learning process, which requires intense communication and collaboration between different actors in order to take into account the multi-dimensional aspects of innovation (Van Lancker et al., 2016).

Innovation is defined differently across disciplines. For example, in engineering design innovation is related to the novelty of product content and function, whereas in business and management disciplines innovation is focused on the effect of products and its relations to markets and actors engaged (Isaksson et al., 2019). Our

work is more focused on management and sustainability transition studies, thus, the same PSS can be considered an innovation when deployed in different territories, even if the technology remains the same. From this perspective, we argue that a sustainable PSS is not a technological innovation per se (Ceschin, 2014). PSS include technological artefacts, but the innovative element is mainly related to the social dimension and how local actors offer and introduce solutions to the territory to satisfy a societal need, e.g., mobility, housing, health, etc.

The literature review presented below is the base for the conceptualization of a framework (see more Section 4.1) intending to explain how collaborative territorial networks are formed and mobilize different levels of resources to address local sustainability challenges and generate sustainable value.

2.1. Defining the territory in sustainable product-service systems networks

Companies have a dual need to form and manage external networks which produce value, as well as using their internal capabilities to profit from resources available through these networks (Huggins and Johnston, 2010; Lavie, 2006). When actors are connected in networks, they can access resources from their partners and new resources dependent on the network's structure, can emerge (Lavie, 2006). The consolidation of the cooperative relations between companies leads to their mutual specialization (e.g., co-design, co-production, co-evaluation, etc.). Through their complementarity, companies ensure the possibility of developing high-value-added products and services (Vaileanu-Paun and Boutillier, 2012).

In a PSS, the creation of a network to design and implement the offering is driven by a vision, which represents the final goal to be achieved by the company through the development of a PSS innovation for sustainability (Ceschin, 2013). The vision from a sustainability perspective should be crafted as a hybrid strategy, which requires companies to be ready and willing to make efforts that match both sustainability and competitive requirements (Baumgartner and Ebner, 2010). Accordingly, PSS providers need to expand their networks beyond their value chains towards including relevant actors from the science, policy and societal domains (e.g., research centers, governmental institutions, NGOs, special interest groups, etc.) (Ceschin, 2013; Raven, 2005). The mixture of formal and informal relations with other actors, specifically related to knowledge-sharing relations, such as universities, R&D labs, and other firms, is vital from a systemic approach (Huggins and Johnston, 2010). The formalized PSS network structure is intentionally created and has clearly identifiable members that design and develop a functional offering. This formal network in PSS, similarly to the technological innovation system networks, enables actors to coordinate their strategies and organize collective action (Musiolik et al., 2018, 2012).

In this study, the space is called territory. The concept of territory is polysemic and often refers to the formal categories of pregiven geo-political boundaries such as cities, regions or nations. Based on the definition of Pecqueur (2008), we define the PSS territory as *"the network of actors located within a defined geographical space (even if its boarders fluctuate) intending to identify and solve a production problem seen or felt as being shared by the stakeholders"*. Territories are dynamic open systems that interconnect to other systems, which allows them to export and import resources needed for innovation and implementation of PSS (Buclet, 2014).

A territory-based sustainable PSS intends to acknowledge the importance of shortening the distance between spaces of production and consumption. In addition, this approach provides a pertinent dimension for framing issues related to sustainable development that consider the design and implementation of solutions on the scale of specific territorial perimeters such as cities and regions (du Tertre et al., 2017). Acknowledging this space allows the material impact of the interactions between industrial systems, nature, and society to be captured (Buclet and Donsimoni, 2018). Thus, the vision guiding the collaboration activities in the PSS network should be aligned to sustainability issues identified at a territorial level (e.g., local employment, waste management). From this perspective, the PSS innovation is considered central to the ecological, societal, and economic sustainability transition of the territory where it is implemented.

Building a sustainable and territorial PSS network results in developing a community structured by interactions based on reciprocal commitments, exchanges of information knowledge, and the pooling of resources that enable the development and sustainability of the PSS network (ADEME et al., 2019). The network structure and role of actors are continually evolving (Ceschin, 2013).

In our current production and consumption systems, the PSS territory might transcend a single geographical space, as these usually integrate actors and resources (e.g., raw materials, products, energy and knowledge) coming from different scales and territories (Allais and Gobert, 2019; Tyl et al., 2015a). Thus, based on the concepts of multi-actor (Buclet, 2011b) and multi-local systems (Tyl et al., 2015a), we conceive PSS strategies as multi-territorial (Allais and Gobert, 2019) (Fig. 1).

2.2. Social embeddedness shaping socio-spatial interactions

Territorial stakeholder networks have been extensively studied by industrial symbiosis and industrial ecology disciplines , which seek and implement synergies between stakeholders to reduce the environmental impacts of human activities on ecosystems (Buclet, 2011b) . While geographical proximity often facilitates symbiotic relations between organizations, it is often not a sufficient condition (Ashton and Bain, 2012). The symbiosis occurs in a particular territory and needs to consider social practices (Boons and Howard-Grenville, 2009; Granovetter, 1985) cultural norms, the regulatory environment, and the actions of stakeholders (Brullot et al., 2014; Spekkink and Boons, 2016). The collaborative capacity of stakeholders can emerge before or during the collaborative activities (Spekkink, 2015, 2013). However, the collaborations between actors from different industries that have never collaborated before might emerge through the implementation of the PSS innovation (Hein et al., 2018). Thus, understanding the enablers for forming and collaborating in a territorial PSS network is highly relevant for understanding how sustainable PSS innovations are developed and embedded in localized spaces (Buclet, 2014; Cook, 2018).

From a dyadic and network perspective, the relations in a PSS exist along a theoretical continuum from purely market-based transactions to purely socially embedded relations, based on the exchange of intangible resources that are less fungible, such as asking for advice or favors that are not formalized in the shape of contracts (Ashton and Bain, 2012). The embeddedness theory argues that economic action is embedded in ongoing social ties that can facilitate or derail exchanges between actors (Granovetter, 1985). This broader contextualization of the organizational activities draws attention to how social structures and processes enable, and also constrain, activities (Boons and Howard-Grenville, 2009; Dacin et al., 1999; Uzzi, 1997). An actor becomes embedded through multiple types of repeated interaction with other actors, during which the actor's behavior is influenced by relationships with others, and the norms that are shared within the group. Actors, relationships, and networks may be embedded through different mechanisms or dimensions: structural; cognitive; cultural; political (Zukin and DiMaggio, 1990); spatial and temporal (Boons and Howard-Grenville, 2009). Structural embedded-

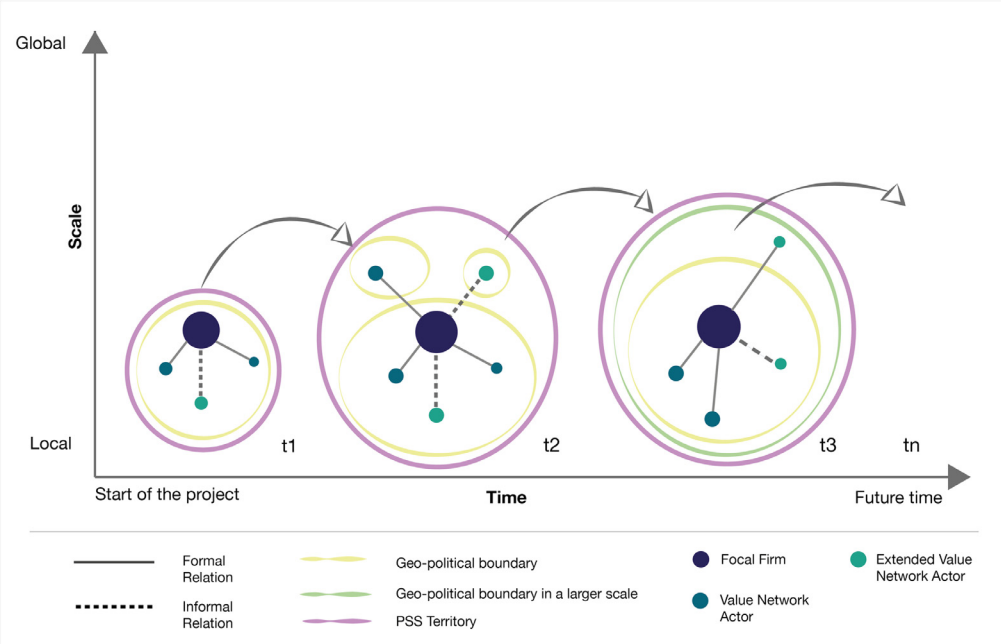

Fig. 1. Example of a multi-spatial, scalar and temporal PSS territory.

ness is related to the morphology of the network and the position of actors in it (who is connected to whom and how). It is composed of trust, fine-grained information transfer and joint problem-solving skills at a dyadic and network level (Uzzi, 1997). Cognitive embeddedness comprises shared understanding of certain situations (Ashton and Bain, 2012), here it relates to aspects of PSS such as the vision, functioning, practices, resources, and processes. Cultural embeddedness represents the different practices, norms, routines at a territorial, industry, societal, and system level (Ashton and Bain, 2012). Political embeddedness in a PSS applies to the distribution of power among actors in the network (Zukin and DiMaggio, 1990) and the influence of policies and nongovernmental organizations over corporate activities (Boons and Howard-Grenville, 2009). Spatial and temporal embeddedness draw attention to how geographical proximity and time influences the interactions between actors (Boons and Howard-Grenville, 2009). Through these lenses we hope to capture the essence and quality of PSS relationships.

2.3. Stakeholders and resources

The collaborative activities by the PSS value network strategically create and shape a supportive system of resources in the design and implementation of PSS innovations. Identifying the stakeholders' relations is an essential first step to understand the constellation of stakeholders influencing the success of the innovation. Stakeholders are defined as (groups of) actors who hold interests regarding the issue at stake (Freeman and Reed, 1983). Frooman (1999) extends the understanding of stakeholder relationships by emphasizing indirect relationships between stakeholders and the focal company. From this perspective, we define PSS stakeholders as the actors directly or indirectly involved the design and implementation of the PSS and influence the PSS themselves. In a PSS, stakeholders deploy resources for value creation through value networks. Feng (2013) defines a stakeholder value network as *"a multi-relational network consisting of a focal organization, the focal organization's stakeholders, and the tangible and intangible value exchanges between the focal organization and its stakeholders, as well as between the stakeholders themselves"*. Stakeholder value networks

Table 1
Example of PSS stakeholders. Adapted from Brezet and Van Hemel (1997), Tyl et al. (2015b).

Formal Network Actors	Extended Network Actors
PSS provider	Competitors
Final customer	Industrial organizations
Industrial customer	Governmental authorities
Distributors	Financers and insurance
Suppliers	Chamber of commerce and industry
Recyclers	Innovation center
Waste and treatment company	University research center
Subcontractors	Consumer organization
	Civil pressure groups / NGO's
	Trade unions

are not limited to economic transactions. They can represent social exchanges in general due to their theoretical grounding in social exchange theory and resource dependence theory (Cameron et al., 2011). The stakeholder value network focuses on understanding how the focal organization and its stakeholders provide resources to each other in a specific collaboration. They are used for comprehending the distribution of power among industrial symbiosis stakeholders (Hein et al., 2017) and in PSS, for highlighting how PSS providers seek to be the central integrator of resources and to increase the power in the network (Salonen and Jaakkola, 2015).

For identifying stakeholder and value networks, we use the PSS the stakeholder classifications of eco-innovation from Brezet and Van Hemel Brezet and Hemel (1997) and further adapted by Tyl et al. Tyl et al. (2015). In addition, the literature identifies two groups of stakeholders taking part in the PSS value network (Table 1), namely: PSS formal network actors, which includes the PSS provider and value chain actors, and PSS extended network actors including all relevant types of actors capable of protecting, supporting and fostering the PSS innovation in the different transition phases (Ceschin, 2013).

In stakeholder value networks, economic and social exchanges are characterized by value flows between stakeholders, which describe different types of resources exchanged between the focal organization and its stakeholders. The resources use optimization

can be achieved through the new stakeholder configurations lead by the converge of interests on optimizing the system. Thus, the successful implementation of the PSS relies on the capability of PSS designers to create new stakeholder configurations and develop an integrated system of products, services, and communication that is coherent with the medium-long perspective of sustainability, while being economically feasible and socially acceptable today (Manzini and Vezzoli, 2003).

In a PSS network, stakeholders create and deploy resources at organizational, network and territorial levels. The resource-based view literature defines *organizational resources* as all tangible and intangible assets, capabilities, organizational processes, firm attributes, information, knowledge, etc., controlled by a firm (Wernerfelt, 1984). Some of these resources (but not all) are central for implementing strategies for the competitive advantage of firms (Barney, 1991) that improve their efficiency and effectiveness (Musiolik et al., 2012). Most of the time, the tangible resources of organizations are visible and can be quantified. They relate mainly to the equipment used and the infrastructure, both physical (e.g., access to natural resources) and technological (e.g., sophisticated mainframes or advanced machinery) (Durnev et al., 2004). At the same time, intangible resources are deeply rooted in a firm's history and encompass immaterial assets such as patents, know-how, firm culture, reputation, partnerships, etc. (Musiolik et al., 2012). Immaterial assets are valuable differentiating factors and sources of competitive advantage; however, their management is still minimal and fragmented (Fustec et al., 2011; Gobert and Allais, 2017).

In PSS networks firms get access to the resources of their partners, while, at the same time, resources are created through the interactions between actors (Lavie, 2006). The *network resources* are assets that can be defined as of strategic value for the network members, such as trust among members, network culture, a common understanding of goals, a specific model of network governance, and the network's reputation (Musiolik et al., 2012).

Territorial resources are specific resources that are dependent on the geographical or production environment, in the sense of place, of history and culture, which impact how resources are valued. These resources follow the logic of access rather than property (Colletis and Pecqueur, 2018), and are tangible and intangible. Territorial resources can be classified as: natural; built environment/artificial; human; organizational; relational; financial; institutional/political; and cultural (Camagni, 2008; Delgadillo Jaime et al., 2019; Moine, 2006). In addition, territorial resources are mobilized according to a logic of endogenous territorial development, paying attention to territorial specificities and projects carried out locally (Colletis and Pecqueur, 2018).

2.4. Sustainable value creation

Value creation is a construct used for two main purposes, either describing a process showing how value is created by companies (Lepak et al., 2007) or as a component of a business model (Bocken et al., 2013). In this study we use value creation as a process, referring to the activities that a firm or organization performs to generate and transfer value. In particular, sustainable value refers to the economic, social and environmental benefits (Hart and Milstein, 2003) created by a company and its value network (Yang et al., 2017), and perceived by multiple stakeholders (Stubbs and Cocklin, 2008). Traditionally, value creation is understood through monetary trade-offs (Laukkanen and Tura, 2020), however, with firms showing more interest in responding to sustainability issues, the focus has shifted towards the integration of environmental and social elements of different actor groups (Cronin et al., 2000). This shift has resulted in an expansion of the concept of value creation to cover intangible value elements such as psychological, emotional and cognitive factors, as well as experiences (Cronin et al., 2000), and environmental conservation (Stubbs and Cocklin, 2008).

Environmental value means the business' impact on the natural environment and natural capital (Stubbs and Cocklin, 2008). Social value includes elements that society in general, or certain individuals, consider valuable, including, for example, issues related to well-being and happiness. These are often linked to psychological value elements (Den Ouden, 2011). In addition to positive value elements and increased benefits, sustainable value creation also requires the consideration and prevention of potential negative impacts, also called negative externalities (Tura et al., 2019). In a PSS, the relationship between consumers and producers is significantly altered, as the service has to be delivered directly to the costumer and user. Thus imposing new constraints of geographical and cultural proximity (Allais and Gobert, 2016a). The creation and the delivery of value is highly dependent on the quality of relations between stakeholders.

From a territorial perspective, sustainable value depends, among other things, on the benefits achieved through the integration of synergies between local actors and the enhancement of positive environmental and social factors consistent with local territorial challenges (e.g. local employment, infrastructure development, the attractiveness of the local region, etc.)(du Tertre et al., 2017). In addition, in a territorial PSS, the economic value created should consider the long term objectives of strengthening individual and collective resources.

3. Methods

The design research methodology (DRM) proposed by Blessing and Chakrabarti (Blessing and Chakrabarti, 2009) was used as the main reference throughout the research. This paper present a literature-based research clarification (RC); a comprehensive descriptive study I (DSI) based on the analysis of two PSS cases. As part of the research clarification a first literature review, presented on Section 2, was conducted to develop a conceptual framework. The aim of the literature review is not to develop a best practices approach to the development of locally developed PSS offerings. It rather aims to explain the situatedness of the PSS innovation through different disciplinary lenses to advance the dialogs in the PSS sustainability studies. This approach looks at the formation of PSS networks in sustainable value creation activities and the social, spatial and temporal mechanisms that hinders or derail the network relations and its outcomes. The findings of the literature review are articulated in conceptual framework presented in Section 4.1. The framework is applied to two territorial PSS studies, and a final framework including the insights provided by the PSS cases is proposed in the discussion section.

3.1. Data collection territorial PSS studies

As part of the comprehensive DSI phase, the conceptual framework is furtherly articulated through two comprehensive PSS studies, modern cloth diapers as a service and packaging as a service. The case studies aim to validate the framework and furtherly articulate the literature with real examples. The two cases were selected considering their success on integrating territorial actors in the design and implementation of their business models for sustainability. The results from the analysis provides further insights into how the network of local actors mobilize and create resources for sustainable value creation with and for their territory. The case studies were conducted using primary and secondary data, the results were discussed with participants for feedback. Further details on the cases are presented in Sections 4.1 and 4.2. During the study interviews were conducted combined with social network mapping using the Net-Map tool. Appendix A in the Supple-

mentary Material provides a list of the main questions asked during the interviews. The Net-Map tool is an empirical research tool that combines social network and power mapping (Schiffer and Hauck, 2010). The tool enables participants to learn about their own position in the network and discuss their views with others. In the first part of the interview, participants described their role in the organization, a brief narrative of the development of the project, the challenges for the diffusion, and their vision for the sustainable PSS innovation. An initial list of key stakeholders on the design and implementation of the PSS was retrieved from the interview. PSS stakeholders were identified as actors participating and influencing the design and implementation of the PSS. In addition, we only took into consideration the actors with whom the PSS provider is directly interacting (Cameron et al., 2008).

As a second part of the interviews, researcher and participants jointly started the network mapping process on a large sheet of paper using the Net-Map tool; this was the case for the modern cloth diapers as a service. The Net-Map tool was adapted to the Miro digital platform for the interview with the packaging as a service company. This process consisted of the following steps: i) All the relevant stakeholders in the innovation implementation from the interviewee were identified. Interviewees were asked, "Who influences or is influenced by the implementation of the PSS?", the list of stakeholders extracted from the first part of the interview was presented to the participants and they choose and added other relevant stakeholders in regards to the design, experimentation, and implementation phases of the PSS. ii) Linkages of knowledge, information, money and other resources between actors were identified by the interviewees and indicated by differently colored arrowheads, which were oriented according to the direction of the flow; during the mapping actors were asked to explain the type of relationships (contractual/informal) and their perception of the relations, thus, detailed information about types of knowledge, communication, resources and embeddedness were captured. Adding actors and links whenever they came to mind was encouraged.

3.2. Data analysis territorial PSS studies

The entire interview sessions and the participatory network mapping were recorded, transcribed for narrative analysis, which was used to interpret the results from the networks. Additional information was collected through reports, and available data from the organizations websites. The analysis is conducted through five main activities: undercover the vision of the organization and contextualization within the territorial problematic; analyzing the PSS actor network (who are the key stakeholders in the PSS innovation); analyzing resource flows in value creation activities (identification of key organizational, territorial and network resources); analysis of proximity and embeddedness of actor relations influence in value creation; and a synthesis of sustainable value creation for the actors, network, and the territory. Finally, the results from the cases were presented to the organisations and discussed for evaluation.

3.2.1. Vision

The vison information was retrieved from information provided in the interviews and the reports and media news related to the studies.

3.2.2. Actor network relations and resources flow

The results from the Net-Map tool were digitalized to represent the actor connections and the different geographical scales where they operate. All of the stakeholders and relationships identified through the Net-Map tool were considered in the network analysis as it is crucial to understand the innovation from the PSS provider perspective. The sustainable value activities and benefits flow network diagrams were generated with Gephi software. The characterization of the stakeholder relations was completed with the qualitative information provided on the interviews.

3.2.3. Proximity and embeddedness of actor relations

In addition, the relations were analyzed in terms of geographical, cultural, cognitive, structural, and political embeddedness (see more Section 2.2). Geographical or spatial embeddedness was interpreted as the physical proximity between actors. The cultural embeddedness was recorded as the content of communication between actors, the sharing of values e.g., sustainability, solidarity, frequency of communication, and type of communication. Cognitive embeddedness was related to the open-mindedness to new ideas and innovations, shared mental models on benefits and functioning of the offerings. The structural embeddedness is related to the connectivity and trust among actors in the network. The political embeddedness was recorded as the power relations in the network and the influence of policies and non-governmental organizations over corporate activities.

3.2.4. Resources deployed in value creation activities and value benefits

Through a qualitative analysis of the interviews and secondary data we were able to identify key resources deployed by stakeholders for value creation activities and the resulting value benefits flows. The identified value creation activities covered design, production, distribution, use, and end-of-life of the offering. The value benefits of the activities were analyzed to identify their economic, social and environmental outcomes, in four levels organizational, customer, network and territorial. Financial and extra-financial assessment tools consider companies as systems that enable value creation through tangible and intangible resources (Fustec et al., 2011). We use the work from Fustec et al. Fustec et al. (2011) and the repository of strategic intangible resources of Cap'immateriel (ATEMIS et al., 2019) to identify the resources and value benefits at both, organizational and network levels. In these repositories organizational resources are evaluated by an associated capital (value benefits) see more in Appendix B in the Supplementary Materials. The main categories of the capitals are: financial, physical, manager, knowledge, shareholder, collaborator, organizational, territorial ecosystem, customer, digital, brand, and partnership (see more in Appendix C in the Supplementary Materials). The customer value benefits cannot be assessed trough the aforementioned repository, in order to asses we used the classification proposed by Van Halen et al. Van Halen et al. (2005) and adapted by Chou et al. Chou et al., (2015) (see more in Appendix D in the Supplementary Materials). Accordingly, the authors summarize four categories of customer value benefits: tangibles, interaction, prices, and sustainability. In addition, to describe the territorial benefits we took the classification of territorial resources presented in (Delgadillo Jaime et al., 2019) and based in the work of Camagni (2008) and Moine (2006) which categorizes resources in natural, built environment, human, organizational, relational, financial, institutional and cultural. Appendix E in the Supplementary Material summarizes the description of the territorial capitals.

4. Results

4.1. Conceptual framework: territorial PSS networks for sustainable value creation

Starting from the main elements identified from the theoretical foundations identified in the literature review (Section 2), we propose a conceptual framework that provides a comprehensive description on the development of territorial value networks in the

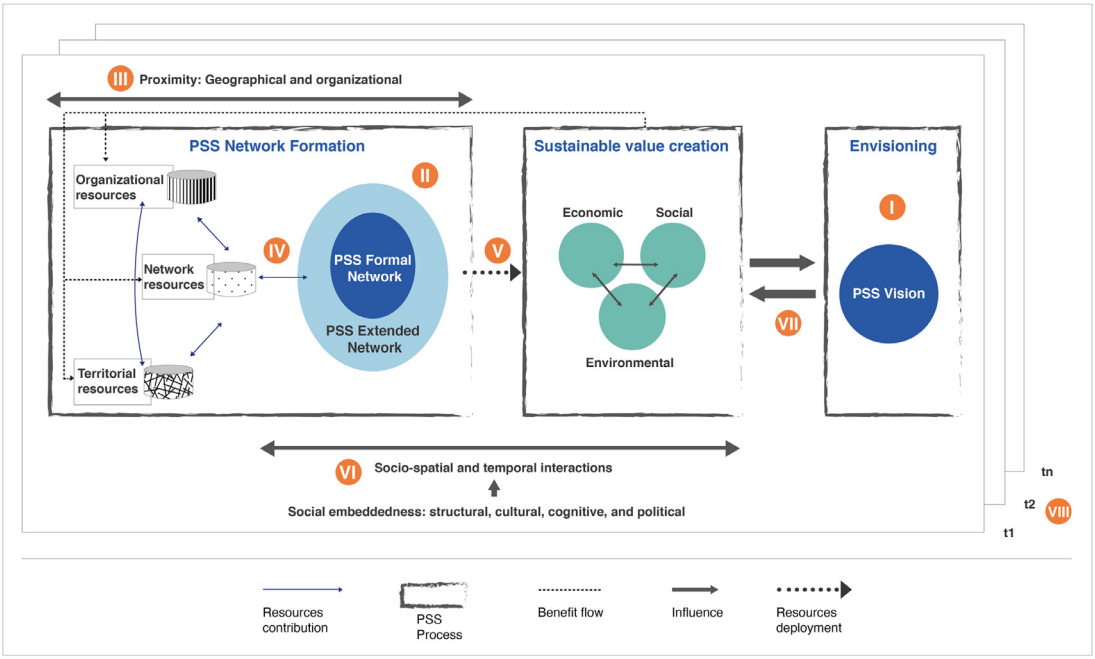

Fig. 2. Conceptual framework on building territorial PSS networks for sustainable value creation.

design and implementation of PSS for sustainability. The framework hypothesizes factors that aims at improving the consideration and understanding of important contextual features that hinder the network relations and its outcomes. The definitions and sources used in the framework are presented on Table 2.

The framework is presented in Fig. 2. In synthesis, the entry point of the framework is the (I) project vision, which drives actors to consolidate a cooperative network to develop the PSS (II). The consolidation of relations between actors is influenced by the different dimensions of proximity (III). When the network is consolidated actors use and create strategic resources (IV) which are deployed for sustainable value creation (V). The sustainable value creation process of the PSS network is influenced by the different dimensions of social embeddedness (VI). During the different phases of the sustainable PSS innovation, the initial vision (VII) might be shaped by the network of actors participating in the design and development, while, on the other hand, a specific vision might also drive the network to achieve that vision. The conceptual framework acknowledges the dynamic nature of these processes (VIII), which could be analyzed from different perspectives i.e. from a life cycle perspective or as a societal embeddedness process.

4.2. Territorial PSS studies

To refine the previously presented conceptual framework, two PSS comprehensive cases analysis was conducted. The two examples were selected considering their success in integrating territorial actors in the design and implementation of their business models for sustainability. The results from the analysis provide further insights into how the network of local actors mobilize and create resources for sustainable value creation with and for their territory.

4.2.1. The case of modern cloth baby diapers in france

For reasons of confidentiality, we refer to the case study entity as 'CDiapers ', which stands for Cloth Diapers Services. This case was chosen as the social enterprise, founded in 2009, is a pioneer in this type of service in France. Also, the organization took the lead in the standardization of ecological cleaning of baby diapers for cloth diapers in France. The case study was conducted based on primary data from two interviews resulting in a total of three and a half hour interview with the director of CDiapers conducted in September 2019 and February 2021. Due to the small size of the organization, the interviews with the founder and director provided the most complete perspective on the implementation of the innovation.

The big actors of the disposable baby diapers industry are multinationals that sell single use products in large quantities to consumers seeking to maximize their purchase of hygiene products at the lowest cost. The controversy over the environmental impact of this foreign trade has led companies to integrate eco-design strategies into their products, by focusing on improving recyclability, or degradability, and weight reduction (Cordella et al., 2015).

As a minority group in the market, some consumer groups, including families, hospitals, and daycare centers concerned about the health and the environmental issues connected with disposable diapers, are breaking away from the dominant mode of consumption and are turning to the use of modern, cloth, baby diapers (Serra, 2018). In comparison with traditional cloth diapers, modern cloth diapers integrate eco-design features focused, among other factors, on improving water usage, breathability, drying time, and user-friendliness (Hoffmann et al., 2020). The sustainability of baby diapers, in general, has been focused on the environmental dimension. However, a more systemic approach, which integrates the social dimension of the offerings, is lacking. Thus, we aim to comprehend the changes between actor relationships and the resources mobilized when transitioning to a modern cloth diapers service by applying our framework.

CDiapers offer a service of modern cloth diapers in Strasbourg, France. Their **vision** is to *"help citizens to reduce their environmental footprints by providing information in sustainable practices in the hygienic care of children and adults by facilitating the clean cloth diapers service while contributing to the enhancement of a local economy demonstrating solidarity"*. The activities of CDiapers are aligned with the national waste reduction programs (ADEME, 2015), which include the promotion of the use of cloth diapers and appropriate cleaning practices.

Table 2
Concepts and references used in the Framework.

Process	Component	Sub-component	Definition
Envisioning	Vision	/	PSS idea or concept (Vezzoli, 2007) involving the broader network of actors which include actors expectations and roles (Ceschin, 2013)
PSS Stakeholder Network Formation	PSS stakeholder value network	/	Actors (groups) who hold interests regarding the issue at stake (Freeman and Reed, 1983) and are directly or indirectly involved the design and implementation of the PSS and/or influence the PSS themselves.
	PSS formal Network	/	Value chain actors directly involved in the PSS implementation.
	PSS extended Network	/	Actors that directly and indirectly influences the implementation and diffusion of the innovation.
	Proximity	Geographical	Reduction of distances (and time) that physically separate actors (Boschma, 2005).
		Organizational	Belonging to the same organization or same network . It is based on thecommon understanding and sharing of coordination actions, strategies, and routines within an organization or between organizations (Boschma, 2005).
	Resources	Organizational resources	All tangible and intangible assets, capabilities, organizational processes, firm attributes, information, knowledge, etc., controlled by a firm (Wernerfelt, 1984). Some of these resources (but not all) are central to conceiving of and implement strategies for the competitive advantage of firms (Barney, 1991) that improve their efficiency and effectiveness (Musiolik et al., 2012).
		Network resources	Assets that can be defined as of strategic value for the network members, such as trust among members, network culture, a common understanding of goals, a specific model of network governance, and the network's reputation (Musiolik et al., 2012).
		Territorial resources	Resources dependent on the geographical or production environment, in the sense of place, of history and culture, which impact how resources are valued. These resources follow the logic of access rather than property (Colletis and Pecqueur, 2018), and are tangible and intangible.
		Resource flow	Exchange of resources between stakeholders.
Socio-spatial and temporal interactions	Embeddedness	Structural embeddedness	Related to the morphology of the network and the position of actors in it (who is connected to whom and how). It is composed of trust, fine-grained information transfer and joint problem-solving skills at a dyadic and network level (Uzzi, 1997).
		Cognitive Embeddedness	Shared understanding of certain situations (Ashton and Bain, 2012), here it relates to aspects of PSS such as the vision, functioning, practices, resources, and processes. Through these lenses we hope to capture the essence and quality of PSS relationships.
		Cultural embeddedness	Represents the different practices, norms, routines at a territorial, industry, societal, and system level (Ashton and Bain, 2012).
		Political Embeddedness	In a PSS applies to the distribution of power among actors in the network (Zukin and DiMaggio, 1990) and the influence of policies and nongovernmental organizations over corporate activities (Boons and Howard-Grenville, 2009).
Sustainable Value creation	Sustainable Value creation	/	Activities that a firm or organization performs to generate and transfer economic, social and environmental value (Hart and Milstein, 2003) created by a company and its value network (Yang et al., 2017), and perceived by multiple stakeholders (Stubbs and Cocklin, 2008).
	Resources deployment	/	Use of resources in value creation activities.
	Benefit flow	/	A benefit flow represents a transfer of value from one stakeholder to another and are captured
	Resources contribution		Dependencies between different resource levels.

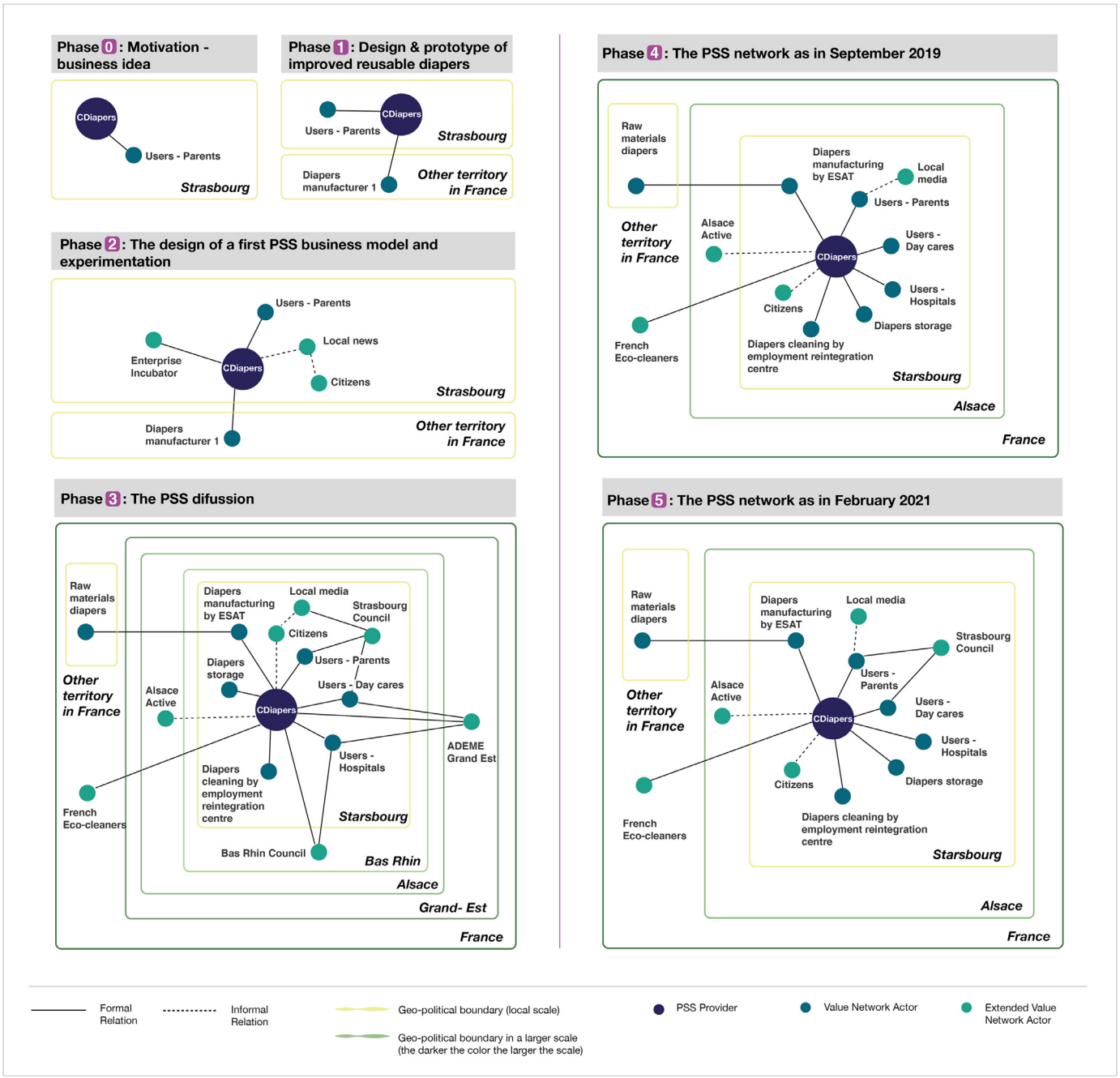

Fig. 3. PSS Territorial Actor Network evolution CDiapers.

The results from the study show the evolution of CDiapers **territorial network** which involves a high diversity of actors from the civic, public, and private spheres in Strasbourg (Fig. 3). In addition, other actors on different scales such as department, regional and national take part in the external network. An extended description of the actors' roles is provided in Appendix F in the Supplementary Material.

The balance between **geographical proximity** and environmental and social considerations were for the PSS provider to source biologically sourced hemp and organic cotton from France and create partnerships with local actors to manufacture and clean cloth diapers. In addition, geographical proximity between territorial actors was essential to establish strong links within the PSS network. Face-to-face encounters were also the key for fined-grained information exchanges (**cognitive embeddedness**), which resulted in the creation of strategic intangible resources. Some examples of these resources are the knowledge and techniques involved in producing cloth diapers with the ESAT (handicap association), the diapers cleaning standards developed with the employment reinsertion center, and the training of hospital staff promoting the adoption of modern cloth diapers to families. The synergies between the ESAT and the employment reinsertion center, as presented in Fig. 3 led to the creation of an inclusive approach and gave the services a justified reputation for solidarity, which allowed them to get financial and training support from the governmental authorities.

Our results show that cognitive, cultural, and political embeddedness were relevant for the implementation of the innovation. **Cognitive embeddedness** between different actors was developed through a variety of activities. First, it was developed through the

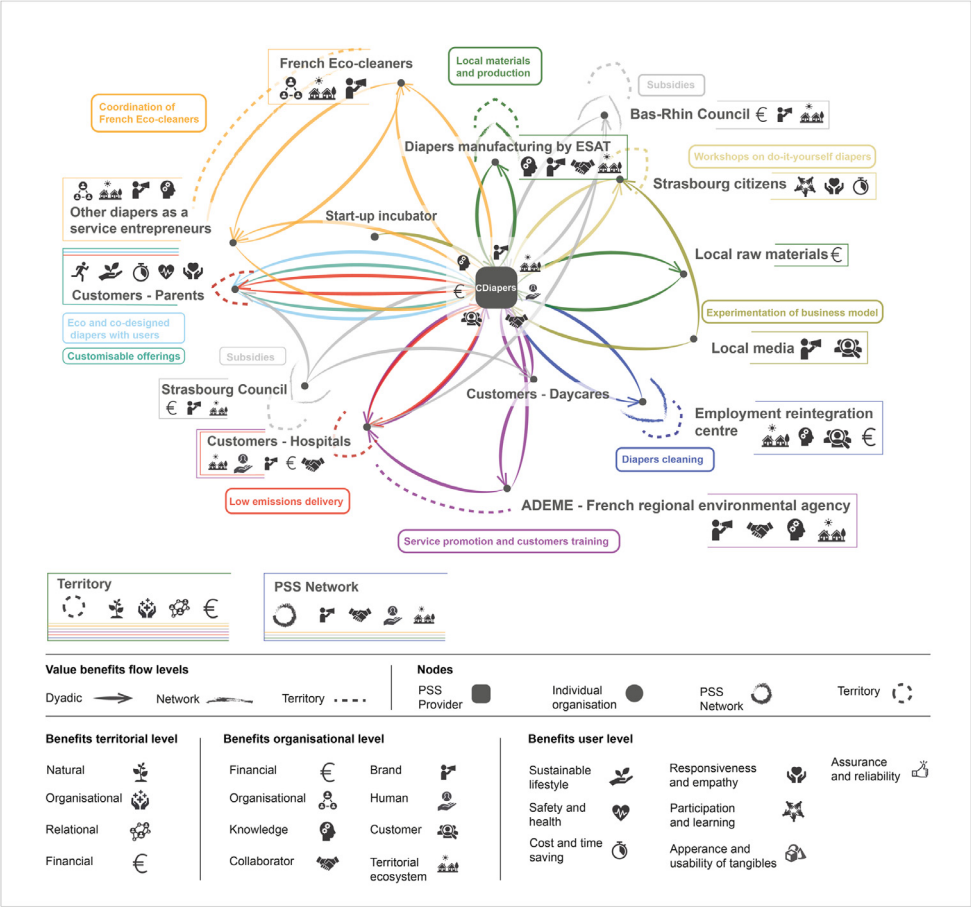

Fig. 4. Sustainable value creation activities related to the CDiapers and the flow of benefits.

training provided to hospitals by ADEME and Daycare centers on the advantages of modern cloth diapers. Secondly, by interaction mainly between parents and midwives (hospitals) and the daycare workers. We assume that the trustful connections (**structural embeddedness**) between actors influenced the establishment of cognitive embeddedness. In addition, **cultural embeddedness** regarding environmental and social justice values with customers, midwives, and the diapers producer was one of the main reasons for having strong relationships. Finally, from a **political embeddedness** perspective, the PSS innovation was aligned with the political agenda from the region and the local government in terms of reducing waste for households and promoting solidarity. Thus, political actors such as the local council from Strasbourg, Bas-Rhin, and the ADEME (French environmental agency) supported the promotion of the innovation through subventions, information, and advertisement of families and the experimentation and training of B2B customers, such as the daycares and hospitals.

The **sustainable value creation** outcomes in terms of activities and benefits are presented in Fig. 4.

4.2.2. The case of reusable food take away boxes in switzerland

For reasons of confidentiality, we refer to the PSS project as 'CircularBox' . The concept of CircularBox consists of the following: the customer takes one of the reusable boxes for his takeaway menu. After eating from the box, the customers simply hand it over to the CircularBox partners (e.g., fine dining restaurants, food trucks and catering companies) participating or keeps the box for reuse. The business model relies on partner's potential savings in the purchasing of the disposable packaging and waste management costs. The cost of using the box is a deposit that is paid back whenever the box is returned. The company was founded in Switzerland, and it currently has partners or franchises in other countries in Europe. The study was conducted based on primary data from a one and a half hour interview with one franchise start-up in Europe. This study is focuses on analysing of the original business located in Switzerland, as the project from the interviewed franchise partner started last year and has been temporarily stopped by the current global pandemic. The interviewed member of the start-up worked closely with the original company director in Switzerland to develop and replicate their offering, which provides reliable knowledge on the company's main activities. The results of the study were presented to the company for feedback.

The increasing environmental pressures of single-use packaging demand alternatives that decrease material use, waste generation, and littering. One of these alternatives is reusable packaging systems, which are recognized to have improved environmental and economic impacts when compared to single-use alternatives (Coelho et al., 2020; Greenwood et al., 2021). The increase of take away food worldwide in the past ten years has increased the use of single use packaging, which poses increased costs on waste management for cities. In a national context, takeaway packaging takes third place regarding costs for waste disposal in Switzerland (Federal Office for the Environment, 2011). Thus, to avoid management costs and promote a sustainable city image, municipalities have started to increase the support of projects that reduce the utilization of single-use packaging, such as reusable systems. The reusable packaging trend has been growing, driven by consumers' demand for more eco-friendly options and the potential cost savings and brand recognition for restaurants and other food catering companies. In addition, this trend is expected to grow with

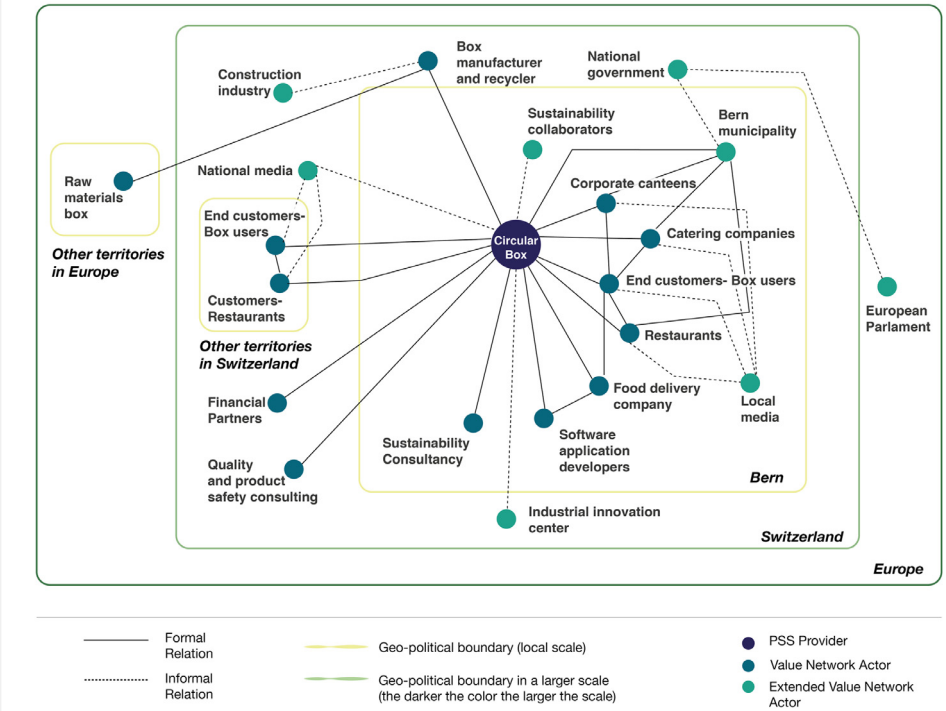

Fig. 5. CircularBox territory Actor Network, October 2020.

the current calls by international and European institutions for action on business to reduce the production of single-use packaging and governments to establish policies and mechanisms to accelerate the transition (Foschi and Bonoli, 2019). One of the main constraints of implementing reusable packaging systems is related to reverse logistics design for distribution and returns. Thus, a territorialized approach of reusable food takeaway packaging has the potential to facilitate the material resource flows in the system while offering a variety of benefits to multiple actors in the territory.

The company's **vision** is to reduce plastic waste produced from single-use packaging that causes environmental problems *"Disposable packaging is becoming a problematic issue all over the world. Waste is still an omnipresent reality and poses a challenge for the environment, societies, governments, and end consumers. Awareness of environmental issues is increasing and people are willing to take action"*. The box, in addition to preventing waste from packaging, can reduce the amount of food waste, as the container allows users to safely transport (thanks to the anti-leakage design) and conserve the leftovers. For the city of Bern, this project is essential to their waste prevention plans from take away restaurants, which is high, especially in the summer months. Furthermore, the potential savings from cleaning, emptying city garbage containers, and processing waste related costs encourage the waste prevention plans. In addition, according to the EU's New Plastic Regulation, cities and more particularly food catering establishments will be forced to offer ecological packaging solutions by 2021.

The study results show that the CicularBox **territorial network** involves a high number of local actors in Bern and Switzerland (Fig. 5). An extended description of the actors' roles is provided in the Appendix E in the Supplementary Material.

The **geographical proximity** was a vital catalyzer factor in face-to-face encounters for learning about the business model and creating trust with customers (restaurants, catering companies, canteens) and end customers (final users). The **spatial embeddedness** of the network is observed through the high prevalence of territorial actors at a local and national level involved in the design and implementation of the innovation. In addition, the cultural understandings about plastics and food waste environmental and economic impacts on a local and global scales played an essential role in the diffusion of the PSS innovation. The analysis also highlighted the **cultural** and **political embeddedness** of the PSS innovation and the city of Bern sustainability transition plans, which are reinforced through the collaboration with other sustainability-related actors in the territory. The **cultural embeddedness** between the company and its customers is assumed to be high. Customers use the boxes as a statement of their involvement in the sustainability transformation of the catering industry and society in a broader scale.

On the **cognitive embeddedness** the PSS provider and the manufacturer share the cognitive frame on the valorizing damaged products through recycling. Other examples of cognitive embeddedness are visible between the PSS provider and the food delivery company, such as the shared mental models on the benefits of the reusable boxes locally. We assume that fine-grained information for developing strategies merging the two business models of the companies was necessary.

Fig. 6 presents some of the value creation activities and the flow benefits from CircularBox implementation.

5. Discussion

5.1. Combining literature and practice on the territorial PSS for sustainability: the proposition of a refined conceptual framework

The territorial approach of sustainable PSS seems promising as it provides a broader perspective on how the innovations create sustainable value for different actors and contribute to the short term and the long term development of a territory. The PSS cases show the complexity of the PSS innovation process, which cannot be isolated from its territorial context. As pointed by literature, a strategic and shared vision of a territory is a significant driver

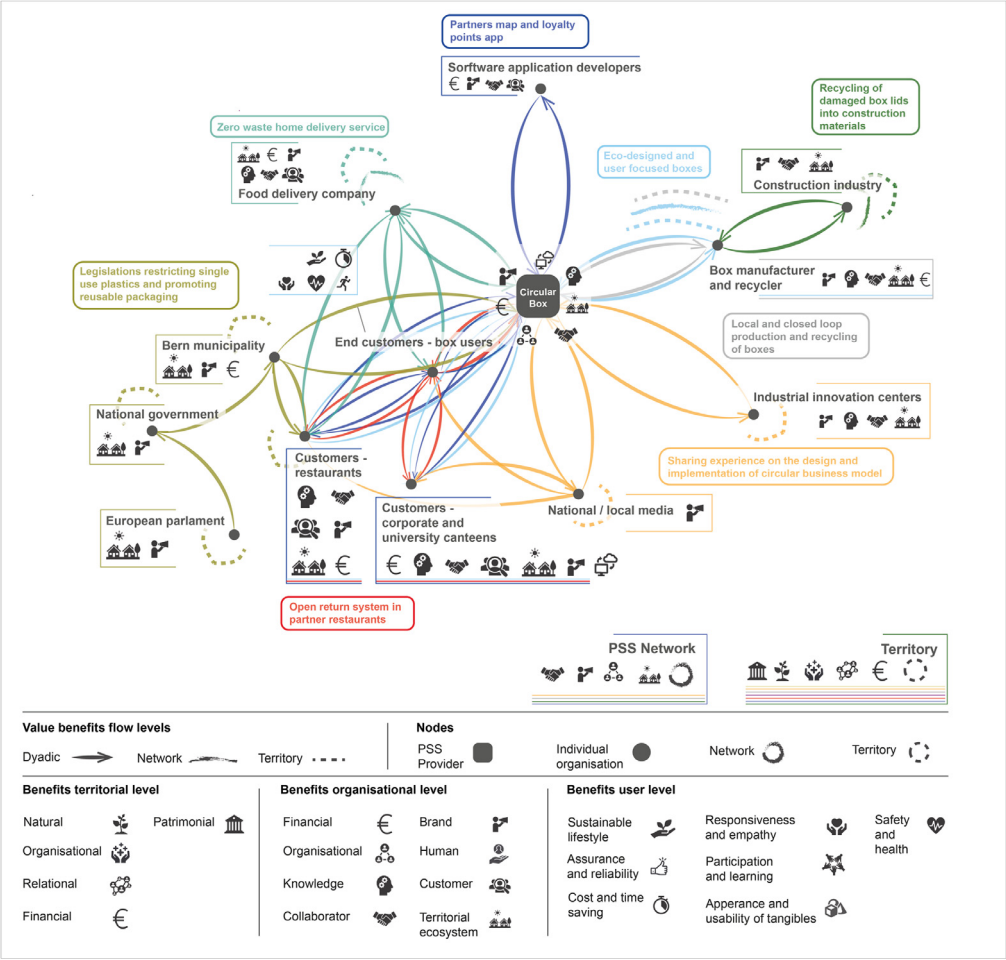

Fig. 6. Sustainable value creation activities related to CircularBox and the flow of benefits.

for achieving ambitious sustainability transformations e.g. the circular economy (Preston, 2012). Recent studies show that from a materials perspective, the territorial milieu enables material efficiency and recovery and a strong shared regulatory environment, creating a trust relationship and a favorable business environment (Bassi et al., 2021). Even if the resource efficiency of the system was influential in the territorial design of the offerings, it was not the only purpose in the design of the PSS cases. A broader vision in the PSS design integrated specific territorial issues, such as waste reduction, local employment, citizens' well-being, and social justice. This finding highlights the importance of formulating strategic goals of the PSS, which also considers the meta-goals of the territories, including but not limited to resource efficiency. From this viewpoint, the PSS provider, as the coordinator of the PSS network, should acknowledge a long-term vision including the territory during strategy development, as this will guide the design and innovation decisions (Hallstedt et al., 2013). This role, particularly for companies, involves strategic envisioning, tactical networking, operational innovation, and learning (Gaziulusoy and Brezet, 2015).

As suggested in previous PSS studies for sustainability e.g. Vezzoli et al. (Vezzoli et al., 2015) Chen (Chen, 2018) Joore and Brezet (Joore and Brezet, 2015) Cook (Cook, 2018, 2014), we argue that parting from a broader vision of the sustainability challenges and the diverse value benefits in a particular context enhances the possibility of developing PSS offerings that meet social needs. The relation between the specific PSS for sustainability vision and the sustainability vision of a territory could be considered as a reflexive process. The PSS design and innovation team influences a territorial vision, thus playing a proactive role in the sustainability transition of a territory. At the same time, the territorial vision (e.g. vision of the sustainability paths from governmental authorities, citizens, institutions and other stakeholders of the territory) influences the meaning and trajectory of the PSS innovation. Moreover, our results show that the integration of territorial actors in the design and implementation of the innovation is crucial for developing a comprehensive understanding of the meaning and sustainability potential of the innovation. As presented in Section 4, the actors in the PSS network provide different pieces of information, knowledge into the innovation process, e.g. insights on social practices related to the PSS innovation, the meanings for the different actors, production knowledge, consumption knowledge. These results are aligned with the earlier findings of Cook (2018, 2014), which highlight that the design and innovation process needs to recognize that the meanings and characteristics of a PSS are locally constructed.

Companies aiming to develop sustainable PSS innovations need to take a broader strategic design attitude that involves establishing relations with other companies and broader stakeholders, considering the contextual conditions that may favor or hinder its implementation and adoption (Allais and Gobert, 2019; Ceschin, 2013; Cook, 2018). This is especially important for business managers and designers as fostering sustainable PSS innovation requires rethinking the way products and services disrupt not only business models but also organizations, industries (Baldassarre et al., 2020) and territories (Buclet, 2014). This approach might pose considerable challenges for companies as they

have to rethink their strategic and operational practices to create sustainable value (Allais and Gobert, 2016a) and strengthen their individual and collective capabilities (Buclet, 2014; du Tertre et al., 2017). Consequently, PSS designers need to identify key stakeholders that could participate in the design and development of the innovation, understand the types of resources they could mobilize and the value they could create (Chen, 2018). The proposed framework can help designers and managers to face these questions. Furthermore, we assume that integrating of value criteria for different actors and levels in the early PSS design process can support discussion and negotiations between different departments (Bertoni, 2019) and stakeholders in the value network (Garcia Martin et al., 2019) for assessing the suitability and sustainability of concepts according to the local contexts where they will be implemented (Allais and Gobert, 2019). From this perspective, there is a growing interest using digital platforms that could enhance the territorial data management and embrace collaborative functionalities while reinforcing territorial actor networking (Pirola et al., 2020).

The territorial PSS studies highlight a diversity of territorial actors and the multi-scale and dynamic nature of the innovation networks. For instance, some of the extended value network actors of CDiapers and CircularBox were local communities, innovation centers and organizations, public authorities, and NGOs promoting sustainability practices. The actors operating at a multi-scale were mainly public authorities and institutions which provided financial resources, training for their customers, and knowledge on the management of the innovation. These relations were vital for legitimizing the PSS in the territory and supporting its diffusion. In addition, other extended network actors (e.g., innovation centers, sustainability and design consultancies, financial partners) were essential for supporting the design and development of the company's business models, products, and services. It is apparent from our results and the literature that PSS designers and managers are required to identify, involve and manage actors within their formal (Dokter et al., 2021) and extended value networks from early in the design and development process. From this perspective, designers and managers in PSS can play as connectors for establishing strategic dialogs between actors (Meroni, 2008; Vezzoli et al., 2014), establish future visions and act as agents of change (Banerjee, 2008) in the development of territorial PSS sustainable networks.

The graphical representation of network diagrams enabled the companies studied to better comprehend PSS innovations as extended territorial networks of value creation. The resources and network perspective is important for companies developing and implementing innovations for facilitating its development and actors' cooperation (Allais and Gobert, 2019; Musiolik et al., 2018, 2012). While earlier PSS studies have recognized the importance of resource mobilization for successful PSS design and implementation, most of the time, the resource concept remained at an organizational level, with exception of the work from Allais and Gobert (Allais and Gobert, 2016b, 2016a). The framework defines three different levels of resources, value creation, and value benefits analysis: organizational, network, and territorial, which sheds light on the roles and effects of the PSS network activities that explain the wider industrial, and economic implications of the offering (Garcia Martin et al., 2019). In this line, participants highlighted that a more comprehensive explanation of the tangible and intangible value benefits through the capitals on different levels could help their organizations to develop more compelling narratives of the innovations for engaging with diverse stakeholders and diffusing the innovation.

The results from the case studies highlight the importance of cultural, cognitive, and political embedded relationships for the adoption and diffusion of innovations in a territory. The cultural embeddedness of actors in the CircularBox network was related to understanding the sustainability issues about plastics and food waste for final users and the costumers from a local and global perspective. While in the case of CDiapers, cultural and political embeddedness was related to babies' wellness, negative environmental impacts of disposable diapers, and social justice of marginalized groups and their (re)integration on the production systems. Similarly, in both cases, the political embeddedness of the networks with the local and regional political agendas in terms of sustainability transition paths was extremely important for the diffusion of the innovation in terms of financial support and promotion of services. This is relevant as the cultural and political embeddedness highlight the collective values, meanings and policies that legitimize the sustainable PSS innovation in the territory. In addition, the cognitive embeddedness was crucial for the innovation's adoption, for example, sharing mental models on the benefits and functioning of the offerings, which were developed by one-to-one interactions (e.g., with personal training) and the information supports on the economic, social and environmental benefits. Currently, in the literature of PSS and sustainability, the spatial and structural embeddedness are recognized as important, for facilitating the PSS production and provision (Allais and Gobert, 2016a; Buclet, 2014), while the cultural, political and cognitive embeddedness are understudied. Understanding and leveraging cultural, political and cognitive embeddedness is essential for comprehending some of collective and individual factors that influence the diffusion and resilience of sustainable PSS innovations.

In the context of the COVID-19 pandemic, our results show that the spatial embeddedness and shared values (cultural embeddedness) were essential to draw on the solidarity of their customers and end-users. Thus, for example, the customers of CDiapers during the first months of the pandemic washed the diapers themselves without breaking their contracts with PSS provider, while CircularBox supported its partner restaurants by buying back of their surplus boxes and receiving a month free as a thank you for their loyalty. These results are in line with earlier findings by Mont et al. (2021), which highlights that organizations operating locally and with interest in value creation beyond monetary value can rely on their communities' civic-solidary capacities to help manage their response towards facing the pandemic.

Through the insights of the territorial PSS cases, a final conceptual framework is presented in Fig. 7. Compared with the initial framework, it integrates the interplay between the PSSs vision and the territorys vision as a driver for network formation and value creation activities.

This framework emphasizes the need for more multi-level approaches to the design of PSS for territorial sustainability. From this perspective the design of PSS that enhances the sustainability transitions of territories must integrate a multi-level approach in which traditional PSS and techniques i.e. DfX approaches (see more (Sassanelli et al., 2020)) or R-strategies (see more (Diaz et al., 2021)) allow designers to include specific criteria in the product and service levels, while also integrating new systemic and territorial thinking into the design to guarantee long term visions (Pereno and Barbero, 2020).

5.2. Limitations of research

The presentation of the framework counts some limits that future research intends to approach. While the current version of the framework brings insights to PSS for sustainability designers and researchers on important processes for the successful implementation and diffusion of a PSS, the framework by itself is not an operational tool for driving the design and development of the innovation. Thus, our future research aims to develop a practical method that combines the strategic design of territorial PSS with more tactical and operational design approaches that can be used in the products and services design and development. Other lim-

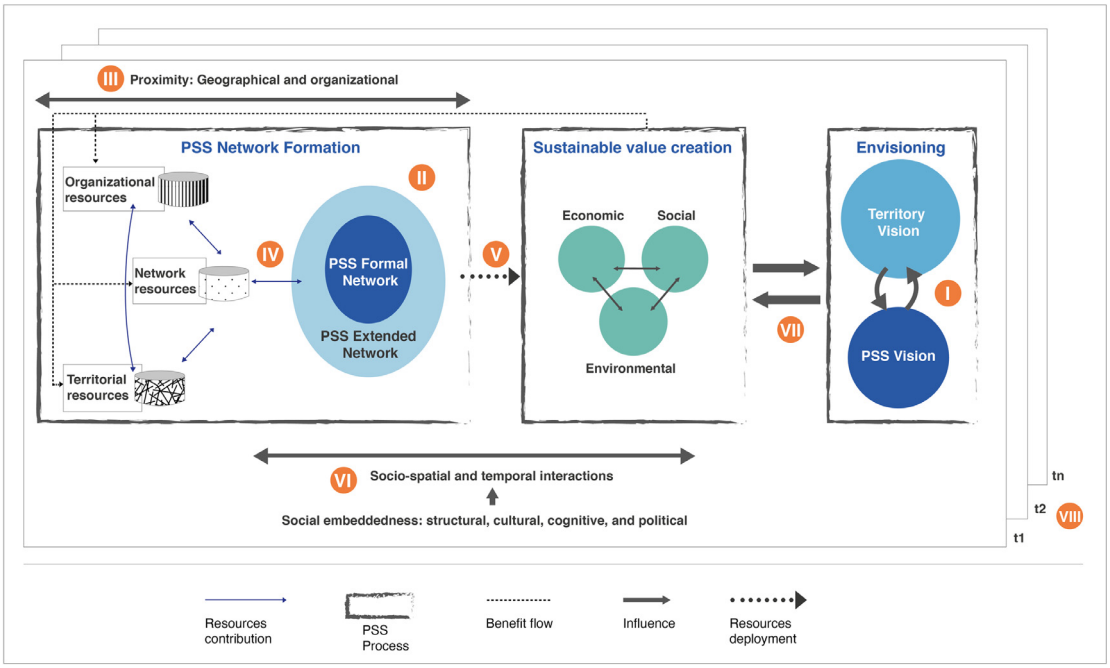

Fig. 7. Refined conceptual framework on building territorial PSS networks for sustainable value creation.

itations of the research carried out include the use of primary and secondary data, which, while providing enough information to analyze, is focused on a PSS provider perspective. The collection of primary data from other actors in the network could have been used for drawing a more diverse perspective of the system. However, the PSS provider perspective presents the most complete perspective of the relations in the design and implementation of the innovation. Moreover, the integration of different stakeholders such as providers, users, local authorities in the participatory session would be fruitful to get a more holistic and exhaustive representation of the network. The multi-stakeholder mapping sessions could result in sharing of knowledge and building a common understanding on the different current and potential actor relationships that enhance the sustainability of the PSS innovation.

Furthermore, the framework presented needs to be further tested and empirically validated, for example, through conducting case study research in different company sizes and industries. Concerning the nature of the PSS studies selected, it could be questioned the selection of a social enterprise as a case and the validity when applied to a profit-seeking organization. PSS here is studied as a part of a sustainability strategy for organizations, which have to include the environmental, social, and financial objectives (Journeault, 2016). Thus, we argue that our framework can be applied to any organization implementing a PSS for sustainability. The difference between NGOs or social enterprise and profit-seeking organizations relies on prioritizing the objectives, e.g. in the modern cloth diapers as-a-service case, the environmental and social performance was prioritized over financial. In contrast, in the packaging as-a-service case, financial and environmental performance was prioritized over social performance.

6. Conclusion

This paper explores the implementation of a territorial PSS at a city or regional scale as a means to structuring value networks and enhancing its sustainability potential. The territory is not considered only as a space recipient of the innovation. It is a fertile ground for resources and potential synergies. From this perspective, territorial actors mobilize resources for developing economic activities aligned with local sustainability principles and priorities. This study proposes a conceptual framework for the development of PSS for territorial sustainability through a multidisciplinary literature review and examining two territorial PSS studies. This research is set out to answer this question: How can PSS providers consolidate PSS territorial networks and mobilize and create resources to generate sustainable value?

We found out that:

- PSS providers that create territorial networks actively integrate actors from private, public, and social spheres. While integrating actors in the geographical proximity enhance the creation of shorter and closed material loops (material efficiency), organizational proximities (e.g., culture, sharing strategies, and organizational structures) are essential enablers for territorial stakeholder relationships. The network formation is driven by a sustainability vision of the PSS provider orchestrating the formal PSS network and by one of the territories where the PSS is implemented. Parting from a broader vision of the sustainability challenges in a particular territory enhances the possibility of developing PSS offerings that meet social needs as the interdependencies of the PSS and other territorial systems are made explicit, thus, facilitating the adoption and implementation. In addition, our study proves that the creation of territorial synergies positively influences the legitimizing the innovations and enhancing the trust of communities and public authorities in these new business models.
- The mobilization and creation of resources depend on the quality of relationships of stakeholders. This study proves that the embeddedness of relations is a promising approach for understanding the collaborative capacity of territorial stakeholders in a PSS. The consideration and leverage of cultural, cognitive, and political embeddedness are vital for understanding collective and individual factors that influence the diffusion and resilience of the innovations. In addition, the resource perspective provides a more detailed understanding of actors' roles in the PSS innovation process.
- Sustainable value outcomes in PSS for territorial sustainability must be understood from multi-dimensional (economic, social,

and environmental) and multi-level (organizational, network, and territorial) perspectives. In addition, this study proves that the use of immaterial capitals and territorial capitals help understand a broader range value benefits, resulting in compelling narratives of the innovation benefits for stakeholder engagement and concept design discussions and assessment.

The presented conceptual framework has a descriptive nature. Future research has to focus on developing prescriptive method that aids PSS designers for sustainability to integrate the territorial perspective through the whole design process. This is particularly relevant in the front end of innovation and embodiment process design stages to help designers and managers ensure that the stakeholders' relations, products, and services are coherent with the medium and long-term sustainability strategies of the company and territories in which they are implemented. It also provides governments with insights into the role of territorial authorities in influencing the implementations of sustainable innovations and can therefore help to inform effective policymaking. Further research is recommended to validate and examine the implication of applying the framework in different industries and company sizes to clarify the potential and limitations of the territorial approach. This study intends to encourage long-term viability, sustainability and resilience in organizations that may offer more sustainable ways of production and consumption.

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Declaration of Competing Interest

The authors declare that they have no financial interests or personal relationships that might influence the work reported in this paper.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.spc.2021.08.003.

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