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Investigation of Product–Service System Components as Control Points for Value Creation and Development Process

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Abstract: Since the early 2000s, product–service systems (PSS) have become a research concern because the benefits provided cover many aspects. PSS is divided into three types, namely, Type 1: product-oriented, Type 2: use-oriented, and Type 3: result-oriented. PSS is a system comprising different components. As a system compiler, the components are the starting point for the value-creation process and continue to impact the PSS's life cycle. However, elaboration of PSS components in previous studies has lacked. This situation indicates an urgent need to investigate PSS components and, thus, our evaluations of the value creation and the developmental processes of PSS seek to be broad and divergent. The investigation that forms the purpose of this article includes an elaboration of the PSS components, a calculation of the PSS components' importance levels, statistical testing of the differences in importance levels due to PSS type, correlation testing between components, and a determination of the PSS components concerning the sustainability aspect based on the perspective of customers. The investigation began with the development of a questionnaire and a reliability–validity test. In addition, we identify the PSS components, test the difference in importance level using the Mann–Whitney test, and survey customers to determine the sustainability-related components. This article's findings can be used to specify the critical point for value creation and PSS development. The elaborated PSS components are products, services, actors, stakeholder relationships, and technology. The difference in importance level indicates that PSS Type 2 customers perceive a distinction in the importance of technology. The essential components of each type of PSS are distinct, necessitating the use of different development strategies, including for sustainability aspects.

Keywords: product–service systems; components; value creation; control point; consumer behavior

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1. Introduction

Pressure from the competition and rapid technological changes have forced the manufacturing industry to regard service as an added value and product differentiator [1]. The trend of service involvement in value creation in the manufacturing industry has given rise to the term "servitization". Servitization increasingly requires manufacturers to transition from product to product and service integration [2]. Service has shown its contribution to value creation on a non-price basis [3], increasing a firm's economic value [4] and increasing customer loyalty [5]. Based on these benefits, PSS is growing as a manifestation of the integration of products and services [6]. According to the typology, there are three types of PSS, namely Type 1: product-oriented, Type 2: use-oriented, and Type 3: result-oriented [7]. In the product-oriented type, the proportion of products is more significant than the service. In the result-oriented type, the service is prominent. While in the use-oriented type, the balance of products and services is flexible. Although each has a different characteristic, the three types of PSS can form a strategic innovation for manufacturing [8]. PSS is an integrated system of products, services, support networks, and infrastructure designed to meet customer needs, increase competitiveness, and impose a lower environmental impact than traditional business models [9]. The PSS business model increases collaboration

between firms and customers with fewer products but with increased availability, which can increase use time and service life while the required resources decrease [10]. PSS has implemented sustainability and circular economy concepts [11]. PSS can support economic growth through a circular and distributed economy, social equity, social cohesion, and the reduction of environmental impacts [12,13]. Along with the use of PSS in industry, PSS has also developed into several particular topics, including sustainable PSS [14–18], SMART PSS [17,19–23], personalized PSS [21,24,25], and so on. This business model innovation requires an adequate evaluation of value creation and PSS development. Based on the literature review, there needs to be more research regarding the role of the PSS component in the value creation process. In addition, the PSS components have yet to be well elaborated in previous studies, so the evaluations of value creation, value delivery, and PSS development have been neither component-based nor divergent [26].

PSS is designed to achieve a particular value, where the value creation and value delivery process is systemic and needs to be evaluated throughout the life cycle of PSS [27]. The PSS component can be a control point for value creation, value delivery, and the PSS development process. A component aims to perform a specific function according to various design standards and patterns [28]. Value creation starts from components supporting the PSS function to achieve a particular value. Therefore, firms produce a reliable PSS if the components are effectively managed and controlled [29]. In quality assurance for both products and services, firms use components as control points when monitoring product reliability [30], tolerance for production variations [31], and customer satisfaction [32]. Based on previous studies, the evaluation process is related to the customer perspective [19,33,34], cost perspective [35,36], risk and uncertainty perspective [29,37], lifecycle perspective [10,37–39], and so on. Whereas the PSS component affects the value throughout the PSS life cycle, the source of evaluation is a component. Consequently, the research question that arises is what the PSS components are and what the character of the PSS components is.

The identified research gap increases the urgency of the need to investigate the components of PSS as a problematic definition. Thus, the purpose of this article is five-fold: to elaborate on the PSS components based on previous studies and surveys; examine the differences in the PSS components' importance levels among the three types of PSS; find the PSS components' importance levels for every kind of PSS; examine the correlation among components; and examine the PSS component in terms of sustainability, based on the customer perspective. Firms and researchers can use the results of this article as a guide in determining control points for value creation, value delivery, and PSS development. Based on the customer's point of view, firms use the importance levels of the PSS components to figure out where to focus their monitoring and development. PSS development starts with the most critical components while considering the correlation between components. A firm's efforts to research the nature of PSS components, the relationships between PSS components, and the contributions of components to value creation and value delivery for PSS development objectives maybe reduced in the future as a result of this article's findings. According to past research, PSS development has mainly focused on product and service features or innovation [40–44]. However, there are other essential components to develop from the customer's point of view [45–47]. The upshot of this study for researchers is a preliminary inquiry into the characteristics of PSS components that may be used to develop the value creation process, value delivery, and PSS reliability. Reliability analysis is associated with the failure analysis of a component [30,48,49]. This research offers a statistical analysis describing the relationship between components and differences in their significant levels. Another element of this research is its exposure to survey results regarding PSS components that contribute to sustainability. The findings of this research will enhance the use of PSS components as control points for value creation and the PSS development process.

2. Materials and Methods

Several research steps are depicted in Figure 1.

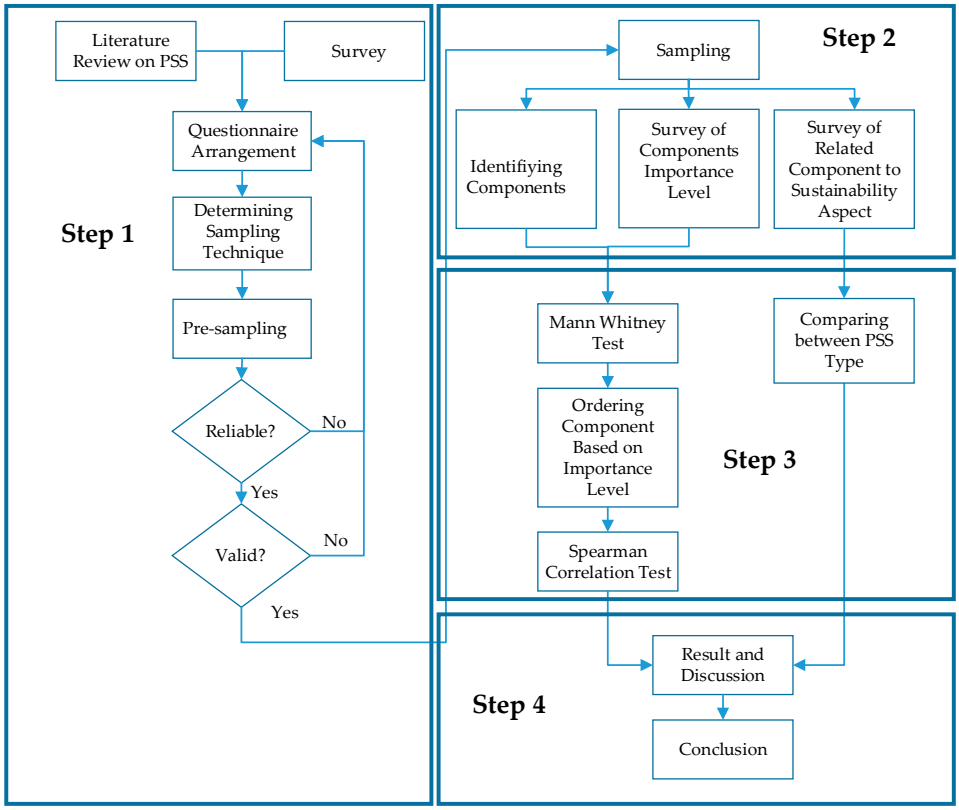

Figure 1. Research Steps.

Figure 1 depicts the four steps of the research process. Step 1 was a questionnaire design survey for the PSS component investigation. A literature review on PSS was used to identify those critical aspects of value creation and value delivery that satisfy the component definition. Numerous previous studies have concurred that PSS consists of products and services that are intentionally designed for specific values [15,29,50–54]. In addition to products and services, the success of PSS also depends on the actors in charge of delivering value to customers [29]. There are two groups of actors: external and internal. Collaboration between external and internal actors significantly affects the PSS development process [52]. Complex PSS currently necessitates good relationships among actors. These relationships are critical to value creation and delivery [51]. The relationship is multi-actor and includes other stakeholders related to the primary resources and strategic factors [53]. The Industrial Revolution 4.0 has also influenced the development of PSS so that technology becomes one of the critical aspects of value creation and delivery [55]. This article elaborates on PSS components based on a literature review, and the definition of components includes products, services, actors, stakeholder relationships, and technology. The five elements were then assembled into a questionnaire.

Step 2 of the research was data collection through a customer survey. The purpose of the survey was to explore ideas and evaluate the importance levels of the PSS components discovered in the literature search. Respondents in this survey were Indonesians who had experience using PSS Type 1, Type 2, or Type 3. Respondents had similarities in culture, government policies, and habits in meeting daily needs. Thus, the sample was selected at random from a vast population. The sample size determination follows confidence interval limits, in which the researcher believes the error will not exceed the error margin [56]. The

Cochran formula, shown in Equation (1), determines the sample size for populations with numerous members [57].

$$n \geq \frac{Z_{\alpha}^{2}(pq)}{e^{2}} \quad (1)$$

where:

n is a sample size
Z_{α} is a standardized normal distribution value for specific alpha
p is the proportion of people who have used PSS
q is the proportion of people who have not used PSS
e is an error margin.

There were validation questions in the questionnaire used to filter the data so that the processed data came only from respondents who had experience with specific PSS. The value of p was calculated by dividing the number of respondents who had used a particular type of PSS by the initial observation of 30 respondents. The sample size must be logically determined to strike a good balance between effort, time, cost, and estimates of population parameters [58]. The researcher was 90% confident that the difference between the sample statistics and the population parameter was less than 0.1. Thus, the value of alpha and margin error is 10%. Table 1 presents the determination of sample size for each type of PSS.

Table 1. Calculation of sample number.

No	Type of PSS	p	q	Minimum Sample Size	Real Sample Size
1	Type 1: Product-Oriented	0.67	0.33	60 respondents	80 respondents
2	Type 2: Use-Oriented	0.73	0.27	54 respondents	70 respondents
3	Type 3: Result-Oriented	0.73	0.27	54 respondents	72 respondents

After determining the sampling method and the sample size, a pre-sample of 60 respondents was used to test the questionnaire's reliability and validity. Previous studies have emphasized the importance of reliability and validity tests because they are used as criteria for the quality of the questionnaire [59]. A reliability test ensures consistent results if the questionnaire is given to a respondent at different times or to several respondents simultaneously [60]. Cronbach's Alpha is a coefficient often used to indicate reliability, which is divided into several categories, as in Table 2 [61].

Table 2. Reliability category.

No	Cronbach's Alpha	Reliability Conclusion
1	0.90 and above	Excellently reliable
2	0.70–0.89	Highly reliable
3	0.50–0.69	Moderately reliable
4	0.49 and below	Less reliable

The result of the reliability test in this research is presented in Table 3.

Table 3. Reliability Test Result.

No	Type of PSS	Alpha Cronbach	Reliability Conclusion
1	Type 1: product-oriented	0.852	Highly reliable
2	Type 2: use-oriented	0.636	Moderately reliable
3	Type 3: result-oriented	0.819	Highly reliable

The reliability test results indicate that the questionnaire was appropriate as a measuring tool in this study. Meanwhile, a validity test was carried out to show the accuracy of the questionnaire in measuring what it was intended to measure [59]. The validity test

showed the quality of the questionnaire in measuring the importance of the PSS components identified in previous studies. Suppose the validity test results obtained invalid results. In that case, the PSS component as a question variable in the questionnaire must be deleted because it is significantly irrelevant to the intended PSS. The PSS component was considered valid if the corrected item-total correlation value was greater than the r-table value of 0.2542. Table 4 shows the results of the validity test.

Table 4. Validity test result.

No	Type of PSS	PSS Component	Corrected Item-Total Correlation	Validity Conclusion
1	Type 1: product-oriented	Product	0.630	Valid
		Service	0.708	Valid
		Actor	0.776	Valid
		Stakeholder Relationship	0.578	Valid
		Technology	0.650	Valid
2	Type 2: use-oriented	Product	0.357	Valid
		Service	0.405	Valid
		Actor	0.440	Valid
		Stakeholder Relationship	0.296	Valid
		Technology	0.475	Valid
3	Type 3: result-oriented	Product	0.497	Valid
		Service	0.671	Valid
		Actor	0.615	Valid
		Stakeholder Relationship	0.601	Valid
		Technology	0.691	Valid

The reliability and validity test results indicate that the questionnaire and the data obtained could be accounted for in answering the objectives of this study. The investigation of the PSS component in this article consisted of identifying the PSS component by elaborating on previous studies and surveys; testing different populations for the PSS components' importance level in each type; calculating the PSS components' importance level; analyzing the correlation between the PSS components, and calculating the percentage of the PSS component associated with sustainability.

Exploring previous studies, recognizing the PSS part's role in influencing value, and ensuring its suitability in terms of the definition of a component were the steps in identifying the PSS component. Efforts to identify PSS components considered the type of PSS. The differences in these characters are described in Table 5 [7].

Table 5. Type of PSS.

No	Type of PSS	Properties
1	Type 1: Product-Oriented	The firm sells the product and provides the necessary services for its use.
		The firm provides guidance or consultation on how to use or the most effective way to use the products it sells.
2	Type 2: Use-Oriented	Ownership of the product rests with the firm, not the customer. The firm is responsible for carrying out maintenance, repair, and control. The customer, also known as the lessee, pays a regular fee for using the product. However, the leaser has unrestricted access or use rights to the leased product.

Table 5. *Cont.*

No	Type of PSS	Properties
2	Type 2: Use-Oriented	The customer does not have unlimited access or use rights to the product. Meanwhile, product ownership and responsibility for maintenance, repair, and control are still with the firm.
		Multiple partners are gathered in one location, and the product is simultaneously utilized.
		The customer no longer purchases the product but instead pays a fee based on the product's output and level of use.
3	Type 3: Result-Oriented	The firm's tasks are delegated to third parties through outsourcing contracts, but the quality of the work is still monitored using performance indicators.
		The firm conveys results, which can be in the form of products or services, to clients.

After knowing the classification of PSS and its characteristics, an identification of PSS components was carried out. Based on the research of previous studies, Table 6 shows key aspects of value creation fitting the definition of components.

Table 6. PSS component exploration.

No	PSS Component	References
1	Product	[15,29,50–54]
2	Service	[15,29,50–54]
3	Actor	[29,51,52,54,62,63]
4	Stakeholder Relationship	[6,50,51,53,54,64–66]
5	Technology	[15,50,53–55,62,67–72]

In the interim, various responses were obtained from customer surveys. Using an affinity diagram, some answers were categorized into the PSS component extracted from prior studies, while others were irrelevant to the definition of the component. Table 7 displays the results of customer identification based on a survey.

Table 7. Identification of PSS components based on the customer perspective.

Type of PSS	Product	Service	Actor	Stakeholder Relationship	Technology	Irrelevant Answer
Type 1: Product-Oriented	Product Design	Service Variety	Friendliness in interaction	Other customer's experience	Information system	Price
	Ease of use	Ease of access	Patience	Collaboration	Social media	Promotion
	Appearance	After-sales service	Clarity in conveying	After-sales relationship		Sustainability
	Product Quality	Service Warranty	Education to customer	Customer Testimony		Benefit
	Product Warranty	Delivery Process	Third actor			Economy
	Superiority	Complaint handling				Offer location
	Reputation	Payment method				Advertisement
	Availability					
	Maintenance					

Table 7. *Cont.*

Type of PSS	Product	Service	Actor	Stakeholder Relationship	Technology	Irrelevant Answer
Type 2: Use-Oriented	Quality Guarantee	Access duration	PSS Knowledge	Experience	Infrastructure	Price
	Ease of use	Quality Guarantee	Communication	Customer Testimony	Information system	Promotion
	Safety	Service policy and terms	Delivery Process	Trust	e-commerce	Event
	Maintenance	Security		Key Opinion Leader		Trend
	Creative Innovation			Peer User Review		
Type 3: Result-Oriented	Product Quality	Service Quality	Attitude	Cooperation	Communication channel	Price
	Product Variety	After-sales service	Skill	Good relationship	Data management	Promotion
	Product Warranty	Reputation	Experience in service	Customer's Sociopsychology	Flexibility	Performance report
	Reputation	Ease of access	Communication	Trust		
	Flexibility	Flexibility	Flexibility	Flexibility		

Step 3 of the research was data processing, including an examination of PSS component importance levels and the relationships between different PSS components in terms of sustainability. After elaborating on the PSS components, the investigation continued with a population difference test of the PSS components' importance levels for each type. The results can be used to consider specific treatment needs for each component in planning value creation and PSS development. The test was carried out by using the Mann–Whitney test. The Mann–Whitney test is used to examine the difference between two independent populations through the median without knowing the distribution of the two populations [73]. In cases with unequal sample sizes, the error probability cannot be well controlled by either the Student's *t*-test or the Mann–Whitney test; however, even in that case, the Mann–Whitney test is still better than the Student's *t*-test [74,75]. The hypotheses built for the Mann–Whitney test are presented in Table 8.

Table 8. Hypotheses for Mann–Whitney test.

No	Hypothesis	Objective of Test
1	Hypothesis 1 H_0: $\eta_{P1} = \eta_{P2}$ H_a: $\eta_{P1} \neq \eta_{P2}$	Assess whether PSS Types 1 and 2 have different levels of importance for the product as components.
2	Hypothesis 2 H_0: $\eta_{P1} = \eta_{P3}$ H_a: $\eta_{P1} \neq \eta_{P3}$	Assess whether PSS Types 1 and 3 have different levels of importance for the product as components.
3	Hypothesis 3 H_0: $\eta_{P2} = \eta_{P3}$ H_a: $\eta_{P2} \neq \eta_{P3}$	Assess whether PSS Types 2 and 3 have different levels of importance for the product as components.
4	Hypothesis 4 H_0: $\eta_{S1} = \eta_{S2}$ H_a: $\eta_{S1} \neq \eta_{S2}$	Assess whether PSS Types 1 and 2 have different levels of importance for the service as components.
5	Hypothesis 5 H_0: $\eta_{S1} = \eta_{S3}$ H_a: $\eta_{S1} \neq \eta_{S3}$	Assess whether PSS Types 1 and 3 have different levels of importance for the service as components.

Table 8. *Cont.*

No	Hypothesis	Objective of Test
6	Hypothesis 6 H_0: $\eta_{S2} = \eta_{S3}$ H_a: $\eta_{S2} \neq \eta_{S3}$	Assess whether PSS Types 2 and 3 have different levels of importance for the service as components.
7	Hypothesis 7 H_0: $\eta_{A1} = \eta_{A2}$ H_a: $\eta_{A1} \neq \eta_{A2}$	Assess whether PSS Types 1 and 2 have different levels of importance for the actor as components.
8	Hypothesis 8 H_0: $\eta_{A1} = \eta_{A3}$ H_a: $\eta_{A1} \neq \eta_{A3}$	Assess whether PSS Types 1 and 3 have different levels of importance for the actor as components.
9	Hypothesis 9 H_0: $\eta_{A2} = \eta_{A3}$ H_a: $\eta_{A2} \neq \eta_{A3}$	Assess whether PSS Types 2 and 3 have different levels of importance for the actor as components.
10	Hypothesis 10 H_0: $\eta_{SHR1} = \eta_{SHR2}$ H_a: $\eta_{SHR1} \neq \eta_{SHR2}$	Assess whether PSS Types 1 and 2 have different levels of importance for the stakeholder relationship as components.
11	Hypothesis 11 H_0: $\eta_{SHR1} = \eta_{SHR3}$ H_a: $\eta_{SHR1} \neq \eta_{SHR3}$	Assess whether PSS Types 1 and 3 have different levels of importance for the stakeholder relationship as components.
12	Hypothesis 12 H_0: $\eta_{SHR2} = \eta_{SHR3}$ H_a: $\eta_{SHR2} \neq \eta_{SHR3}$	Assess whether PSS Types 2 and 3 have different levels of importance for the stakeholder relationship as components.
13	Hypothesis 13 H_0: $\eta_{T1} = \eta_{T2}$ H_a: $\eta_{T1} \neq \eta_{T2}$	Assess whether PSS Types 1 and 2 have different levels of importance for the technology as components.
14	Hypothesis 14 H_0: $\eta_{T1} = \eta_{T3}$ H_a: $\eta_{T1} \neq \eta_{T3}$	Assess whether PSS Types 1 and 3 have different levels of importance for the technology as components.
15	Hypothesis 15 H_0: $\eta_{T2} = \eta_{T3}$ H_a: $\eta_{T2} \neq \eta_{T3}$	Assess whether PSS Types 2 and 3 have different levels of importance for the technology as components.

Furthermore, calculating the PSS components' importance levels was analogous to calculating the mean importance level of attributes in the SERVQUAL case [76]. Table 9 displays the average importance of PSS components for Types 1, 2, and 3. The importance level measurement used a scale of 4.

Table 9. Importance level of PSS component.

No	Component	Importance Level (Scale of 4)		
		PSS Type 1: Product-Oriented	PSS Type 2: Use-Oriented	PSS Type 3: Result-Oriented
1	Product	3.56	3.46	3.49
2	Service	3.51	3.63	3.56
3	Actor	3.34	3.41	3.25
4	Stakeholder Relationship	3.09	3.33	3.21
5	Technology	3.45	3.67	3.33

The investigation continued into the correlation analysis between components. PSS is a system composed of synergistic components that contribute to overall value creation. Therefore, studying the interaction between components is vital for an examination of value creation or PSS development. Several coefficients can be used to show the relationship between variables, such as Kendall's τ, the Ghini measure, Blomqvist's β, Spearman's ρ, and Pearson's correlation [77]. Spearman's ρ and Pearson's correlation are two coefficients commonly used in statistical testing [78]. Spearman's ρ is considered a regular Pearson's correlation regarding the proportion of variability taken into account [79]. Pearson's

correlation explains the relationship between two variables through a linear function, while Spearman's ρ does this through a monotonic function [80]. By using the monotonic function, Spearman's ρ does not need to pay attention to the distribution of the data and is suitable for use on a Likert scale with a value level [81]. Therefore, Spearman's ρ was used in this study to analyze the relationship between PSS components in each type. The last investigation into PSS components was undertaken to determine the relationship between PSS components in terms of sustainability, based on the voice of the customer. A comparative analysis was carried out between the types of PSS based on the data obtained. Thus, firms concentrate on the components that contribute to the value creation and development of PSS in terms of sustainability for PSS Types 1, 2, and 3. Step 4 of the research was the result and conclusion. At this stage, the research results are discussed and summarized to contribute to the current development within the PSS industry and its research and to elaborate future research opportunities.

3. Results

There are three types of PSS with eight characteristics that are influenced by the dominance of the PSS components that constitute them. Referring to the definition of components, the results of the identification of PSS components from previous studies are presented in Table 6. Based on the description of PSS, many previous studies agree that products and services are components of PSS [9,27,82]. Product and service integration prioritizes the value creation process and value delivery over resources [83]. In addition, actors as subjects in value creation and value delivery have begun to be research topics, with related research including the design of an actor-network map, to map tasks and enhance the roles of actors [63,69], and the investigation and development of collaborations between actors to support their functions both internally and externally [52,62]. Previous studies have shown an appreciation for the significance of collaboration between actors and stakeholder relationships. Stakeholder relationships are needed in value creation between actors [6]. Customer surveys have also supported the importance of stakeholder relationships in value creation and delivery for PSS Types 1, 2, and 3. As shown in Table 7, customers stated that collaboration, experience, and influence between stakeholders affected the value creation and value delivery processes of PSS. Along with Industrial Revolution 4.0, the critical role of technology in servitization has been consistently increasing [84], thus affecting the evolution of PSS [55]. Based on the previous studies' exploration, the elaborated PSS components were product, service, actor, stakeholder relationship, and technology. Referring to the definition of components, these five components were designed intentionally to support the value creation and delivery in various patterns and standards. If there was a failure in the product, service, actor, stakeholder relationship, or technology, the PSS offered to customers failed because it did not match the set value.

The identified PSS components were in line with the results of the customer survey through open-ended questions. Most of the respondents provided diverse responses, yet it turned out that the reactions remained related to the PSS component attributes found in the previous study. The results of the polarization of the answers are presented in Table 7. Meanwhile, several respondents answered critical aspects of value creation that needed to be more relevant to the definition of components. In PSS Type 1, many customers conveyed ideas related to the product, such as product quality. This was following the characteristic of PSS Type 1. PSS Type 1 places a heavier emphasis on the product aspect of product and service integration [7]. Meanwhile, the ideas customers conveyed the least were related to technology and included information systems and social media. In PSS Type 1, technology supports PSS, as, for example, in knowledge management tools [85]. PSS Type 2 was distinct in this regard. In Table 7, it was evident that customer ideas were diverse and relatively dispersed across the five PSS components. As an implication, customers perceive equality in terms of the dominance of each component over the other. This follows the requirements of PSS Type 2, which has four distinct characteristics. These characteristics are displayed in Table 5. In PSS Type 3, customers considered the flexibility of all components

to be necessary for the value creation and value delivery processes. This follows the characteristics of PSS Type 3, requiring flexibility to gain diverse customer loyalty.

3.1. The Components' Importance Level Difference Test between PSS Types

An investigation of components' importance level differences between PSS types was conducted using the Mann–Whitney test. The decision in the Mann–Whitney test was drawn by comparing the *p*-value and alpha of 5%. The null hypothesis was rejected if the *p*-value was less than the alpha of 5%. Table 10 shows the result of the Mann–Whitney test, which was based on the hypothesis shown in Table 8.

Table 10. Mann–Whitney Test Result.

No	Hypothesis	*p*-Value	Decision	Conclusion
1	Hypothesis 1 H_0: $\eta_{P1} = \eta_{P2}$ H_a: $\eta_{P1} \neq \eta_{P2}$	0.3002	Do not reject H_0	There is no significant difference between PSS Type 1 and Type 2 regarding the product's importance level.
2	Hypothesis 2 H_0: $\eta_{P1} = \eta_{P3}$ H_a: $\eta_{P1} \neq \eta_{P3}$	0.4549	Do not reject H_0	There is no significant difference between PSS Type 1 and Type 3 regarding the product's importance level.
3	Hypothesis 3 H_0: $\eta_{P2} = \eta_{P3}$ H_a: $\eta_{P2} \neq \eta_{P3}$	0.7814	Do not reject H_0	There is no significant difference between PSS Type 2 and Type 3 regarding the product's importance level.
4	Hypothesis 4 H_0: $\eta_{S1} = \eta_{S2}$ H_a: $\eta_{S1} \neq \eta_{S2}$	0.2187	Do not reject H_0	There is no significant difference between PSS Type 1 and Type 2 regarding the service's importance level.
5	Hypothesis 5 H_0: $\eta_{S1} = \eta_{S3}$ H_a: $\eta_{S1} \neq \eta_{S3}$	0.5799	Do not reject H_0	There is no significant difference between PSS Type 1 and Type 3 regarding the service's importance level.
6	Hypothesis 6 H_0: $\eta_{S2} = \eta_{S3}$ H_a: $\eta_{S2} \neq \eta_{S3}$	0.5204	Do not reject H_0	There is no significant difference between PSS Type 2 and Type 3 regarding the service's importance level.
7	Hypothesis 7 H_0: $\eta_{A1} = \eta_{A2}$ H_a: $\eta_{A1} \neq \eta_{A2}$	0.4169	Do not reject H_0	There is no significant difference between PSS Type 1 and Type 2 regarding the actor's importance level.
8	Hypothesis 8 H_0: $\eta_{A1} = \eta_{A3}$ H_a: $\eta_{A1} \neq \eta_{A3}$	0.7538	Do not reject H_0	There is no significant difference between PSS Type 1 and Type 3 regarding the actor's importance level.
9	Hypothesis 9 H_0: $\eta_{A2} = \eta_{A3}$ H_a: $\eta_{A2} \neq \eta_{A3}$	0.3019	Do not reject H_0	There is no significant difference between PSS Type 2 and Type 3 regarding the actor's importance level.
10	Hypothesis 10 H_0: $\eta_{SHR1} = \eta_{SHR2}$ H_a: $\eta_{SHR1} \neq \eta_{SHR2}$	0.0649	Do not reject H_0	There is no significant difference between PSS Type 1 and Type 2 regarding the stakeholder relationship's importance level.
11	Hypothesis 11 H_0: $\eta_{SHR1} = \eta_{SHR3}$ H_a: $\eta_{SHR1} \neq \eta_{SHR3}$	0.2171	Do not reject H_0	There is no significant difference between PSS Type 1 and Type 3 regarding the stakeholder relationship's importance level.
12	Hypothesis 12 H_0: $\eta_{SHR2} = \eta_{SHR3}$ H_a: $\eta_{SHR2} \neq \eta_{SHR3}$	0.6683	Do not reject H_0	There is no significant difference between PSS Type 2 and Type 3 regarding the stakeholder relationship's importance level.
13	Hypothesis 13 H_0: $\eta_{T1} = \eta_{T2}$ H_a: $\eta_{T1} \neq \eta_{T2}$	0.0362	Reject H_0	There is a significant difference between PSS Type 1 and Type 2 regarding technology's importance level.
14	Hypothesis 14 H_0: $\eta_{T1} = \eta_{T3}$ H_a: $\eta_{T1} \neq \eta_{T3}$	0.6171	Do not reject H_0	There is no significant difference between PSS Type 1 and Type 3 regarding technology's importance level.
15	Hypothesis 15 H_0: $\eta_{T2} = \eta_{T3}$ H_a: $\eta_{T2} \neq \eta_{T3}$	0.0173	Reject H_0	There is a significant difference between PSS Type 2 and Type 3 regarding technology's importance level.

The two-population test results shown in Table 10 were utilized for the value creation evaluation and PSS development plan. If the test results show no difference between the two populations being tested, customers have the same view of the importance level of specific PSS components in all types of PSS. Thus, the firms do not need to give special treatment to the PSS component when preparing the value creation evaluation and development plan, even though it is a different type of PSS. The results of the Mann–Whitney test displayed in Table 10 show differences in the importance level of the technology component for PSS Type 1 versus PSS Type 2 and PSS Type 2 versus PSS Type 3. Furthermore, there was no difference in the importance level of the technology component between PSS Type 1 and PSS Type 3. Customers perceived the critical role of technology in PSS Type 2. Referring to Table 5, there are four characteristics of PSS Type 2 that require technological assistance in accelerating the value creation and value delivery of PSS. Regarding leased product maintenance, technology can act as a communication channel to facilitate and expedite access, as a knowledge management manager, and as a maintenance, repair, and operation tool. As a control point for value creation and the development of PSS Type 2, the technology needed special attention because customers gave different levels of importance to it than they did PSS Type 1 and PSS Type 3.

3.2. The Components' Importance Level

Components are an essential part of PSS for value creation and delivery processes that are tailored to the type of PSS. For example, in PSS Type 1: product-oriented, the product as a component is more prominent than other components. Therefore, it is necessary to investigate the importance of the PSS component in each type based on the customer's perspective. Figure 2 shows how the significance of the PSS components was judged from the customer's point of view for the three types of PSS.

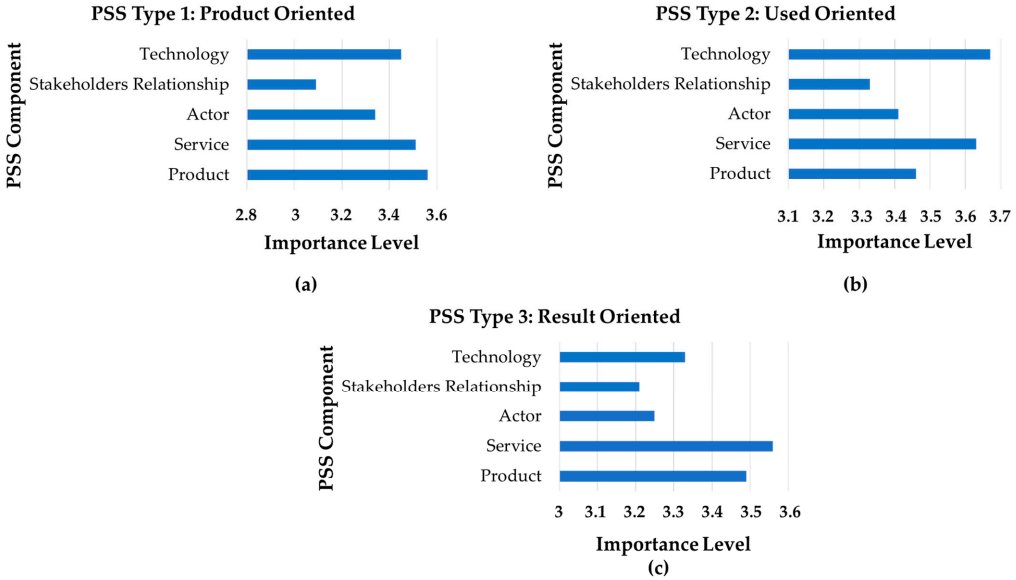

Figure 2. Importance level of PSS components: (**a**) PSS Type 1: product-oriented; (**b**) Type 2: use-oriented; (**c**) Type 3: result-oriented.

Figure 2 was created using the information supplied in Table 9. Figure 2a demonstrates that the product is the most critical component of PSS Type 1. As an implication, customers of PSS Type 1 are focused on the product, and the product becomes the driver of value creation and value delivery for consumers. Furthermore, Table 7 shows that customers focus on a product's quality, warranty, design, and other features that are representative of the voice of the customer when regarding the product's importance. After the product, PSS Type 1 also considers service to be a significant component. The service is considered capable of attracting customers even though the product is still the main focus of PSS Type 1.

In contrast to PSS Type 3, Figure 2c demonstrates that the essential component is service. In the result-oriented type, most firms offer creative and attractive service designs. Meanwhile, the product is a side offering that can support the service process. In the use-oriented type, most firms demand rapid, widespread, and enormous data handling for customer service, so technology plays a significant role. As an implication, firms need to focus not only on service and product innovation but also on the preparation of technology to help with service delivery in PSS Type 2. In value creation, each component will interact with other components and create a particular value. Technology is always in third place for every PSS type. However, the importance of technology in PSS Type 2 differed significantly from that in PSS Type 1 and PSS Type 3. This was supported by the results of the two population tests presented in Table 10. Considering the broad and diverse scope of PSS Type 2, technology plays a vital role in the value creation and delivery processes in PSS Type 2. As in Figure 2b, the service component was in second place and the product component was in third place. As an implication, the wide variety of PSS Type 2 components requires firms to be responsive and adaptive to changes in the business environment, such as changes in market trends and customer tastes. Technology and service are components that assist firms in responding to these demands. Technology improves process efficiency rapidly so that customers become satisfied. Meanwhile, service provides attractiveness through unique and creative offers so that customers feel fulfilled. On the other hand, other components will continue to work to support the value creation of PSS.

3.3. Correlation between PSS Components

Decision-making in the Spearman correlation test is conducted by comparing the *p*-value with 5% alpha. If the *p*-value is less than alpha, the null hypothesis is rejected. In general, the hypothesis tested on Spearman's is

H_0: $\rho = 0$, which means there is no correlation between the two PSS components.

H_a: $\rho \neq 0$, which means there is a correlation between the two PSS components.

Table 11 presents the results of the Spearman correlation test.

Table 11. Spearman correlation test.

Type of PSS	Associated Variables	*p*-Value	Decision	Conclusion
Type 1: Product-Oriented	Service and Product	0	Reject H_0	There is a correlation between Service and Product
	Actor and Product	0.001	Reject H_0	There is a correlation between Actor and Product
	Actor and Service	0	Reject H_0	There is a correlation between Actor and Service
	Stakeholder Relationship and Product	0.025	Reject H_0	There is a correlation between Stakeholder Relationships and Products.
	Stakeholder Relationship and Service	0	Reject H_0	There is a correlation between Stakeholder Relationships and Service.
	Stakeholder Relationship and Actor	0	Reject H_0	There is a correlation between Stakeholder Relationship and Actor.
	Technology and Product	0.001	Reject H_0	There is a correlation between Technology and Product.
	Technology and Service	0.001	Reject H_0	There is a correlation between Technology and Service.
	Technology and Actor	0	Reject H_0	There is a correlation between Technology and actor.
	Technology and Stakeholder Relationship	0.001	Reject H_0	There is a correlation between Technology and Stakeholder Relationships.

Table 11. *Cont.*

Type of PSS	Associated Variables	*p*-Value	Decision	Conclusion
Type 2: Use-Oriented	Service and Product	0.007	Reject H_0	There is a correlation between Service and Product
	Actor and Product	0.003	Reject H_0	There is a correlation between Actor and Product
	Actor and Service	0.002	Reject H_0	There is a correlation between Actor and Service
	Stakeholder Relationship and Product	0.171	Do not reject H_0	There is no significant correlation between Stakeholder Relationships and Products.
	Stakeholder Relationship and Service	0.288	Do not reject H_0	There is no significant correlation between Stakeholder Relationships and Service.
	Stakeholder Relationship and Actor	0.013	Reject H_0	There is a correlation between Stakeholder Relationship and Actor.
	Technology and Product	0.01	Reject H_0	There is a correlation between Technology and Product.
	Technology and Service	0	Reject H_0	There is a correlation between Technology and Service.
	Technology and Actor	0.011	Reject H_0	There is a correlation between Technology and actor.
	Technology and Stakeholder Relationship	0.026	Reject H_0	There is a correlation between Technology and Stakeholder Relationships.
Type 3: Result-Oriented	Service and Product	0	Reject H_0	There is a correlation between Service and Product
	Actor and Product	0	Reject H_0	There is a correlation between Actor and Product
	Actor and Service	0	Reject H_0	There is a correlation between Actor and Service
	Stakeholder Relationship and Product	0.002	Reject H_0	There is a correlation between Stakeholder Relationships and Products.
	Stakeholder Relationship and Service	0.004	Reject H_0	There is a correlation between Stakeholder Relationships and Service.
	Stakeholder Relationship and Actor	0	Reject H_0	There is a correlation between Stakeholder Relationship and Actor.
	Technology and Product	0	Reject H_0	There is a correlation between Technology and Product.
	Technology and Service	0	Reject H_0	There is a correlation between Technology and Service.
	Technology and Actor	0	Reject H_0	There is a correlation between Technology and actor.
	Technology and Stakeholder Relationship	0	Reject H_0	There is a correlation between Technology and Stakeholder relationships.

As an implication, the information obtained from correlation is for component treatment. If there is a significant relationship between components, treating specific components will affect other components. Based on Table 11, most of the PSS components were related. In PSS Type 2, the obtained information showed that the stakeholder relationship component and the product did not have a significant relationship, and the same was true of the stakeholder relationship and service components. This indicates that the variability of the importance of products and services is not linearly related to the variability of

stakeholder relationships. Changes in stakeholder relationships will not affect changes in products and services or vice versa. As an implication, firms can engineer products and services without paying attention to the customer's view of the stakeholder relationship. Changes in products and services are more related to technological changes. The *p*-value for product and technology and service and technology was smaller than alpha 5%. This result supports the results of the Mann–Whitney test, which shows that customers felt the role of technology was more critical in PSS Type 2 than in Types 1 and 3. The examples of business fields in PSS Type 2 are cloud drives, equipment rental, Gojek, Grab, Uber, Market Place, and Copier Producer. This industry is directly tied to the role of technology. Thus, the products and services offered to customers will also be impacted. Technology also has a significant correlation with stakeholder relationships in PSS Type 3. As a result, firms prioritizing the building of relationships with stakeholders also need to emphasize the development of technology. The PSS Type 3 offered to customers is focused on results, which good relationships with stakeholders will facilitate. Technology supports the building of stakeholder relationships through the provision of advanced facilities. In addition, a significant correlation exists between stakeholder relationships and actors in PSS Type 1. This is the background of the need for collaboration between actors in value creation and value delivery related to product and service integration and supported by technology.

3.4. The Sustainability-Related Components

Based on Figure 3a, the dominant component related to sustainability in PSS Type 1 was the product component. This fits with the characteristics of PSS Type 1, which focuses on products in the integration of products and services. As a result, products will play a significant role in achieving sustainability. Implementing product life cycle management (PLCM) improves the products' function in terms of sustainability. PLCM enables the creation of a closed-loop supply chain through the product design process. When a product reaches the end of its useful life, a closed-loop supply chain allows for reuse, remanufacturing, and recycling. Thus, a circular economy, sustainable materials selection, and green product design and production techniques achieve sustainability. Meanwhile, the proportion of products and services is potentially balanced in PSS Type 2, so that service can play an essential role in achieving sustainability. This can be seen in Figure 3b. Service innovation provides fewer products and the concept of dematerialization. Product and service integration offers a new alternative for customer consumption materials away from tangible products and towards intangible products. Thus, there is business sustainability for the firm, which can then focus on producing products to keep the market going while finding ways to help customers keep their business. In addition, the service offering influences customers to accept remanufactured products more readily. Thus, product and service integration creates closed-loop resource flows [6]. Operationally, product and service integration will require technology as a supporting tool that contributes to the achievement of sustainability. These achievements can be seen in the efficiency of the processes that can be carried out by technology. This is in line with the survey results shown in Figure 3b. Technology was in second place after service regarding its relationship to sustainability. Figure 3c shows that the stakeholder relationship is most related to sustainability. In PSS Type 3, or result-oriented PSS, the PSS often relates to customers or other stakeholders. Thus, achieving the sustainability goal will depend on how much each stakeholder knows about green processes, green products, green services, and green partners. This is supported by the survey results shown in Figure 3c. The stakeholder relationship component had a percentage that was not very different from the product, service, and actor components. Customers are provided products and services, whereas actors are the subjects of PSS delivery to customers.

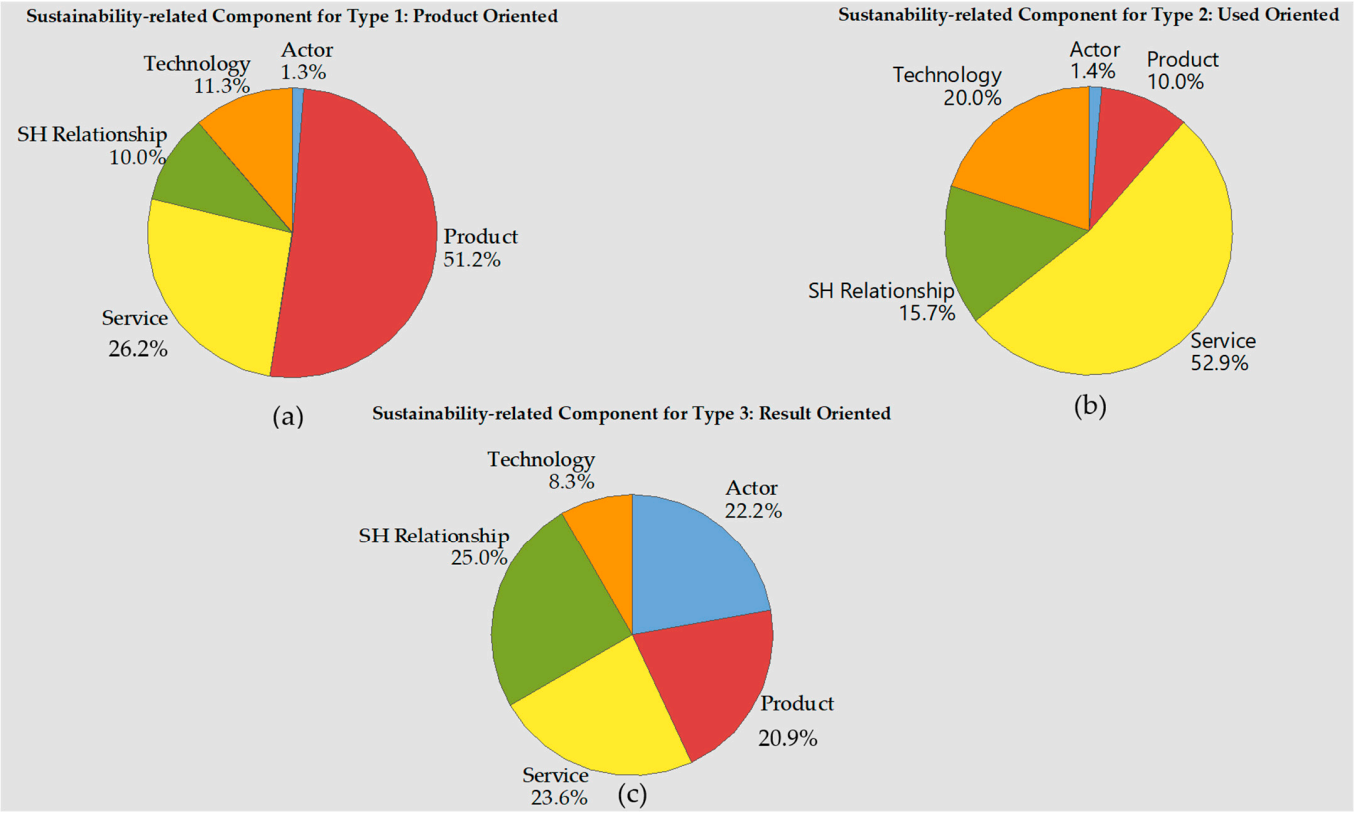

Figure 3. PSS component related to sustainability: (**a**) PSS Type 1: product-oriented; (**b**) Type 2: use-oriented; and (**c**) Type 3: result-oriented.

4. Discussion

As the system is a collection of interacting entities, it is necessary to clarify the PSS components to understand the system thoroughly [86]. Components conforming to the designer's expectations can contribute to the function of the PSS under the purpose of its creation. These functions relate to value creation and value delivery. Thus, PSS components are utilized as the control point for value creation, value delivery, and PSS development. The value creation process begins with the development of components that make up the PSS. Each component has a specific function and role in supporting a PSS. Each component synergizes with other components to form a PSS with particular values throughout its life cycle. The PSS component will affect value creation and value delivery. Based on the excavation of previous research and customer surveys, the PSS components elaborated are product, service, actor, stakeholder relationship, and technology.

Product

The product is one of the physical aspects of PSS offered to customers. Customers can capture the existence of the product through the five senses. The critical elements of the physical product definition are geometry, material specifications, and process plans [87]. Products contribute to value creation through certain functions related to these critical elements. The product underwent a role change in PSS and is no longer the primary value provider [88]. However, products as tangible commodities are still used to meet user needs [89]. Therefore, the product can be used as a control point for value creation and PSS development related to reliability, design, and conformity.

Service

Service is part of an industry with elements of action, performance, effort, or process that must be delivered to customers. According to the new concept, service is seen as an activity involving both the firm and the client with value creation deriving from the process [88]. Four service characteristics can be compared with the characteristics of the

product component: intangibility, heterogeneity, inseparability, and perishability [90,91]. Intangibility means that a service is invisible and has no tactile quality, but its existence can be felt through emotional factors. Heterogeneity means that service cannot be standardized or made to feel personal. The different customer experiences affect how service is given. Inseparability implies that services are produced and consumed simultaneously, thus requiring customer involvement. Perishability means that the service cannot be preproduced or stored but has a particular period in which it satisfies customers, which is affected by market trends. Through these four characteristics, services contribute to the value creation of PSS. Thus, services can be used as control points for value creation and the PSS development process by paying attention to the indicators derived from the four service characters. Intangibility indicators can be used concerning customer emotions. Service can be defined based on the actions performed on the customer or the nature of the ownership granted to the customer [92]. Through these actions or ownership, a response will appear in customer emotions. Customers experience emotion because they perceive a value. The emotion of satisfaction is one such example. Excellent service delivery provides satisfaction [93] because there is value as an intermediary between excellent service and satisfaction [94]. In heterogeneity, factors relating to the adequacy of customer expectations can be utilized to determine the customer's tolerance zone [95]. In inseparability, factors relating to consumer participation and intimacy can be used to facilitate the establishment of relationships with reciprocal advantages. Perishability can be utilized as a service innovation indicator. In the ecosystem, services can be categorized based on their supporting, regulating, provisioning, and cultural roles [96]. Service contributes to the value creation of PSS, so service is therefore one of the components of PSS.

Actor

PSS delivery to clients involves value-creation activities with specific functions. For these activities, the actor has a critical role as the subject. A life-cycle-oriented PSS involves actors in the design process [54]. Failures that occur due to actor errors affect the value conveyed to customers or the other actors in the value chain. Actors who are also stakeholders have contributed to efforts to build stakeholder engagement. Therefore, the actor's competence needs to be considered. For example, digital competence is required when evaluating and developing smart PSS. Actors have a critical role in value creation and value delivery from PSS, so the actor is one of the PSS components that can be used as a control point for value creation and development of PSS because it supports cross-domain knowledge sharing [97].

Stakeholder relationship

Stakeholder theories discuss how stakeholders impact product development and are related to market information for product development [65]. This stakeholder engagement can be reflected in the broad and close stakeholder relationship. The idea of PSS itself shows how meaningful the relationships are between stakeholders. PSS is the ultimate customer–firm relationship with mutual benefits regarding costs, resources, performance, and innovation ideas [98]. The stakeholder relationship is indispensable in realizing stakeholder engagement, which can provide several advantages such as credibility, the anticipation of controversy, the assurance of transparency and accountability, increasing relevance, the improvement of quality, and enriched feedback [99]. Stakeholder integration in the design and development of PSS involves customers, firms, and value chain actors [64]. PSS is a blend of products and services supported by network actors and can be part of a particular business model or innovation strategy [51]. A strong actor-network can be seen from the abilities of each actor and the number of actors that can help the intended value-creation process. In the meantime, the relationship reflects how well stakeholders partner with each other. This is one of the points in evaluating the performance of the product and service mix [66]. The stakeholder relationship is designed and built to support the value creation of PSS.

Technology

At the moment, firms are required to offer PSS and to understand customer habits throughout the PSS life cycle [100]. In this case, technology supports the process. Technologies such as the Internet of Things (IoT), cloud computing (CC), and big data analytics (BDA) can increase the adoption of innovative services in manufacturing [68], accelerate the servitization process through value creation, and improve customer relationships as part of Industrial Revolution 4.0 [67,71]. In strategic interests, firms utilize remote monitoring technology for service integration [101]. Technology also improves service functions to satisfy customer desires and expectations [70]. The role of technology is also increasingly visible in PSS related to value co-creation and the achievement of sustainability [102]. Technology changes the way one creates value by embedding technology in the product, acting as a medium and tool for the generation of value-added e-services as a solution package [103]. Technology can develop PSS into smart PSS, a trending research concern [104]. Another role of technology in the value delivery process from PSS is as a communication channel, product administration, or customization offering [105]. Based on the critical role of current and future technology for PSS, technology can be considered one of the components of PSS, one which is used as a control point for value creation and PSS development. These control points can be related to technical problems, critical evaluation or performance, or problem-oriented usage [106].

Tables 6 and 7 are the basis for elaborating on the five PSS components. This is slightly different from other references, which state that the PSS component consists of products, services, supporting networks, and infrastructure [9,88]. The supporting network is related to knowledge, capacity, a collaborative network, and resources. Meanwhile, supporting infrastructure provides a supportive network that includes production plants, service agents, basic facilities, and ICT. However, the scope of supporting networks and infrastructure is divergent. Narrowing the scope of supporting networks and infrastructure facilitates the identification of the aspects influencing the PSS value. In addition, actors, stakeholder relationships, and technology have been frequently discussed in previous studies. These are all critical components of PSS's value creation and delivery process. These three things are compatible with the definition of components and are in line with the coverage of the supporting network and infrastructure mentioned above. The PSS component must be specific and critical as a control point for value creation and PSS development. In addition, identifying other components of the supporting network and infrastructure can be an exciting topic for future research, considering that PSS is still growing following industry developments and customer tastes.

The elaborated PSS components in this article can be utilized by industry and researchers. Fulfilling customer requirements starts with the five components of the PSS, which are carried out during the PSS design stage and will continue to be carried out simultaneously at the next step. The five components of PSS will remain influential throughout a PSS's life cycle. A firm can control and design the expected PSS by knowing how these five components work. Evaluating value creation, value delivery, and PSS development can be focused on particular components. These priorities should consider the customer's viewpoint so that the firm's decision will effectively meet customer requirements. In addition, the correlation between components also needs to be considered because improving a component can be pervasive and simultaneous. This article discusses the priorities and correlations between PSS components in PSS Types 1, 2, and 3, which can be used as references in the evaluation process of value creation and PSS development. The results of the Mann–Whitney test show that firms need to maximize the role of technology in the processes of value creation and value delivery in PSS Type 2. Technology plays many roles in PSS, such as acting as a communication media between stakeholders, production tools, information systems, knowledge management tools, and other roles. Customers view technology's role as more significant in PSS Type 2 than in PSS Types 1 and 3. In PSS Type 2, the dominance of products or services can be proportioned so that other components are required to bolster the value creation and delivery processes. However, additional research is necessary to

determine the type of technology that most affects value creation and delivery processes. In addition, the priority of component development from the perspective of an MCDM-based firm is also an exciting and valuable research topic. PSS research is still growing, as a result of the many benefits provided by PSS on aspects of customers, firms, government, society, and the environment. Therefore, PSS is closely related to the issue of sustainability. PSS has the potential to reduce the number of products by introducing alternative product usage scenarios [107,108], and firms become more responsible for product service in the case of closed material cycles [6,107]. Firms are encouraged to perform material recovery when the product enters the end-of-life phase so that less waste is burned or stockpiled and so that they support a circular economy [6,16,27,89,107]; PSS can change the development of technical dematerialization because the customer only pays for the service or function on offer [107]. This article has presented the PSS components that are related to achieving sustainability based on customers' perspectives as users of PSS Types 1, 2, and 3. Based on the information in this article, firms can select PSS components to be developed to contribute more to the achievement of sustainability. In the future, research can be undertaken on the link between the PSS components and the achievement of sustainability. Suppose the development of PSS components is conducted through collaboration, in that case, a multi-echelon mathematical model for the supply chain can be used for future research, one that optimizes component development by increasing cooperation in stages [109]. In addition, grey flexible linear programming can be used to cope with uncertain parameters in the development of PSS components [110].

5. Conclusions

This article summarizes the findings of an investigation into PSS components utilized as convergent control points for value creation and PSS development. The investigation consisted of elaborating on the PSS component from previous research and surveys of customers, testing the difference in importance of the components, calculating the significance of the PSS components, and determining the PSS components related to sustainability based on customers' perspectives. Firms and researchers can utilize the results of this article to determine critical points in the evaluation and development of PSS because the PSS component is one constituent of PSS, one that plays a role in value creation and delivery. This article is part of initial research on PSS development that provides directions for an understanding of the characteristics of PSS constituents. The directions derived from this research findings are a research contribution. The findings that researchers and firms can utilize are as follows:

- The elaborated PSS component can explain, based on previous research and customer perspectives, the way that PSS constituents play an essential role in the value-creation process. This means that attention in the development of PSS can be focused on developing and managing these components effectively and efficiently.
- The importance of the PSS components presented in Table 9 and Figure 2 can be utilized to consider which component of the PSS development to start with. The level of importance was calculated based on the customers' perspectives so that PSS development is carried out in line with customer priorities.
- Correlation analysis between components helps determine the impact of the development of one component on other components so that anticipatory and efficient actions can be taken.
- Component analysis related to sustainability aspects can be used for the development of sustainable PSS that is component-based and convergent so that the efforts made are practical and efficient.

Components are the system constituents engineered to fulfill roles according to various design standards and patterns. PSS is a system consisting of several components. Based on the research of past studies and surveys, the PSS components include the product, the service, the actor, the relationship between stakeholders, and the technology. The results of two population tests reveal differences in the importance of technology for PSS

Types 1 and 2. Additionally, there are differences in technology for PSS Types 2 and 3. As an implication, customers feel that there is a difference in the critical role of technology in PSS Type 2. There is sufficient evidence that products, services, actors, and stakeholder relationships have different levels of importance for PSS Types 1, 2, or 3. Based on the level of importance, the product is the most critical component in PSS Type 1, the technology is the most crucial component in PSS Type 2, and the service is the most critical component in PSS Type 3. The level of importance for the five PSS components is presented in Table 9. The sustainability aspects relate to products for PSS Type 1, services for PSS Type 2, and stakeholder relationships for PSS Type 3.

Limitations in this research are related to the scope of the sampling. The survey was conducted in Indonesia using a random sampling technique so that the results are not global and are therefore influenced by culture, government policies, and business ethics for companies adapted to local wisdom. In different country conditions, the level of importance of the PSS components may be different. However, this research can be repeated for global conditions, and comparative analysis can be carried out to widen the perceived benefits.

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References

1. Kozlowska, J. A Methodology of Strategic Analysis for Servitization of the Manufacturing Company. *WSEAS Trans. Bus. Econ.* **2021**, *18*, 126–138. [CrossRef]
2. Kohtamäki, M.; Rabetino, R.; Einola, S.; Parida, V.; Patel, P. Unfolding the Digital Servitization Path from Products to Product-Service-Software Systems: Practicing Change through Intentional Narratives. *J. Bus. Res.* **2021**, *137*, 379–392. [CrossRef]
3. Sousa, R.; da Silveira, G.J.C. Advanced Services and Differentiation Advantage: An Empirical Investigation. *Int. J. Oper. Prod. Manag.* **2020**, *40*, 1561–1587. [CrossRef]
4. Kanatlı, M.A.; Karaer, Ö. Servitization as An Alternative Business Model and Its Implications on Product Durability, Profitability & Environmental Impact. *Eur. J. Oper. Res.* **2021**, *301*, 546–560. [CrossRef]
5. Borishade, T.T.; Ogunnaike, O.O.; Salau, O.; Motilewa, B.D.; Dirisu, J.I. Assessing the Relationship among Service Quality, Student Satisfaction and Loyalty: The NIGERIAN Higher Education Experience. *Heliyon* **2021**, *7*, e07590. [CrossRef] [PubMed]
6. Schoonover, H.A.; Mont, O.; Lehner, M. Exploring Barriers to Implementing Product-Service Systems for Home Furnishings. *J. Clean. Prod.* **2021**, *295*, 126286. [CrossRef]
7. Tukker, A.; van den Berg, C.; Tischner, U. S5W4Product-Services: A Specific Value Proposition. In *New Business for Old Europe: Product-Service Development, Competitiveness and Sustainability*; Routledge: Oxfordshire, UK, 2013; pp. 21–34. [CrossRef]
8. Manzini, E.; Vezzoli, C. Product-Service Systems and Sustainability Opportunities for Sustainable Solutions; Milan, Italy. 2002. Available online: www.unep.org (accessed on 14 August 2022).
9. Haase, R.P.; Pigosso, D.C.A.; McAloone, T.C. Product/Service-System Origins and Trajectories: A Systematic Literature Review of PSS Definitions and Their Characteristics. *Procedia CIRP* **2017**, *64*, 157–162. [CrossRef]
10. Martin, M.; Heiska, M.; Björklund, A. Environmental Assessment of a Product-Service System for Renting Electric-Powered Tools. *J. Clean. Prod.* **2021**, *281*, 125245. [CrossRef]
11. Pecorari, P.M.; Lima, C.R.C. Correlation of Customer Experience with the Acceptance of Product-Service Systems and Circular Economy. *J. Clean. Prod.* **2021**, *281*, 125275. [CrossRef]

12. Johnson, E.; Plepys, A. Product-Service Systems and Sustainability: Analysing the Environmental Impacts of Rental Clothing. *Sustainability* **2021**, *13*, 2118. [CrossRef]
13. Vezzoli, C.; Parra, B.G.; Kohtala, C. *Lecture Notes in Mechanical Engineering Designing Sustainability for All The Design of Sustainable Product-Service Systems Applied to Distributed Economies*; Vezzoli, C., Kohtala, C., Parra, B.G., Eds.; Springer: Mexico City, Mexico, 2021.
14. Alty Amalia, F.; Aprianingsih, A. Business Model of Jamu as Indonesian Traditional Herbal Medicine in New Economy. *Asian J. Technol. Manag.* **2017**, *10*, 19–28. [CrossRef]
15. Hernández Pardo, R.J.; Bhamra, T.; Bhamra, R. Sustainable Product Service Systems in Small and Medium Enterprises (SMEs): Opportunities in the Leather Manufacturing Industry. *Sustainability* **2012**, *4*, 175–192. [CrossRef]
16. Hernandez, R.J. Sustainable Product-Service Systems and Circular Economies. *Sustainability* **2019**, *11*, 5383. [CrossRef]
17. Li, X.; Wang, Z.; Chen, C.H.; Zheng, P. A Data-Driven Reversible Framework for Achieving Sustainable Smart Product-Service Systems. *J. Clean. Prod.* **2021**, *279*, 123618. [CrossRef]
18. Negash, Y.T.; Calahorrano Sarmiento, L.S.; Tseng, M.L.; Jantarakolica, K.; Tan, K. Sustainable Product-Service System Hierarchical Framework under Uncertainties: The Pharmaceutical Industry in Ecuador. *J. Clean. Prod.* **2021**, *294*, 126188. [CrossRef]
19. Abdel-Basst, M.; Mohamed, R.; Elhoseny, M. A Novel Framework to Evaluate Innovation Value Proposition for Smart Product–Service Systems. *Environ. Technol. Innov.* **2020**, *20*, 101036. [CrossRef]
20. Bu, L.; Chen, C.H.; Ng, K.K.H.; Zheng, P.; Dong, G.; Liu, H. A User-Centric Design Approach for Smart Product-Service Systems Using Virtual Reality: A Case Study. *J. Clean. Prod.* **2021**, *280*, 124413. [CrossRef]
21. Chiu, M.C.; Huang, J.H.; Gupta, S.; Akman, G. Developing a Personalized Recommendation System in a Smart Product Service System Based on Unsupervised Learning Model. *Comput. Ind.* **2021**, *128*, 103421. [CrossRef]
22. Wu, C.; Chen, T.; Li, Z.; Liu, W. A Function-Oriented Optimising Approach for Smart Product Service Systems at the Conceptual Design Stage: A Perspective from the Digital Twin Framework. *J. Clean. Prod.* **2021**, *297*, 126597. [CrossRef]
23. Yang, X.; Wang, R.; Tang, C.; Luo, L.; Mo, X. Emotional Design for Smart Product-Service System: A Case Study on Smart Beds. *J. Clean. Prod.* **2021**, *298*, 126823. [CrossRef]
24. Catulli, M.; Sopjani, L.; Reed, N.; Tzilivakis, J.; Green, A. A Socio-Technical Experiment with a Resource Efficient Product Service System. *Resour. Conserv. Recycl.* **2021**, *166*, 105364. [CrossRef]
25. Mourtzis, D.; Angelopoulos, J.; Panopoulos, N. Personalized PSS Design Optimization Based on Digital Twin and Extended Reality. *Procedia CIRP* **2022**, *109*, 389–394. [CrossRef]
26. Mourtzis, D.; Doukas, M.; Fotia, S. Classification and Mapping of PSS Evaluation Approaches. In *IFAC-PapersOnLine*; Elsevier: Amsterdam, The Netherlands, 2016; Volume 49, pp. 1555–1560. [CrossRef]
27. Beuren, F.H.; Pereira, D.; Fagundes, A.B. Product-Service Systems Characterization Based on Life Cycle: Application in a Real Situation. *Procedia CIRP* **2016**, *47*, 418–423. [CrossRef]
28. Mcgregor, J.D.; Stafford, J.A.; Cho, I.-H. Measuring Component Reliability. In *Automated Reasoning and Prediction 6th ICSE Workshop on Component-Based Software Engineering (CBSE)*; IEEE: Portland, OR, USA, 2003; Volume 2003.
29. Kimita, K.; Sakao, T.; Shimomura, Y. A Failure Analysis Method for Designing Highly Reliable Product-Service Systems. *Res. Eng. Des.* **2018**, *29*, 143–160. [CrossRef]
30. Jin, T. *Reliability Engineering and Service*; Wiley: Texas, TX, USA, 2018; Volume 148.
31. Lin, E.M.H.; Tseng, M.M. Tolerances of Customers' Requirements: A Review of Current Researches. *Procedia CIRP* **2018**, *72*, 1208–1213. [CrossRef]
32. Berger, C.; Blauth, R.; Boger, D. Kano's Methods for Understanding Customer-Defined Quality. *Cent. Qual. Manag. J.* **1993**, *2*, 3–36.
33. Mert, G.; Aurich, J.C. A Software Demonstrator for Measuring the Quality of PSS. In *Procedia CIRP*; Elsevier: Amsterdam, The Netherlands, 2015; Volume 30, pp. 209–214. [CrossRef]
34. Yoon, B.; Kim, S.; Rhee, J. An Evaluation Method for Designing a New Product-Service System. *Expert. Syst. Appl.* **2012**, *39*, 3100–3108. [CrossRef]
35. Osako, L.F.; Matsubayashi, M.O.; Takey, S.M.; Cauchick-Miguel, P.A.; Zancul, E. Cost Evaluation Challenges for Internet of Things (IoT) Based Product/Service-Systems (PSS). In *Procedia CIRP*; Elsevier: Amsterdam, The Netherlands, 2019; Volume 84, pp. 302–306. [CrossRef]
36. Shen, L.; Sun, C.; Ali, M. Role of Servitization, Digitalization, and Innovation Performance in Manufacturing Enterprises. *Sustainability* **2021**, *13*, 9878. [CrossRef]
37. Mo, J.P.T. Performance Assessment of Product Service System from System Architecture Perspectives. *Adv. Decis. Sci.* **2012**. [CrossRef]
38. Mert, G.; Waltemode, S.; Aurich, J.C. Quality Assessment of Technical Product-Service Systems in the Machine Tool Industry. In *Procedia CIRP*; Elsevier: Amsterdam, The Netherlands, 2014; Volume 16, pp. 253–258. [CrossRef]
39. Xin, Y.; Ojanen, V.; Huiskonen, J. Knowledge Management in Product-Service Systems—A Product Lifecycle Perspective. In *Procedia CIRP*; Elsevier: Amsterdam, The Netherlands, 2018; Volume 73, pp. 203–209. [CrossRef]
40. Chou, J.R. A TRIZ-Based Product-Service Design Approach for Developing Innovative Products. *Comput. Ind. Eng.* **2021**, *161*, 107608. [CrossRef]
41. Fadeyi, J.A.; Monplaisir, L.; Aguwa, C. The Integration of Core Cleaning and Product Serviceability into Product Modularization for the Creation of an Improved Remanufacturing-Product Service System. *J. Clean. Prod.* **2017**, *159*, 446–455. [CrossRef]

42. Halstenberg, F.A.; Stark, R. Study on the Feasibility of Modelling Notations for Integrated Product-Service Systems Engineering. In *Procedia CIRP*; Elsevier: Amsterdam, The Netherlands, 2019; Volume 83, pp. 157–162. [CrossRef]
43. Kubota, Y.; Murakami, F.; Kimita, K.; Shimomura, Y. The Task to Design Highly Service-Oriented Product-Service System. In *Procedia CIRP*; Elsevier: Amsterdam, The Netherlands, 2017; Volume 60, pp. 416–421. [CrossRef]
44. Salwin, M.; Kraslawski, A.; Lipiak, J.; Gołębiewski, D.; Andrzejewski, M. Product-Service System Business Model for Printing Houses. *J. Clean. Prod.* **2020**, *274*, 122939. [CrossRef]
45. Sassanelli, C.; Pezzotta, G.; Pirola, F.; Terzi, S.; Rossi, M. Design for Product Service Supportability (DfPSS) Approach: A State of the Art to Foster Product Service System (PSS) Design. In *Procedia CIRP*; Elsevier: Amsterdam, The Netherlands, 2016; Volume 47, pp. 192–197. [CrossRef]
46. Yin, D.; Ming, X.; Liu, Z.; Zhang, X. A Fuzzy ANP-QFD Methodology for Determining Stakeholders in Product-Service Systems Development from Ecosystem Perspective. *Sustainability* **2020**, *12*, 3329. [CrossRef]
47. Zhang, Z.; Xu, D.; Ostrosi, E.; Cheng, H. Optimization of the Product-Service System Configuration Based on a Multilayer Network. *Sustainability* **2020**, *12*, 746. [CrossRef]
48. Pietrantuono, R.; Popov, P.; Russo, S. Reliability Assessment of Service-Based Software under Operational Profile Uncertainty. *Reliab. Eng. Syst. Saf.* **2020**, *204*, 107193. [CrossRef]
49. Wang, N.; Ren, S.; Liu, Y.; Yang, M.; Wang, J.; Huisingh, D. An Active Preventive Maintenance Approach of Complex Equipment Based on a Novel Product-Service System Operation Mode. *J. Clean. Prod.* **2020**, *277*, 123365. [CrossRef]
50. Vezzoli, C.; Parra, B.G.; Kohtala, C. *Designing Sustainability for All*; Springer: Berlin/Heidelberg, Germany, 2021.
51. Hein, A.M.; Poulain, B.; Jankovic, M.; Chazal, Y.; Fakhfakh, S. Product Service System Design in a System of Systems Context: A Literature Survey. In Proceedings of the International Design Conference, DESIGN, Cavtat, Croatia, 24 May 2018; Volume 6, pp. 2891–2902. [CrossRef]
52. Azevedo, L.S.; Toledo, J.C.d.; González, M.O.A. Understanding the Interaction Between Actors in the Product-Service System Development. *Prod. Manag. Dev.* **2017**, *15*, 67–75. [CrossRef]
53. Marilungo, E.; Peruzzini, M.; Germani, M. *Review of Product-Service System Design Methods*; Springer International Publishing: Cham, Switzerland, 2016; pp. 529–540. [CrossRef]
54. Tan, A.R. Service-Oriented Product Development Strategies. Ph.D. Thesis, Technical University of Denmark, Lyngby, Denmark, 2010.
55. Gaiardelli, P.; Pezzotta, G.; Rondini, A.; Romero, D.; Jarrahi, F.; Bertoni, M.; Wiesner, S.; Wuest, T.; Larsson, T.; Zaki, M.; et al. *Product-Service Systems Evolution in the Era of Industry 4.0*; Springer: Berlin/Heidelberg, Germany, 2021; Volume 15. [CrossRef]
56. Walpole, R.E.; Myers, R.H.; Myers, S.L. *Probability and Statistics for Engineers and Scientists*, 9th ed.; Lynch, D., Ed.; Prentice Hall: Boston, MA, USA, 2012.
57. Uakarn, C.; Chaokromthong, K.; Sintao, N. Sample Size Estimation Using Yamane and Cochran and Krejcie and Morgan and Green Formulas and Cohen Statistical Power Analysis by G*Power and Comparisons. *Apheit Int. J.* **2021**, *10*, 76–88.
58. Khadka, J. Sampling Error in Survey Research. *Int. J. Sci. Res.* **2019**, *8*, 2214–2220. [CrossRef]
59. Oktavia, R.; Irwandi, I.; Rajibussalim, T.; Mentari, M.; Mulia, I.S. Assessing the Validity and Reliability of Questionnaires on the Implementation of Indonesian Curriculum K-13 in STEM Education. In *Journal of Physics: Conference Series*; Institute of Physics Publishing: Bristol, England, 2018; Volume 1088. [CrossRef]
60. Hamed Taherdoost, A.; Lumpur, K. Validity and Reliability of the Research Instrument; How to Test the Validation of a Questionnaire/Survey in a Research. 2016. Available online: https://hal.archives-ouvertes.fr/hal-02546799 (accessed on 27 August 2022).
61. Hinton, P.; Brownlow, C.; Mcmurray, I.; Cozens, B. *Spss Explained*; Routledge: Oxfordshire, UK, 2004. [CrossRef]
62. Marcon, A.; Ayala, F.; Frank, A.G.; Story, V.; Burton, J.; Raddats, C.; Zolkiewski, J. Capabilities Supporting Digital Servitization: A Multi-Actor Perspective. *Ind. Mark. Manag.* **2022**, *103*, 97–116. [CrossRef]
63. Lindahl, M.; Sakao, T.; Carlsson, E. Actor's and System Maps for Integrated Product Service Offerings—Practical Experience from Two Companies. *Procedia CIRP* **2014**, *16*, 320–325. [CrossRef]
64. Delgadillo, E.; Reyes, T.; Baumgartner, R.J. Towards Territorial Product-Service Systems: A Framework Linking Resources, Networks and Value Creation. *Sustain. Prod. Consum.* **2021**, *28*, 1297–1313. [CrossRef]
65. Yip, M.H.; Phaal, R.; Probert, D.R.; Hang, M.; Phaal, R.; Stakeholder, D.R.P. Stakeholder Engagement in Early Stage Product-Service System Development for Healthcare Informatics. *Eng. Manag. J.* **2015**, *9247*, 52–62. [CrossRef]
66. Sun, H.; Wang, Z.; Zhang, Y.; Chang, Z.; Mo, R.; Liu, Y. Evaluation Method of Product-Service Performance. *Int. J. Comput. Integr. Manuf.* **2012**, *25*, 150–157. [CrossRef]
67. Pirola, F.; Boucher, X.; Wiesner, S.; Pezzotta, G. Computers in Industry Digital Technologies in Product-Service Systems: A Literature Review and a Research Agenda. *Comput. Ind.* **2020**, *123*, 103301. [CrossRef]
68. Ardolino, M.; Rapaccini, M.; Saccani, N.; Gaiardelli, P.; Ruggeri, C.; Ardolino, M.; Rapaccini, M.; Saccani, N.; Gaiardelli, P. The Role of Digital Technologies for the Service Transformation of Industrial Companies. *Int. J. Prod. Res.* **2018**, *56*, 2116–2132. [CrossRef]
69. Numata, E.; Hosono, S.; Sakaki, H.; Izukura, S.; Kimita, K.; Shimomura, Y. Disciplines for Designing PSS Actor Network. *Procedia CIRP* **2015**, *30*, 408–414. [CrossRef]

70. Huang, H. Performance Effects of Aligning Service Innovation and the Strategic Use of Information Technology. *Serv. Bus.* **2014**, *8*, 171–195. [CrossRef]
71. Prabhu, V.; Taisch, M.; Kiritsis, D. Preface. *IFIP Adv. Inf. Commun. Technol.* **2013**, *415*, V–VI. [CrossRef]
72. Dotti, S.; Gaiardelli, P.; Pinto, R.; Resta, B. ICT Functionalities in the Servitization of Manufacturing. *IFAC* **2013**, *46*, 2063–2068. [CrossRef]
73. Milenovic, Z.M. Application of Mann-Whitney U Test in Research of Professional Training of Primary School Teachers. *Metod. Obz. Časopis Za Odgoj. Obraz. Teor. I Praksu* **2011**, *6*, 73–79. [CrossRef]
74. Gibbons, J.D.; Chakraborti, S. Comparisons of the Mann-Whitney, Student's t, and Alternate t Tests for Means of Normal Distributions. *J. Exp. Educ.* **1991**, *59*, 258–267. [CrossRef]
75. Zimmerman, D.W. Comparative Power of Student T Test and Mann-Whitney U Test for Unequal Sample Sizes and Variances. *J. Exp. Educ.* **1987**, *55*, 171–174. [CrossRef]
76. Hartono, M.; Chuan, T.K. How the Kano Model Contributes to Kansei Engineering in Services. *Int. J. Res. Pract. Hum. Factors Erg.* **2011**, *54*, 987–1004. [CrossRef]
77. Liebscher, E. On a Multivariate Version of Spearman's Correlation Coefficient for Regression: Properties and Applications. *Asian J. Stat. Sci.* **2021**, *1*, 123–150.
78. Alsaqr, A.M. Remarks on the Use of Pearson's and Spearman's Correlation Coefficients in Assessing Relationships in Ophthalmic Data. *Afr. Vis. Eye Health* **2021**, *80*, 1–10. [CrossRef]
79. Hauke, J.; Kossowski, T. Comparison of Values of Pearson's and Spearman's Correlation Coefficients on the Same Sets of Data. *Quaest. Geogr.* **2011**, *30*, 87–93. [CrossRef]
80. Rebekić, A.; Lončarić, Z.; Petrović, S.; Marić, S. Pearson's or Spearman's Correlation Coefficient-Which One to Use? *Poljoprivreda* **2015**, *21*, 47–54. [CrossRef]
81. Lobo, M.; Guntur, R.D. Spearman's Rank Correlation Analysis on Public Perception toward Health Partnership Projects between Indonesia and Australia in East Nusa Tenggara Province. In *Journal of Physics: Conference Series*; Institute of Physics Publishing: Bristol, England, 2018; Volume 1116. [CrossRef]
82. Annarelli, A.; Battistella, C.; Costantino, F.; di Gravio, G.; Nonino, F.; Patriarca, R. New Trends in Product Service System and Servitization Research: A Conceptual Structure Emerging from Three Decades of Literature. In *CIRP Journal of Manufacturing Science and Technology*; Elsevier: Amsterdam, The Netherlands, 2021; pp. 424–436. [CrossRef]
83. Zeeuw van der Laan, A.; Aurisicchio, M. A Framework to Use Product-Service Systems as Plans to Produce Closed-Loop Resource Flows. *J. Clean. Prod.* **2020**, *252*, 119733. [CrossRef]
84. Paiola, M.; Schiavone, F.; Khvatova, T.; Grandinetti, R. Prior Knowledge, Industry 4.0 and Digital Servitization. An Inductive Framework. *Technol. Forecast. Soc. Change* **2021**, *171*, 120963. [CrossRef]
85. Zhu, H.; Gao, J.; Cai, Q. A Product-Service System Using Requirement Analysis and Knowledge Management Technologies. *Kybernetes* **2015**, *44*, 823–842. [CrossRef]
86. Scherer, J.O.; Kloeckner, A.P.; Ribeiro, J.L.D.; Pezzotta, G.; Pirola, F. Product-Service System (PSS) Design: Using Design Thinking and Business Analytics to Improve PSS Design. In *Procedia CIRP*; Elsevier: Amsterdam, The Netherlands, 2016; Volume 47, pp. 341–346. [CrossRef]
87. McKay, A.; Kundu, S. A Representation Scheme for Digital Product Service System Definitions. *Adv. Eng. Inform.* **2014**, *28*, 479–498. [CrossRef]
88. Guan, H. A Design Framework for Customer-Oriented PSS Based on Three Dimensional Concurrent Engineering Approach; Nouvelle-Aquitaine. 2019. Available online: https://tel.archives-ouvertes.fr/tel-02365276 (accessed on 10 August 2022).
89. Baines, T.S.; Lightfoot, H.W.; Evans, S.; Neely, A.; Greenough, R.; Peppard, J.; Roy, R.; Shehab, E.; Braganza, A.; Tiwari, A.; et al. State-of-the-Art in Product-Service Systems. *Proc. Inst. Mech. Eng. B J. Eng. Manuf.* **2007**, *221*, 1543–1552. [CrossRef]
90. Wolak, R.; Kalafatis, S.; Harris, P.; Hill, K. An Investigation into Four Characteristics of Services. *J. Empir. Gen. Mark. Sci.* **1998**, *3*, 22–43.
91. Vargo, S.L.; Lusch, R.F. The Four Service Marketing Myths: Remnants of a Goods-Based, Manufacturing Model. *J. Serv. Res.* **2004**, *6*, 324–335. [CrossRef]
92. Daskin, M.S. *Service Science*; Wiley: Hoboken, NJ, USA, 2011. [CrossRef]
93. Mosahab, R.; Mahamad, O.; Ramayah, T. Service Quality, Customer Satisfaction and Loyalty: A Test of Mediation. *Int. Bus. Res.* **2010**, 3. [CrossRef]
94. Caruana, A.; Money, A.H.; Berthon, P.R. Service Quality and Satisfaction—The Moderating Role of Value. *Eur. J. Mark* **2000**, *34*, 1338–1353. [CrossRef]
95. Wirtz, J.; Lovelock, C. *Service Marketing: People, Technology, Strategy*, 8th ed.; World Scientific Publishing Co. Inc.: Hackensack, NJ, USA, 2019; Volume 1.
96. Danley, B.; Widmark, C. Evaluating Conceptual de Fi Nitions of Ecosystem Services and Their Implications. *Ecol. Econ.* **2016**, *126*, 132–138. [CrossRef]
97. Wiesner, S.; Lampathaki, F.; Biliri, E.; Thoben, K.D. Requirements for Cross-Domain Knowledge Sharing in Collaborative Product-Service System Design. In *Procedia CIRP*; Elsevier: Amsterdam, The Netherlands, 2016; Volume 47, pp. 108–113. [CrossRef]

98. Xing, K.; Ness, D. Transition to Product-Service Systems: Principles and Business Model. In *Procedia CIRP*; Elsevier: Amsterdam, The Netherlands, 2016; Volume 47, pp. 525–530. [CrossRef]
99. Motu'apuaka, M.; Whitlock, E.; Kato, E.; Uhl, S.; Belinson, S.; Chang, C.; Hoomans, T.; Meltzer, D.; Noorani, H.; Robinson, K.; et al. Defining the Benefits and Challenges of Stakeholder Engagement in Systematic Reviews. *Comp. Eff. Res.* **2015**, *5*, 13. [CrossRef]
100. Pezzotta, G.; Sassanelli, C.; Rossi, M.; Fotia, S.; Terzi, S. The Product Service System Lean Design Methodology (PSSLDM) Integrating Product and Service Components along the Whole PSS Lifecycle. *J. Manuf. Technol. Manag.* **2018**, *29*, 1270–1295. [CrossRef]
101. Grubic, T.; Jennions, I. Remote Monitoring Technology and Servitised Strategies—Factors Characterising the Organisational Application. *Int. J. Prod. Res.* **2018**, *7543*, 1–17. [CrossRef]
102. Li, A.Q.; Found, P. Towards Sustainability: PSS, Digital Technology and Value Co-Creation. In *Procedia CIRP*; Elsevier: Amsterdam, The Netherlands, 2017; Volume 64, pp. 79–84. [CrossRef]
103. Zheng, P.; Wang, Z.; Chen, C.H.; Pheng Khoo, L. A Survey of Smart Product-Service Systems: Key Aspects, Challenges and Future Perspectives. *Adv. Eng. Inform.* **2019**, *42*, 100973. [CrossRef]
104. Wahyudi, R.D.; Laksono Singgih, M.; Suef, M. Prior and Future Research on Quality-Driven Product Service Systems: A Literature Review. In Proceedings of the International Conference on Engineering and Information Technology for Sustainable Industry, New York, NY, USA, 28–29 September 2022; pp. 1–4. [CrossRef]
105. Dinges, V.; Urmmetzer, F.; Martinez, V.; Zhaki, M.; Neely, A. *The Future of Servitization—Technologies That Will Make a Difference*; University of Cambridge: Cambridge, UK, 2015.
106. Sube, T.; Wilkens, U.; Hohagen, S.; Artinger, F. Digital Competence of Stakeholders in Product-Service Systems (PSS): Conceptualization and Empirical Exploration. In Proceedings of the 10th CIRP Conference on Industrial Product-Service Systems, Linkoping, Sweden, 29–31 May 2018; pp. 197–202.
107. Mont, O.K. Clarifying the Concept of Product-Service System. *J. Clean. Prod.* **2002**, *10*, 237–245. Available online: www.cleanerproduction.net (accessed on 12 October 2022). [CrossRef]
108. Beuren, F.H.; Gomes Ferreira, M.G.; Cauchick Miguel, P.A. Product-Service Systems: A Literature Review on Integrated Products and Services. *J. Clean. Prod.* **2013**, *47*, 222–231. [CrossRef]
109. Ghasemi, P.; Khalili, H.A.; Chobar, A.P.; Safavi, S.; Hejri, F.M. A New Multiechelon Mathematical Modeling for Pre- and Postdisaster Blood Supply Chain: Robust Optimization Approach. *Discret. Dyn. Nat. Soc.* **2022**, *2022*, 2976929. [CrossRef]
110. Goodarzian, F.; Abraham, A.; Ghasemi, P.; di Mascolo, M.; Nasseri, H.; De, H.N. Designing a Green Home Healthcare Network Using Grey Flexible Linear Programming: Heuristic Approaches. *J. Comput. Des. Eng.* **2021**, *2021*, 1468–1498. [CrossRef]