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Adoption of Use-Oriented Product-Service Systems for Electronic Devices in Austria: Exploring Key Acceptance Factors

Einführung von nutzungsorientierten Produkt-Service-Systemen für elektronische Geräte in Österreich: Untersuchung der wichtigsten Akzeptanzfaktoren

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Summary

E-waste has one of the greatest impacts on the environment and is the fastest-growing waste stream globally. The ever-ongoing growth in our economy and unsustainable consumption patterns ask for a change. Use-oriented product-service systems (u-PSS) are a promising business model to address this change by acting toward a circular economy. However, the implementation of u-PSS can face various challenges because it requires a fundamental shift in how companies interact with consumers as well as consumers' preferences. Therefore, this study aims to identify factors of acceptance for adopting u-PSS for electronic devices in Austria. To gather specific data, an online survey was conducted with 287 participants. The hypotheses were tested using multiple regression analysis. The results reveal that out of the tested factors, environmental awareness and information are the most important factors of acceptance. For a successful implementation, key determinants include service provision, device durability, and comprehensive information about u-PSS.

Keywords: circular business models, use-oriented PSS, consumer acceptance, question of ownership, electrical and electronic equipment

Zusammenfassung

Elektroschrott hat eine der größten Auswirkungen auf die Umwelt und ist der weltweit am schnellsten wachsende Abfallstrom. Das ständige Wachstum der Wirtschaft und die nicht nachhaltigen Konsumgewohnheiten erfordern einen Wandel. Nutzungsorientierte Produkt-Service-Systeme (u-PSS) sind ein vielversprechendes Geschäftsmodell, um diesen Wandel in Richtung einer Kreislaufwirtschaft anzugehen. Die Umsetzung von u-PSS kann jedoch mit verschiedenen Herausforderungen konfrontiert sein, da sie einen grundlegenden Wandel in der Art und Weise, wie Unternehmen mit Verbraucher:innen interagieren, sowie in den Präferenzen der Verbraucher:innen erfordert. Ziel dieser Studie ist es daher, Akzeptanzfaktoren für die Einführung von u-PSS für elektronische Geräte in Österreich zu identifizieren. Um spezifische Daten zu sammeln, wurde eine Online-Befragung mit 287 Teilnehmenden durchgeführt. Die Hypothesen wurden mit Hilfe der multiplen Regressionsanalyse überprüft. Die Ergebnisse zeigen, dass von den getesteten Faktoren Umweltbewusstsein und Information die wichtigsten Faktoren für die Akzeptanz sind. Für eine erfolgreiche Implementierung sind die Bereitstellung von Diensten, die Langlebigkeit des Geräts und die umfassende Information über u-PSS die wichtigsten Voraussetzungen.

Schlagwörter: zirkuläre Geschäftsmodelle, nutzungsorientierte PSS, Verbraucherakzeptanz, Eigentumsfrage, elektrische und elektronische Geräte

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1. Introduction

Over the last decade, utilization of the Internet and mobile phones has increased drastically (Kemp, 2020). In the year 2020, 4.57 billion people used the internet and 5.15 billion mobile phone users were recorded, which is around 60% of the global population (Rajesh et al., 2022). The increasing demand for electronic devices in the past decades and years is leading to a growing number of problems associated with it, such as raw material exploitation, overconsumption, and generation of e-waste (Forti et al., 2020).
According to the definition provided by the European Union (EU; 2018),

> Electrical and electronic equipment or "EEE" means equipment which is dependent on electric currents or electromagnetic fields to work properly and equipment for the generation, transfer and measurement of such currents and fields and designed for use with a voltage rating not exceeding 1000 V for alternating current and 1500 V for direct current.

The waste of these EEE is framed as waste from electrical and electronic equipment (WEEE) or abbreviated e-waste (Pan et al., 2022). E-waste, along with the extraction of raw materials for electrical and electronic equipment (EEE), has one of the greatest impacts on the environment (Perkins et al., 2014). Furthermore, e-waste represents one of the most important waste streams currently and is growing faster than any waste source (Pekarkova et al., 2021). E-waste includes waste from home appliances, computers and laptops, smartphones and batteries (Fernandes et al., 2023). In this study, the term "electronic device" includes smartphones, laptops, notebooks, tablets, smartwatches, and other small appliances. According to the 2020 global E-waste monitor report, in 2019, e-waste amounted to 53.6 million metric tons and only 17.4% of that amount was collected and recycled, whereas for the much greater part, there is no information on proper waste management (Forti et al., 2020). By 2030, global e-waste is predicted to increase by almost 40% to 74.7 million metric tons (Forti et al., 2020).
E-waste contains precious metals, for example, silver and platinum, which hold an immense value both from an economic as well as an environmental perspective (Bressanelli et al., 2020). Substances such as lead or cadmium, both found in electronic devices, are highly toxic and harmful to the environment (Bressanelli et al., 2020). As a response to the increasing magnitude of this waste stream, several legal regulations are implemented. One such regulation is the WEEE Directive of the EU (De Felice et al., 2014). In addition, purchasing behavior, improved product lifespans, and adequate collection and recycling of EEE are predominantly influenced by consumers (Corsini et al., 2020). Circular economy (CE) strategies are considered one solution to tackle the aforementioned challenges associated with e-waste (Geissdoerfer et al., 2016). The CE Action Plan of the European Commission suggests maximizing the capture of such waste to safeguard the environment and avert financial setbacks (European Commission, 2020).
The ever-ongoing growth in our economy and unsustainable consumption patterns ask for a change. One approach to addressing this change is by embracing the concept of CE and thereby implementing circular business models (CBMs) (Geissdoerfer et al., 2020; Lewandowski, 2016). CBMs are key in terms of a progressive transition toward a sustainable economic system, especially consumption issues such as resource scarcity or waste reduction need to be addressed (European Commission, 2020). CE proponents describe the need to overcome traditional linear consumption patterns (MacArthur, 2013). CBMs can be implemented by offering product-service systems (PSS) instead of owning the products, and thereby going beyond the paradigm of having to possess a product (Cherry and Pidgeon, 2018). Different types of PSS have been identified. This study focuses specifically on use-oriented product-service systems (u-PSS), which include, for example, renting, leasing, and product sharing (Borg et al., 2020; Tukker, 2004).
u-PSS are a promising business model to achieve more sustainability for implementing CBM for the demand side (Zhang et al., 2015). However, user acceptance is significantly holding back the potential of CBMs and due to that lack of acceptance, a lack of incentives for CE business models comes along (Kirchherr et al., 2017). It requires a fundamental shift in how companies interact with consumers (Tukker, 2015) and how consumers perceive ownership and adopt their preferences (Armstrong et al., 2015). Therefore, this study aims to examine the acceptance by means of different factors of switching from traditional possession-based systems to u-PSS for people living in Austria. The insights obtained from this study can contribute to a successful implementation of u-PSS, with a particular emphasis on effectively persuading the demand side, that is, consumers. The research question is:

> What are the factors of acceptance for consumers in Austria to adopt u-PSS for electronic devices?

2. Literature review and state of the art

2.1. Adoption of PSS

In support of transitioning away from a linear economy to a CE (MacArthur, 2013; European Commission, 2020), new CE business models have been proposed, including "servitization" models aiming to offer products as a service, rather than selling them outright (Bocken et al., 2016).

PSS can be divided into three different categories, namely product-oriented, use-oriented, and result-oriented PSS, as shown in Figure 1 (Tukker, 2004). Concerning product-oriented PSS, not only a product is sold, but also additional services are provided, for example, maintenance or warranty over a certain period. In u-PSS, the product ownership lies with the service provider, who may or may not be the original manufacturer. Customers pay for the utilization of the product and its functionalities over a specific period, such as through renting or leasing arrangements (Tukker, 2004). Result-oriented PSS is described as activity management or outsourcing, where a service replaces the product, thereby contrasting with u-PSS (D'Agostin et al., 2020).

According to the classification provided by Tukker (2004), u-PSS can be categorized into leasing, renting, or sharing, and a cross between these three or the so-called pooling. All three categories ensure access to a product or service without claiming ownership. In product leasing, the provider retains the ownership and is typically responsible for maintenance, repair, and control of the product. A regular fee is paid to use the product. The lessee usually enjoys unlimited and exclusive access to it, and a transfer of ownership can be agreed upon at the end of the leasing period at a defined price. In a product renting or sharing scenario, ownership remains with the provider as well. The main difference to leasing is that in a renting or sharing arrangement, there is no unlimited and individual access. With product rental, a specific product is used by different consumers over different periods of time. With product sharing, a specific product is used by different consumers over the same period of time. Whereas leasing, renting, and sharing are used sequentially, pooling refers to the simultaneous utilization of these different forms (Tukker, 2004).

While PSS have been already effectively implemented in different business-to-business contexts, for example, printers or construction machinery, they have not been as effective and successful in consumer markets so far (Vermunt et al., 2019). However, over the last decade, u-PSS have been experimented with and started to be implemented in several sectors, for example, car sharing or bike rentals (Tunn et al., 2021). Lawson et al. (2016) identified the flexibility and opportunity to enjoy the latest products without ownership responsibilities as one of the main benefits offered by u-PSS. Another driver for the adoption of u-PSS, as identified by Rousseau (2020), is the recognition of their positive environmental impact. With the substantial change in production and consumption systems, PSS can provide a solution to become more sustainable. This is particularly due to the main objective of PSS to prolong the product life cycle (Santoso and Erdaka, 2015).

The underlying barriers that hold consumers off from PSS are primarily a lack of knowledge and information, as well as economic obstacles, convenience, and the desire to own a product (Borg et al., 2020; D'Agostin et al., 2020; Mont, 2002). However, the inherent convenience of u-PSS com-

Value mainly in product content	**Product-service system**			**Value mainly in service content**
	Product content (tangible) → Service content (intangible)			
Pure product	**A: Product oriented**	**B: Use oriented**	**C: Result oriented**	Pure service
	1. Product related advice and consultancy	2. Product lease 3. Product renting/sharing 4. Product pooling	5. Activity management 6. Pay per service unit 7. Functional result	

Figure 1. Classification of product-service systems (adopted from Tukker, 2004)
Abbildung 1. Klassifikation von Produkt-Service Systemen (In Anlehnung an Tukker, 2004)

pared to traditional ownership underpins the need to not only address and overcome these barriers, but also point out the advantages of PSS (Borg et al., 2020). Companies can, for instance, emphasize the financial benefits of u-PSS that include repair costs and other services that are not included in ownership. In addition, the possibility to change a product and the limited responsibility could offset consumers' concerns (Borg et al., 2020).

2.2. Factors of acceptance to adopt u-PSS

In the following part, the hypotheses are stated, which are supported by a comprehensive literature review to emphasize their significance and relevance.

2.2.1. Flexibility

In the context of u-PSS, flexibility entails the freedom of utilizing a product without the necessity of ownership, allowing individuals to use the product solely when and if needed (Catulli et al., 2017). Flexibility is considered one of the main driving factors for the willingness to adopt u-PSS and is closely linked to consumer satisfaction (Edbring et al., 2016). Sattari et al. (2020) have identified intertwined measurements including "freedom," commitment, variability, and guaranteed access. Among these, guaranteed access plays a crucial role in the acceptance of u-PSS. Without this guaranteed access, the flexibility aspect would be compromised, emphasizing the need to consider flexibility and guaranteed access coherently (Edbring et al., 2016). Another important aspect of flexibility involves the possibility to test products, which offers an opportunity that rigid ownership does not allow for. PSS allows customers not to stick to one specific product, but provides the possibility to switch and adapt to one's preferences. This aspect points out the importance of exploring new things and varying their consumption (Kim and Hwang, 2021). Highlighting the factor flexibility, the first hypothesis is derived as follows:

H_1: Flexibility makes consumers adopt u-PSS for electronic devices.

2.2.2. Peer influence

Peer influence plays a significant role in shaping consumer behavior, as acknowledged in various studies (Borg et al., 2020; Nguyen et al., 2017; Sattari et al., 2020). Consumers tend to buy based on the influence of others, and the willingness to adopt u-PSS depends on the adoption of peers (Baek and Choo, 2015). In addition, the media puts pressure on consumers to more environmentally conscious decision-making, which is often passed on to peers or via societal expectations (Shrivastava et al., 2021). Peer influence can also serve as a legitimation for individuals' consumption behavior and can inspire them to try out new consumption patterns, including PSS (Baek and Choo, 2015). Thus, the hypothesis concerning peer influence is:

H_2: Peer influence makes consumers adopt u-PSS for electronic devices.

2.2.3. Environmental awareness

To successfully implement new (sustainable) business models, consumers are the most important stakeholders that need to be convinced. Therefore, Sattari et al. (2020) highlight the particular importance of communicating that PSS are superior to other systems in environmental terms and therefore important for consumers' decision-making. If consumers become aware of that connection, it could convince environmentally aware consumers to choose PSS (Sattari et al., 2020). People with higher sustainability knowledge and environmental awareness tend to be more willing to pay for PSS due to the realized positive ecological impact (D'Agostin et al., 2020). From these findings, the third hypothesis is derived:

H_3: Environmental awareness makes consumers adopt u-PSS for electronic devices.

2.2.4. Compatibility

Compatibility refers to the alignment of a person's beliefs, values, and needs with a certain product or service (Rogers, 2014; Schmidt et al., 2014). When a product is in harmony with a person's beliefs, they are more likely to use it and vice versa (Rogers, 2014). Taking into account consumers' specific needs, such as accessibility to service and repair facilities, compatibility can be significantly enhanced (Schmidt et al., 2014). Compatibility is especially relevant in terms of environmental concerns and can determine success (Schmidt et al., 2014). Specifically, if an environmentally conscious person perceives a product or service as being superior in terms of its environmental impact, they are more likely to choose it (Schmidt et al., 2014). To underpin this relationship, the following hypothesis is derived:

H_4: Compatibility makes consumers adopt u-PSS for electronic devices.

2.2.5. Economic value

Economic value is viewed as one of the most important drivers for the successful adoption of PSS (Edbring et al., 2016). Liu et al. (2017) further state that integrating the economic perspective and thereby putting attention on the price is key

for the willingness to utilize u-PSS. This specifically means that the willingness to adopt u-PSS is, to a large extent, determined by the economic benefit that customers pursue. If renting a product is significantly cheaper than buying it, the willingness is significantly increased (Liu et al., 2017). The economic value does not mirror the monetary value solely, but also includes the nonmonetary value that a consumer receives, for example, repairing and additional services, which serves as another motivator (Armstrong et al., 2015; Fani et al., 2022). Therefore, the fifth hypothesis is:
H_5: Economic value makes consumers adopt u-PSS for electronic devices.

2.2.6. Information

Geissdoerfer et al. (2020) emphasize the importance of new business models that follow the CE concept in adopting alternative systems such as u-PSS. However, a lack of information about these new systems can hold off potential customers. This highlights the importance that information has on the system and the service offered (Geissdoerfer et al., 2020). Given that PSS represents a relatively new consumption approach, consumers perceive high risks associated with PSS (Edbring et al., 2016). These perceived risks include hygienic concerns as well as risks of intrusion upon privacy and personal space (Edbring et al., 2016). Therefore, providing clear and trustful information is crucial for the acceptance of adopting PSS (Armstrong et al., 2015; Edbring et al., 2016). The sixth hypothesis is stated as follows:
H_6: Information makes consumers adopt u-PSS for electronic devices.

3. Materials and Methods

3.1. Literature research

The methodological section begins with an insight into the literature to examine the current state of knowledge about the acceptance of u-PSS. With the help of different search engines, the literature research was carried out. The most recent studies possible were chosen to receive information about state-of-the-art knowledge. The research topic of adopting u-PSS for electronic devices and the underlying factors of acceptance were brought forward through the snowball method. The focus of factor selection was placed on u-PSS in particular, which is why the six factors were selected exclusively. The hypotheses were derived from that process (Doering and Bortz, 2016).

3.2. Primary data collection and questionnaire

Given the aim of this study, quantitative descriptive research was carried out. As no new hypotheses were generated but already formulated hypotheses were tested, an explanatory approach was chosen (George and Mallery, 2019). To receive information about consumers' attitudes about adopting u-PSS for electronic devices, a standardized questionnaire was used. In total, the questionnaire comprised 14 questions and was structured in four parts, that is, ecological attitude, attitude toward u-PSS, the willingness to introduce u-PSS, and sociodemographic questions. The first part of the questionnaire was a short introduction to the topic and the survey itself. As the targeted audience was people living in Austria, the first question filtered out the sample by asking about permanent residency. For most of the questions, a metric scale was used with a number of levels from 1 – strongly disagree to 5 – strongly agree. The question for the factors of acceptance (independent variables [IVs]) was asked using latent variables, as they are used to assess complex relationships and have the possibility to capture underlying dimensions or factors that cannot be observed directly (Bollen, 2003). The dependent variable (DV) asked if the participants would adopt u-PSS and there were four response options: "yes, definitely," "yes, maybe," "probably not," and "certainly not."
The sample is nonprobabilistic as it is a convenience sample, given the financial, material, and human resources constraints that do not allow for a probabilistic sampling (Stockemer, 2018). All of them have already been identified as successful and derived from the literature, promising reliability and validity. Scales are taken from the literature and can be found in Appendix A. The questionnaire was qualitatively and quantitatively pretested and then distributed online via social media platforms in the form of snowball sampling (Doering and Bortz, 2016). The questionnaire was filled out once by each participant, therefore it is a cross-sectional study that provides a snapshot of the current attitude of the target group (Doering and Bortz, 2016).

3.3. Data analysis and interpretation

The raw data material was content-wise sorted, errors cleaned out, and the data was annotated, coded, and formatted, so that it was ready to be analyzed properly. Appendix B comprises a correlation matrix that displays the relationships between all variables, highlighting the positive and negative

correlations. DV is adopting u-PSS, and IVs are the different factors of acceptance, respectively. The IV contained six different factors, which were asked using a five-point Likert scale. Both DV and IVs represent a metric scale (Doering and Bortz, 2016).

To test the hypotheses, DV was tested against IV using a multiple regression model, illustrated in Figure 2. To find correlations, Pearson correlation test was applied. Given a significance level of $p < 0.05$, each factor of acceptance was tested against DV. For comparing other ordinal with ordinal data, Kendall's tau test was used. Sociodemographic questions are on a nominal scale, and therefore, Chi-square test was applied to compare it with other data. After testing the hypotheses and finding correlations and other connections within the data, the identified results are compared to contemporary literature in the section "Discussion."

4. Results

4.1. Sample Description

In total, 287 people participated in the survey; however, only 210 completed it. Most of the participants that did not complete the survey had no Austrian residency, which was a prerequisite for this survey. Due to missing or misleading information, an additional sorting out led to 204 participants. Table 1 shows the sociodemographic characteristics of the participants, including gender, age, city population, and educational level.

Overall, more than half (56.9%) stated that they would consider adopting u-PSS. Concerning participants' ecological attitude, 76% stated that they felt generally well familiar with environmental issues. A positive correlation between the items ecological attitude and factors of acceptance could be identified ($p < 0.05$). Participants with a higher ecological attitude also considered the given factors of acceptance as more important. Furthermore, a positive correlation between participants' purchase decisions for sustainable products and the factor of acceptance environmental awareness could be found.

4.2. Hypothesis testing

First, Pearson correlation test was applied to identify correlations between DV and the respective IVs and test the validity of the different factors. Table 2 shows the averages for each factor (on a scale from 1 to 5) to illustrate the level of agreement with the statements. All averages are above the center of the scale, revealing that the acceptance for all the tested factors is relatively high and none of the factors has a negative impact on the adoption of u-PSS. The highest averages can be found for environmental awareness, compatibility, and information. Table 2 also shows the respective *p*-values and the correlation coefficients. All *p*-values are below the significance level of 0.05. The coefficients are generally rather low, indicating a moderate association. The highest coefficients are found for environmental awareness, compatibility, and information.

To test the hypotheses, a multiple regression analysis was carried out. Table 3 shows the multiple regression analysis of the different tested factors of acceptance and the adoption of u-PSS.

Model 1 refers to the control variables age, gender, and education. It can be seen that the control variables do not have a significant impact on the adoption of u-PSS, except for gender in model 2. Model 2 compiles all tested factors as well as the control variables, and therefore is the full multiple regression analysis, where it is determined whether the hypotheses are accepted or rejected. The overall model supports the influence that the tested factors have on the adoption of u-PSS. Information has the strongest effect size in model 2 (0.16), followed by environmental awareness (0.13). The findings of model 2 show that environmental awareness and information have a significant impact on the adoption of u-PSS. This means that hypotheses 3 and 6 can be corroborated and are identified as factors of acceptance for adopting u-PSS. With

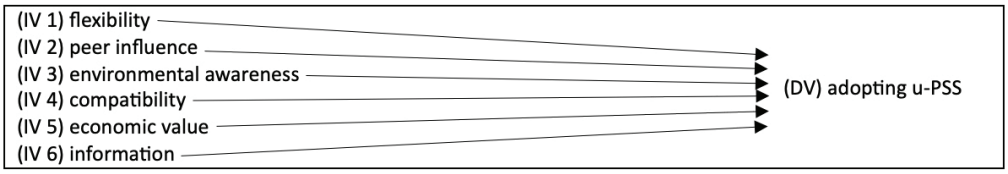

Figure 2. Graphic representation of the research model
Abbildung 2. Grafische Darstellung des Forschungsmodells

Table 1. Demographic characteristics of the survey participants
Tabelle 1. Demografische Merkmale der Teilnehmenden an der Umfrage

Demographic variable		*N* = 204
Gender	Female	130
	Male	68
	Others	6
Age (years)	<18	2
	18–25	126
	26–35	24
	36–50	17
	>50	35
City population (inhabitants)	<1000	15
	1000–10,000	43
	10,000–50,000	17
	50,000–100,000	5
	100,000–1 million	15
	>1 million	109
Educational level	Statutory education	7
	Vocational training	33
	A-levels	109
	University degree	55

a significant F-statistic and an adjusted $R^2 = 0.19$, 19% of the variance can be explained with the model.

5. Discussion and Conclusions

u-PSS present a compelling alternative to conventional ownership-based business models (Suppipat and Hu, 2022). Generally, an acceptance for adopting u-PSS for consumers in Austria could be identified and more people consider adopting u-PSS (under certain circumstances) than there are people who do not. Nevertheless, there seem to be two diverging clusters at both ends. Put differently, people either see great potential in u-PSS as an alternative business model or they are critical of it. One reason for such controversial opinions could be that u-PSS is a relatively new approach toward business models and has not gathered much attention so far (D'Agostin et al., 2020; Edbring et al., 2016). Therefore, the participants of the survey might have heard of PSS for the first time and their information is limited to the short informative text provided in the survey.

Table 2. Correlation between factors of acceptance and willingness to adopt u-PSS
Tabelle 2. Korrelation zwischen Akzeptanzfaktoren und der Bereitschaft zur Einführung von u-PSS

		Adopting u-PSS	
Factor	**Mean**	**correlation coefficient**	**p-value**
Flexibility	3.40	0.20	0.01*
Peer influence	2.86	0.19	0.01*
Environmental awareness	3.88	0.39	0.01*
Compatibility	3.72	0.32	0.01*
Economic value	3.22	0.23	0.01*
Information	3.63	0.42	0.01*

*Significant at a level of 0.05

With the aim of this study being to identify the factors of acceptance for consumers in Austria to adopt u-PSS, the results reveal that two of the six factors that have been tested can be corroborated. Other studies identified similar results (Borg et al., 2020; D'Agostin et al., 2020; Rousseau, 2020). Environmental awareness was found to be the most important factor. According to Lawson et al. (2016), individuals who prioritize environmentally friendly actions are also more convincible to adopt u-PSS. This further demonstrates the potential of u-PSS among environmentally concerned customer groups. Sattari et al. (2020) argue that targeting and effectively conveying this customer group is an important factor for a successful implementation. If environmentally conscious consumers are persuaded of the environmental benefits of u-PSS, they are likely to influence their surroundings to adopt u-PSS as well (Borg et al., 2020; Sattari et al., 2020).

Information was another important factor of acceptance in this survey. As pointed out by Zheng et al. (2017), high-quality information about the provided product and service is crucially important for implementing new business models. Not only that this information allows potential consumers to understand the new product/service, but also it provides the opportunity to value the unique propositions and therefore contributes to a successful adoption (Schmidt et al. 2014; Zheng et al., 2017). Applied to u-PSS, clearly communicating the benefits is inevitable for consumer acceptance. This includes, for example, pointing out the possibility to switch between products during the contract period and that repair services are included in the contract (Borg et al., 2020; Tukker, 2015). In addition, it is crucial to highlight that the used devices undergo thorough technical testing, align with the latest advancements in technology, and are comparable with new devices (Armstrong et al., 2015; Borg

Table 3. Hypothesis testing: multiple regression analysis
Tabelle 3. Hypothesenprüfung: Multiple Regressionsanalyse

	Adopting u-PSS	
	Model 1	**Model 2**
Control variables		
Age	0.00	0.00
Gender	0.07	0.22*
Education	0.04	0.01
Hypotheses		
H1 – Flexibility		0.05
H2 – Peer influence		0.00
H3 – Environmental awareness		0.13*
H4 – Compatibility		0.07
H5 – Economic value		0.06
H6 – Information		0.16*
F-statistic	0.41	6.00*
Multiple R^2	0.01	0.23
Adjusted R^2	-0.01	0.19

*Significant at a level of 0.05 ($p < 0.05$)

et al., 2020). Moreover, hygienic concerns can be enfeebled by providing high-quality information about the cleaning procedure (Borg et al., 2020).

The factor price has not been identified as a significant factor in this study, but as it is also stated in the literature, it can depend on the product that is offered through PSS whether or not the factor price is significant. Borg et al. (2020) argue that the acceptance is determined by whether renting is cheaper than owning. This underpins the importance of the factor economic value. Their study affirms the relevance of the price and states that the factor of economic value, particularly when the rental price is lower compared to ownership costs, significantly enhances the potential for the proliferation of PSS (Borg et al., 2020). This holds true for people who are more willing to adopt u-PSS as well as for people who prefer ownership.

In general, participants with a higher environmental awareness also tend to be more open to adopting u-PSS. Other studies confirm these results and argue the importance of including environmental aspects for more sustainable production and consumption systems (Catulli et al., 2017; Santoso and Erdaka, 2015; Zhang et al., 2015). However, others argue that it is unclear which environmental implications PSS will have (Amasawa et al., 2019; Saksanian et al., 2020) and that PSS might not effectively reduce resource use or waste, as they have the potential to cause rebound effects that diminish the anticipated environmental benefits (Stål and Corvellec, 2018). Adding on that, Liu et al. (2017) found out that environmental awareness and concerns do not automatically result in a changed behavior toward more sustainable options. The study conducted by Cherry and Pidgeon (2018) provides valuable insights that contradict previous findings that renting or leasing leads to a lack of care for the products. In fact, their research suggests rather the opposite, indicating that unowned products are treated with greater care. This aligns with the findings in this survey, as several participants stated that they would be more incentivized to take care of the product as the ownership lies with others and they would have to reason and justify potential damages, which again speaks in favor of PSS in terms of sustainability.

It is beyond the scope of this study to address the question of causality. Given the circumstance of using a convenience sample, the results can lack representativeness and the generalizability of the findings is limited. A convenience sample was used for reasons of research economy. As the research is still in its infancy, the study is intended to provide a first set of basic results to identify general trends. The results serve as a first point of reference with a quantitative approach. In addition, the sociodemographic characteristics of this survey reveal a certain level of sampling bias as it is not representative of the Austrian population. As the survey was distributed using the snowball sampling method, some population groups tended to be overrepresented, whereas others were underrepresented in the survey. One other constraint is that many participants have questioned the positive outcomes of u-PSS, environmentally as well as economically, or felt genuinely uninformed, even though a short informative description of u-PSS was given. Another limitation is the selection of the six factors. The literature search focused u-PSS in particular, which is why other relevant factors were not taken into account. One more constraint of the study is that only 19% of the variance can be explained with the model, which means that the variables integrated in the model can only explain a rather small part of DV. However, as the factors were also derived from the scientific literature on u-PSS, it seems that more research is needed to find a common basis and the appropriate factors in this still new field of research. Most of the research in this area to date has been qualitative research on sometimes very specific technologies/products, which, according to our model, may not be applicable to the broader scope of u-PSS.

In terms of future research, the focus can, therefore, lay more on explorative methods to explicitly find generally valid factors of acceptance for PSS, which can then be confirmed or refuted in studies like ours (with an even larger *n*). For further studies, undertaking a probabilistic sample with larger

n samples is suggested to enhance the generalizability of said findings and collect data representative for the Austrian population. Furthermore, it is recommended to communicate how u-PSS could practically work and highlight the possible advantages of u-PSS more clearly when trying to find the factors of acceptance. The successful introduction of PSS for electronic devices hinges on the effective implementation of this new business model. Key determinants are the provision of the included services, ensuring durability of the devices, and offering comprehensive information about the advantages of product-service systems over ownership. It is only when these aspects are considered and customers are persuaded of the benefits that PSS can serve as a reliable and valid alternative to conventional business models.

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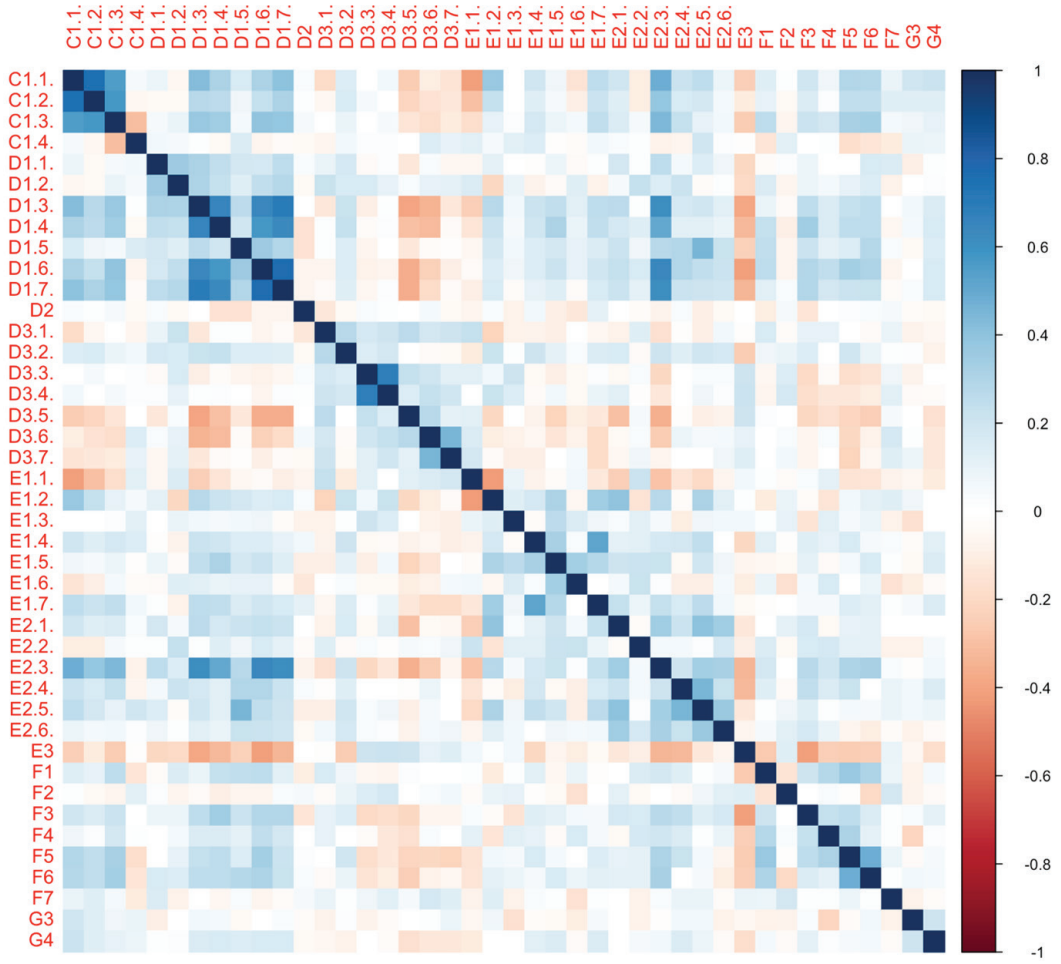
Appendix A: Measurement scales

D1. Factors of acceptance	Scale item
Flexibility (adapted from D'Agostin et al., 2020)	Possibility of testing a product before purchasing
Peer influence (adapted from D'Agostin et al., 2020)	Social prestige for using new and green technology
Environmental awareness (adapted from D'Agostin et al., 2020)	Less solid waste generation and greenhouse gas emissions and familiarity with sustainability as a lifestyle
Compatibility (adapted from D'Agostin et al., 2020)	Compatibility and consistency with values and beliefs, experiences, and needs of potential users
Economic value (adapted from Sattari et al., 2020)	Renting the product is cheaper than buying it
Information (adapted from D'Agostin et al., 2020)	Perceived need for a lifestyle change into a more sustainable option

Appendix B: Correlation matrix

The correlation matrix displays the relationships between all ordinal variables, highlighting the positive and negative correlations. C1.1. to G4 refer to the questions that can be found in the questionnaire, with the second number ascribing the different answer options for the respective questions. The correlation matrix ranges from –1 to 1, with negative numbers (illustrated in red shades) indicating a negative correlation and the blue shades indicating a positive one.