

Article

Investigating the Potential Adoption of Product-Service Systems in the Luggage Industry To Promote Sustainability

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Abstract: The travel-goods industry is an essential part of the larger travel and tourism sector, but it creates significant environmental impacts due to resource and energy consumption. This study investigates the feasibility and sustainability potential of servitisation concepts within the travel-goods industry, and the Product-Service System (PSS) models, in particular, to identify steps towards a more sustainable travel industry in the future. It explores the sustainability-related drivers within the luggage industry and identifies barriers to the adoption of servitisation models, and opportunities for value creation for both consumers and commercial organisations. Business models are mapped into a typology to highlight different pathways to PSS adoption, underpinned with empirical data collected via a consumer sentiment survey and semi-structured interviews with industry experts. Even though the analysis revealed shifting consumer attitudes towards servitisation concepts within the travel-goods market, with a significant level of interest emerging for specific PSS models, at present, the widespread adoption of PSS is hindered. This is due to the fragmented nature of global supply chains and entrenched ownership values. Addressing supply chain issues regarding end-of-life systems to sustainably manage products beyond functional obsolescence is critical. In parallel, product-oriented PSS models are more likely to increase, driven by a burgeoning resale market and supported by digital technologies, which in turn can lead to greater prospects for use-oriented PSS adoption and eventually, reduced environmental impacts.

Keywords: Product-Service System (PSS); Circular economy; Luggage; sustainable travel; sustainable consumption; sustainable production

1. Introduction

In recent years the travel and tourism industry has been identified as being a prominent contributor to environmentally damaging greenhouse gas emissions via air, sea, and road transportation. The United Nations World Tourism Organization reports that tourism-related transport emissions represented 22% of global transport emissions in 2016 (UNWTO, 2019). In addition to transportation emissions, physical travel goods, such as luggage and travel bags, can also create environmental impacts, especially in the final stages of their life cycle. Considering the scale of the luggage market, which in 2019 was estimated at USD 22 billion (Statista, 2021), the environmental impacts of luggage production, use, and end-of-life management are important to look at. Structured luggage and travel bags are usually composed of moulded polymer components, aluminium tubes, plastic zippers, and synthetic rubber wheels, which are combined mechanically and chemically with synthetic textiles and various reinforcement materials. Therefore, luggage and travel bags are composite products, which according to the authors' understanding of waste management, when wasted are not easily classified to either disassemble and recycling or recovery processes.

In the USA, luggage waste is classified under *Miscellaneous Durable Goods* for waste management, and of this category, only 2% was recycled in 2018 (EPA, 2021). In the EU, luggage and travel bag waste fall into the broader category of municipal solid waste (MSW) which is considered to be recycled at an average rate of 48% (Eurostat, 2021). However, the European MSW recycling rate accounts for the management of recyclable waste materials (i.e., plastics, metals, glass, paper/cardboard) and organic waste (e.g., food waste, grass clippings, leaves) that are easily distinguished and can be separated at source (e.g. household). Bulky waste such as luggage is not properly classified and therefore, any attempt to correctly process it using the European List of Wastes (LoW) (Ec.europa.EU, 2019) is futile, which explains the lack of detailed statistics on individual bulky waste categories, including luggage. This is currently obstructing the generation of any insights into luggage and travel bag waste management.

Aside from design and functionality, luggage as a product category can be characterised by an intertwined relationship between different stakeholders (including the owner) *vis-à-vis* its use and handling. During the luggage's use phase, the owner is seldom in control, or even in sight of their luggage, having agreed responsibility and liability for carriage to airlines, upon ticket purchase for air travel. When not in use, luggage is kept in storage for short, medium, and even long periods, seeing infrequent use (Eurostat, 2021). The changes brought about by the COVID-19 pandemic, where business-related travel is being questioned and the adoption of online video conferencing becomes ubiquitous (Borko et al. 2020; Ioannides and Gyimóthy, 2020), have urged the travel sector to rethink their business models. Some of the main questions that arise relate to how luggage can be utilised more intensively and efficiently, for longer periods, and how can they become more sustainable in the future.

Indeed, as a product category luggage has somehow failed to receive adequate academic attention in terms of environmental impacts and sustainability issues, presumably because the impact of carbon emissions associated with travel, especially air travel, dwarfs that of the luggage industry, which is arguably smaller; thus, it has received little to no attention. Moreover, as a product category, luggage is designed to offer a service, lending itself to the development of a new business model that could create value for consumers and businesses alike whilst reducing negative environmental, economic, and social impacts through reuse (Mont, 2002; Goedkoop et al. 1999; Pialot et al. 2016); a practice that is increasingly gaining traction.

Product Service Systems (PSS) are business models (BMs) that can provide a means with which to monitor and prevent waste generation and promote dematerialisation and resource efficiency through circular economy principles (Stahel, 1994; Tukker, 2015). PSS can offer the opportunity to dematerialise and decouple the ownership of materials, components, and products from the provision of function. In turn, this can lead to reduced primary resources and energy consumption, improved resource management, and optimisation in value chains (Goedkoop, 1999). However, despite the potential for PSS to help drive the sustainability agenda, the uptake and adoption of such models remain limited (Catulli, 2012; Moro et al. 2018), especially in Business to Consumer (B2C) commercial relationships (Catulli, 2012; Ceschin and Gaziulusoy, 2019). Globally recognised brands such as IKEA are helping to re-frame the narrative on the re-sale of furniture and homewares (IKEA, 2021); instigating the transition. Many high-end fashion and luxury brands are now offering their versions of PSS, too, such as the ThredUp - Rent the Runway (RtR) partnership, a US-based apparel rental and subscription service that uses the PSS model to inspire the sense of a community that swaps everything from clothes to inspiration and ideas. ThredUp, successfully began trading on the NASDAQ in March 2021 (Debter, 2021), becoming the first largest online consignment and thrift shop. This booming economic growth would potentially drive more interest in long-term maintenance and repairability, with the travel goods industry not wanting to miss opportunities to generate revenue.

The use of PSS in the travel goods industry has not to date emerged as a successful business strategy. However, the literature indicates that despite barriers, its

implementation could lead to capability development in the travel-goods industry, providing businesses with certain strategic advantages (Bressanelli et al. 2018). While there is wide-ranging literature on luggage (or baggage) inspection techniques and airport security scanning systems research (Khan et al. 2020; Akcay and Breckon 2022), and occasionally on luggage design with a focus on polymer composites, design-engineering and ergonomics studies (Santos et al. 2021; Kmetty et al. 2010; Jung et al. 2007), there is a distinct lack of academic research into any life-cycle stages (production, distribution, usage and end-of-life) of luggage and travel goods within a PSS framework. This points to a significant research gap, which this study aims to investigate by exploring the feasibility and sustainability potential for the application of PSS models within the context of luggage and travel goods. Via this explorative analysis, the study seeks to identify steps toward a more sustainable travel industry in the future. In doing so, the study proposes a typology of pathways to PSS adoption and investigates their potential implementation in the future. Using a mixed-methods approach the study gains qualitative data from consumers and insights from the perspectives of luggage manufacturers, to assess the potential for certain PSS types to achieve success in both environmental and economic terms.

2. Literature Review

PSS models have been developed from concepts of servitisation from the late 1980s and 1990s (Vandermerwe and Rada, 1988; Stahel, 1994; Friend, 1994). A concise and often-cited definition of a PSS follows, “a system of products, services, supporting networks and infrastructures that are designed to be competitive, satisfy customer needs and have a lower environmental impact than traditional business models” (Mont, 2002, p.239). They are also known by the terms Integrated Product Service Offering (IPSO) (Lindahl et al. 2013), and Sustainable Product-Service System (S.PSS) (Ceschin, 2014; Vezzoli et al. 2021). As described by Manzini and Vezzoli (2002) there are three main categories of PSS: i) services that add value to a product life cycle, by extending its use, for example, ii) services that provide enabling platforms for customers such as a mobility or accommodation function, and iii) services that provide a result to a customer, such as clean laundry, or heated water for example. Tukker (2004) provides a clearer definition of these three primary categories and some sub-categories of PSS in diagrammatic form, shown here in Figure 1, which are the: *Product-oriented*, *Use-oriented* and *Results-oriented* that have since become common nomenclature.

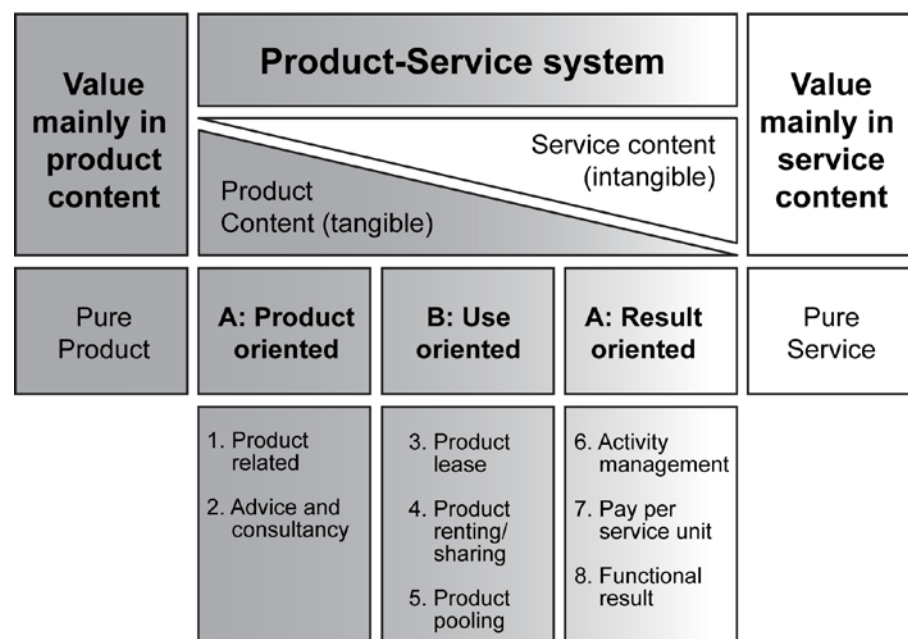


Figure 1. Categories and sub-categories of Product-Service Systems (PSS) adapted from Tukker (2004).

A product-oriented PSS is largely based on the conventional sale, purchase, and ownership transfer of a product, but with additional services added. These services could be maintenance contracts, take-back agreements at the product's end-of-life (EoL) stage, and advice or consultancy on how best to utilise the product (Tukker, 2004). An example of a product-oriented PSS is purchasing office equipment with an after-sales service agreement that involves on-site checks and repairs to keep the equipment in good working order. The use-oriented PSS is sometimes referred to as an *access-based consumption* (ABC) model (Catulli et al. 2013), or a *user-oriented* model, and is generally represented via product leasing, renting or sharing, and pooling schemes. In all three schemes, both the ownership of the product and responsibility for its maintenance and take-back remain with the provider. The customer can only purchase the use of, or access to, the product. Leasing usually allows the user (or user group) to have unlimited access to the product within a time frame (e.g., leasing office equipment across a period of many months or years), whereas renting or sharing requires that the product be used sequentially by multiple users (e.g., renting a car for a few days). Product pooling allows the product to be used simultaneously between users (e.g., car-pooling with multiple passengers) (Tukker, 2004). *Results-oriented* PSS can be described as a model where service is sold, with the products involved in the provision of the service identified by the provider and not necessarily by the customer. For example, this could be the provision of ambient lighting to office space, without specifying the exact type or amount of lighting elements to be installed.

Regarding the feasibility of a given PSS, Mont (2002) outlines three main areas of *uncertainty*: i) the readiness of companies to adopt; ii) the readiness of consumers to accept; and iii) associated environmental implications. Successful business-to-business (B2B) PSS models, which often involve industrial equipment and other investment goods (Baines et al. 2007; Gaiardelli et al. 2014; Tenucci and Supino 2020) do not appear to easily translate to B2C models. Luggage is a product that presents certain specific challenges as its use pertains to factors outside of the control of the user, such as the occasional damages occurring when the luggage is under the airlines' control; as well as accidental damage due to weather conditions, and so on. At the time of writing, there are no published plans from European or UK regulators to enact any Extended Producer Responsibility (EPR) requirements that would cover products like luggage (Ec.europa.EU, 2021; hse.gov.uk). Local councils in the UK offer bulky waste collection at a price, however, specific guidelines for the disposal of luggage are not readily available. Often, the luggage collected is transferred to a Household Waste Recycling Centre (HWRC) where it would become part of the same waste code as other mixed rigid plastics (e.g. garden furniture, code: 20 01 39), or it's mixed with other bulky waste (with the LoW code 20 03 07) of which fate depends on the waste management practices employed by different authorities and HWRCs; in the UK the majority almost certainly goes to either landfill or incineration (the likelihood of either varies in other countries). This, unfortunately, leaves consumers with little clarity as to whether luggage may be recycled (NLWA, 2021). While PSS can create the conditions for sustainable luggage handling and management (Manzini and Vezzoli, 2002, Xing et al. 2013), it will not necessarily lead to better environmental outcomes or better market outcomes as these depend on a case-by-case basis (Tukker, 2004; Lindahl et al. 2013).

Another barrier to the adoption of PSS by businesses and consumers is the potential for *rebound effects*, where the positive effects of a PSS are cancelled by unintended negative effects (Walnum et al 2014; Vivanco et al. 2016). Rebound effects are usually associated with environmental impacts. Goedkoop et al. (1999) conclude that for PSS to be truly sustainable and avoid rebound effects via alternative consumption, the perceived value must be high in combination with low environmental impact. In effect, any newly launched PSS should be priced such that there are no savings made which could then be spent elsewhere on energy and material-consuming goods and services.

Further barriers to use-oriented PSS uptake are the environmental impacts of leasing and rental models (Cline, 2019; Johnson and Plepys, 2021). The amount of energy and emissions related to delivery and pick-up services, dry cleaning and sterilisation, and potential repairs, is likely to negate any impact reduction through the manufacture of fewer physical products. By way of example, Johnson and Plepys (2021) measured the environmental impacts of a fashion rental BM in Sweden, using Life Cycle Analysis (LCA), and presented several stark implications for consumer behaviour. They state that “*Consumers who rent clothing should fully replace their purchasing needs and avoid partial substitution*” (p. 20) in addition to wearing the rented garments multiple times during the rented period (Johnson and Plepys, 2021). The delivery and pick-up aspects could be addressed partly by the P2P sharing BM typology, where consumers can lend and borrow their luggage to those within their geographic area, ideally exchanging via public transport or on foot. Currently, though, this is not something attracting consumers to engage with, despite studies showing that familiarity with digital sharing culture and service (e.g., smartphone apps, social media platforms and online ordering) can be a driver of commercial success in PSS (Catulli et al. 2020).

3. Methods

The nature of this study dictated that a blend of empirical and secondary research data be compiled in a largely inductive process to explore the entrenched thinking and emerging sentiments from consumers and experts alike on the reusability of travel goods via the PSS. The data collection took place in two stages. In the first stage, we employed an explorative survey targeting consumers; in the second stage, we conducted in-depth semi-structured interviews with experts working in the travel goods industry to identify consumers and experts, leading to critical discussion points on PSS feasibility.

The academic literature about the various facets of PSS was explored via widely known online search engines and academic platforms (e.g. Web of Sciences, Scopus, ScienceDirect). For up-to-date statistics relating to travel goods and associated markets, various sources were accessed such as websites of the European Union, US and British government sites, and business statistics sites such as Forbes and Statista. Conventional and emergent BMs within the travel-goods market were identified, researched and mapped into four discrete PSS BM types to make sense of their potential implementation.

3.1. Online Explorative Survey

The online consumer sentiment explorative survey was conducted via an anonymous online questionnaire to collect data from luggage-owning travellers living in the UK and Europe. The survey was restricted to adults over 18 and the purpose of the questionnaire was to understand perceptions towards both product-oriented and use-oriented PSS. The questionnaire was composed of 37 questions using the Qualtrics XM platform (Qualtrics.com) and was divided into four sections: demographics, current luggage ownership, and use, maintenance and disposal, and luggage rental and leasing. Instead of focusing only on consumer behaviours, we collected data on perceptions of luggage leasing and renting potential. Ranking-style questions were employed within the questionnaire, to elicit sentiment and preference, and also to gauge the relative popularity of each response (see Supplementary Material). Qualtrics XM was selected as it is a trusted online survey platform in higher education organisations in Europe and the US (Businesswire, 2013) and is also used by the National Health Service (NHS) in the UK (gov.UK Digital Marketplace). The questionnaire was distributed via email, web, SMS, and social media.

The survey took an average of 10 minutes to complete. The survey was launched on the 1st of July and it automatically closed at 11:59 pm on the 3rd of August 2021. The data was anonymised before their analysis, including deleting the postcode. We promoted participation in the online survey via social media accounts on LinkedIn, Facebook and Instagram and via snowballing. Facebook and Instagram are among the top four most popular social media platforms in the UK in 2019 (Avocado Social, n.d.); hence, their selection.

A total of 106 respondents completed the survey which is considered to be a sufficient sample for the study.

3.2. In-depth Expert Interviews

A purposeful sample of 10 experts from across 10 different brands and nationalities (British, German, French, Chinese) were selected and directly connected for the interview stage that aimed to capture the views of senior product development and marketing managers within the travel-goods industry. The experts were selected based on the following criteria: 1) had a direct professional association with the travel-good industry, working for one of the brands explored in the survey; 2) represented a specific speciality including sales management, marketing-communications, product-marketing and new product development; 3) had a direct relationship with the sustainability team with the business they represented. The purpose of the interviews was to gauge the experts' opinions regarding the existence of servitisation in the industry and thoughts on how PSS could be adapted to the travel sector in the future (see Supplementary Material). Five experts were finally recruited via professional associations and former working relationships – the rest of them were unresponsive. Employing Bogner and Menz's (2009) typology of interview strategies classify these semi-structured interviews as *Interviewer as Co-Expert*, within a type of interaction they specify as *the theory-generating expert interview*. The specialist competence is similar and specialist knowledge and vocabulary are shared to develop theory through induction whilst revealing knowledge and insight within the given thematic framework (Bogner and Menz, 2009; Döringer 2020).

All interviews were conducted between the 12th and 28th of August 2021, lasted about one hour each, and were conducted over Zoom with the auto-caption function enabled. The interviews were audio-recorded to allow for automatic transcription which was then checked for accuracy before thematic analysis. During the interviews, participants answered a series of questions about their understanding of sustainability in the travel-goods industry, the customer needs, and the potential application and barriers to PSS adoption (such as renting and leasing) in the travel goods/luggage market and their impact on their business. The interview protocol can be seen in *Supplementary Material*. It contained seven specific questions (Q#) and one open-ended question. Q1 and Q2 were designed aiming to identify the company's priorities in terms of sustainability and whether such considerations have started to gain precedence in the travel-goods industry. Q3 was designed to investigate customer needs and how the company captures and utilises this knowledge in designing its strategy. Q4-Q6 were aimed at gathering the views of the industry on the likelihood of adopting the PSS in their business, the degree of adoption needed to improve their sustainability credentials and the barriers perceived in doing so. Q7 was designed to investigate the challenges related to the "if" and "how" of PSS adoption. Finally, the open-ended question was designed to investigate the company's ideas, insights and concerns with sustainability and the need for changing their BM.

4. Results

4.1. PSS BM typology

Four hypothetical PSS business model types were created using evidence from the literature. The typology (Figure 2A-2D) combines visual aspects of systematic flow charts with graphical value mapping to give a depiction of product, data, and value flow, along with centres of energy and resource consumption via various processes, such as cleaning the luggage and End of Life (EoL) management. The intention is to create a visual structure for analysis and comparison. For reasons of clarity, the diagrams cannot be entirely comprehensive in terms of data ownership and transfer within each model which, as discussed, is an important aspect of use-oriented PSS BMs.

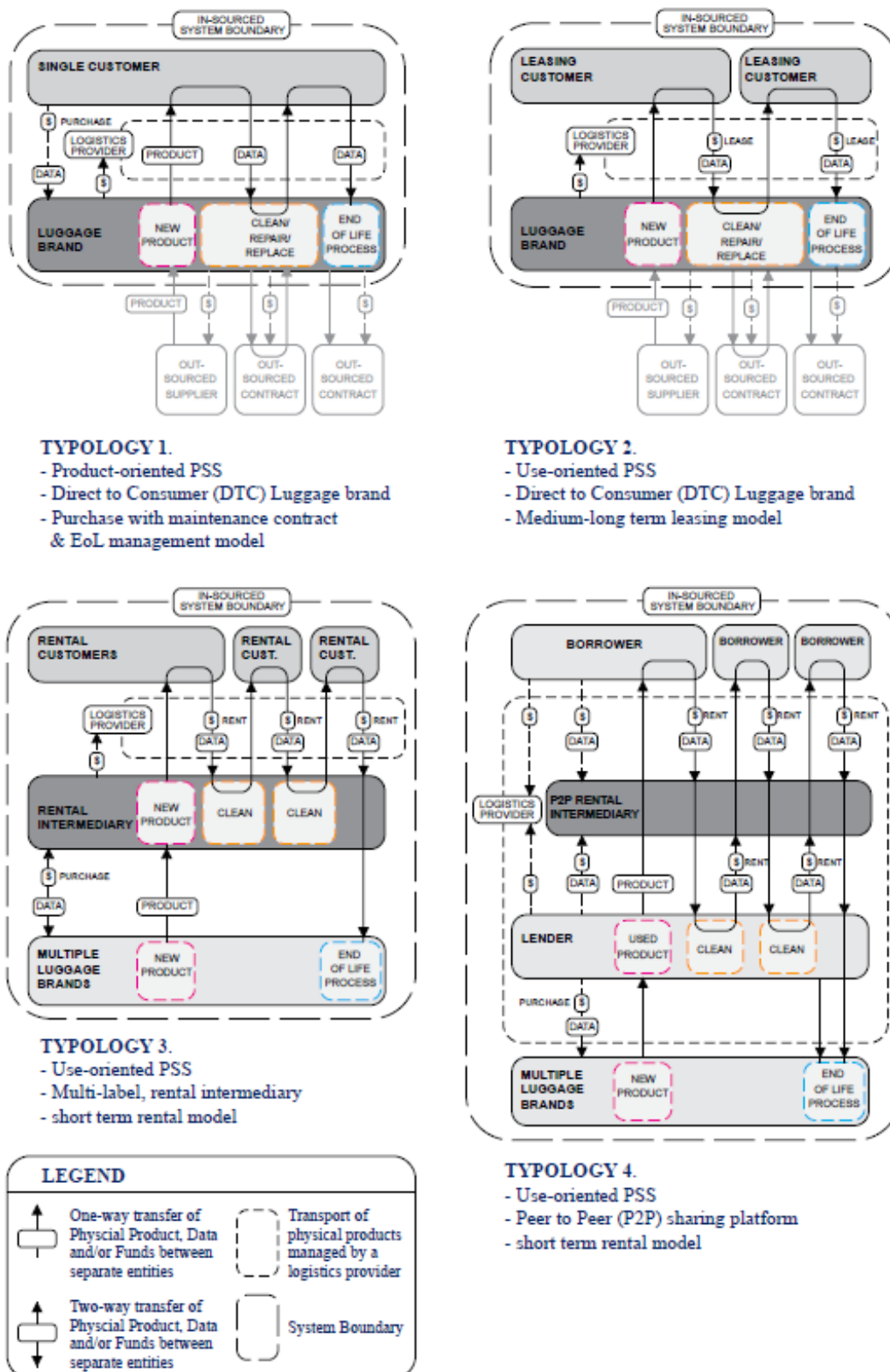


Figure 2. PSS BM mapping into four types: (A) and (B) describes a relationship between luggage brand and consumer(s), and (C) and (D) depict a complex relationship where intermediaries (rental/leasing agencies, rental app companies) intervene to promote reuse.

Typologies 1 and 2 describe the relationship a luggage brand could have with a customer across the life cycle of a product, with a product-oriented PSS (A) and a use-oriented PSS (B). Both concentrate on a notional 'Direct to Consumer' (DTC) brand (as opposed to wholesale) with vertically integrated production (i.e., the brand owns its production facilities, usually ensuring a shorter supply chain). The potential outsourcing of production, cleaning and EoL management is shown below the diagrams in pale grey. This is to indicate the additional levels of complexity involved in the processes depicted, given the prevalence of outsourced production in the travel-goods industry. *Typologies 3 and 4* are elaborations of use-oriented PSS, enabled and distributed largely by online digital technologies. They indicate how intermediaries can create BMs with value propositions utilising their online platforms with, (C) the physical products of separate luggage brands, and (D) through users sharing their physical products.

Typology 1: shows that ownership is transferred to the customer and that at subsequent moments the luggage manufacturer manages the cleaning and maintenance and eventually the EoL processes. With each transfer of the product, it is assumed that some data is collected, about user habits or potential physical weak points on the product. Shown as a dotted line box between the brand and the customer (and in other areas on other typology diagrams), the logistics provider (for example DHL or FedEx) can benefit economically from deliveries to and from the customer.

Typology 2: describes the relationship between the luggage brand and multiple customers who could lease (or rent) a piece of luggage for a pre-agreed period. As with *Typology 1*, the luggage company must manage maintenance, cleaning and EoL processes. Again, it's quite likely that the brand would engage third parties to carry out these processes (shown below in pale grey). Significant here is that each time a piece of luggage is transferred between manufacturer and customer both economic value and data (which has a value) is also transferred.

Typology 3: depicts a situation where a rental/leasing agency purchases products from a luggage manufacturer to then rent or lease out to customers. It becomes the rental company's responsibility to manage the cleaning and maintenance of products coming back and forth from renters, and to manage the EoL process – indicated here as a return to the manufacturer. Notable here is the potential for multiple transfers of data and economic value between the rental platform and customer, but only a single transaction between luggage manufacturer and customer (the rental agency in this case).

Typology 4: is a peer-to-peer (P2P) rent-share network, managed by an intermediary. In this situation, consumers borrow a piece of luggage from other consumers via an online platform with pricing set by the lender, who is also a consumer. The product delivery and return method are agreed upon between the lender and borrower, as are cleaning and maintenance. The online intermediary provides the platform for communication between parties, takes a percentage of the rental fee from both borrower and lender, and provides a method of insuring both parties, to encourage correct usage and return of the product. If the sharing is done within a radius that doesn't require private motorised transport (i.e., the exchange is completed on foot or by public transport) then this typology could indeed have positive environmental impact benefits.

These typologies were examined through discussion with industry experts (see section 4.2). They were found to be relevant if not convincing to the experts for largely economic reasons. It was generally perceived that types 3 and 4 would not currently be commercially viable for most existing luggage brands, whereas types 1 and 2 could potentially return economic value and were thus preferred.

4.2. Expert interviews

The group of five industry experts interviewed represented two brands within one of the world's largest luggage manufacturing groups, a company within a global luxury conglomerate, and one global premium lifestyle brand which is also part of a larger commercial group, and which produces a range of products in addition to luggage. Whilst all

interviewees are high-level managers and directors within their respective companies and have high degrees of control over product development and related activities, none are board-level 'C-suite' directors (e.g., Chief Executive Officer, Chief Operating Officer).

The first interview question centred on the travel industry's reaction to a reported increase in sustainability concerns amongst travellers, following the outbreak of COVID-19. This drew a wide selection of responses; from the identification of recycled materials as a primary action to carbon-neutral declarations, discussion of product quality and durability, and travel frequencies that may be more prevalent in the coming years. Regarding the specific nature of the question and the mixed views elicited, it was clear that no industry-wide perspective on sustainability currently exists.

Discussing major factors driving the luggage industry towards greater environmental sustainability, the risk versus opportunity and shareholder value featured as the most important themes. As both brands represented belong to publicly listed companies, there was a recognition of share price and the need to develop and comply with corporate social responsibility (CSR) guidelines to attract and maintain investment. Some of this communication on compliance was described as *greenwashing*. It was noted that the development of corporate communication strategies for sustainability is now a necessity for all brands, whether or not these strategies lead to measurably effective actions.

The potential for government-driven regulatory action which might force change within the industry was acknowledged as a slight possibility but was seen as less likely to drive change in the short term compared to profit-imperative related to sales, as well as other forms of commercial pressure. To this end, a comment was made that large retailers (in Europe and UK) are now introducing measures to stock only products that adhere to their own "Green-Label" product sustainability guidelines, possibly to facilitate their own CSR compliance. If future regulations in the form of manufacturer take-back directives were to occur, it was agreed that this would prove difficult for most of the industry in the West to cope with, due to the prevalence of Far-East production, fragmented supply chains, and wholesale distribution. Where potential take-back directives were deemed more achievable, was in vertically integrated and DTC businesses, where a brand owns the means of production (finished goods factories) and distribution (online/offline stores). It was also mentioned by most interviewees that luggage brands would need to rethink their product design approach towards embracing *design for disassembly*, but how achievable this might be was not elaborated on.

When asked whether customers were in search of new or enhanced services within the luggage market, the issues of logistics and distribution consistently came up as an important factor – more so than sustainability issues. One manager called the high consumer expectations for near-instantaneous delivery after their online purchase, "*The Amazon mentality*". For the more premium brands represented, the trend for mass-customisation in consumer products (Horizon 2020 European Commission, 2021) was mentioned as something sought after by their customers. It appears, however, that product-oriented and use-oriented PSS models are not being actively considered by luggage brands, nor requested by consumers. One manager noted that where their brand had implemented a product-oriented PSS in the form of an extended warranty programme with sustainability goals promoted, the consumer take-up had been limited.

Managers from the more premium brands also claimed that their customer care programmes, including product warranty, have been offering a sustainability-oriented service already, by concentrating on maintaining and extending product life. In so doing, it could encourage customers to question the value of product warranties more carefully and avoid (what one interviewed expert called) *spurious guarantees*. Further on questions into use-oriented PSS, it was identified that retail price points for luggage were rarely high enough to encourage consideration of use-based models (unlike car rental where purchase prices are considerably higher). Consumers can always find luggage at a price that suits them, irrespective of the related environmental issues. According to all managers, their brands had explored use-oriented PSS to some extent (some beginning around 2010) and

had concluded that the price-value equation did not work well enough for either consumer or provider, to warrant the actual implementation of actual schemes.

Regarding rental and/or leasing, hygiene was consistently highlighted as a barrier to adoption and seen to be most likely the consumer's primary concern. Beyond the emotional and hygiene aspects of ownership versus access, two further themes were evident here. The physical logistics of providing a reliable rental system was cited as something very difficult and probably not commercially viable at this moment, and secondly, the business proposition of access-based consumption was in almost direct opposition to the conventional purchase-with-warranty proposition, i.e., requiring a comprehensive business model transformation.

4.3. Consumer sentiment survey

The survey generated an overall sample size of 110 respondents. Whilst it is acknowledged that the sample size is not large, the responses still provide meaningful insights into the research. A demographic breakdown shows the sample is 55% female, 40% male with 5% non-binary or preferring not to say. The sample is well distributed across age groups, with 11% of respondents being from the 18-25 age group, 20% from the 26-35 age group, 42% from the 36-45 age group, 18% from the 46-55 age group, and 7% from the older than 56 age group; 2% of the respondents preferred not to say. The sample is 60% UK and 35% EU and Non-EU European nations, with 5% preferring not to say. The sample is more than 60% in full-time employment and very well educated, with more than 85% of respondents holding a bachelor's degree or higher, 31% with master's degrees or higher and 8.5% with doctorates. These levels of education are much higher than national averages in EU European countries and the UK (Statista, 2021) however when cross-sectional filtering was done between higher and lower educational levels attained, the variation in results was not significant.

Also, to be noted is that 15% of respondents have worked or are working in the travel-goods industry, but again this grouping showed no meaningful differences within results. Various other filters were applied to detect data categories beyond what was visible through demographic grouping and the most notable difference between respondents who claimed interest in use-oriented PSS and those who did not. Whilst the data suggests there may be two different mindsets at play here, it is too simplistic to suggest that the PSS-interested respondents are more aware or concerned with sustainability issues per se. Responses to certain other questions, especially those related to the repair and disposal of luggage, reveal contradictory opinions from both groups.

Participants were asked to answer travel frequency-related questions based on their pre-COVID-19 travel experience to gain an understanding of ownership of luggage types and travel habits. Respondents across all demographics thought they would be travelling a similar amount when COVID-19 pandemic restrictions were lifted, although 34% believed they would be taking fewer trips for longer. An overwhelming 95% and 97% of participants owned pieces of both small cabin-size and large check-in-size luggage, respectively. Cabin-sized luggage was used up to 10 times per year by 81% of people whereas large check-in size luggage was used less than 5 times per year by 83%, which clearly shows there are long periods where large luggage sits unused. When asked about ownership by brand, over 40% were able to name a single well-known brand as their primary luggage used, with all other brands recording 5% or less, with 12% of respondents not knowing their brand of luggage.

Users' sentiments toward their luggage, in terms of warranty value, repair status, and disposal methods were the focus of the third section of the survey. Less than 14% of participants bought their current luggage with the warranty as a primary consideration, and 57% were neutral ('neither agree nor disagree') when asked whether their warranty represented good value, suggesting a lack of interest or concern in this area. A clear majority (70%) would be more likely to repair large luggage than cabin-size luggage, despite cabin luggage being used much more frequently. Around 54% of respondents stated that

they have never had their luggage repaired, and 12% even claimed they *wouldn't* repair their luggage. Around 55% of the respondents claimed that they have left broken luggage for municipal waste collection as the most common form of disposal, with 31% disposing of still-functional luggage the same way (with municipal solid waste) suggesting that this was due to the luggage being unwanted. When given options for product-oriented services associated with a new luggage purchase, 40% of all respondents chose a trade-in for a discount on a new item. Following this option, a guaranteed re-purposing-recycling EoL service proved narrowly more interesting to consumers than maintenance and repair services (Figure 3). Notable is that customisation was the lowest priority by far, despite several experts interviewed for the study claiming this as an important area of commercial consideration. Interestingly, when comparing the answers of PSS-interested and un-interested respondents, the trade-in option was preferred by 54% and 26% respectively, suggesting very different views on this point.

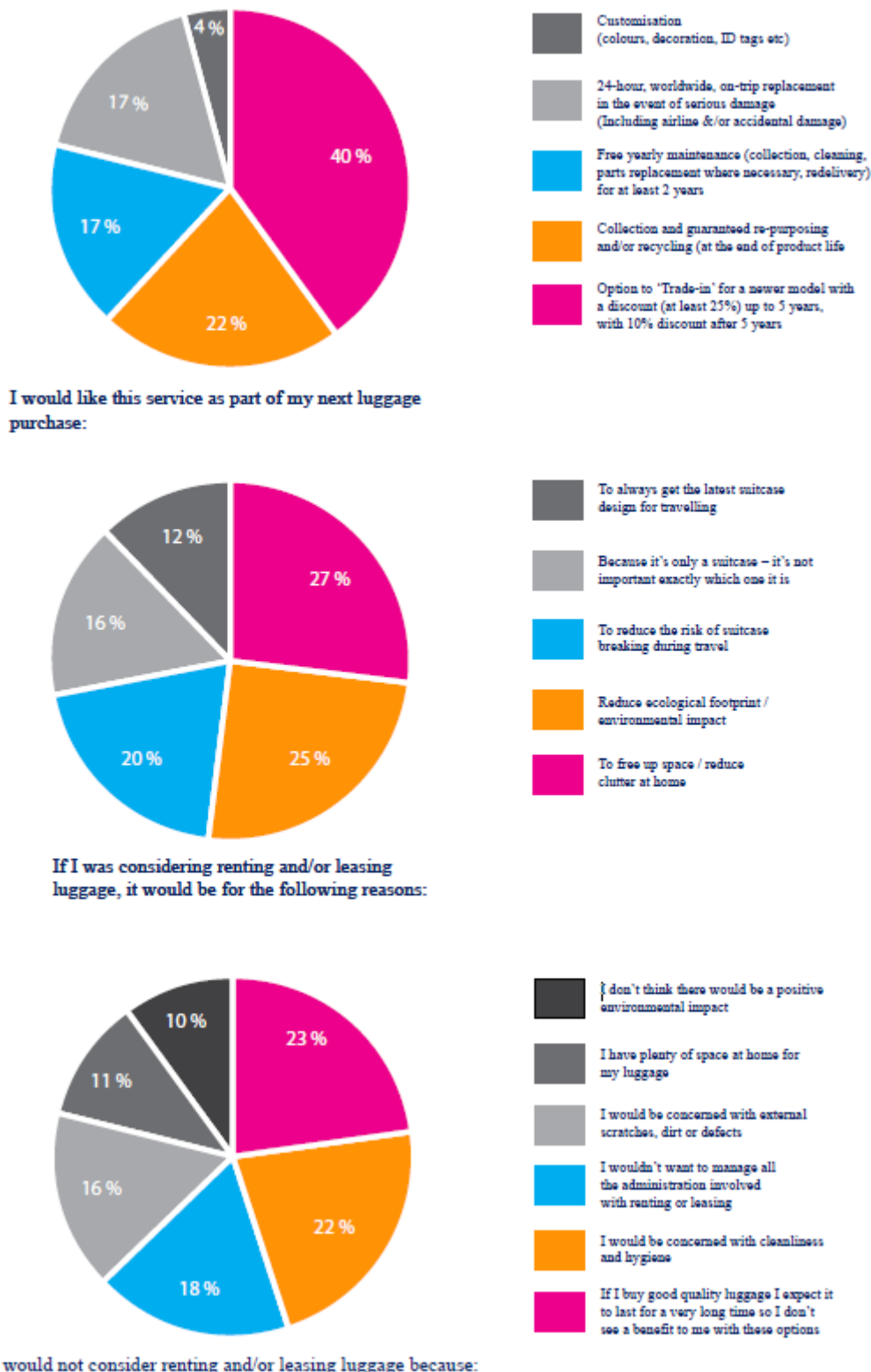


Figure 3. Three selected consumer sentiment survey responses.

In the final section of the questionnaire, participants were asked to rate their interest in use-oriented PSS models such as renting, leasing, subscription, and P2P sharing models for luggage usage. A sizeable 30% - 45% (exact percentages vary depending on the model

in question) of total respondents were not interested; however, the remaining majority of around 60% showed some level of interest in these models. Around 25% of those interested in renting or leasing cited the reduction of environmental impact as their top consideration. This came narrowly behind saving space and reducing clutter in the home at 27%. Avoiding management of damaged or broken luggage was the third priority in this category (see Figure 3). For the general sample, the least popular form of PSS was the P2P model. However, 45% of those who had already professed interest in use-oriented PSS still gave a positive response to the idea of renting their luggage *to others* through a P2P platform and 58% to the idea of renting luggage *from others* via the same method.

The questionnaire contained several questions regarding potential pricing for renting, leasing and subscription, and although these data should be approached with caution due to the limited sample size, there are some interesting results, nonetheless. Whether reflecting on renting (short term) or leasing (longer term), respondents were twice as likely to be interested in large-size luggage than small. When given a sliding scale of price options (where renting or leasing becomes cheaper with longer contracts), the most popular rental options for large luggage were £2 / €2 per day (51 %) followed by £5 / €5 per day (38%) and the most popular leasing option was £25 / €25 for 1 year (at 41%). Whilst the rental figures are not entirely economically unrealistic in 2021 (depending on rental periods), they suggest that many people cannot fully conceive a reasonable price-value equation for this typology of PSS, compared to a conventional purchase-ownership transaction.

When measuring total responses, and when filtering for those claiming an interest, the two primary barriers to the adoption of use-oriented PSS were hygiene concerns, and the belief that purchasing good quality luggage makes the proposed alternatives irrelevant (see Figure 3). These two answers accounted for 22% and 23% respectively of all responses. The third reason was the concern that there would be too much administration and hassle involved in the use-oriented systems at 18%, although this third reason was slightly less a factor when filtering for younger respondents.

Only 10% believed that there wouldn't be a positive environmental impact on the use-oriented PSS models although this may reflect a lack of reliable offers and reliable sustainability information available in this area. The final question raised additional associations of buying good quality luggage and clarified that much of the total sample preferred the idea of purchasing second-hand or *re-sale* refurbished luggage from a trusted brand, rather than renting or leasing luggage. Measuring the responses of those interested in use-oriented PSS with those not interested, here again, there was a notable disparity, with 67% of *interested* respondents preferring the re-sale option compared to 54% of *not interested*.

5. Discussion

The collected empirical data and insights on the potential for PSS in shifting the travel-goods industry towards greater sustainability have highlighted many emerging issues. These are contextualised within a conceptual framework of *acquisition, use and disposal versus value-retention processes (VRP)*. This framework encompasses policy recommendations.

5.1. Acquisition

At the business level, the recent flood of corporate investment and rising consumer interest in the second-hand (re-sale) market (Gibault, 2021) has begun to drive systemic change and could soon become a mainstream model. Increasing product lifespan can help reduce negative environmental impacts *only* if the improved product longevity is directly linked to a reduction in new products made and purchased. In turn, this, questions whether the commercial constructs of sales growth and market share will endure as the main drivers of shareholder value for publicly listed companies - which includes owners

of the largest luggage brands. Therefore, a conflict emerges, wherein shareholder pressure is supposedly driving sustainability programmes, only to maintain market share and eventually sell more products, leading to little or no change to overall environmental impacts.

At the customer level, as with many consumer goods, the acquisition of luggage has been shifting to online purchases for some time, often with home delivery. Even though customers are demanding faster and more convenient delivery service like never before, this trend of home delivery and pick-up has not yet translated to any effective luggage rental or leasing BMs such as those seen within the clothing and fashion accessories industry. It appears consumer interest in the rental and leasing of luggage only exists in theory, potentially due to the rise of pro-environmental mindsets, however, in practice, there is no consumer demand for such service, nor have brands implemented any such offers. However, widespread online shopping and the convenience this offers to consumers, alongside the increasingly small living and storage space in new houses could transform the way consumers use luggage. This could be an opportunity for luggage brands to transform their businesses and use PSS as a new way of promoting circularity focusing on keeping products in use for longer, which shouldn't be left untapped. Nonetheless, organising deliveries and pick-ups will take up time, require mental bandwidth, and include a certain degree of hassle; all when luggage is available to purchase at price points to suit almost every budget. In this regard, the emergence of distributed ledger technologies (of which Blockchain is perhaps best known) has the potential to support such ventures as traceability in the long term and along the luggage's lifecycle journey will be necessary, but this will add to the costs and time required to roll this out (LaPuerta, 2019; McDowell, 2019). Mont (2002); Rexfelt and Hiort af Ornäs (2009) comment that higher-priced items tend to be more successful in use-oriented PSS, however, arriving at a price-to-value ratio that works for both consumers *and* providers will continue to be a challenge to use-oriented PSS adoption, until the pool of available products is smaller, yet of higher quality.

5.2. Use

Consumers consider their luggage to be a box to carry belongings in, but even so, they still prefer to buy and own that box. There is a variety of reasons for this, including the perceptions of functionality, availability and value. Luggage is rarely in *active* use, but when it is, it must endure intense physical conditions such as extreme temperatures, heavy weights-in-motion, shocks, bumps and handling by various people and machines. Not all these factors will always be part of a consumer's choice during acquisition, but they become apparent during the use phase. It could be argued that long-lasting, durable products that prove trustworthy to the user can engender a motivation to maintain and repair, and a high initial purchase price can further support this. Perceiving an acquired object as a valuable personal item or an investment with measurable value beyond your stewardship is very different to perceptions of a basic consumable commodity to be discarded at EoL. Whilst the concept of the sharing economy has many facets (Curtis and Lehner, 2019), ideas of community are linked to notions of trust, which can be key drivers of success – or failure – in PSS models (Rexfelt and Hiort af Ornäs, 2009; Catulli, 2012).

Within a rental or sharing system, the existence (or absence) of trust, that one individual will treat a product as well as another individual, becomes an issue (Cherry and Pidgeon, 2018). While evidence on consumer behaviour towards second-hand products is still scarce, it can be suggested that the luggage-sharing system is particularly interesting in that respect, as the risk of consumers becoming accountable for damages is much higher compared to other goods. This is because the handling of the luggage (especially of big and medium sizes) is not the sole responsibility of the consumer. Damages could be incurred when human and machine baggage handlers are not motivated to treat luggage carefully. This is one situation where use-oriented PSS luggage models could fail in comparison to clothing rental BMs where it is in the best interests of every actor in the system to keep the product in good condition for as long as possible. Another important barrier

to the adoption of use-oriented PSS is hygiene, even though this is less prevalent for luggage rather than clothing. While these concerns may be entirely reasonable, the relative success of RtR and its fashion-bag rental equivalents, along with the success of Airbnb, would suggest that when a level of trust in sharing is established, and where a verifiable cleaning system is developed, issues like hygiene cease to be insurmountable obstacles. In the case of the perceived risk of damage, this could become less of an issue with popular high-end brands as consumers' risk perception can be influenced positively. Some high-end brands are known to offer good quality, durable products that could spur confidence over the risk of damage during the use phase of the luggage, for which consumers can become accountable. Therefore, if this systemic anomaly can be answered, then the use-oriented PSS in the travel goods sector can potentially enjoy a higher take-up potential.

5.3. Disposal versus Value-Retention Processes (VRP)

An argument that supports the adoption of use-oriented BMs from the users' perspective, is that it frees users from dealing with repair and EoL disposal responsibilities. Results from the consumer sentiment survey (see *Supplementary Materials, A. Online Explorative Survey*), showed that few people ever have their luggage repaired and are often more likely to throw it away than seek out repair options. Currently, there are very few convenient, accessible, and sustainable EoL alternatives for luggage available in the market. Luggage of all types is readily available at very low to very high prices, which almost certainly determines aspects of users' decisions to repair or discard. The survey response points to the fact that *low prices* likely contribute to a *throwaway mentality*.

A drive amongst policy-makers is emerging to counteract a throw-away mentality by focusing on producers and promoting maintenance, repair and remanufacture in addition and complementary to, recycling. In a 2018 report the International Resource Panel of the United Nations described "*Value-retention processes such as remanufacturing, refurbishment, repair and arranging direct reuse, enable, to varying degrees, the retention of value, and in some cases the creation of new value for both the producer and customer, at a reduced environmental impact.*" (IRP, 2018, p. 272). Given this basis and moves towards ERP regulation by the EU (Ec.europa.EU, 2021), It seems reasonable to suggest that luggage brands should be responsible for taking back luggage waste via some form of EPR, and in so doing, should adopt new approaches to sustainability and the circular economy. In tandem with commercial transformation, new industrial capabilities and infrastructure development will be required for EoL product management, for processes such as finished goods disassembly, remanufacturing, and recycling of materials. As observed by the expert interviewees in this study, more vertically integrated companies, with shorter supply chains, are better equipped to transition towards these more circular business formats that require such services and activities (see *Supplementary Materials, Table 1. Responses to interview questions, Q2, Q7*).

Despite the indication that few luggage brands are well placed to implement these new models, due to a reliance on outsourced production and complex supply chains, it is recommended that EoL management systems and certifications are urgently developed in this case for luggage but indeed for most kinds of physical consumer products in circulation. This in turn should lead to new industries, new revenue-generating activities, and more circular business models (IRP,2018). Change may yet be driven by other stakeholders, such as innovative e-commerce platforms, powerful retailers or from regulation in the form of EPR. From both business and consumer perspectives, creative formulation and bold implementation of PSS models will surely be needed for negative environmental impacts to be reduced to a level where travel and tourism can be truly sustainable.

6. Conclusions

Major stakeholders in the luggage industry are aware of the sustainability issues associated with their business but do not have a clear nor shared vision of how to manage these issues. This seems partly due to a viewpoint that commercial aviation, which plays

a measurably larger role in global carbon emissions than the comparatively small luggage industry, will remain a dominant form of travel. Many consumers, despite the implications of continuing to travel as before, appear open to engaging in new and potentially more sustainable models of usage and ownership however there is a distinct lack of attractive offers available in this space, as well as issues associated with perceived risk of damage accountability and hygiene.

Nonetheless, the use-oriented PSS typology in the luggage industry can be a catalyst for change. Luggage is a product that is often moderately or rarely used, it takes up space and, most importantly, it can be detached from possession as the infrequent use reduces the sense of ownership. Confidence in sharing luggage needs to be developed based on customer-brand trust to maintain a relationship that will drive the rollout of this model and increase loyalty. This can be supported by online sharing platforms and technologies such as distributed ledgers, where higher-value luggage production with a smaller overall pool of products will become possible. Effectively, this would be disrupting the current norms and pushing through for clever design, use of durable materials, and convenient maintenance and repair services in the luggage industry as well as other product manufacturing sectors. An advanced leasing and sharing model(s) that suit different needs and match people's demands and expectations is a way to transition to circularity. Whilst achieving this presents organisational and logistical challenges, it is likely to initiate a paradigm shift in current BMs away from a reliance on product ownership and towards greater levels of service provision that can generate a diverse pool of revenues. The challenge for the industry is to capture and allocate economic value through this shift, supporting the circular economy principles whilst avoiding negative externalities, and promoting greater resource efficiency and reduced environmental impacts.

Notwithstanding the challenges to PSS implementation, the luggage industry is ripe for disruption. Whether it be an established manufacturer changing their approach, an emergent brand or a digital platform, the stakeholder that will find the right mix of product and service should appeal to a customer base that is willing to engage. Environmentally, the PSS in the travel industry appears to be making sense due to decreases in resource use, energy use and carbon emissions across the entire system. The likelihood of negative *rebound effects*, along with the complex logistics-related impacts, will need to be further explored to prevent unintended consequences. Yet, a novel PSS that questions the very need for owning the luggage, to begin with, can be refreshingly disruptive and can potentially promote change. This jump to a *results-oriented* PSS has the potential to shake up the entire industry, and if such a scheme could be designed to measurably reduce environmental impacts at scale – then it could be an extremely important step towards sustainable travel.

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