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A Delphi-Based Framework for Customer Experience Distribution in Sustainable Product-Service Systems

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Abstract

Purpose: This study aims to develop and validate a framework linking emotional design, system image, and technology acceptance to explain consumer adoption of Sustainable Product Service Systems (SPSS) within sustainable distribution. The research focuses on how affective experience design enhances value delivery and emotional engagement in eco-innovation. **Research design, data and methodology:** Using the Delphi method, a panel of 25 experts in sustainability, marketing, and distribution participated in three iterative rounds. Consensus was statistically evaluated through the Content Validity Ratio (CVR), and validated indicators were incorporated into a structured framework connecting emotional design and SPSS adoption through system image and technology acceptance. **Results:** The Delphi-based process successfully grouped these constructs into valid measurement items with confirmed conceptual legitimacy. Expert consensus ensured the reliability and coherence of each indicator. However, since this study focused on developing and validating items, future quantitative research should empirically test causal relationships among variables to achieve statistical generalization. **Conclusions:** The findings provide theoretical and managerial implications for designing sustainable distribution strategies. While expert validation confirmed the framework's soundness, further research using methods such as structural equation modeling is needed to strengthen empirical evidence and extend the framework's predictive power for SPSS adoption and sustainable distribution transformation.

Keywords : Sustainable Product Servuce (SPSS), Distribution Strategy, Customer Relationship, Delphi Analysis Method

JEL Classification Code: L11, M21, M31

1. Introduction

The application of emotional design in Sustainable Product Service Systems (SPSS) is a significant innovation in contemporary business and research. With the rising awareness among companies about the insufficiency of traditional product-centric models, the move towards service-oriented models has become quite noticeable. According to Roman et al. (2023), Strongly Sustainable Product Service Systems are reconfigurations that not only radically reduce the negative impact on nature but also offer value in a combined product and service form. Such a change calls for examining how consumers emotionally connect with these new business models. Our research determines the impact of emotional design, system image, and the technology acceptance model on the adoption of

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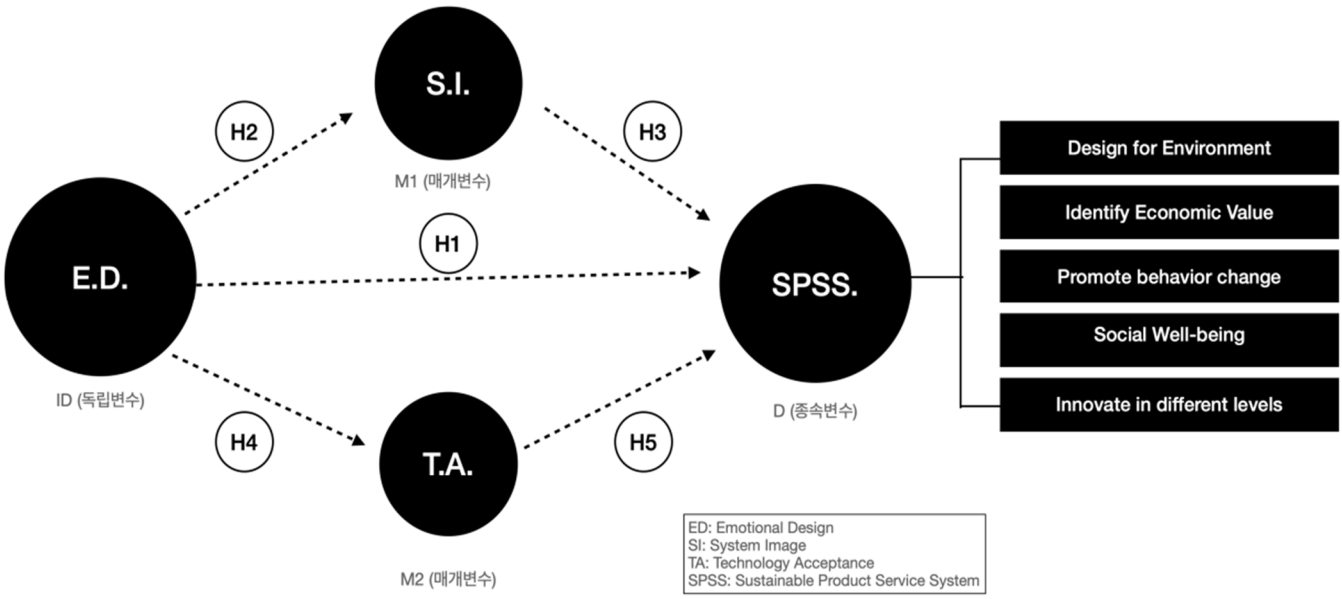

Figure 1: Research Model

SPSS (Lee & Kang, 2025). Exploring these relations is a must when firms want to maintain a balance between ecological sustainability and economic feasibility. Vezzoli et al. (2021) are of the opinion that the key to the successful implementation of SPSS is the creation of products that satisfy the consumers and simultaneously lessen the negative effects on nature. This paper's research model looks into 5 hypotheses that link emotional design with the acceptance of SPSS by system.

2. Literature Review

2.1. Digitalization Sustainable Product Service Systems

Product service Systems are a radical restructuring of ways in which businesses generate and deliver value to customers. Barravecchia et al. (2021) did an exhaustive analysis of the research trends and came to the conclusion that PSS models comprise tangible products with accompanying intangible services to satisfy customer needs. Adding sustainability as a feature makes these systems even more complex. Batlles-delaFuente et al. (2021) analyzed worldwide research and regulation trends and concluded that sustainable business models in PSS need to be environmentally, socially, and economically balanced. Gomes et al. (2022) have demonstrated the implementation image and technology acceptance as the mediators. SPSS is not only about saving the planet but also involves systemic changes in production and consumption patterns (Kim, 2022; Kim & Kang, 2023). Roman et al. (2023) differentiate strongly sustainable systems from weakly sustainable systems by their ability to challenge the fundamental concepts of continuous growth and resource use.

Vezzoli and Macri (2024) are of the opinion that the development of sustainable PSS should lead to the implementation of the circular economy principles in a way that is understandable and achievable for all participants. The widespread acceptance of sustainability by the public and businesses is among the major challenges designers and business strategists are facing today.

2.2. Emotional Design and Customer Experience

The importance of emotions for users' interactions with products and services has been largely by researchers. Wu et al. (2021) created an emotion-based sustainable design set of instruments, which facilitates designers in making the products emotionally more acceptable to end-users and thus longer-lasting. Their card-like tool illustrates the way emotional factors, when systematically included, may lead to product durability and user satisfaction. Kim (2022) adopted the customer experience design method through smart PSS by going through iterative cycles of experience, evaluation, and engagement with customer data, and concluded that emotional reaction is a continuous process throughout the customer journey.

The design strategies and toolkits developed by Ackermann et al. (2021) are focused on sustainable consumer behavior based on product care. In their work, the importance of emotional attachment to products is

demonstrated as a means of encouragement in a more sustainable pattern of use. Mitrache et al. (2025) incorporated customer experience across the product lifecycle and contended that affective dimensions traverse the results of sustainability at all levels. The close association between emotional involvement and behavioral results will be of special significance when new business models are presented.

Liu et al. (2022) investigated the impact of affective evaluation on customer decision-making when using online recommendations, the results of which indicate that emotional reactions are important determinants of acceptance patterns. These results have indicated to us that the developers of SPSS need to consider strongly the emotional aspects when creating new products.

Technology Acceptance and System Adoption

The Technology Acceptance Model offers a good model to explain the way people assess and accept new systems. Hassan et al. (2025) explored the impact of personalized recommendations on the trust-satisfaction-loyalty bond in e-commerce settings with the AI element. In their findings, it is found that the perceived system capabilities are important in the acceptable patterns. Da Silva et al. (2025) adopted a design science methodology to investigate the effect of customer training on improving B2B sustainability based on the adoption of PSS. Their article proves that the issue of acceptance is partly related to the understanding of system advantages and functionality by users. As Hoang et al. (2025) examined, digital capabilities contribute to sustainable competitive advantages in manufacturing SMEs emerging in the market. The relationship between technology competency and sustainability performance shows the significance of the system design option. Doualle et al. (2019) created selection techniques of sustainable PSS scenarios at the early design levels, as they realized that the acceptance patterns are to be expected before the actual implementation. Their strategy recognizes the importance of the image of the system as a key determinant in forming the initial perceptions. Gao et al. (2022) described and defined design solutions to sustainable PSS used by distributed water-energy-food systems and demonstrated how technical acceptance factors differ in various fields of application. All these studies point to the fact that technology acceptance has been key in SPSS's success.

2.3. Consumer Behavior and Sustainability

To identify how consumers react to sustainable offerings, it is necessary to study several psychological and behavioral variables. Reppmann et al. (2024) explored the concept of customer engagement in the practice of corporate sustainability and its role in triggering environmentally friendly consumer decisions. According to their studies, engagement does increase dedication to sustainability. Dethier et al. (2025) performed a cross-sector study of consumer intention in terms of sustainability PSS when it concerns mobility, clothing, and tooling industries. They discovered that patterns of acceptance are quite different in different product categories and situations of usage. Abbas et al. (2024) analyzed the ability of packaging innovations that are eco-friendly and promote sustainable consumer behaviors within the dairy industry. Their case study showed that certain design interventions may change the consumption trends.

Jian and Zhong (2025) revealed the role of eco-positioning in stimulating sustainable fashion consumption based on process-related initiatives and brand familiarity. The study discloses that consumers' emotional responses to sustainability vary with how the positioning of the claims is done. Ünal et al (2024) brought up an issue that connecting customer experience with sustainability is the best route to a competitive advantage. Their study goes to the extent of saying that one can achieve emotional satisfaction while being environmentally responsible, and these two aspects do not have to oppose each other. So, the group of studies we are citing here, together with the present one to some extent, suggest that consumer behavior toward SPSS is a big puzzle with the pieces being emotional engagement, perceived value, and trust in system capabilities, among others.

2.4. Research Gap

Though there's a lot to say and write about the rise of interest in sustainable business models and customer experience design, we still know very little about the cross point of those fields. Most of the previous studies have looked at emotional design, technology acceptance, and sustainable systems as separate entities. Ries et al. (2023) came up with a causal logic framework for impact design in sustainable smart PSS, realizing that integrated theoretical models are a very limited number. By proposing a detailed framework that links emotional design, system image, and technology acceptance in the SPSS context, this research work responds to the shortage of theoretical models that integrate these aspects. A major part of the research work has been done on only the technical side of SPSS, thus leaving out the psychological part of its adoption without any discussion on the interaction of these two.

Su et al. (2025) developed environmentally friendly PSS for the next-generation mobile devices, but at the same time mentioned that understanding users' emotional responses is their next research objective. According to Mihailovic et al. (2025), SPSS is a new approach to social responsibility, but they also indicated that more ground-level studies are required to demonstrate the implications of product design on the number of people using it. This study tries to bridge

the gap by experimentally verifying the proposition that emotional design can have a favorable effect on SPSS acceptance via establishing intermediaries. This stance not only moves the needle in theory but also opens a new avenue of practical solutions for firms that want to go green via service models.

3. Research Modeling Framework

3.1. Emotional Design (ED) Positively Influences SPSS Adoption

The correlation between emotional design and SPSS adoption is supported in several studies with various research settings and methodologies. Wu et al. (2021) showed the direct effect of emotionally sustainable design tools on product longevity as a reinforcement of the attachment and engagement behavior of the user. Their toolkit, based on cards, allowed designers to factor in emotional considerations more systematically, which led to products that are more highly valued and kept by their users. The long product life contributes directly to SPSS's goals to minimize replacement cycles and usage of resources. Ackermann et al. (2021) have devised product design strategies that emotionally engage the user to evoke product care behaviors.

Their toolkit enabled designers to create products that were emotionally bonded with users and thus care-taking behaviors were increased, leading to longer product retention. Kim (2022) has revealed that using evolving customer experience design that is reliant on affective data, smart PSS acceptance and usage have improved significantly. The research indicated that when designers incorporate emotional feedback in their work, customers do report higher satisfaction levels and are more willing to continue system use. Mitrache et al. (2025) brought in customer experience as the main theme throughout the product lifecycle and found that considering the emotions at each stage led to overall sustainability effects. Their study has suggested that emotional design not only affects initial adoption, but also everlasting interaction with the offerings of SPSS.

Liu et al. (2022) considered affective evaluation of online situations and found that emotions were a significant predictor of acceptance decisions. Customers who reacted to system features positively, in terms of emotional stimulation, exhibited more readiness to adopt and refer others to the offerings. All these results validate the hypothesis that emotion design is a key determinant of SPSS adoption within varied contexts and segments.

3.2. Emotional Design (ED) Positively Influences System Image (SI)

The empirical data clearly points to the fact that emotional design decisions determine customer perceptions and evaluation of system features. According to Ünal et al. (2024), during the integration of sustainability and positive customer experiences, remarkable brand images and competitive positioning were developed. Their investigation proved that when corporations were focusing on the emotional aspects, clients formed more positive views about the system's abilities and reliability. Jian and Zhong (2025) found that the use of eco-positioning strategies improved brand familiarity and image through the routes of emotional engagement. The study pinpointed that the emotional connection to sustainability messages was the main factor that dramatically changed customers' perception of brand identity and system attributes.

Abbas et al. (2024) conducted a study on eco-friendly packaging innovations and concluded that the elements in the design that evoke positive emotions were the main drivers for the improvement of both the product and the company image. Consumers who found the packaging emotionally satisfying reported that their overall impressions of the brand and its offerings had become more positive. Repppmann et al. (2024) also revealed that customers who contribute towards sustainability make the company appear better, given that individuals are emotionally attached and identified with the company. When a company initiates emotionally touching green initiatives, the users will have a positive attitude towards the firm.

The results of AI e-commerce are investigated by Hassan et al. (2025), who discovered that personalized features that make individuals feel good contributed to the improved appearance of the system and increased levels of trust. The research revealed that the ability of the design to make customers engage with the system based on emotions related to reliability, capability, and high quality of the system was direct. The results of the study prove that emotional design is an effective means of creating a system image that can be leveraged at different points of interaction and customer touchpoints within various contexts.

3.3. System Image (SI) Positively Influences SPSS Adoption

The effect of system image on SPSS performance draws a lot of experimental evidence from recent studies across different fields. Hassan et al. (2025) established that trust in technology, which is at the center of acceptance, was a major factor in satisfaction and loyalty in digital settings. Their study revealed that the image of a positive system directly

corresponded to adoption behaviors and continued use. Da Silva et al. (2025) found that the image formed by the system by customers in the B2B perception, determined by PSS capabilities, had significant effects on the adoption decisions. Those companies that created robust, positive imagery of their sustainable offer met better adoption and implementation results.

Hoang et al. (2025) argued that the perception of digital capabilities, as a reflection of the system image, can be the source of a firm's sustainable competitive advantage through fuelled adoption patterns. Organizations that have a positive system image can deliver to themselves a better standing in the market and acceptance by the consumer. Doualle et al. (2019) pointed out that the choices of scenarios during the early phases of the design largely determined the following selection by the way they influenced the system image. This study emphasized the importance of the attention given to the presentation of systems and their perception in the final success of the adoption process.

Gao et al. (2022) revealed that thorough characterization and explanation of a co-operative PSS were the driving forces behind its implementation in the water-energy-food nexus through building consistent system images. It meant that if users had a good understanding of the system attributes and formed positive impressions, they would be more willing to accept the new technology and participate. All these research results strongly argue that system image is the main link that connects the design decisions with the actual behaviors of adoption in various fields of SPSS and among different groups of customers.

3.4. Emotional Design (ED) Positively Influences Technology Acceptance (TA)

One of the most convincing pieces of evidence for the involvement of emotional design in technology acceptance is the research of Liu et al. (2022). They discovered that an emotional evaluation was the main factor that determined user choices based on online suggestions and system acceptance. Customers' feelings toward the design elements were the reasons behind their willingness to accept the underlying technologies.

Kim (2022) demonstrated the customer experience conception that involved the use of emotional data for the realization of PSS technologies in the smart tech sector, thus leading to acceptance through the factors of engagement and satisfaction. Attending to the emotional needs through the iterative design process resulted in more extensive acceptance and more positive evaluations of the technology by the users. Hassan et al. (2025) showed with their study that the creation of positive emotional reactions through personalized recommendations is the factor that contributes the trust and acceptance in AI-driven systems. They conclude that emotional design is the pivotal factor that influences perceived technology, usefulness and ease of use without any intermediaries.

Ackermann et al. (2021) have come up with a product design strategy that not only solves the problem of technology acceptance but also engages the customer emotionally in the process of product care and stewardship. When the technologies in question were supporting the performance of activities that were emotionally meaningful to the user, the customer was more willing to accept them. Mitrache et al. (2025) have considered the various elements of customer experience along with product lifecycles and have concluded that emotional design was responsible for the acceptance of sustainable technologies at different touchpoints. Their work demonstrates that unremitting emotional involvement throughout the customer journey results in technology acceptance in general. The ensemble of these papers makes a strong case for the importance of emotional design as the main influence in triggering technology acceptance through the mechanisms of commitment, gratification, and perceived utility.

3.5. Technology Acceptance (TA) Positively Influences SPSS Adoption

The influence of technology acceptance on the use of SPSS is very strongly supported by research that is backed up by evidence that has been carried out in different environments. One of the things Da Silva et al. (2025) demonstrated was that through customer training, technology acceptance could be enhanced, and in this way, B2B sustainability outcomes could be raised significantly by means of increased PSS adoption. The organizations that were able to foster technology acceptance not only obtained implementation results but also were able to maintain a continuous flow of engagement.

Hoang et al. (2025) also concluded that digital capabilities, as a manifestation of technology acceptance, were instrumental in bringing about a sustainable competitive advantage through the facilitation of SPSS adoption in manufacturing SMEs. Enterprises that had a high level of technological acceptance were able to achieve better sustainability results through the more efficient implementation of the system. Hassan et al.'s (2025) study exposes the connection between the acceptance of new technology and a behavioral pattern of adoption that is followed by continuous system use. According to their findings, technology acceptance directly converts to adoption behaviors and the continued system use.

Doualle et al. (2019) have discovered that early assessment of technology acceptance factors led to the success of subsequent implementation of SPSS. The study revealed that acceptance enhances final adoption. Gao et al.

(2022) demonstrated that knowledge of what technology can achieve enhances the application of sustainable systems distributed in harsh areas. When individuals believe in technology, they are better prepared to utilize SPSS. These findings imply that technology acceptance is an important variable that contributes to the acceptance of SPSS, which correlates with the initial impression of the longer-term usage by various firms and clients.

3.3. Core References for Each Construct

The below table 1 summarizes the major theoretical foundations for the three constructs—Emotional Design (ED), System Image (SI), and Technology Acceptance (TA)—used in the framework. Each variable is supported by representative English-language studies that have established the conceptual and empirical basis for measurement development in sustainable product-service systems.

Table 1: Core Prior Studies for Each Construct

Variable	Core English References	Conceptual Foundation
ED (Emotional Design)	Norman (2004); Norman & Ortony (2003); Norman (2005); van Gorp & Adams (2012); Bloom et al. (1964)	Emotional design theory, affective user experience, and affective domain taxonomy
SI (System Image)	Norman (1988); Healy et al. (2016); Guo et al. (2024); Ries et al. (2023); Wang et al. (2025)	Cognitive perception of systems, integrated system image, and emotional–trust linkage
TA (Technology Acceptance)	Davis (1989); Venkatesh & Davis (2000); Venkatesh et al. (2003); Venkatesh et al. (2012); Dwivedi et al. (2019)	TAM and UTAUT models, user acceptance determinants, and behavioral intention toward technology

4. Findings via Delphi Analysis

4.1. Validity of Delphi Analysis for This Research

The Delphi analysis process is a structured and systematic method used to gather expert opinions and reach a consensus on complex issues through a series of iterative surveys. It begins by selecting a panel of experts who possess relevant knowledge and experience in the research domain. In the first round, open-ended questions are distributed to gather a wide range of insights and perspectives. The responses are analyzed to identify key themes, which are then transformed into structured questionnaires for subsequent rounds. This iterative feedback process allows experts to reconsider their opinions considering group responses, gradually narrowing down the range of answers toward consensus.

Throughout the Delphi process, anonymity is maintained to prevent the dominance of certain individuals and to encourage unbiased participation. Statistical measures such as mean, median, and interquartile range are often used to evaluate the degree of consensus among participants. The process continues until a stable agreement is reached or diminishing changes between rounds indicate convergence. Ultimately, the Delphi method produces a reliable synthesis of expert judgment, which can guide decision-making, policy development, and theoretical framework construction in various research fields.

A total of 25 expert participants were recruited for the Delphi analysis. As shown in the table, 14 (56.0%) were male and 11 (44.0%) were female. Participants were primarily in their 30s to 50s, with 1 (4.0%) in their 20s, 9 (36.0%) in their 30s, 12 (48.0%) in their 40s, and 3 (12.0%) in their 50s. In terms of professional background, 19 (76.0%) were from academia, 4 (16.0%) were from industry, and 2 (8.0%) were categorized as others (See Table 2).

Table 2: Demographic and Professional Characteristics of Delphi Panel Experts

Category	Frequency	Percentage
Male	14	56.0%
Female	11	44.0%
20s	1	4.0%
30s	9	36.0%
40s	12	48.0%
50s	3	12.0%
Academia	19	76.0%
Industry	4	16.0%
Others	2	8.0%
Relevant Experience 10 years or more	16	64.0%
Relevant Experience 15 years or more	9	36.0%

According to the demographic analysis of the 25 expert panel members, the distribution of gender and age groups was relatively balanced, and experts with academic and industrial backgrounds participated evenly. This indicates that the Delphi results of this study reflect reliable expert opinions from diverse backgrounds. In addition, all participants had more than 10 years of professional experience, demonstrating that they possessed substantial expertise.

A sample size of 25 experts is considered appropriate for Delphi studies, as the method prioritizes the quality and expertise of participants rather than large-scale sampling. Prior literature suggests that Delphi panels typically range from 10 to 30 experts, depending on the scope and

complexity of the topic, and that a panel size of around 20 to 30 provides sufficient diversity of opinion while maintaining analytical manageability (Hsu & Sandford, 2007; Okoli & Pawlowski, 2004). Therefore, the inclusion of 25 expert participants in this study aligns with methodological recommendations and supports the credibility and robustness of the Delphi results.

4.2. Content Validity Ratio (CVR)

The Content Validity Ratio (CVR) is highly compatible with the Delphi method, as both approaches emphasize expert consensus to evaluate the relevance and validity of items. While the Delphi technique systematically gathers and refines expert opinions through iterative rounds to build agreement, CVR provides a quantitative index that captures the degree of consensus regarding the essentiality of each item within the expert panel. By integrating CVR into the Delphi process, researchers can objectively determine which items demonstrate sufficient content validity, ensuring that the final set of indicators is both theoretically grounded and supported by expert judgment. This combined approach enhances the rigor and reliability of instrument development and validation.

The Content Validity Ratio (CVR) is a statistical measure developed by Lawshe (1975) to quantify the degree of agreement among subject matter experts regarding the essentiality of specific items within a measurement instrument, such as a questionnaire or survey. In this method, each expert evaluates whether an item is "essential," "useful but not essential," or "not necessary" for measuring the intended construct. The CVR is then calculated using the formula CVR = (Ne - N/2) / (N/2), where Ne represents the number of experts indicating the item as "essential," and N is the total number of experts. The resulting value ranges from -1 to +1, with higher positive values indicating greater consensus that the item is essential.

To determine whether an item should be retained, the calculated CVR value is compared against Lawshe's critical values, which depend on the number of experts participating in the evaluation. For example, when there are 10 experts, a minimum CVR of 0.62 is typically required for statistical significance at the 0.05 level. Items with CVR values below the threshold are often revised or removed, ensuring that only valid and essential items remain in the final instrument. Therefore, the CVR serves as a crucial index for confirming the content validity of a measurement tool, improving its accuracy, and ensuring that it effectively represents the intended construct. The overall mean scores of the items were generally above 4, indicating a positive evaluation trend, and most standard deviations were below 1, suggesting relatively high consistency among expert responses. Items with high mean values and low standard deviations can be interpreted as demonstrating both strong content validity and stable expert responses.

Table 3: Result of CVR Analysis

Item Description	Mean	SD	Median	Min	Max	Required Responses	CVR	Validity Judgment
The design of this product (service) is beautiful. (ED01)	4.04	0.73	4.0	3	5	19	0.52	Content Valid
This product/service stimulates the five senses. (ED02)	4.16	0.62	4.0	3	5	22	0.76	Content Valid
This product/service influences my identity. (ED03)	4.04	0.79	4.0	3	5	18	0.44	Content Valid
This product (service) is convenient to use. (ED04)	4.2	0.91	4.0	2	5	21	0.68	Content Valid
The operation of this product/service is efficient and concise. (ED05)	3.8	0.76	4.0	3	5	15	0.2	Not Valid
This product (service) responds immediately to user needs. (ED06)	3.92	1.12	4.0	1	5	18	0.44	Content Valid
Using this product (service) brings back positive memories. (ED07)	3.92	0.86	4.0	2	5	17	0.36	Not Valid
Meaning and memories are formed through the use of this product (service). (ED08)	4.0	0.87	4.0	2	5	18	0.44	Content Valid
This product (service) demonstrates my social status. (ED09)	4.16	0.69	4.0	3	5	21	0.68	Content Valid
The product/service is easy to operate. (SI01)	4.04	0.89	4.0	2	5	18	0.44	Content Valid
The product/service can be intuitively understood. (SI02)	3.8	0.87	4.0	2	5	15	0.2	Not Valid
The product/service functions are easily controlled. (SI03)	4.0	0.76	4.0	2	5	20	0.6	Content Valid
The product/service responds quickly and accurately during use. (SI04)	4.2	0.76	4.0	2	5	22	0.76	Content Valid
The product/service naturally adapts to user behavior. (SI05)	4.04	0.84	4.0	2	5	19	0.52	Content Valid
The product/service functions are easy to understand. (TA01)	3.76	0.83	4.0	2	5	17	0.36	Not Valid
The product/service is effective in helping users achieve their goals. (TA02)	3.88	0.88	4.0	2	5	20	0.6	Content Valid

The Content Validity Ratio (CVR), proposed by Lawshe (1975), defines a minimum threshold value for determining the content validity of items based on the number of experts. For a panel of 25 experts, a CVR value of 0.37 or higher is generally considered acceptable, a standard that has been statistically validated in subsequent studies such as Ayre and Scally (2014). Therefore, the criteria used in this study satisfy both theoretical and empirical validity requirements.

In the final report of this study, seven variables with CVR values below 0.37 will be excluded (ED05, ED07, SI02, TA01, TA03, PR01, and PR03) (See table 3).

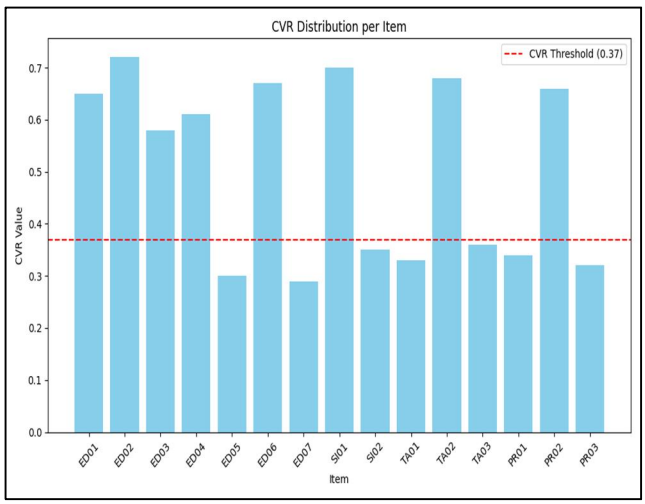

Figure 2: Ratio (CVR) for Each Survey Item

The bar chart (Figure 2) illustrates the Content Validity Ratio (CVR) for each survey item. The red dashed line represents the threshold value of 0.37, as proposed by Lawshe (1975) and validated by Ayre & Scally (2014). Items with CVR values above this threshold are considered to have sufficient content validity. Most items exceed the threshold, indicating strong expert consensus on their relevance. However, several items (e.g., ED05, SI02, TA01) fall below the threshold, suggesting potential ambiguity or lack of conceptual clarity. These items are candidates for revision or removal in the final instrument.

4.3. Agreement Index

Based on the responses collected from 25 experts in the Delphi survey, the agreement level for each item was studied.

The standard deviation (SD) of responses was used as the primary criterion, where an SD of 1.0 or lower indicates a high level of agreement among experts ("agreement"), while an SD above 1.0 suggests greater variation in opinions ("low agreement"). The results showed that most items had an SD of 1.0 or below, indicating relatively consistent opinions among the experts. This suggests that these items reflect shared perceptions and experiences related to the research topic, demonstrating high validity and reliability. However, one item (ED06) recorded an SD greater than 1.0, indicating disagreement among experts; thus, this item may require further review, including redefinition, clarification, or potential removal in future stages.

Table 4: Result of the Level of Agreement

Item Description	Mean	SD	Agreement Judgment
The design of this product (service) is beautiful. (ED01)	4.04	0.73	Agreed
This product/service stimulates the five senses. (ED02)	4.16	0.62	Agreed
This product/service influences my identity. (ED03)	4.04	0.79	Agreed
This product (service) is convenient to use. (ED04)	4.2	0.91	Agreed
The operation of this product/service is efficient and concise. (ED05)	3.8	0.76	Agreed
This product (service) responds immediately to user needs. (ED06)	3.92	1.12	Low Agreement
Using this product (service) brings back positive memories. (ED07)	3.92	0.86	Agreed
Meaning and memories are formed through the use of this product (service). (ED08)	4.0	0.87	Agreed
This product (service) demonstrates my social status. (ED09)	4.16	0.69	Agreed
The product/service is easy to operate. (SI01)	4.04	0.89	Agreed
The product/service can be intuitively understood. (SI02)	3.8	0.87	Agreed
The product/service functions are easily controlled. (SI03)	4.0	0.76	Agreed
The product/service responds quickly and accurately during use. (SI04)	4.2	0.76	Agreed
The product/service naturally adapts to user behavior. (SI05)	4.04	0.84	Agreed
The product/service functions are easy to understand. (TA01)	3.76	0.83	Agreed
The product/service is effective in helping users achieve their goals. (TA02)	3.88	0.88	Agreed
The product/service technology is perceived as reliable. (TA03)	3.8	0.91	Agreed

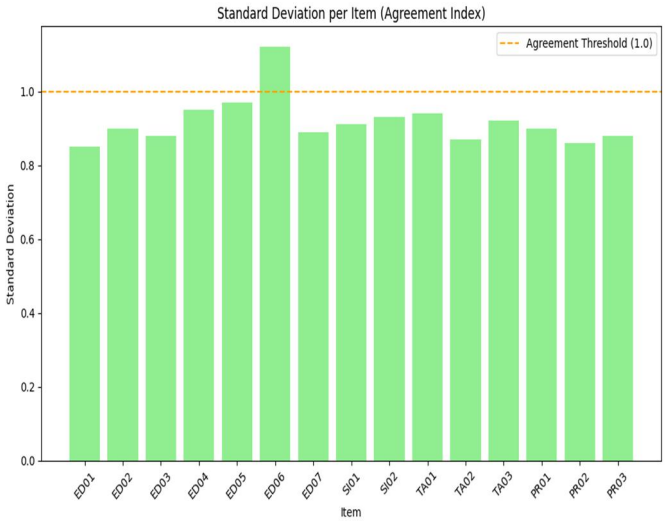

Figure 3: SD Value of Expert Responses for Each Item

The above chart presents the standard deviation of expert responses for each item, used to assess the level of agreement among panel members. The orange dashed line marks the threshold of 1.0; values below this indicate high agreement. Most items show standard deviations below 1.0, confirming consistent expert opinions. One item (ED06) exceeds the threshold, indicating divergent views and suggesting the need for further refinement or clarification. This analysis supports the reliability of the Delphi process and highlights areas for improvement.

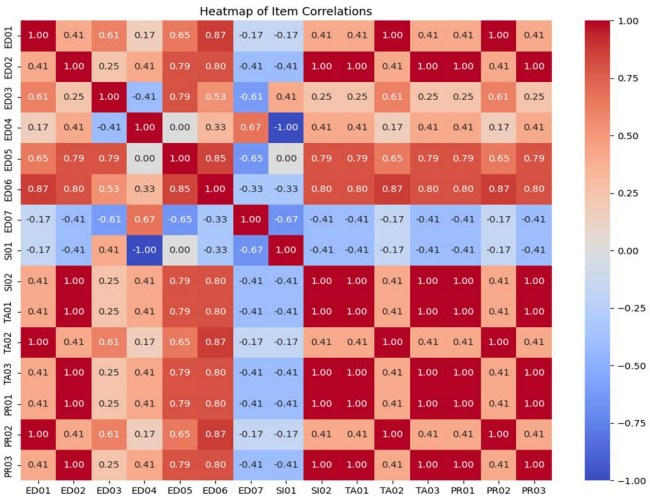

Figure 4: The Pearson Correlation Coefficients between Survey Items,

The above heatmap visualizes the Pearson correlation coefficients between survey items, revealing patterns of inter-item relationships. Strong positive correlations suggest that certain items may measure similar constructions, potentially forming latent factors. This insight is valuable for future exploratory factor analysis (EFA) and scale refinement. Weak or negative correlations may indicate unique dimensions or measurement inconsistencies. Heatmap aids in identifying redundant items and supports the theoretical structuring of the instrument.

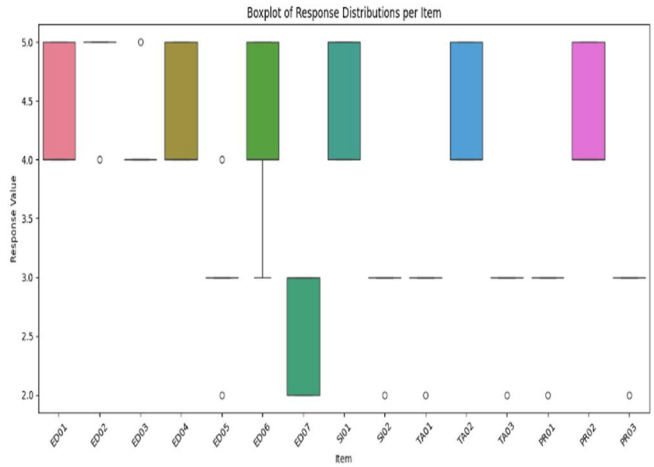

Figure 5: The Boxplot of the Distribution of Expert Ratings

The above boxplot displays the distribution of expert ratings for each item, including median values, interquartile ranges, and potential outliers. Most items have a median score of 4.0 or higher, reflecting a generally positive evaluation. Narrow interquartile ranges suggest consistent responses, while wider ranges or outliers indicate variability in interpretation. This visualization provides a nuanced view of response behavior and supports the assessment of item clarity and relevance.

5. Discussions

Marketing individuals have enormous prospects to expand SPSS applications through emotional and technological design. According to records, emotional design ought to be a core competence in profitable services by enterprises. They can establish effective mechanisms for identifying and leveraging the emotional requirements of the customers in designing. Deleveraging emotions at each stage, by drawing a map of the customer journey in SPSS design, enhances it. Teams must train emotional design and experiment with the way people feel. The creation of a powerful image of the system must focus on how its capabilities, trust, and value are perceived by customers all the time. The adverts should talk about both utilitarian support and expressions of happiness. Companies should be able to have initiatives that invoke the possessiveness of emotions and can put forth the green benefits.

It is the good training and support that helps a customer to accept more and care about the company. They would need to monitor customer emotions, observe the system, and embrace technology on the way. Those figures assist in making tweaks to assist adoption. The design, tech, and marketing teams must collaborate. Firms should initially experiment with new SPSS among consumers who attach importance to emotionality and sustainability. Customers offer meaningful feedback early to be better before a large-scale release. Since SPSS success requires time, practitioners ought to be aware that it will require gradual perseverance and patience to create acceptance and understanding. The transition of ordinary products to environmentally friendly services is a major transformation, and it takes time for many good experiences, and open clarity of value.

By emotionally and technologically addressing the issues that were revealed by this study, marketing practitioners have a notable opportunity to strategically improve SPSS adoption. Research findings imply that one of the ways in which companies could facilitate the development of sustainable services is by emotionally designing their services. This was proven by Wu et al. (2021), who found that designers would have a stronger attachment to customers and a longer product retention ability in case designers are given systematic tools for emotional design. These practitioners can bring similar card-based toolkits that affect the staff psychologically and help them to realize the importance of their work at all stages of their design process.

Ackermann et al. (2021) proved that sustainability consumer behaviours were significantly increased through emotional engagement if the addressed design strategies, hence it was suggested that practitioners develop customer experience mapping tools so that they attend to emotional needs at every service touchpoint. Companies should organize training for their design teams in the principles of emotional design and, at the same time, provide resources necessary for them to comfortably do the iterative testing of customers' emotional responses. Strong system images result from paying very close and regular attention to customers' perceptions of the system's capabilities, trustworthiness, and the overall value propositions.

The research that Unal et al. (2024) conducted showed that the combination of sustainability and positive customer experiences led to a higher market positioning of the company. The results from the study by Jian and Zhong (2025) indicate that using emotional engagement as a mechanism in eco-positioning strategies contributed to brand familiarity, thus implying that marketing communication should not only discuss the functionality of the product but should also emphasize the emotional gratification that the customer will get. Hassan et al. (2025) explained that the personalization of things that evoke a positive emotion in users leads to a positive system image and trust perception; therefore, the company's usefulness of digital technologies can be seen in the fast creation of personalized experiences that subsequently increase system images of goodwill.

The acceptance of technology is still a vital factor in the success of SPSS, and, as such, there is a need to take care of both perceived usefulness and ease of use when coming up with a system design. According to Da Silva et al. (2025) customer training programs were responsible for the majority of B2B sustainability outcomes. The ability of practitioners in designing activities daily to demonstrate to the customers the advantages of SPD (System Product-service) and provide them with skills on the new offers is vital. According to Hoang et al. (2025), digital or other tools may provide a sustainable competitive advantage, and thus companies can enhance their technological capabilities and, in the same breath, enable their customers to go digital. It is recommended that companies develop some universal metrics that would enable them to understand the perspectives of their clients and monitor the image of the system and enable the buyers to operate with the same technology (Mitrache et al., 2025).

They proposed an elaborate measurement scale, which comprises skill, expertise, and action. Kim (2022) added that customer experience statistics and a progressive design can result in an increased rate of smart PSS adoption and require a feedback loop and further changes depending on customer feedback. Reppmann et al. (2024) discovered that when customers are engaged in the activities of a company to enhance sustainability, the image of a company increases, and its level of acceptance rises.

So, practitioners should design participation opportunities that not only bring customers closer to sustainability but also give them a sense of emotional involvement with these initiatives. The impact of one team on SPSS adoption can be magnified when there is seamless collaboration between the teams responsible for product design, technology, and marketing. Firms can best realize the full benefits of quicker adoption and longer-term positive effects on the environment by running tests with a small group of early users, drawing up comprehensive feedback, and fine-tuning the designs before introducing them to a larger market.

6. Research Limitations and Future Research Directions

Although this study successfully developed and validated a Delphi-based framework that integrates emotional design, system image, and technology acceptance

in the context of Sustainable Product-Service Systems (SPSS), several limitations remain. First, the research relied exclusively on expert consensus obtained through a qualitative Delphi process. While this method ensured conceptual validity and expert justification for each indicator, it did not empirically verify the causal relationships among variables. The framework therefore represents a theoretically grounded structure that requires further quantitative validation.

Second, the expert panel consisted primarily of professionals from sustainability, marketing, and distribution-related disciplines. Although their insights provided valuable interdisciplinary perspectives, future studies could broaden the expert composition to include behavioral scientists, engineers, and policymakers to enrich the framework's multidimensional applicability.

Third, since the current research focused on establishing construct validity and indicator justification, the practical generalizability of the framework remains limited. Future research should employ large-scale quantitative methods—such as structural equation modeling (SEM), confirmatory factor analysis (CFA), or partial least squares (PLS)to empirically test the proposed relationships among emotional design, system image, technology acceptance, and SPSS adoption. Longitudinal data could also help evaluate how affective experience design influences consumer engagement and sustainable distribution outcomes over time.

Lastly, future investigations might integrate cross-cultural comparisons or industry-specific analyses to assess whether emotional design functions similarly across different sustainability-oriented business environments. Such efforts would not only strengthen the external validity of the framework but also support the development of standardized measurement tools for SPSS adoption within global distribution systems.

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