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# Researching product-service systems for consumers: insights from a systematic literature review

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## Abstract

Product-service systems (PSSs) have the potential to integrate a variety of sustainability strategies as producers are incentivised to design and market less material-intensive products and prolong use-cycles. While diffusion of PSSs in industrial cases is well reported, consumer acceptance remains a key barrier to more ambitious use- and result-oriented PSS outside of niche markets. This paper systematically reviews the literature on B2C PSSs to synthesise four factors impacting on consumer acceptance of PSSs and their hypothesised relationships. Further it is argued that considering the impact of all four factors would strengthen evaluative research on B2C cases.

**Keywords:** product-service systems, consumers, barriers for acceptance

## Purpose

Driven by mounting interest in sustainable paradigms of production and consumption, research activity on product-service systems (PSSs) is increasing because of their potential to improve financial, social and environmental outcomes. Arguing that such product service bundles incentivise producers to improve in-use efficiency and prolong product to save costs and increase asset utilisation as per rationale of what has been coined the circular economy (compare Tukker, 2015), ‘sustainable PSSs’ in particular have increased attention.

However, while industrial examples of PSSs are abundant and successful cases have been reported from a variety of industries, ambitious use- and result-oriented Business-to-Consumer (B2C) PSSs supported by business models that do not transfer ownership of supporting physical artefacts to the consumer but instead rely on more complex service

components for value generation are researched and implemented less (Vezzoli et al., 2015). Given that use- and especially result-oriented PSSs in which client and provider agree on an outcome or result but do not *a priori* specify how that outcome will be delivered (Tukker, 2004) are claimed to have the largest potential for environmental performance improvements, this is unfortunate, but unsurprising as ‘user acceptance remains a black box’ (Vezzoli et al., 2015, p7).

After initial optimism in the attractiveness of PSSs for consumers (Mont, 2002), the lack of success of such PSSs has in later studies been partially attributed to the various sacrifices and risks consumers are required to accept and when opting for PSSs over more conventional products and services for meeting needs. Since then, more empirical studies have widened the scope to go beyond the PSSs themselves to consider the additional complexity in the business models through which they are provided (e.g. Armstrong et al., 2015; Catulli & Reed, 2017). Similarly, recent reviews, most notably Annarelli et al. (2016), Reim et al., (2015), Tukker (2015), and Vezzoli et al. (2015) have shed light on the variety of enablers and barriers of PSS in the marketplace at large, however, even though that consumer acceptance is widely cited to be a major barrier to the success of PSSs, no literature review has focused explicitly on the consumer perspective - instead focus has been placed on individual configurational factors of the PSSs or their supporting business models. This is unfortunate as a more nuanced understanding of consumer attitudes would aid in designing operationally and financially viable PSSs.

Before this background, this study reviews the field of B2C PSSs research to synthesize and categorise the various defining factors underpinning PSS acceptance by consumers into sensible categories to guide future research.

## Methodology

This study utilised a five-step systematic literature review methodology (SLR) as shown in Figure 1 (adapted from Denyer & Tranfield, 2009).

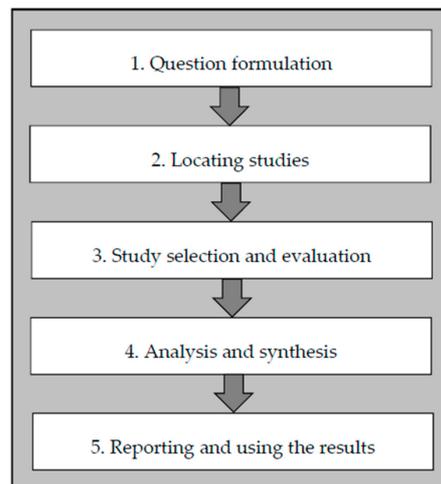


Figure 1 – Five-step systematic literature review process.

The review questions of step 1 followed on from the purpose of this study which emerged after surveying existing literature reviews and identifying their gaps in sufficiently explaining and categorizing the lack of success of more ambitious PSSs in consumer markets as outlined above. The review questions are therefore given as:

- Which factors impact on consumer acceptance of PSS?

- How can these factors be considered in empirical research evaluating consumer acceptance of PSS?

Five databases were consulted for the purpose of identifying studies for potential inclusion: “Web of Science – Core Collection”, “EBSCO Business Complete”, “SCOPUS”, “ProQuest”, and “EmeraldInsight”, following Tukker’s (2015) rationale that literature on PSS would be found within the engineering, IT, and business management domains. Search strings in titles, abstracts, and keywords were applied based on an initial screening of three recent PSS literature reviews (Beuren et al., 2013; Reim et al., 2015; Tukker, 2015). All searches were conducted from 5 July 2017 to 7 July 2017, focusing on research articles from scholarly journals in English from 2000 to 2018. Table 1 gives the overview of relevant search strings in databases and the corresponding results.

Table 1 – Search strings and hits in selected databases.

Database	Search string	Application of search string
Web of Science (Core Collection)	((TS=((pss OR "product service system*" OR "product-service system*") AND (consum* OR customer* OR b2c OR market OR implement*))) AND LANGUAGE: (English) AND DOCUMENT TYPES: (Article) Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=2000-2017	785
EBSCO Business Complete	(AB pss OR "product service system*" OR "product-service system*") AND (AB consum* OR customer* OR b2c OR market* OR implement*) Scholarly (Peer Reviewed) Journals; Published Date: 20000101-; Publication Type: Academic Journal; Document Type: Article; Language: English	268
SCOPUS	TITLE-ABS-KEY(( pss OR "product service system*" OR product-service AND system* ) AND ( consum* OR customer* OR b2c OR market* OR implement* )) AND ( LIMIT- TO ( PUBYEAR , 2017 ) OR LIMIT- TO ( PUBYEAR , 2016 ) OR LIMIT- TO ( PUBYEAR , 2015 ) OR LIMIT- TO ( PUBYEAR , 2014 ) OR LIMIT- TO ( PUBYEAR , 2013 ) OR LIMIT- TO ( PUBYEAR , 2012 ) OR LIMIT- TO ( PUBYEAR , 2011 ) OR LIMIT- TO ( PUBYEAR , 2010 ) ) AND ( LIMIT- TO ( DOCTYPE , "ar" ) ) AND ( LIMIT- TO ( LANGUAGE , "English" ) ) AND ( LIMIT- TO ( SRCTYPE , "j" ) )	633
ProQuest	ab((pss OR "product service system*" OR "product-service system*") AND (consum* OR customer* OR b2c OR market* OR implement*))Date: After 01 January 2000  Source type Scholarly Journals Document type Article Language English	120
Emerald Insight	((pss OR "product service system*" OR product-service system*") AND (consum* OR customer* OR b2c OR market* OR implement*)) – Past 2000 and Articles/ Chapters	550

Study selection and evaluation was conducted after removing duplicate studies and applying a quality appraisal based on SJR indicators of Q1/Q2 to ensure quality of reviewed articles. Table 2 and Table 3 give an overview of the applied exclusion and inclusion criteria with explanatory rationales, which were first applied to titles and abstracts of remaining articles, and then to full texts.

Table 2 – Exclusion criteria.

Exclusion criterion	Rationale
Firms upstream of the OEM	Articles that take an inward-looking perspective and analyse changes necessary for supply chains when running or transitioning to a PSS business model are out of scope

Organisational and operational challenges of PSSs for OEM firms	Articles discussing which organisational, operational, or financial challenges firms face in their design and delivery of PSS, particularly when transitioning from a traditional sales-based business model to a PSS, are out of scope if not connected to how this impacts on the consumers
Cases of B2B or industrial PSSs	As the focus of this review is on consumer perceptions of PSS and recent literature reviews have shown that B2B and B2C challenges are not similar, articles on B2B and industrial PSSs are out of scope
Physical product design	Articles that solely occupy with product design paradigms (e.g. cradle-to-cradle) to support sustainability or (re-)manufacturing potential of PSSs are out of scope if it is not explained how this impacts on consumers

Table 3 – Inclusion criteria.

Inclusion criterion	Rationale
Role of PSSs in (changing) consumption paradigms	Articles exploring how uptake of PSSs will change consumerism, particularly the role of the consumer or user in the process and looking at rights and responsibilities can contribute to identifying the space within which PSS consumption takes places
Theoretical or empirical evaluation of B2C PSSs and associated business models	Articles identifying what drives or inhibits consumer interest and purchase intention of PSSs and which aspects of business models are determinants for such drivers and inhibitors explain consumer acceptance
Concepts and methodologies on design and development of PSSs for consumers	Additional knowledge may be extracted from articles in which the consumer and consumer preferences are explicitly and meaningfully included in studies on design and development of B2C PSSs

Application of these exclusion and inclusion criteria resulted in 79 articles for further review. Figure 2 below gives an overview of the complete article selection process with numbers of papers rejected and taken forward papers at each step.

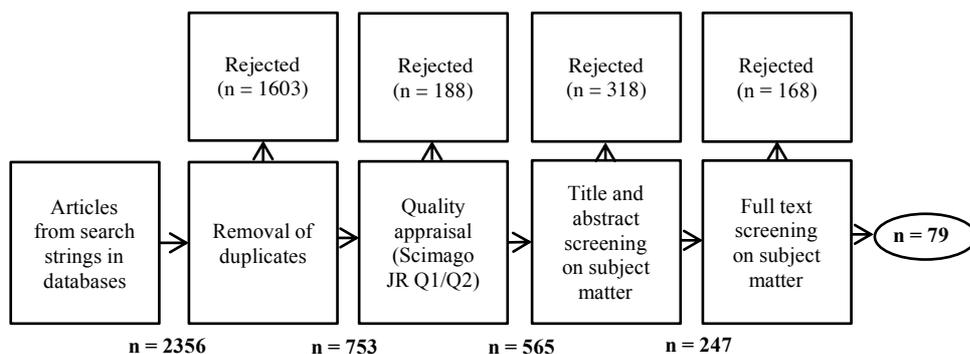


Figure 2 – Article selection process.

The 79 papers were analysed for both descriptive and thematic content. After reviewing a portion of the papers, preliminary findings were discussed, and a data extraction sheet developed, with relevant themes discussed and defined to minimise bias in the data extraction phase. This data extraction sheet firstly provided information later used in the descriptive analysis such as publication year and journal, as well type, i.e. conceptual contributions, methodological contributions, empirical work, model building, or literature reviews, and, in the case of papers focused on implementation of PSSs, industry or product. The second part of the data extraction sheet used for the thematic analysis provided a list of relevant themes to cluster extracted knowledge, which is given in Table 4 together with definitions.

Table 4 – Relevant themes for thematic analysis.

Relevant theme	Definition
Drivers of PSS implementation	Information on who would be interested in providing or consuming PSSs, and why
PSS definition(s)	How PSSs are defined or classified, either presenting a new definition or citing an established one
Advantages of PSSs for consumers	Information on why consumers would be/ could be willing to purchase a PSS over a competing alternative offer – a distinction was made here between empirically tested hypotheses in distinct cases or products, and more general claims typically backed up by literature
Disadvantages of PSSs for consumers	Information on what drawbacks consumers can expect when purchasing a PSS over a competing alternative offer – a distinction similar to the previous one was adopted
Consumer groups	Information on which type of consumers might be more accepting/ interested in PSS offers in given examples
Barriers to PSS provision or consumption	Issues that currently impede PSSs provision or consumption
Enablers for PSS provision or consumption	Solutions addressing problems from the previous theme, as well as more general enablers that would improve the success of PSSs in consumer markets if implemented

Coming to the last step of the five-step literature review process, the following is dedicated to reporting the results descriptively and thematically and to synthesizing the displayed knowledge for the purpose of answering the review questions.

### Descriptive Results

The 79 selected articles are analysed in this section with regards to their publication year, journal, and article type to display how research on B2C PSSs has progressed. From Figure 3 below it is apparent that research activity has experienced a rapid increase recently, with the *Journal of Cleaner Production* leading the conversation with 35 publications. Overall the field is fragmented however with a total of 31 different journals making contributions to the field, with six journals having published three or more articles on the topic since 2000 and accounting for a total of 48.

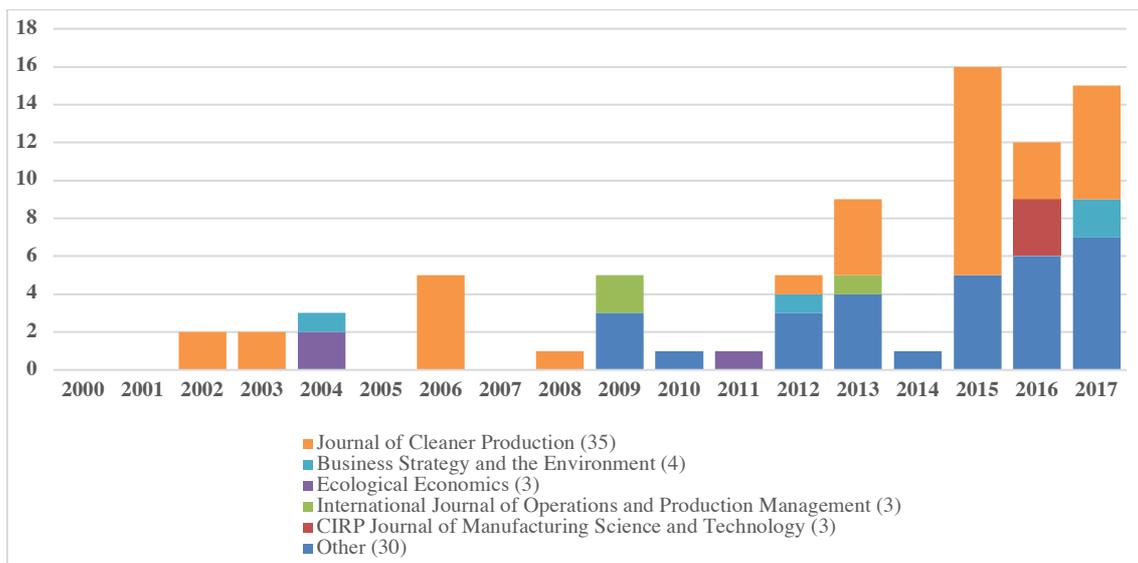


Figure 3 – Journal publications per year.

In terms of the types of articles that are published it is apparent that after initial conceptual contributions the field is now being driven by empirical research, frequently on specific cases of B2C PSSs where researchers investigate consumer perceptions. The variety of literature reviews on closely situated topics such as or Annarelli et al.'s (2016) analysis of research streams within the PSS literature or the review on the fit of PSSs with sustainability and the circular economy by Tukker (2015) have been included to augment this review where appropriate.

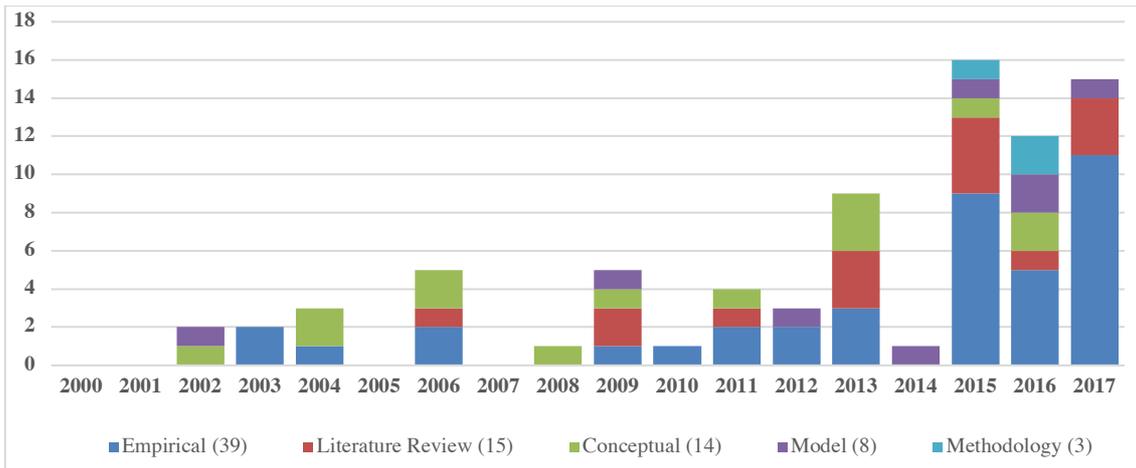


Figure 4 – Types of journal publications per year.

### Thematic Results

Previous reviews have already sufficiently addressed the matter of converging on common definitions and typologies for PSS; while Goedkoop et al.'s (1999) early definition of PSS as 'a marketable set of products and services capable of jointly fulfilling a user's need', later adopted in Mont's (2002) seminal paper remains popular due to its inclusiveness, this definition is typically augmented by Tukker's (2004) three categories of product-, use-, and result-oriented PSS which are further differentiated into eight subcategories or types that have later been analysed as business models (Reim et al., 2015).

Similarly, the proposed drivers of PSS in this review mirror those found in other reviews, with part of the authors following the spirit of servitisation and arguing that companies can improve their competitiveness by switching from selling physical goods to creating difficult to imitate and longer lasting service relationships (Lightfoot et al., 2013; Luoto et al., 2017). Other authors explicitly stress the potential environmental, and, less often, social gains that PSS could achieve (Halme et al., 2004; Kang & Wimmer, 2007; Scheepens et al., 2015), with some overlap between the two groups as PSSs are claimed to have the potential align economic, social, and environmental interests (Piscicelli et al., 2015). PSSs is also seen as a method of diffusing innovations such as solar technologies (Shih & Chou, 2011) by way of sharing risk between producer and consumer. Explicit consumer demand is not given as a driver for PSSs, but it is expressed that consumers are increasingly becoming aware of the drawbacks of the current production and consumption paradigms and could recognise the potential of PSS to alleviate while offering sufficiently similar or even superior value.

As such authors expect that the 'relative advantages [will be] the main driver for the diffusion of PSS' (Rexfelt & Ornäs, 2009). Here other reviews by Tukker (2015) and

Reim et al. (2015) identify the variety of benefits PSS could have for consumers, which largely depend on the specific type of PSS and associated business model and will not be repeated here in detail. The potential benefits touch on the full range of value types that consumers might draw from the consumption of a product or service and broadly include financial, emotional, social, quality, and environmental considerations (compare Catulli & Reed, 2017). On the side of disadvantages, the diversity increases, with perceived risk being a recurring theme – in more ambitious PSSs that diverge further from the norm consumers worry about the potential loss of control through a lack of ownership, the potential loss of quality through a lack of newness, or potential financial losses through more long-term relationships (Armstrong et al., 2015) as well as others. Some studies point towards perceived risk being the stronger reason for a lack of consumer interest, as PSSs are seemingly readily recognised to be more innovative, economical, and environmentally friendly alternatives, but ownership-less PSSs especially create uncertainty which might be mitigated through assurances, warranties, and trust (Armstrong et al., 2015; Rexfelt & Ornäs, 2009).

The importance of the perceived value and risk of a given PSS case might however ultimately depend on specific consumer preferences and product use-regimes as two quotes from the PSS literature itself summarise: ‘Consumers simply value owning things and having control’ (Tukker, 2015, p88) vis-à-vis ‘Temporary needs and wishes can be fulfilled by temporary use...instead of owning the product. Users can be liberated from the burden of owning’ (Kang & Wimmer, 2007, p1149). Mont (2004) thus claims that in a case of a pram leasing PSS wealthy, educated, urban users with a preference for environmentally friendly consumption would be a viable target group – characteristics that are mirrored by Cherubini et al. (2015) in the case of electric cars. A recurring theme here is that early conceptual papers were optimistic about the preference of consumers for ‘green’ products (e.g. Kang & Wimmer, 2007; Mont, 2002), while later empirical research finds that consumers are aware of the potential for a superior environmental performance of several types of PSS (Armstrong et al., 2015) – this awareness however only shows a negligible impact on consumption choices as other product and business model characteristics are seen as more important for most consumers (Catulli & Reed, 2017). Piscicelli et al. (2015) delve deeper into what defines active and engaged users of lending and borrowing PSSs in the UK and finds shared personal value dispositions and demographic characteristics, which one on the hand compel these users to be attracted to the environmental value of such business models, and on other hand discount the unattractiveness and high perceived risk of ownership-less consumption that is claimed by other researchers (Linder et al., 2017; Tukker, 2015). This is also explained by referring to culture: ‘Consumers in certain parts of the world are more likely to accept [a] PSS... consideration of the cultural conditions is necessary for [a] PSS, and a company should first verify that the correct conditions appear to be in place’ (Beuren et al., 2013, p225). Overall it can be expected that successful use- and result-PSSs would target specific consumer groups with specific preferences and narrow use-regimes that align with the environmental aspect or the lower economic cost through-use of ownership-less PSS – as such ‘[PSS] are best explored within small niches’ (Armstrong & Lang, 2013, p11).

Looking beyond the immediate consumer, the environment in which PSSs compete with existing products, given that ‘consumer acceptance of PSS depends on the alternatives consumers have at hand’ (Rexfelt & Ornäs, 2009, p677), is defined by established and known patterns of production and consumption for a particular product or need category. These environments typically encompass the presence of an existing supporting infrastructure, institutional arrangements, and a known legal backdrop for

consumption which is based on the purchase of exclusive ownership and use rights of a product artefact, and subsequent use/consumption and disposal of product artefacts over which the owner has full control (Reim et al., 2015; Rexfelt & Ornäs, 2009; Plepys et al., 2015). Taking the example of carsharing and -pooling, regardless of immediate characteristics of a PSS such as price or availability, supporting infrastructure like dedicated centrally located parking facilities and integrated transportation policies present very real barriers and ‘individual market players may find it difficult to change logic of established markets’, requiring buy-in from a disperse set of actors granting subsidies in infrastructure, policy support, and direct changes to existing transportation services (Plepys et al., 2015, p4), despite it being argued that carpooling is sufficiently similar to car renting the decrease consumer apprehension (Alfian et al., 2014). Vezzoli et al. (2015) review these barriers further and find that PSSs and business models successful in niche markets might lack the resources to change overall dominant production and consumption logics sufficiently to enter the mainstream, which mirrors the findings from the consumer-centric research previously.

### **Discussion and Contribution**

Reviewing the literature on PSSs in B2C context reveals that the field has retained its early focus on sustainability as set out by Goedkoop et al. (1999) and Mont (2002), with later publications in the *Journal of Cleaner Production* especially strengthening the notion that the PSS concept carries an explicit or implicit aim of lowering emissions and resource consumption, even as it is accepted now that the achievement of that aim is not certain and difficult to prove conclusively in a given case. In this regard the literature on B2C PSSs seems to be more cohesive than its close neighbours in servitisation and industrial PSSs, as well as the research stream on PSS and business models, which continues to debate whether the sustainable ambition is integral to the PSS (compare Tukker, 2015). Less attention has been given to the social benefits beyond those emerging directly from a reduced environmental burden engendered by an economic shift to services and PSSs, despite some recognising the potential of PSS involving sharing and value co-creation to lead to ‘more meaningful experiences’ between users of PSS (Piscicelli et al., 2014, p2) and offer more social interaction (Armstrong & Lang, 2013). The difficulty of measuring or proving the social benefit is more acute here, although methods such as LCA might be adapted (Scheepens et al., 2015).

The variety of potential advantages and disadvantages of PSS over competing alternatives for meeting needs by consumers in a given case is ever growing and points towards the need for segmenting research along more distinct lines than product-, use-, and result-oriented PSSs that forms the basis for most work. It appears that the ‘what’ of the PSS and the ‘how’ of its associated business model and delivery mechanism presents a dual challenge for researchers and practitioners alike – designing and evaluating the value offering in the PSS itself cannot be fully divorced from the business model that supports and enables it in practice (Reim et al., 2015), making the identification of distinct advantages and disadvantages of the value offer difficult to attribute precisely. It might therefore be hypothesised that a PSS based on product renting/sharing (which would fall into the use-oriented category), is less influenced by worries about access to the utility it provides or hygiene as literature might indicate, but more by the minutiae of return policies, payment terms, and transaction costs emerging out of how exactly the PSS is offered and delivered, and the perceived uncertainty and risk presented here. As such PSS solutions ‘can be composed in an infinite number of ways’ (Rexfelt & Ornäs, 2009), and research has progressed most substantially in areas where researchers have focused on individual product groups like prams (Catulli & Reed, 2017; Mont, 2002, 2006) or fashion

(Armstrong et al., 2013; 2015; 2016) with the goal of uncovering the relevant factors for adoption for a set of distinct and specified PSSs and business models.

On a higher level it has been established that four aspects need to be considered when researching B2C PSS: the specific PSS and its associated business model which presents the consumer with a mix of value and risk which might not be immediately apparent, existing alternatives with a different, but known mix of value and risk, the consumer itself being defined by preferences, use-regimes, values and demographics, and the wider environment in which a consumption decision takes place, impacting on the other factors to varying degree, with Vezzoli et al.'s (2015) proposed figurative 'black box' at the centre.

In the absence of a changing environment that either withdraws support given to the take-make-use-dispose model of production and consumption, which seems unlikely, or actively extends support to PSS providers by integrating them in a more coordinated push towards more sustainable consumption such as the circular economy (compare EMF, 2012), it is hypothesised that a) PSS adoption will depend on PSS providers finding ways of lowering the perceived risk of their offers for consumers, and b) consumers becoming less risk averse.

It is recommended that all of the four aspects are considered in future empirical work on the evaluation of consumer acceptance of PSSs as an analysis of the full picture yields more conclusive insights than looking at factors in isolation. This is because, similar to the attempt to divide PSSs from their business models as discussed previously, it appears entirely possible to find that a lack of consumer interest in a PSS is not caused by its value offer, the way it is delivered, or consumer preferences, but by doubt among consumers whether the necessary public infrastructure exists to support its operation reliably in practice or the support given from a public actor to a competing product or service (compare Cherubini et al., 2015; Plepys et al., 2015).

As such it appears unlikely that a better environmental performance will be the main relative advantage of PSSs, and it would be valuable to investigate PSSs and business models that better mitigate and share risks between provider and consumer, as well as communicate this effectively to alleviate the various concerns cited in literature. The impact of trust in this process also needs to be specified further as the complexity and sheer otherness of more ambitious PSSs and business models emerging in literature could mean that consumers will be unable to develop comprehensive product knowledge on relative advantages and disadvantages of PSSs prior to purchase, which could be mitigated by a high degree of trust in the provider.

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