

Sustainability-oriented service innovation

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Title: Sustainability-oriented Service Innovation: An emerging research field

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Abstract

Current environmental, social and economic sustainability challenges are increasingly becoming sources of motivation for both manufacturing and service companies when attempting to innovate their businesses. In recent years, there has been growing interest from academics, policy-makers and practitioners on service innovation as a new business logic for companies to address societal challenges regarding sustainability. Nevertheless, research specifically focusing on service innovation in relation to sustainability is scarce, and ultimately scattered across different research fields. Thereby, only limited clues are available for companies willing to address sustainability challenges through service innovation. To encourage further research in this direction, this paper systematically reviewed the available literature by investigating peer-reviewed publications (from 2004 up to and including 2015) across different fields, which jointly focus on services, innovation and sustainability. The literature review confirmed both the growing amount of research on service innovation in relation to sustainability, as well as the lack of an overarching field to clearly identify such a phenomenon. The review also revealed that three main existing research streams (service innovation, product-service system and sustainability-oriented innovation) contribute to the investigation topic, though all have specific focuses when it comes to the sustainability and innovation dimensions considered. Taking stock of the descriptive and thematic analysis of the review and the identified research gaps, the paper concludes by discussing the need for a clear recognition of the emerging field of sustainability-oriented service innovation, and by outlining several future research pathways for its further enhancement.

Keywords – Services, Service Innovation, Sustainability, Sustainability-oriented Innovation (SOI), Sustainable innovation, Product-service system (PSS)

1. Introduction

Increasing local and global concerns over environmental, social and economic sustainability issues (e.g. Solomon et al., 2007; Rockström et al., 2009) have generated calls for both product and service companies to change their operations and offerings (e.g. Lubin & Esty, 2010; Gunasekaran & Spalanzani, 2012). Nowadays, sustainability is no longer considered as a cost for business, but as a key driver for innovation and business development (e.g. Nidumolu et al., 2009; Porter & Kramer, 2011).

In recent years, there has been a growing interest from academics, policy-makers and practitioners on a wider and holistic perspective of service innovation as a new promising “transcendent business logic” fostering sustainability (Enquist et al., 2015). Adopting a service logic (Vargo & Lusch, 2008; Gustafsson et al., 2016) is considered crucial “for co-creating value and sustainability in the network of a complex service system” (Enquist et al., 2015, p. 182), in which several stakeholders are engaged in creating value, while achieving sustainability (Saviano et al., 2017). In line with this perspective on service innovation (IfM & IBM 2008; Ostrom et al., 2010; 2015), companies can develop new service-based solutions to address the several sustainable development goals (SDGs) as defined in the Agenda 2030 (UN, 2015).

Yet, while the academic and business communities are calling for further investigation into the ways in which service innovation and sustainability are linked (Djellal & Gallouj, 2015; 2016; Holmlund et al., 2016), research explicitly focused on these topics still remains scarce (Djellal & Gallouj, 2016; Saviano et al., 2017; Rantala et al., 2018). Although studies investigating the relationship between innovation and sustainability have proposed several concepts and terms (Carillo-Hermosilla et al., 2010; Adams et al., 2012; Franceschini et al., 2016), none of these focus on a broader and holistic perspective of service innovation for sustainability.

To fill this gap, this study had two main goals. First, it reviewed the rising number of studies investigating the relationships between services, innovation and sustainability. Second, based on the insights from the literature review, it aimed at discussing the boundaries of an emerging field captured by the label “sustainability-oriented service innovation” (SOSI). This study included a systematic literature review investigating peer-reviewed papers that jointly focussed on the topics of services, innovation and sustainability in the period 2004-2015.

The paper is organised as follows. Section 2 explains the overall research strategy including purposes and method. Section 3 presents a descriptive and thematic analysis of the results. Section 4 offers a general discussion of the gaps and insights revealed by the results. Section 5 discusses the need of defining the SOSI field and offers a first definition. Section 6 provides several future research pathways, which can stem from the SOSI definition. Section 7 concludes.

2. Research strategy

2.1. Research purpose and approach

The starting point of this paper is recognition of the value of a common research field, from which further research can then be encouraged (IBM Research, 2004; Chesbrough, 2005). SOSI appears as an emerging research topic but its contours are still blurred. To better define these contours, this study offers a systematic literature review and discusses the sampled papers in an analytical way (Seuring et al., 2005; Jones & Gatrell, 2014).

To the best of our knowledge, a review of research focusing on services, innovation and sustainability had yet to be conducted, although a number of reviews have explored two of these topics. For example, Klewitz and Hansen (2014), and Adams et al. (2015) reviewed literature focusing on innovation and sustainability, whilst Carlborg et al. (2014), Snyder et al. (2016), and Witell et al. (2016) instead focused on services and innovation. Finally, Mont

and Tukker (2006), as well as other subsequent authors (e.g. Beuren et al., 2013; Reim et al., 2015), reviewed the more specific topic of the combined offer of products and services in relation to sustainability; an approach linked to the idea of PSS literature.

In line with these prior reviews, this paper also aimed to offer a thematic analysis, complementing a more descriptive, bibliographic analysis of the sampled studies. The thematic analysis was performed at two main levels: the first level was concerned with the definition of recognisable research streams, whilst the second level investigated the ways in which key topics relevant to SOSI (in particular, sustainability dimensions, innovation dimensions and policy) appeared across the various research streams. Overall, this analysis provided insights on key research findings thus far, as well as highlighted clear research gaps for the future.

2.2. Time frame for the search

A necessary aspect of the search strategy was the identification of a time frame. As mentioned previously, relevant existing literature reviews were relatively new. Thus, a time span of ten years appeared sufficiently broad for our search. Given that the authors commenced their investigation in 2015, the publication time frame was 2004 to 2015. Note that 2004 was particularly meaningful for service research, for it was during this year that the idea of creating a new multidisciplinary academic field dedicated to services, explicitly termed “service science”, first emerged (IBM Research, 2004; Chesbrough, 2005).

2.3. Search methods

The literature was systematically explored by searching peer-reviewed publications (from 2004 up to and including 2015) from different fields, placed at the intersection of the broad topics of services, innovation and sustainability. A search strategy was developed (as shown

in Figure 1), by following clear systems of rules and steps (Tranfield et al., 2003; Snyder et al., 2016; Witell et al., 2016), thus leading to a comprehensive, reproducible identification, evaluation and interpretation of the existing knowledge (Fink, 1998; Seuring et al., 2005).

INSERT FIGURE 1 here

The initial search strategy included broad search criteria to ensure that all relevant articles would be identified. To guarantee that the papers dealt with scientific research, managerial books and reports were excluded. Following this orientation, the decision was made to search a global database of publications, imposing the combined presence of the terms “service(s)”, “innovation(s)” and “sustainability” within the abstract, title and/or keywords of the publications. The selection of general search terms such as these permitted the early identification of as many relevant papers as possible. In our case, the search was able to highlight papers dealing with the crucial “service/s development” string (Carlborg et al., 2014), meaning they also had the potential to offer insights regarding “innovation” and “sustainability”. At the same time, the imposition of the keyword “sustainability” sought to identify those papers that, while jointly investigating topics of “services” and “innovation”, also offered insights on the holistic concept of sustainability. This filter thus excluded articles that potentially dealt with service innovation in specific environmental, social or economic issues, and that failed to incorporate specific reference to holistically regarded sustainability. The search strategy also included several sustainability-based studies across a number of multidisciplinary areas. Yet, the inclusion of the “services” and “innovation” search terms made sure that, within these areas, the investigation dealt with the convergence of the three topics of interest.

To achieve maximum results, the search included the asterisk (*) to alter the syntax for the three keywords, thus: “service*”, “innovation*” and “sustainab*”. This adjustment ensured that the search found all words beginning with the prefixes of interest, including nouns and

adjectives, as well as the plural and singular variations. Finally, the multidisciplinary search strategy aimed to cover the widest possible range of scientific fields and journals, and thus obtain the broadest possible overview of the literature.

2.4. Initial search and narrowing of the sample

The initial search yielded 2,342 articles through Scopus; a database considered one of the most complete when it comes to global research (Anttonen et al., 2013). The next step narrowed the sample of papers by following several criteria; papers had to be peer-reviewed publications, in English, and they had to offer full access to the text. Moreover, a first reading of the abstract enabled narrowing this first sample by keeping papers that were jointly focused on services, innovation and sustainability, and by removing those papers where a substantial focus on the three topics could not be found. This step ultimately narrowed the sample down to 208 articles, of which the entire text would be reviewed.

A full reading of the 208 papers revealed some recurring patterns. First, although many of the articles used the term “sustainability” in the abstract, few actually defined, conceptualised, or emphasised the term throughout the paper. In most cases, the use of the term “sustainability” was conceived as referring to the firm itself; in particular, to its existence or survival over time. Similarly, the use of the adjective “sustainable” occurred mostly within the label of “sustainable competitive advantage”, referring to the firm’s ability to optimally position itself with respect to its competitors. Second, although many of the articles dealt jointly with innovation and sustainability, and included “services” in the abstract, there were few cases where the rest of the paper followed through to provide insights into service innovation. In many cases, the combination of the three terms occurred due to the presence of the “ecosystem services” label in papers concerning natural and ecological systems, such as those

dealing with the way a forest “serves” in retaining water in the ground. These papers were removed from the sample, being considered not relevant to the investigation.

Reading of the full texts of the narrowed sample of 208 articles was carried out by two researchers. The readers identified those articles that met the inclusion criteria of focusing jointly on services, innovation and sustainability topics. They compared and discussed their results, and in cases of disagreement consulted a third researcher to reach a common verdict. From this stage, a final sample of 61 articles was selected for detailed analysis. The table in Appendix A lists all papers, providing information on their authors, title, publication outlet, year of publication and research stream to which they belong according to our categorisation (explained later in the paper). Notice that the two most recent papers were published online in 2015, but their final publication year turned out to be 2016.

3. Results

3.1. Descriptive analysis

A quantitative bibliographical analysis in terms of journals and years of publication (Tranfield et al., 2003; Seuring & Müller, 2008; Klewitz & Hansen, 2014) offered a first descriptive analysis. The final sample was composed of 61 papers, of which 51 were articles published in refereed journals and 10 conference proceedings. Applying the Scopus categorisations, the sample could be classified into different journal subject areas, as depicted in Figure 2. The area of “Business, Management and Accounting” accounted for the most with 26% of the papers, followed by “Energy” and “Engineering” with 19% and 17%, respectively.

Figure 2 also shows the evolution of the number of papers in the chosen period, revealing the rising importance of the topic under investigation. Indeed, 89% of papers in the final sample have been published in the last six years (2010-2015), and thus only 11% in the first six years

(2004-2009). This growing trend tends to support the validity of our research purpose, as well as the specific methodological choice of focusing the review of literature on the chosen years.

INSERT FIGURE 2 here

Studies in the topic of our investigation were widely spread amongst different journals. The *Journal of Cleaner Production (JCLP)* was the outlet containing the largest number of articles (Table 1). The other journals accounted for only one paper each.

INSERT Table 1 here

3.1.1. Keyword frequencies analysis

The relevance of each keyword was assessed by relying on their frequency in the final sample. These keywords were indicated in the Scopus search results. This step entailed removing the most general keywords (“innovation”, “research” and “industry”) to achieve a meaningful graphical representation (Figure 3).

INSERT FIGURE 3 here

Figure 3 shows three evident “spikes” corresponding to the keywords, which can be identified within the intersections of joint studies on “services”, “innovation” and “sustainability”. In particular, there were connections between sustainability and innovation (represented by the keyword phrase “sustainable innovation”), innovation and services (by the keyword phrase “service innovation”), and between services and sustainability (by the keyword phrase “product-service systems”). The keyword frequencies analysis allowed assessing the relevance of specific research streams, i.e. service innovation (SI), product-service system (PSS) and innovation for sustainability, linked to the umbrella term of sustainability-oriented innovation (SOI) (Jay & Gerard, 2015). There was a clear spike of emphasis on PSS research in the manufacturing industries. This was also confirmed by the

presence of related keyword phrases, including “product design”, “product development” and “sustainable products”. The connection between products and services was further identified by the presence of the keyword phrase “products and services” in the keyword frequency analysis. Figure 3 also reveals the emphasis of research on “environmental” aspects, with significantly less focus being given to more social issues. Indeed, there were only two cases of the “economic and social effect” keyword phrase, while there were 11 instances of “environmental impact” and “environmental management”, plus instances of many other keywords also referring to environmental sustainability.

3.1.2. Methodologies and sectors analysis

Figure 4 summarizes the research methods chosen in the sampled studies. Most of the articles and conference proceedings (about 80%, n=49) employed empirical methods, with some presentation of theoretical insights. The adoption of empirical research was particularly strong in the PSS field. In the subset of 49 empirical studies, the most commonly used methods were those of case studies and surveys, or questionnaires. Of the 20% of the final sample that were strictly theoretical papers (n=12), approximately half belonged to the field of PSS.

INSERT FIGURE 4 here

Our thematic analysis was aimed at identifying the extent to which the published research covered the different service sectors. A wide range of service sectors was covered (Figure 4), such as energy (e.g. Arnold & Barth, 2012; Hannon et al. 2015; Hyytinen & Toivonen, 2015), transport (e.g. Tietze et al., 2011; Lai et al., 2015), health care (e.g. Wilson et al., 2012; Srivastava & Shainesh, 2015), water and waste (Swilling, 2010; Cruz & Paulino, 2013; Spiller et al., 2013), hospitality (Razumova et al., 2015), retail and consumer services (e.g. Liao et al., 2014), logistics service providers (e.g. Zailani et al., 2011; Rossi et al., 2013), and

information and communication technology (ICT) (Hjalmarsson & Lind, 2011; Ferrer et al., 2012). As Figure 4 shows, three of the four most frequently addressed sectors were transport, energy, and waste, which in fact often appeared in studies on public services and so-called urban services, and they were often connected to pressing environmental issues such as air pollution. The area of information, communication and digital technology was also often considered. The ICT sector was seen as increasingly addressing sustainability issues by developing innovative IT service offerings oriented towards sustainability or “sustainable IT services” (SITS) (Harmon & Demirkan, 2011; Harmon, et al., 2012). Despite the mention of many service sectors in the literature, most of the studies were sectoral case studies that did not aim for a general understanding of the SOI activities of service companies, or the design, development and delivery of new sustainable service offerings.

3.2. Thematic analysis

The thematic analysis of the final sample of papers (n=61) was aimed at discussing the variation in the topic of our investigation (Thorpe et al., 2005; Klewitz & Hansen, 2014).

3.2.1. Main categories: research streams

At a broad first level, as discussed in the keyword frequencies analysis, three main existing research streams could be recognized.

INSERT Table 2 here

The column “category” in Table 2 identifies those three research streams with the labels product-service system (PSS), service innovation (SI) and sustainability-oriented innovation (SOI). Almost 40% of the final sample of papers belonged to the PSS stream, with many having been published in the JCLP (e.g. Tukker & Tischner, 2006; Liedtke et al., 2015; Vezzoli et al., 2015), whilst the remaining papers were more or less equally divided between

SI (31%) and SOI (29%) research streams. Table 2 also indicates five key papers for each category.

The final sample of papers (n=61) was divided in these three research streams as follows. Firstly, the content of each paper was scanned for the use of the relevant labels (PSS, SI and SOI). Most of the papers could be categorised in this way and the categorisation made by two different authors was then checked by a third one. In case of doubt, the publication outlet of the paper also provided hints, as each stream could be associated to specific journals. The references cited in the paper could also be exploited to classify papers. The SOI stream was less crystallised as a field when compared to PSS and SI, meaning that the SOI category naturally included a more diverse set of papers.

The second level of analysis identified key topics for each research stream. Accordingly, the rest of Table 2 was designed as follows: the columns represented broad focus areas. These covered, firstly, the two main sustainability dimensions, “environmental” and “social”, next to the economic dimension (Seuring & Müller, 2008); secondly, innovation dimensions (“System”, “Design”, “Technology”, “Organisation”, “Customers”) as crucial factors that can foster and support SOSI; and, thirdly, their focus on “Policy”. The grey shades of the table cells indicate the share of studies in each of the three streams that clearly included a given focus, with darker cells indicating a stronger focus.

3.2.2. Sustainability dimensions

For each research stream, the dimensions of sustainability that the sampled studies focused upon were analyzed, in particular whether they explicitly addressed environmental and social sustainability, next to economic sustainability. Although all papers adopted a holistic approach to sustainability issues, most of them still focused mainly on the environmental and economic aspects of sustainability; only 18% of the papers focused on social sustainability

issues. Most importantly for our purpose, one-third of the papers in the final sample placed the same focus on environmental, social and economic sustainability issues. Within this same third of papers, a wealth of different labels and concepts is used, mostly concerned with specific environmental aspects.

As for the variation among the identified three categories mentioned above, at least two-thirds of the papers in the SOI category were strongly focused on environmental sustainability issues. This category included terms such as “eco-innovations” (Carrillo-Hermosilla et al., 2010), “environmental uncertainty” and “environmental degradation” (York & Venkataraman, 2010), “carbon footprint innovation” (Theodoulidis et al., 2011), “eco-friendly innovation” (Wijnants et al., 2012), “energy-efficient and climate-friendly solutions” (Arnold & Barth, 2012), “environmental gains” (Keskin et al., 2013), “green innovation” (Wu & Sun, 2008; Weng et al., 2015), “environmental innovations” (Potts, 2010; Razumova et al., 2015), and “eco-innovative orientation” (Segarra-Ona et al., 2016).

Similarly, in the PSS research stream, environmental issues were also predominant. Common terms were “climate change” and “material efficiency approach” (Rynikiewicz, 2006), “whole life-cycle environmental performance” (Evans et al., 2007), “environmental innovations” and “environmental improvements” (Ceschin & Vezzoli, 2010), “waste prevention” (Cook et al., 2012), “green public procurement” (Bratt et al., 2013), “environmental impact” (Tang & Bhamra, 2012; Paloheimo et al., 2016), and “CleanServs” (Wolfson et al., 2014).

Both SOI and PSS had a much weaker focus on social sustainability (Table 2). In the former, common terms were “rural poor communities” (Arora & Ali Kazmi, 2012) and “social practices” (van Vliet, 2012), while in the latter, terms such as “social livelihoods” (Xing et al., 2013) and “sustainable energy access” (Pailman et al., 2015) were present.

Regarding papers in the SI stream, social and environmental sustainability dimensions appeared equally. In this category, almost 25% of papers focus on environmental aspects, and almost 25% place emphasis on social issues. On the topic of environmental sustainability, studies in SI use concepts like “green innovation” (Zailani et al., 2011), “eco-efficient services” (Anttonen et al., 2013), “clean development mechanism” (Cruz & Paulino, 2013), “eco-efficiency” (Rossi et al., 2013), “green services” or “ecologically sustainable services” (Cocca & Ganz, 2015), and “reducing natural resource use” (Paloheimo et al., 2016). For studies mainly referring to the social sustainability dimension, several included such terms as “older people” and “health and social care” (Wilson et al., 2012), “food security and safety” and “better dietary habits” (Galli et al., 2014), “inclusion” and “socially driven service innovation” (Reynoso et al., 2015), and “service divide” (Srivastava & Shainesh, 2015).

3.2.3. Innovation dimensions

There is by now a wide consensus among academics regarding the multidimensional nature of service innovation (e.g. Carlborg et al. 2014; Janssen et al., 2016). The picture emerging from our analysis was that several studies embraced the idea that developing innovative service solutions, which addressed sustainability challenges, require changes along several dimensions (Jay & Gerard, 2015). Key innovation dimensions, labelled here as “system”, “design”, “technology”, “organisation” and “customers”, resonated with innovation dimensions commonly defined in the service innovation literature (see, for instance, den Hertog, 2000).

The most frequent key innovation dimension turned out to be “system”, stressing the importance of developing and orchestrating partnerships or networks to foster and support the integration and collaboration among stakeholders when creating value through new sustainable service solutions (Kindström et al., 2013; Enquist et al., 2015). A system focus

could be found in more than 60% of the papers, most commonly in the PSS and SI categories, as well as SOI papers, albeit to a lesser degree. In particular, PSS studies used terms like “partnership building” (Evans et al., 2007; Partidário et al., 2007), “collaborative networks” (e.g. Lelah et al., 2012), “cooperation” (Hernandez-Pardo et al., 2013), “service system” (Vezzoli & Penin, 2006; Wolfson et al., 2014), “innovation system” (Hannon et al., 2015), and “system innovation” (Tukker & Tischner, 2006; Vezzoli et al., 2015). The papers in SI used terms such as “system design” (Wilson et al., 2012), “civic food networks” and “public private partnerships” (Galli et al., 2014), and “service system” (Zhang et al., 2010; Srivastava & Shainesh, 2015). The papers in the SOI stream use terms like “network design” (Hjalmarsson & Lind, 2011) and “stakeholder theory” (Weng et al., 2015).

The second key innovation dimension in terms of importance was “design”, referring to the conceptual component of new sustainability-oriented service solutions (Nidumolu et al., 2009). The design factor was particularly strong in the PSS literature, with terms like “experimental designs” (Vezzoli & Penin, 2006), “design strategy” and “environmental product design” (Tang & Bhamra, 2012), “design process” (Hernandez-Pardo et al., 2013), and “design for sustainability” (Ceschin, 2014; Vezzoli et al., 2015). SOI papers also focused on this dimension, though to a lesser degree, through such terms as “network design” (Hjalmarsson & Lind, 2011), “design for sustainability” and “eco-design” (Küçüksayraç et al., 2015). Within SI research the focus on the design dimension of innovation was much weaker, with one isolated example being the focus on “system design” (Wilson et al., 2012), which was in fact also related to the more prominent system dimension.

The innovation dimension of “technology” appeared most predominantly across SI studies, though it also received some degree of attention in PSS and SOI studies. In SI research, technology was viewed as a crucial way for service companies to develop service innovation and increase their service offerings (e.g. den Hertog, 2000). The papers in SI included several

terms referring to the technological aspect of innovations, such as “e-waste recycling” and “technology” (Zhang et al., 2010), “green IT”, “information technology” and “IT service” (Harmon & Demirkan, 2011), “cloud services” and “computing industry” (Ferrer et al., 2012), “sustainable IT”, and “technology roadmapping” (Harmon et al., 2012), “smartcard payment” and “technology-based service innovation” (Liao et al., 2014), “technology” (Reynoso et al., 2015) and “digital divide” (Srivastava & Shainesh, 2015). PSS papers also considered the technological dimensions of new solutions, with such terms as “information and communication technology (ICT)” (Hernandez-Pardo et al., 2013), and “mobile telephony infrastructure” (Pailman et al., 2015). The SOI stream was instead less focused on technology, though certain terms were present, including “green technology” (Wu & Sun, 2008), “community-based Internet access”, “digital service innovation”, “seamless Wi-Fi connectivity”, “sensor”, “urban computing” and “wireless sensor network” (Wijnants et al., 2012).

Regarding the dimension of “organisation”, business model innovation had emerged as a means to foster and support service innovation (e.g. Kindström & Kowalkowski, 2014), enabling companies to achieve or provide certain benefits of sustainability (Boons & Lüdeke-Freund, 2013). The “organisation” factor was addressed by more than half of the papers in the SI category, and by at least a quarter of papers in both the PSS and SOI categories. In particular, common terms in the SI category were “organisation” (Zhang et al., 2010), “business model” and “corporate social responsibility” (Edvardsson & Enquist, 2011), “sustainable business models” (Ganesh, 2012), “strategic planning” (Harmon et al., 2012), “logistics and learning capabilities” (Rossi et al., 2013), “service operations management” (Liao et al., 2014), “solution-focused business models” (Reynoso et al., 2015), and “social entrepreneurship” (Srivastava & Shainesh, 2015).

In the PSS category, papers adopted terms like “managing use and consumption” (Tang & Bhamra, 2012), “strategic sustainable development” (Bratt et al., 2013), “business development” (Tukker & Tischner, 2006; Hernandez-Pardo et al., 2013), “dynamic capabilities”, “innovation management” and “transition path” (Tietze et al., 2013), “sustainable business model” (Hannon et al., 2015), and “business model innovation” (Pailman et al., 2015). While, in the SOI category, terms referring to the “organisation” factor included “entrepreneurship” and “environmental entrepreneurship” (York & Venkataraman, 2010), “carbon management” and “environmental information management” (Theodoulidis et al., 2011), “inclusive business model” (Arora & Ali Kazmi, 2012), “waste water management” (van Vliet, 2012), “new ventures” and “sustainability-driven entrepreneurship” (Keskin et al., 2013), “catchment management” (Spiller et al., 2013), “brand management” and “environmental management” (Strategic Direction, 2013), “corporate social responsibility (CSR)”, “corporate sustainability” and “strategic corporate social responsibility (SCSR)” (Lai et al., 2015).

With respect to the innovation dimension of “customer”, there seemed to be more of a focus on the interactions between companies and their customers or users. This is based on the notion that SOSI often entailed a new form of customer interaction. The “customer” dimension of innovation was investigated by at least 25% of papers in both the SI and SOI categories (Table 2). In particular, in the SI category, papers used terms such as “co-production” (Wilson et al., 2012), “customer needs” (Anttonen et al., 2013), “co-production” (Galli et al., 2014), and “crowdsourced delivery” (Paloheimo et al., 2016). In SOI, there were such terms as “open innovation” and “user integration” (Arnold & Barth, 2012), “corporate citizenship” and “sustainable community development” (Arora & Ali Kazmi, 2012). The PSS stream analyses “consumer behaviour” (Tang & Bhamra, 2012), “community transformation”

(Xing et al., 2013), “citizen centered governance” and “e-participation” (Misra, 2014), “co-creation” (Wolfson et al., 2014), and “open innovation” (Liedtke et al., 2015).

The sampled papers also incorporated several insights on “policy” (Table 2), identifying the role that both institutions and governments could have in stimulating and supporting service innovation geared towards sustainability (e.g. Rubalcaba, 2006; Adams et al., 2015). Insights on “policy” were mainly provided by papers in the SOI stream. Key terms were “environmental policy” (Carrillo-Hermosilla et al., 2010), “regional development” (Potts, 2010), and “institutional change” (Swilling, 2010). However, the role of policy for SOSI was under-investigated by both the research streams of PSS and SI (fewer than 25% of papers for each category). PSS papers did cover “policy instruments”, “policy measures” and “public policies” (Ceschin & Vezzoli, 2010), “green public procurement” and “procurement” (Bratt et al., 2013), “citizen centered governance” and “rural e-governance services” (Misra, 2014), and “government 'demand pull' policy” (Hannon et al., 2015). SI papers mentioned terms such as “sustainable public procurement” (Galli et al., 2014), and “institutions” (Srivastava & Shainesh, 2015).

In sum, each research stream appeared to focus on specific dimensions of innovation, while simultaneously considering multiple dimensions when attempting to define innovation. Interestingly, all streams acknowledged the critical role of the system dimension, indicating that new solutions oriented around sustainability inherently brought a systemic view of those innovations.

3.2.4. Temporal and spatial analysis

In terms of temporal analysis, papers in the PSS category spanned across the entire period, i.e. from 2004 to 2015. However, the first paper jointly focusing on services, innovation and sustainability within the SOI stream was not published until 2008 (Wu & Sun, 2008).

Similarly, in the SI stream, the first paper was not published until 2010 (Zhang et al., 2010). In terms of topic variation over time, social aspects and social sustainability issues were seemingly neglected for many years. Indeed, these topics did not appear in our sample of publications until 2010. Moreover, prior to 2010, there were only marginal references to social aspects, and these only appeared within the PSS research stream (Rynikiewicz, 2006; Evans et al., 2007; Partidario et al., 2007). Since 2010, however, a growing amount of attention has been given to social issues. In the more recent years, several studies have addressed certain specific sub-topics related to social issues, such as the “aging population” (Wilson et al., 2012), “economic divide” (Ganesh, 2012), “ethical value” and “corporate social responsibility” (e.g. York & Venkataraman, 2010; Edvardsson & Enquist, 2011), “social inclusion” (Reynoso et al., 2015), and “service divide” (Srivastava & Shainesh, 2015).

INSERT Table 3 here

Regarding the spatial analysis of the literature, almost 82% of the sampled papers provided specific insights related to the location of the study. In particular, more than half of these papers focused on European countries, and were almost equally distributed among PSS (with slightly more predominance) (e.g. Bratt et al., 2013; Partidario et al., 2007; Liedtke et al., 2015), SI (e.g. Ganesh, 2012; Cocca & Ganz, 2015; Hyytinen & Toivonen, 2015) and SOI (e.g. Keskin et al., 2013; Razumova et al., 2015; Segarra-Ona et al., 2016).

Almost 20% of the papers performed studies localised in Asian countries across all three categories; PSS (e.g. Xing et al., 2013; Misra, 2014), SI (e.g. Zhang et al., 2010; Liao et al., 2014) and SOI (e.g. Lai et al., 2015; Weng et al., 2015). Very few studies considered American countries in general, or Latin America in particular (Cruz & Paolino, 2013; Hernandez-Pardo et al., 2013), and minimal attention was paid to Africa (e.g. Swilling, 2010; Ceschin, 2014) or Australia (Potts, 2010). Finally, nearly 14% of studies grouped several

different countries together, and these mainly belonged to PSS (e.g. Vezzoli & Penin, 2006; Ceschin, 2013) and SI (e.g. Harmon et al., 2012; Reynoso et al., 2015) categories.

4. Discussion

This section discusses the results of the descriptive and thematic analysis.

First, as highlighted by the descriptive analysis, researchers are placing increasing importance on the topic of our investigation, i.e. the connection between service innovation and sustainability or SOSI (Figure 2). Nevertheless, research was found to be fragmented and isolated in nature, being thinly spread out across many disciplines and journals (Figure 2 & Table 1). Interestingly, the JCLP was the most frequent publication outlet for the sampled papers, despite not being a journal focused on service research.

Second, the review of literature revealed the relevance of three research streams of SI, SOI and PSS, which investigated the topic of SOSI, despite never explicitly focusing on it (Section 3.2.1). The review of the literature highlighted several publications of PSS research, which had potential relevance when attempting to further enhance our current understanding of how companies can develop new service-based solutions to address sustainability issues. The thematic analysis revealed that the published studies remained primarily concerned with manufacturing industries, and mainly offered insights into how to complement services with product innovation. Thus, there was still room for a more encompassing view on how all kinds of companies can develop service innovation. This demonstrated how more research is needed to incorporate a transcendent business logic (Enquist et al., 2015) in the study of SOSI.

Third, the review of literature confirmed that, despite sustainability entailing social and economic realms, research remained primarily focused on environmental issues. Ultimately, the literature still lacked a holistic approach to sustainability, as evidenced by the wealth of concepts largely applied to specific environmental aspects (Section 3.2.2). Moreover,

available studies still generally neglected the social element of sustainability (Sections 3.2.2 and 3.2.4), though this trend was supposed to be changing in part due to the emergence of “transformative services research” (TSR) (e.g. Anderson et al., 2013). Interestingly, our search strategy did not retrieve any of these studies, since the TSR niche does not take a holistic approach on sustainability; rather, it focuses mainly on social sustainability.

Fourth, our evidence indicated that studies focused on the connection between service innovation and sustainability investigated multiple dimensions of innovation (Rantala et al., 2018). This ranged from the traditional dimension of technology to the more recent understanding that service innovation entails changes in design and in the ways systems of connected actors, customers and value propositions are linked in a network. Our thematic analysis revealed that whilst each stream had a strong focus on only one or two of these innovation dimensions, the system dimension of SOSI appeared across all categories (Section 3.2.3), thus suggesting that these innovations most often involved a change to the system, fostering alignment of stakeholders to ensure a value creation network logic (Vargo & Lusch, 2008).

5. An emerging research field: sustainability-oriented service innovation (SOSI)

Although none of them investigated SOSI specifically, the three main research streams of “sustainability-oriented innovation” (SOI), “product-service system” (PSS) and “service innovation” (SI) were explored to provide insights into the connection between service innovation and sustainability.

Firstly, as reconstructed by Jay and Gerard (2015), the concept of SOI has been developed to spur research on innovations driven by environmental and social sustainability concerns, as

well as economic returns. As it currently stands, SOI is an “umbrella term” that embodies multiple definitions, concepts and approaches (see Carrillo-Hermosilla, et al. (2010) and Adams et al. (2012) for extensive reviews). Yet, a recent literature review on SOI (Adams et al., 2015) highlighted a knowledge gap between manufacturing and service companies (Peiró Signes et al., 2014; Segarra-Ona et al., 2014; 2016), and called for SOI to extend its scope to all innovating companies (Holmlund et al., 2016).

Secondly, the literature on PSS (e.g. Mont & Tukker, 2006; Beuren et al., 2013; Reim et al., 2015) has contributed to the investigation and support of transitioning from a goods-logic to a services-logic as a means of fostering sustainability benefits for society (Tukker, 2004). As such, PSSs have also been successful in enabling the diffusion of sustainability-oriented innovations (SOIs) (Grosse-Dunker & Hansen, 2011). A service perspective (Lusch et al., 2007; Vargo & Lusch, 2008) is considered vital when addressing challenges related to SDGs (Anderson & Ostrom, 2015; Fisk et al., 2016), since service solutions provision helps to direct certain economic systems towards addressing specific customer needs (e.g. Tukker, 2004; Halme et al., 2007). Current research on PSSs also conceptualises the innovation and/or reconfiguration of firms’ business models (Bocken et al., 2014), towards integrating goods and service offerings into more sustainable new solutions (Ceschin, 2013; Mylan, 2015). PSSs can thus foster the development of SOSI, not only through the achievement of environmental savings, but also through the improvement of socio-economic conditions of people (Xing et al., 2013). Yet, PSS research still remains predominantly focused on manufacturing industries (Cook et al., 2006; Kastalli & Van Looy, 2013), due to the fact that the issue under examination is the transformation of product-based systems into more service-oriented systems. PSS research can develop even further by embracing the synthesis approach to service innovation, securing new and wider service business in the compliance to sustainable development goals (Enquist et al., 2015; UN, 2015).

Thirdly, the literature on SI has grown into an established stream within innovation studies (see Droege et al., 2009 for an excellent review). SI is considered as a “multi-dimensional phenomenon” (Carlborg et al. 2014; Janssen & den Hertog, 2016) that can express itself as a “new service concept, new customer interaction, new value system/business partners, new revenue model, new organisational or technological service delivery system” (den Hertog et al., 2010, p. 19). Thus, it is concerned with the implementation of several types of innovations in organisational processes, activities and routines, which affect the design, development and delivery of new service offerings, as solutions or experiences (den Hertog et al., 2010; Janssen et al, 2015). As discussed earlier, SI research has not yet developed a strong focus on sustainability, but the emerging “synthesis” approach implies that service innovation has a much broader application than service companies alone (Coombs & Miles, 2000; Gallouj & Savona, 2010).

The three research streams (PSS, SI, and SOI) were different in how they contributed to the the current understanding of the ways in which companies can address sustainability or SDGs through service innovation. Yet, this knowledge has remained in an embryonic phase and several research gaps still exist (Rantala et al., 2018). Indeed, studies have provided too heterogeneous insights, which, although valuable, are scattered across the literature and are often unrelated with one another. Moreover, there was no recognised transdisciplinary research community that explicitly focused on SOSI (Gustafsson et al., 2016). This knowledge gap also fostered a proliferation of different concepts, terms, labels and innovation approaches by researchers from different fields, making it particularly difficult for those in academia to share results among themselves.

Recent concepts and approaches presented in the literature, such as “CleanServs” (Wolfson et al., 2014) or the idea of “transformative services” (e.g. Anderson et al., 2013), seem to have little opportunity to capitalise on the holistically regarded connection between service

innovation and sustainability. This has resulted in further difficulties to produce stimuli capable of enhancing the embryonic concept of SOSI. CleanServs (Wolfson et al. 2014) has dealt primarily with research on the environmental aspects of economic activity, focusing on topics such as clean technologies, cleaner production and clean innovation. As such, it would not be a broad enough concept for researchers concerned with social and economic sustainability issues to use. On the other hand, the idea of TSR mainly revolves around social issues, and would thus have limited opportunities to inspire holistic research related to service companies and their SOI activities. Instead, this study argues that integrating ideas on transcendent business logics for sustainable service business in the synthesis perspective of SI research has more potential to develop the SOSI field further.

In this paper, our argument has been that a shared research field, identifiable by a clear label, can facilitate both collaboration and dissemination of results among researchers. Therefore, this study proposes the label of “sustainability-oriented service innovation” (SOSI), for this can clearly and uniquely identify a field of research explicitly focused on the connection between service innovation and sustainability. The term “oriented” was chosen following prior insights from SOI research that stressed how addressing sustainability is about a new “direction” (Klewitz & Hansen, 2014), and a ‘dynamic, unfolding process that is achieved over time’ (Adams et al., 2015, p. 181).

INSERT FIGURE 5 here

Theoretically, although they were still blurred, the contours of the SOSI field were emerging (Figure 5), at the convergence of the three main streams (SOI, PSS and SI), discussed above, as well as all those studies investigating the organic relationships between services, innovation and sustainability. As such, Figure 5 is able to provide several valuable insights regarding the connection between service innovation and sustainability.

6. Future research pathways

In 2005, Henry Chesbrough made the case for the emergence of a new service science field.

In our opinion, his comments would now apply to the SOSI field:

Under their watchful eyes, its growth is being stunted. That's not to say those disciplines have made no progress... But they're not making progress across disciplinary boundaries. People in these different areas don't review each other's work because they don't publish in the same journals, and they don't meet because there isn't a definitive conference covering the field. It's no surprise that the work shows little cumulative advance in learning (Chesbrough, 2005).

The definition of the SOSI field would not replace or completely merge the existing fields of SOI, SI and PSS. Instead, this study proposes that these streams are important building blocks towards the development of the SOSI field, which can subsequently develop into an independent and novel research stream benefiting from the several existing contributions. Particularly, the SOSI field builds upon insights from:

1. Research focused on SOI, supporting the design, development or delivery of new or improved service offerings, as well as implementation of new sustainability-oriented organisational practices, activities and processes;
2. Research on SI that embraces the study of service innovation with the aim of addressing environmental, social and economic sustainability issues;
3. Research on PSS, which has had the merit of drawing attention to development and provision of service offerings (solutions or experiences) as a means of addressing sustainability issues, while improving economic returns for companies.

A recognisable and shared label is clearly a necessary condition to spur research on the topic. Sufficient conditions for further development have been outlined above. These are concerned with the development of new theoretical frameworks, and relate to empirical and policy questions surrounding SOSI.

Aiming to provide a starting point for the future development of a transdisciplinary research community in the new area of SOSI, this study offers a preliminary definition of SOSI. In particular, it envisions both the extension of SOI concepts and the further development of PSS research into models applicable beyond manufacturing contexts only. Following the insight from SI research that service innovation is a “multi-dimensional phenomenon” (Janssen & den Hertog, 2016), this study expects SOSI to develop as *a multi-dimensional concept that captures the different elements of new service solutions by addressing environmental, social and economic sustainability issues*. Based on our thematic analysis, key dimensions of SOSI are likely to refer to new system approaches for partnerships with stakeholders, new designs, new technologies, new customer relations or interactions, and new organisational capabilities, linked to environmental, social and economic sustainability goals, and holistically regarded.

To foster further enhancement of the SOSI field, future research should focus on the design and development of new models, which are able to support companies in their SOSI activities. Given the current paucity of research on the organisational dimension of SOSI, more theoretical and practical research is needed, to conceptualise, and then implement, several types of SOSIs as a way to innovate and develop new business models from the perspective of sustainability-oriented business model innovation (Bocken et al., 2014; França et al., 2017). These efforts will also entail the study of the specific organisational capabilities needed for unleashing and managing SOSI into business and thus into society (Amui et al.,

2017). There is need of widening existing capabilities framework for SI (den Hertog et al., 2010; Janssen et al., 2016) by extending them to include sustainability-oriented elements.

Finally, understanding how policy, government and institutions can encourage and support innovative companies is fundamental, as this will help to provide innovative service offerings, which address environmental, social and economic sustainability challenges, and are beneficial in collaborative partnerships between business, government, universities and users (Elzen et al., 2004; UN, 2015). Our review has shown that most studies so far neglected policy issues, but these issues are prominent in calls for more research on service solutions to societal challenges (Gallouj et al., 2015).

7. Conclusions

This study contributed the very first literature review focused on SOSI. More specifically, it conducted a systematic search for peer-reviewed publications (from 2004 up to and including 2015), across a variety of fields, which jointly investigated the topics of services, innovation and sustainability. The literature review revealed that, to date, few studies have explicitly focused on the connection between service innovation and sustainability, despite a growing interest in these research topics. The main contribution of our literature review was to underline that an overarching research field is still missing, and that the available studies mainly stem from the three existing research streams of SOI, SI and PSS, with a dominance of the latter. This result had clear implications for research. A first implication has been that many insights on how service innovation can contribute to sustainability goals were already there, but scattered across fields. This made it difficult to build upon existing research in a systematic way. A second implication is that the convergence of the three streams towards common topics opened the way for the emergence of a a new research field.

This paper introduced the label of “sustainability-oriented service innovation” (SOSI). The different streams of SOI, SI and PSS appeared to all have opportunities to evolve in the direction of SOSI, despite a lack of realisation thus far. The definition of a recognisable label, i.e. SOSI, was just the first step for the theoretical and practical advancement of the new research field.

Three main directions for further research are outlined below.

Firstly, conceptual work is needed to merge and adapt existing conceptual dimensions underlying the three pillars of SOSI. This work will allow specifying the foundations of SOSI for the sake of developing relevant measurement tools capturing its key determinants.

Secondly, with the ambition to not only recognize SOSI but also to understand how to manage it, further research will have to investigate the organizational capabilities needed to implement SOSI. As this implementation is expected to require fundamental changes in how companies approach their business, the identification of key capabilities will have important managerial implications. Here further research can take stock of the rich evidence on the painstaking processes of servitization that companies go through when shifting to a service-oriented business model. Similarly, aiming at more sustainable offers also requires a major rethinking from the side of companies. While a framework such as the one in Janssen et al., (2016) already offers a useful starting point, more research is needed to capture the additional capabilities required by sustainability challenges.

Finally, further research will have to take seriously the policy question, especially if one believes that society would need to promote SOSI as much as possible. Janssen and Castaldi (2018) propose to develop policy rationales using a capability perspective, as an alternative to classical market failure arguments. Then relevant policy questions would be: is there enough SOSI capability development in a region/country? Such an approach makes the investigation of the capabilities needed for SOSI of broader relevance than to companies alone: it is in the

interest of policymakers to check the extent of capability development in the local organizations.

To conclude, it is our hope that these future research efforts will be taken up by a vibrant research community contributing to a currently under-investigated but highly relevant area.

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Table 1. Distribution of papers across journals is shown (total n.° 51 articles, conference proceedings excluded)

Source	n.°
Journal of Cleaner Production	16
Foresight	2
Journal of Business Research	2
Sustainability (Switzerland)	2
Business and Society	1
Energy Efficiency	1
Environmental Innovation and Societal Transitions	1
IEEE Transactions on Engineering Management	1
Information Communication and Society	1
Innovation in Life Cycle Engineering and Sustainable Development	1
International Business Management	1
International Journal of Automotive Technology and Management	1
International Journal of Design	1
International Journal of Production Research	1
International Journal of Sustainability in Higher Education	1
International Journal of Sustainable Engineering	1
International Journal of Technology Management	1
IT Professional	1
Journal of Environmental Policy and Planning	1
Journal of Retailing and Consumer Services	1
Journal of Service Management	1
Journal of Sustainable Tourism	1
Journal of Technology Management and Innovation	1
MIS Quarterly: Management Information Systems	1
Production Planning and Control	1
Resources, Conservation and Recycling	1
Service Industries Journal	1
Strategic Direction	1
Supply Chain Management	1
Sustainability Accounting, Management and Policy Journal	1
Sustainable Development	1
Total Quality Management and Business Excellence	1
Water Resources Management	1

Table 2. The distribution of papers across the identified research streams of product-service system (PSS), service innovation (SI) and sustainability-oriented innovation (SOI) is depicted.

Final Sample (n.° 61)	Categories		Sustainability Dimensions		Innovation Dimensions				Policy	
	Research Streams		Social	Environmental	System	Design	Technology	Organisation		Customer
n.° 24	PSS	e.g. Hannon et al., 2015; Wolfson et al., 2014; Bratt et al., 2013; Xing et al., 2013; Evans et al., 2007; Time Frame: 2004-2015								
n.° 18	SI	e.g. Paloheimo et al., 2016; Srivastava & Shainesh, 2015; Reynoso et al., 2015; Cocca & Ganz, 2015; Anttonen et al., 2013; Time Frame: 2010-2016								
n.° 19	SOI	e.g. Segarra-Ona et al., 2016; Keskin et al., 2013; Carrillo-Hermosilla et al., 2010; Potts, 2010; York & Venkataraman, 2010; Time Frame: 2008-2016								

Table Colours Legend. The different colour gradation identifies the different focus of papers on the identified topics, as highlighted in the thematic analysis. The following percentages are calculated with respect to the total number of each category, indicated on leftmost column.

	Dark gray: 2/3 or more of the papers deals with the topic referred by the columns header.
	Upper intermediate gray: more than half.
	Lower intermediate gray: at least 25%.
	Light gray: less than 25%.

Table 3. The distribution of sampled papers by the different geographical location (based on where the research was focused) is shown.

Final Sample (n.° 61)	Product-Service System (PSS)	Service Innovation (SI)	Sustainability-oriented Innovation (SOI)	Tot.
Africa	2	0	1	3
Asia	2	4	4	10
America	2	1	0	3
Australia	0	0	1	1
Europe	9	7	10	26
Multi-countries	3	3	1	7
Undefined	6	3	2	11

The captions of the figures are as following:

Figure 1. The strategy adopted for searching for peer-reviewed publications jointly focusing on services, innovation and sustainability is depicted.

Figure 2. The distribution of the final sample of papers (n=61), as detected by Scopus results, is respectively depicted per subject area on the left and over time on the right.

Figure 3. The frequency of keywords indicated in the final sample of papers (n=61) is revealed, as detected by Scopus results

Figure 4. On the left, the distribution of empirical research methods and type of data used is shown (n.° = 49 empirical papers). On the right, the distribution of service sectors explicitly addressed in the studies is outlined (n.° = 38, several sectors for each study possible)

Figure 5. This theoretical framework outlines the contours of the emerging “Sustainability-oriented Service Innovation” (SOSI) field. The SOSI field mainly lies at the convergence of the three existing streams of SOI, PSS and SI, as well as all those studies investigating the organic relationships between services, innovation and sustainability.