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Measuring Service Quality and Developing a Roadmap for the E-Science Service Application at the National Research and Innovation Agency (BRIN)

Sinta Pratiwi [1] & Tatang Akhmad Taufik [2]

[1,2] Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia, 60111
E-mail: [1]sinta216@gmail.com, [2]tatang.taufik@gmail.com

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ABSTRACT

This research investigates the E-Service Science Application (ELSA) of the National Research and Innovation Agency (BRIN). In 2022, 77.41% of service requests through ELSA were unfulfilled, significantly impacting BRIN's Non-Tax State Revenue (PNBP) and ELSA Points. The study aims to evaluate ELSA's service quality using the Servqual method and to understand user behavior and intentions through the Technology Acceptance Model (TAM) 2. Questionnaires based on Servqual and TAM 2 models were utilized, with data analyzed via descriptive analysis of each variable and Structural Equation Modeling (SEM) using SmartPLS-3 software. Findings revealed that service quality attributes – tangibility, reliability, responsiveness, assurance, and empathy – were unsatisfactory, as indicated by negative GAPs. Importance-Performance Analysis (IPA) was employed to prioritize areas for improvement. Most respondents showed high intention to use (Mean 4.18) and usage behavior (Mean 4.09), with similar ratings for other TAM 2 variables. These insights contribute to the development of an ELSA Application Roadmap, guiding service enhancements and positioning BRIN as a hub for scientific collaboration.

1. Introduction

In the current era of rapid technological evolution, the influence of digital advancements on societal activities cannot be overstated. With the Indonesian Internet Service Provider Association (APJII) reporting internet users in Indonesia to have reached 210 million in 2021, demonstrating a penetration of 77.02%, the digital economy has burgeoned to a market size of USD 27 billion, with projections suggesting growth to USD 100 billion by 2025[1]. This digital landscape, enriched by about 10% of annual foreign investment, estimated between USD 20-25 billion, underscores Indonesia's potential as a nexus for online application development, aimed at enhancing service accessibility and quality. Within the dynamic landscape of technological advancement, the National Research and Innovation Agency (BRIN) distinguishes itself as a premier provider of research and innovation services [2]. Leveraging the E-Service Science Application (ELSA), BRIN exemplifies its pivotal role in driving scientific progress through technology. This initiative not only facilitates the dissemination of high-quality information but also demonstrates BRIN's commitment to enhancing the operational effectiveness of research activities. Through ELSA, BRIN is at the forefront of integrating digital solutions into the research and innovation sectors, embodying its mission to harness technology for the advancement of science and innovation in Indonesia

However, challenges have been observed in the application's usage, as indicated by data showing that not all service requests through ELSA were fulfilled, leading to a significant loss in Non-Tax State Revenue (PNBP) and ELSA Points for BRIN. For instance, in 2022, the unfulfilled service requests of ELSA reached 77.41% [3]. Therefore, this research aims to measure the service quality level using the Servqual method to identify gaps between user expectations and perceptions [4], followed by the importance performance analysis (IPA) to determine priority attributes for service improvement [5]. Additionally, the technology acceptance model (TAM) 2 will be employed to measure user acceptance of the ELSA technology [6]. The TAM, initially developed by Davis in 1989, predicts customer acceptance of technology and has been refined to include indicators of social impact and cognitive instrumental processes affecting perceived benefits and intentions to use technology. The results from these analyses will lay the foundation for developing a Roadmap for the ELSA application, aimed at enhancing services and increasing state revenue [3].

The investigation into the ELSA application at the National Research and Innovation Agency identified significant gaps in the existing body of research and introduced novel contributions. For instance, as noted by Unggul and Windarto [7], there's a robust examination of user acceptance for technology-based applications, yet a focused assessment on the quality of the ELSA application within the National Research and Innovation Agency is conspicuously absent. This current research fills this gap by employing the Servqual method to assess the ELSA application's quality, laying the groundwork for a roadmap development for the ELSA application. Moreover, despite the application of the TAM model in diverse contexts, as highlighted by Purwandani et al., [8], the exploration into behaviors and intentions towards the ELSA application's technology within the National Research and Innovation Agency has been limited. This research addresses this void by applying the TAM 2 model, offering insights into the factors influencing the behavior and intentions of using the ELSA application. Furthermore, the literature often lacks in providing concrete recommendations for application improvement. This research navigates beyond this limitation by formulating actionable recommendations for the ELSA application's enhancement based on a comprehensive analysis of application quality and user behavior, aiming to elevate the ELSA service within the agency.

In terms of novelty, this research incorporated the Servqual and TAM 2 methodologies to provide a holistic view of the ELSA application's quality and acceptance [6]. This innovative approach allows for a more thorough analysis of factors affecting user satisfaction and acceptance. Specifically focusing on the ELSA application at the National Research and Innovation Agency offers a unique and relevant backdrop to Indonesia's innovation and research needs, ensuring that the findings and recommendations are highly applicable for the enhancement of national innovation. The formulation of a roadmap for the ELSA application's improvement, derived from this analysis, marks a strategic initiative towards ensuring the continuous evolution and effective service provision of the ELSA application to meet user needs. Thus, by exploring previously unaddressed gaps and offering practical recommendations, this study contributes significantly to the literature, potentially enhancing the quality and effectiveness of ELSA services for its users.

The outcomes of the analyses conducted in this study are expected to establish a foundational basis for the development of a Roadmap for the ELSA application [9]. This roadmap is primarily aimed at enhancing the services provided by the application and augmenting state revenue. Central to this research are three pivotal questions. Firstly, the study seeks to ascertain the quality level of the ELSA application as utilized within the National Research and Innovation Agency (BRIN). Secondly, it endeavors to understand the behaviors and intentions of users regarding their engagement with the ELSA application service technology at BRIN. Finally, the research aims to explore strategies for the improvement of ELSA application services at BRIN, with a specific focus on ensuring that the service requests are fully met, thereby addressing the current gaps in service provision.

2. Literature Study

2.1 Service

Service is defined as any action or performance offered by one party (the company) to another (the customer), which is inherently intangible and does not result in ownership of anything, as described by Kotler [10]. Services may or may not be concurrent with the delivery of physical products [10]. They are crucial to the success of various enterprises, particularly in service-oriented activities. The role of service becomes even more critical in a competitive environment where businesses strive to capture market share or customer loyalty. In such competitive contexts, each company must provide high-quality service to maintain its loyal customer base.

Several characteristics of good service, which contribute to customer satisfaction [11]. These include having professional employees, especially those who directly interact with customers; providing adequate facilities and infrastructure to ensure swift and accurate delivery of products to customers; offering a variety of desired products/services so that consumers can purchase a range of products/services in one stop, with the desired quality of both product/service and service; being responsible to each customer from start to finish; delivering services quickly and accurately, especially in comparison with competitors; communicating clearly, pleasantly, and effectively understanding customer desires and needs; ensuring confidentiality in every transaction, particularly financial ones; possessing good knowledge and skills regarding the products sold and other general knowledge; and instilling trust in customers, making them confident in the company's actions [10].

2.2 Service Quality

Service quality is the comparison of actual service received against consumer expectations. When the reality of service exceeds expectations, it is deemed high-quality, leading to customer satisfaction; conversely, when service falls short of expectations, it results in dissatisfaction or disappointment [12]. The essence of service quality lies in meeting and delivering according to consumer needs and desires, thus aligning with their expectations. It is determined by a company's ability to fulfill consumer needs and desires as anticipated by the customers. Tjiptonol (2017) also outlines three main components of the total quality of a service [13]: Technical quality, which relates to the output quality received by the customer

and includes search, experience, and credence qualities; Functional quality, pertaining to the manner in which a service is delivered; and corporate image, involving the company's profile, reputation, and attractiveness. Service quality is perceived as satisfactory when it matches expectations, ideal when it surpasses expectations, and poor when it falls below them. Therefore, the perceived quality of a service depends on the service provider's consistency in meeting consumer expectations. Service quality is a crucial factor in business strategy as it has been proven to enhance profitability, leading to competitive advantages. Good service quality fosters repeat purchases, positive word of mouth, customer loyalty, and differentiation in competitive product offerings (Fawcett & Cooper, 2000; Lacheheub et al., 2020).

2.3 TAM 2

The Technology Acceptance Model 2 (TAM 2), an extension of Davis's 1989 TAM, itself a development of the Theory of Reasoned Action (TRA), is a theory explaining user behavior towards technology adoption [6]. TAM 2, evolving from psychological theories, is based on beliefs, attitudes, intentions, and the user behavior relationship, aiming to elucidate key factors influencing technology acceptance by users. This model elaborates on IT acceptance with specific dimensions impacting user acceptance. TAM studies have been applied across various applications and information system technologies, with diverse applications used in TAM research. Since TAM is based on human behavior issues, its application with the same applications, technologies, and users can yield different results due to cultural differences in different countries. TAM, developed by Davis in 1989, investigates factors influencing information system use by consumers, identifying two key beliefs at its core: the usefulness, which involves an individual's decision to use or reject a technology based on how the technology simplifies activities, and ease of use, the belief that technology use will reduce effort in performing activities. TAM is widely used to study the adoption process in information technology, with its model and indicators proven to explain technology acceptance. TAM provides a basis to understand the influence of external factors on beliefs, attitudes, and intentions of its users. One of TAM's strengths is its robust theoretical foundation, capable of explaining why many technological systems fail in implementation due to lack of user intent to use. Through TAM, the assumption is that when users adopt a new information system, two factors influence them: perceived ease of use and perceived usefulness. This research employs TAM 2 as an indicator to understand the relationship between perceived ease of use and perceived usefulness, the influence of perceived ease of use on user attitudes, the impact of perceived usefulness on actual system use conditions, and the effect of user attitudes on actual conditions.

Venkatesh & Davis further modified TAM 2 by adding social influence and cognitive instrumental processes, making TAM 2 more significant in understanding the acceptance of new technologies [14]. However, one criticism of this model is the excessive variables and relationships between them, which might not be appropriate for testing information systems in government institutions due to concerns of non-validity and reliability arising from the model's complexity.

2.4 Roadmap

Road mapping is a process of planning in specific thematic areas or organizational scopes, driven by predictions of future conditions considered crucial [9]. It involves creating a document, the roadmap, which illustrates projections for the future and the objectives to be achieved [15]. This document details the paths and stages required to attain these goals, who will execute them, when they will be executed, and the resources and capabilities needed. This concept is an outline of a technology planning document, not yet implemented but prepared in anticipation. It includes a preliminary section covering the vision, mission, goals, and scope; market projections detailing the current industry status, key business drivers, market trends, and challenges; technical needs and capabilities required for future products and technologies; a strategy for technology development, including evaluations, prioritizations, and scheduling; and a conclusion with recommendations and action plans. Additionally, it includes appendices with details about the planning process, participants, and related materials, providing a comprehensive framework for strategic technological development and planning [16].

3. Research Method

This research adopts a descriptive quantitative approach, utilizing a survey methodology which includes observation and critical investigation to accurately address specific questions and objects within a community or location [17]. This research integrates variables from the Technology Acceptance Model (TAM) and the Servqual model to assess factors influencing user acceptance and usage behavior of a technology system [6]. The study examines how subjective norms, image, job relevance, output quality, result demonstrability, experience, and voluntariness affect the perceived usefulness and perceived ease of use of a system. These two perceptions are then posited to influence the users' intention to use the system, which ultimately affects their actual usage behavior. The model hypothesizes that experience and voluntariness directly impact perceived usefulness, which along with perceived ease of use, are crucial determinants of users' intention to utilize the technology, leading to actual usage. The framework aims to provide a comprehensive understanding of the factors contributing to the acceptance and effective use of technology systems.

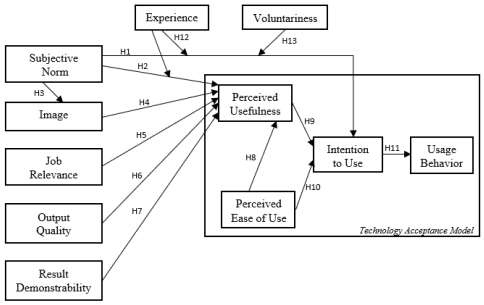

Figure 1. Research Design

The primary data for this study is gathered through interviews and observations, with the expectation that these observations will provide extensive data and information relevant to the research process. To understand user acceptance of the ELSA service application, data analysis is conducted through questionnaire distribution. The primary data comprises recapitulation of data from questionnaire distribution about beliefs in products and services, perceptions of use, ease of use, behavior in usage, and intention to use, sourced from distributed questionnaires. After determining the service quality attributes, questionnaires are disseminated to respondents to analyze the acceptance and usage of the ELSA application. The sample for this research is

$$f(p) = p - p^2$$

$$\frac{df(p)}{(p)} = 1 - 2p$$

$$\frac{df(p)}{df(p)} \; maksimal \; jika \; \frac{df(p)}{df(p)} = 0$$

$$0 = 1 - 2p$$

$$-1 = -2p$$

$$p = 0{,}5$$

The confidence level (Z) used is 95%, hence Z = 1.96 and the margin of error d is 5% or 0.05. The sample size n is calculated as:

$$n = \frac{{Z_{1-\alpha/2}}^2 \, p(1-p)}{d^2}$$

$$n = \frac{1{,}96^2 \, .0{,}5(1-0{,}5)}{0{,}05^2}$$

$$n = \frac{3{,}8416 \, .0{,}5(0{,}5)}{0{,}0025}$$

$$n = \frac{0{,}9604}{0{,}0025} = 384{,}16 = 385 \; respondent$$

In this study, the development of questionnaires serves as a crucial step for evaluating the variables and attributes used in the analysis of service quality on the ELSA application using the Servqual method and further analyzing the acceptance of the information system with the TAM 2 model. The Servqual questionnaire development consists of 5 dimensions: tangibles (physical evidence), reliability, responsiveness, assurance, and empathy. The Servqual variables and indicators include aspects like the modernity of the ELSA application service (X11), the comfort of using the ELSA application (X12), the attractive appearance of the ELSA application (X13), and the ease of operating the ELSA application (X14) under the Tangibles dimension. Other dimensions such as Reliability, Responsiveness, Assurance, and Empathy include variables related to the application's reliability, the promptness of the admin's response to system users, the knowledge and courtesy of the admin, and the comprehensive communication provided by the ELSA application, respectively. These are assessed using a Likert scale. The TAM 2 questionnaire development encompasses 11 dimensions including Usage Behavior, Intention to Use, Perceived Usefulness, Perceived Ease of Use, Subjective Norm, Image, Job Relevance, Output Quality, Result of Demonstrability, Experience, and Voluntariness. Attributes under these dimensions cover a wide range of user interactions with and perceptions of the ELSA application, from how often and how long the application is used, to the user's intentions, the application's usefulness and ease of use, social influences, and the user's own experience and voluntariness in using the application [14].

The research procedure encompasses several stages: obtaining research permission and endorsement from supervising professors, conducting surveys at the research location after securing permission, processing data and compiling a research report under the guidance of the supervising professors, and presenting the research findings to an examination panel. The final stage involves submitting the research findings to the Interdisciplinary School of Management and Technology, Sepuluh Nopember Institute of Technology. The research process applies Servqual and TAM 2 methodologies to develop a roadmap for the ELSA application, aiming to enhance service quality for ELSA application users. The research stages include identifying problems in the ELSA application service, conducting a literature study to establish a theoretical foundation, determining the sample size, conducting questionnaire distribution, and testing the validity and reliability of the questionnaire. The study also involves GAP analysis and Importance-Performance Analysis (IPA) for Servqual, as well as hypothesis testing for the TAM 2 dimensions. The final step is to develop the ELSA Application Roadmap, based on the analysis results, to outline strategies for technological development and marketing projections, identifying technical needs and capabilities, and planning development strategies for the ELSA application. This comprehensive methodology aims to effectively analyze the acceptance of the ELSA system and improve its service quality [14].

4. Result and Discussions

4.1 Descriptive Analysis

The research conducted a descriptive analysis of various variables to understand perceptions and behaviors related to the use of the ELSA application [3]. The analysis revealed significant findings across several key variables. Subjective Norm, a measure of the influence of others' opinions on the respondent's behavior, showed a high average score (4.00), indicating that respondents believe influential people around them think they should use the ELSA application. This suggests a strong social influence component in the decision to use the application. The Image variable, reflecting the perceived prestige and social status associated with using the ELSA application, also scored high (3.75), implying that respondents believe using the ELSA application enhances their social standing and is seen as a status symbol among their peers. Job Relevance, assessing the importance and relevance of the ELSA application to the respondents' work, had a high average score (4.14), indicating that the application is considered important and closely related to their job functions. This demonstrates the application's perceived utility in professional contexts. Output Quality, evaluating the accuracy and reliability of the application's outputs, scored high (4.07), suggesting that respondents are satisfied with the quality and reliability of the information and services provided by the ELSA application. Result demonstrability, assessing the ease of demonstrating and communicating the results and benefits of using the ELSA application to others, also received a high rating (4.08). This indicates that respondents find it easy to articulate and demonstrate the benefits of the application, which is crucial for its broader acceptance and use. Experience with the application was rated highly (4.06), showing that respondents have positive experiences using the ELSA application in their work, contributing to its favorable reception. Voluntariness, measuring the extent to which the use of the application is perceived as voluntary, scored high (4.05), indicating that respondents feel their use of the application is out of free will rather than being compelled by external factors, such as organizational mandates. Perceived Usefulness, one of the most critical measures, scored very high (4.20), reflecting the belief that using the ELSA application significantly enhances job performance and productivity. This suggests that the application is seen as highly beneficial and effective in improving work efficiency. Perceived Ease of Use also received a high rating (4.06), indicating that respondents find the application user-friendly, easy to understand, and convenient to use, which is essential for its adoption and sustained use. Intention to Use, measuring the respondents' likelihood of using the application, was rated high (4.18), showing a strong inclination among respondents to continue using the ELSA application, influenced by their access to and perceived benefits of the application. Finally, Usage Behavior, evaluating the frequency and duration of application use, scored high (4.09), indicating that the application is used regularly and for extended periods by the respondents, reflecting its integration into their daily work routines. These findings collectively demonstrate a positive reception of the ELSA application among its users, characterized by perceived social influence, utility, ease of use, and tangible benefits in professional contexts [18]. The high scores in these variables suggest that the ELSA application is well-regarded and effectively meets the needs and expectations of its users. Therefore, this answers the question of ELSA application quality.

4.2 Servqual Analysis Model

The analysis of the Servqual model in this study was conducted by calculating the gap between the expectations (importance) and the actual performance (perception) of the respondents using a Likert scale questionnaire [19]. The gap calculation involved subtracting the average score of the actual performance from the expected performance for each attribute. The results are summarized in Table 1, which shows the gap scores across various Servqual attributes.

Table 1. Servqual Analysis

Variable		*Importance (I)*	*Performance (P)*	*GAP (P-I)*
Tangibles	Tan1	4,40	4,30	-0,1
	Tan2	4,39	3,94	-0,45
	Tan3	4,38	4,02	-0,36
	Tan4	4,47	3,97	-0,5
Reliability	Rel1	4,42	3,97	-0,45
	Rel2	4,41	3,93	-0,48
	Rel3	4,34	3,95	-0,39
	Rel4	4,39	3,92	-0,47
Responsiveness	Res1	4,44	3,91	-0,53

	Res2	4,43	3,94	-0,49
	Res3	4,46	3,89	-0,57
	Res4	4,41	3,93	-0,48
Assurance	Ass1	4,44	3,97	-0,47
	Ass2	4,47	4,10	-0,37
	Ass3	4,44	3,99	-0,45
	Ass4	4,44	4,03	-0,41
Empathy	Emp1	4,45	3,93	-0,52
	Emp2	4,45	3,78	-0,67
	Emp3	4,43	4,01	-0,42
	Emp4	4,42	3,96	-0,46
Mean		**4,424**	**3,972**	**-0,452**

The findings indicate negative gap scores across all dimensions, suggesting that the actual performance of the ELSA application falls short of user expectations. The highest gap scores are observed in the empathy and responsiveness dimensions, specifically in the attributes related to the adequacy of tools to support the ELSA application and the quick response of the application's admin in addressing user system issues [20]. These areas represent the most significant discrepancies between expectations and reality and hence are critical areas for improvement.

The ranking of attributes based on the gap scores prioritizes attributes with the largest gaps for improvement [5]. The attribute related to the adequacy of tools required to support the ELSA application (Emp2) ranks highest, followed by the quick response of the application's admin to user system problems (Rels3), and so forth. A comprehensive analysis of the Servqual dimensions reveals that Empathy and Responsiveness have the largest gaps, indicating these as the areas requiring the most immediate attention for service quality improvement. Reliability, Assurance, and Tangibles follow, suggesting that these areas also need enhancement, but to a lesser extent. Overall, the average quality of service score of -0.452, while negative, is still within an acceptable range according to the standards set by Parasuraman et al. in Ansari et al. (2019). A score less than -1 indicates good service quality, and a score greater than -1 indicates poor service quality. Thus, the ELSA service quality can be regarded as fairly good, but there is still room for improvement, especially in the areas of Empathy and Responsiveness. Furthermore, the study aligns with Kotler & Keller's [10] perspective that customers form service expectations based on various sources like past experiences, word-of-mouth, and advertising. Businesses that successfully add value to their offerings not only satisfy customers but also delight them by exceeding their expectations. The study also echoes Kotler & Keller's [10] findings that a significant portion of service issues are customer-induced, emphasizing the importance of understanding customer behavior and expectations in service management.

4.3 The Importance of Performance Analysis

The Importance Performance Analysis (IPA) in this research further elaborates on the Servqual method, applying an analytical approach to assess the relationship between the performance of the ELSA service and customer expectations. The core premise of the IPA technique is that customer assessments of actual services received (performance) and their expectations for service delivery are crucial in determining their satisfaction levels with service attributes. This requires correlating initial service expectations of respondents with their actual service experiences [5].

In the IPA calculation, the congruence level between expectations and performance was computed by comparing the service performance received with the desired service expectations. Table 4.24 shows the calculation of the average congruence level in the service quality dimension. The results indicate that the average dimension of service quality is 89.71%, with individual dimensions like tangibles at 92.01%, reliability at 89.81%, responsiveness at 88.33%, assurance at 90.44%, and empathy at 88.34%. These figures suggest that the management of BRIN's service quality across these dimensions does not entirely align with the importance levels as perceived by ELSA users at BRIN. Therefore, this result answers the questions of the quality of ELSA. This gap implies that customer expectations are higher than the performance shown by ELSA, highlighting a need for improvement in the ELSA application's performance [3].

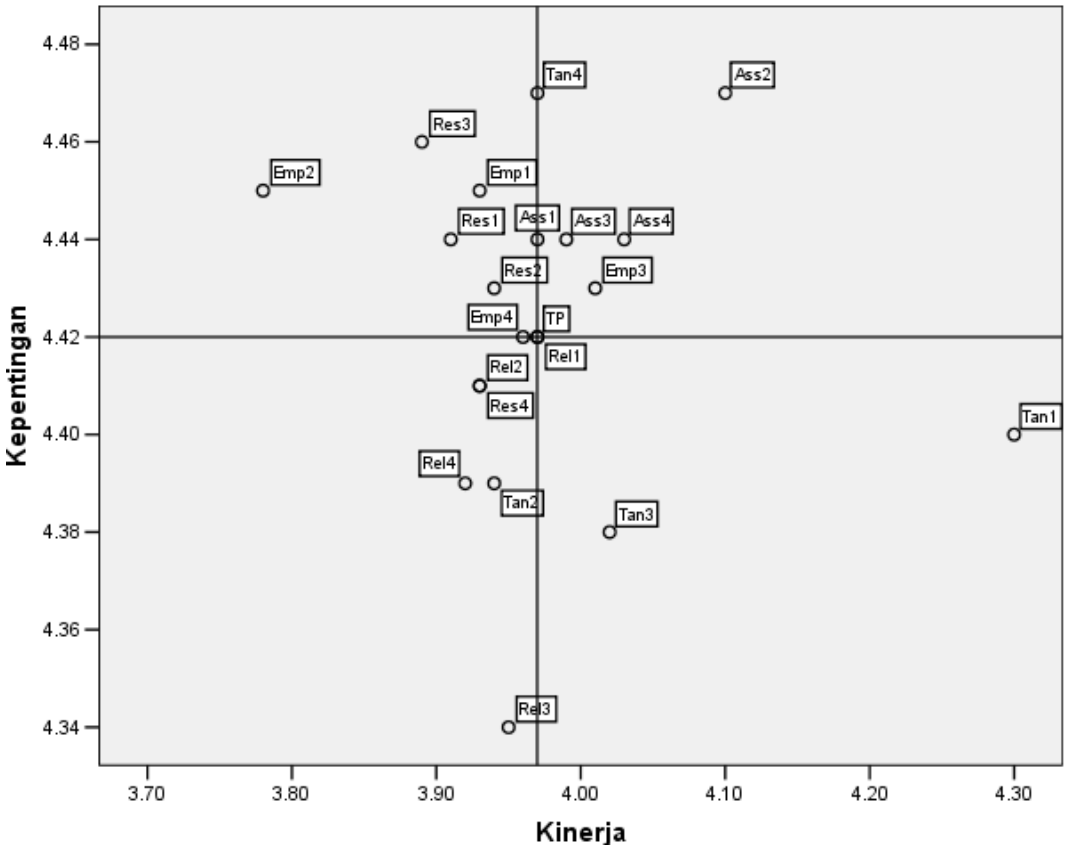

Figure 1. IPA Analysis

The subsequent step in the IPA analysis involves creating a Cartesian Diagram to determine the position of ELSA based on each attribute's item, thus identifying the strategic steps for future improvements. The calculation shows where each service quality dimension at BRIN falls concerning ELSA users' importance levels. Dimensions are categorized into Quadrants A (maintain, high expectation-high perception), B (excessive, low expectation-high perception), C (low priority/ignore, low expectation-low perception), and D (focus here, main improvement priority, high expectation-low perception). The analysis reveals that most attributes fall into Quadrant D, followed by Quadrants A, C, and the least in Quadrant B. This distribution indicates that most attributes proposed to respondents are highly important (Quadrant D and A), while fewer attributes fall into the less important categories (Quadrant C and B).

The implications for managerial practice in marketing suggest that BRIN should prioritize aspects with the lowest performance yet high importance as rated by consumers. These include aspects of Responsiveness (e.g., the application admin's quick response to system users and activities), Empathy (e.g., the completeness of communication and adequacy of tools provided by the ELSA application), Assurance (e.g., the application admin's familiarity with the system), Reliability (e.g., the application's dependability), and Tangibles (e.g., ease of operation of the ELSA application). Improvement in these areas would enhance customer satisfaction and convenience for ELSA users at BRIN. These factors represent critical areas perceived as important by customers but are not currently meeting expectations, suggesting a significant opportunity for BRIN to improve its service quality and user satisfaction [5].

4.4 TAM 2 Analysis with Structural Equation Modeling (SEM)

The analysis of TAM 2 using Structural Equation Modeling (SEM) involves a thorough evaluation of both the inner (structural) and outer models (Hair et al., 2021). In the inner model testing, the R-Squared values are utilized to evaluate the dependent constructs, Stone-Geisser Q-Squared test for predictive relevance, and t-tests along with the significance of the structural path coefficients. The R-Squared values indicate the explanatory power of the model, while Q-Squared values greater than 0 denote that the model has predictive relevance. If Q-Squared values are less than 0, the model lacks predictive relevance. The results of Q-Squared calculations indicate that variables like Image, Intention to Use, Perceived Usefulness, Subjective Norm, and Usage Behavior independently in the model have a good level of prediction [5]

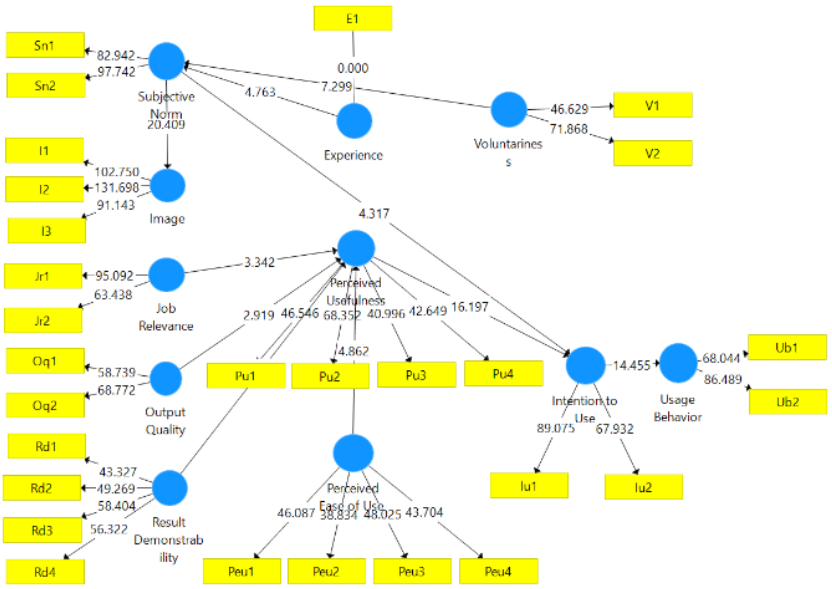

Figure 2. Bootstrapping

The outer model calculation focuses on the validity and reliability of each statement item within a variable. It includes convergent validity, discriminant validity, and composite validity. Convergent validity is established when two instruments measuring the same concept correlate highly. It is recommended that the loading factor values should be above 0.7, although values between 0.50 and 0.60 are acceptable during the early stages of model development. All the variables in this study demonstrated significant outer loadings, indicating no need for model modification. Average Variance Extracted (AVE) is employed to assess discriminant validity. An AVE value of 0.5 or higher indicates good discriminant validity. The results in this study showed that all variables have an AVE above 0.5, confirming their adequate representation of the original data scores. Discriminant validity was further validated using the Fornell-Larcker Criterion, comparing the square root of AVE for each construct against the correlation with other constructs. If the square root of AVE for each construct is greater than its correlations with other constructs, discriminant validity is confirmed. This study's results met this criterion.

Composite reliability was used to measure the reliability of the variables, with a recommended value of 0.70 or higher for composite reliability and 0.60 or higher for Cronbach's alpha. This study's variables met these thresholds, confirming their reliability. Multicollinearity testing, conducted using Variance Inflation Factor (VIF) values less than 10, indicated that there was no multicollinearity issue among the study's variables. Finally, the Partial Least Square (PLS) estimation results showed the significance of the predictive model from the t-statistics and path coefficients between independent and dependent variables. After iterative testing and excluding non-significant constructs, all constructs in the final model were found to be significant. Therefore, no further PLS Algorithm and Bootstrapping were required, confirming the robustness of the TAM 2 model with SEM (Hair et al., 2021).

4.5 Hypothesis Test

Table 2. Hypothesis Test

Hypothesis	*Relations*	*Preliminary Results*	*After Repair 1*	*After Repair 2*	*Final Result*
H1	Subjective norm → Intention to use	Significant	Significant	Significant	Significant
H2	Subjective norm → Perceived usefulness	Significant	Not Significant	-	-
H3	Subjective norm → Image	Significant	Significant	Significant	Significant
H4	Image → Perceived usefulness	Not Significant	-	-	-
H5	Job relevance → Perceived usefulness	Significant	Significant	Significant	Significant
H6	Output quality → Perceived usefulness	Significant	Significant	Significant	Significant

H7	Result demonstrability → Perceived usefulness	Significant	Significant	Significant	Significant
H8	Perceived ease of use → Perceived usefulness	Significant	Significant	Significant	Significant
H9	Perceived usefulness → Intention to use	Significant	Significant	Significant	Significant
H10	Perceived ease of use → Intention to use	Not Significant	-	-	-
H11	Intention to use → Usage behavior	Significant	Significant	Significant	Significant
H12	Experience → Subjective norm	Significant	Significant	Significant	Significant
H13	Voluntariness → Subjective norm	Significant	Significant	Significant	Significant

4.6 Quality Level of ELSA Applications at BRIN

The analysis of the ELSA application quality at BRIN, as indicated by the Gap Analysis, reveals that most respondents rated the dimensions of tangibles, reliability, responsiveness, assurance, and empathy as not yet fully satisfying [3]. The performance in these dimensions was perceived to be lower than the importance placed on them by the users. For instance, the tangible aspect scored 4.06 against an importance rating of 4.41, indicating a performance level that is satisfactory but not exceeding expectations. This pattern was consistent across other dimensions, with performance scores ranging from satisfactory (3.40 to 4.19) to very high (4.20 to 5.00), yet still falling short of the importance ratings.

The findings highlight that while aspects like the modernity, ease of operation, reliability, high accuracy, minimal errors, consistency of the ELSA application, along with the rapid response and credibility of the administrative system were satisfying, they did not fully meet the heightened expectations of the users. This suggests that while the BRIN's ELSA application is performing well in terms of these tangible, reliability, responsiveness, assurance, and empathy aspects, there is a gap between the actual service quality and the higher level of service that users expect [6].

Moreover, the Gap Analysis corresponds with the results from the Importance Performance Analysis (IPA), indicating that these dimensions have not achieved a full alignment between performance and importance as perceived by the ELSA application users at BRIN (a congruence level of less than 100%). This misalignment implies that the quality management of service dimensions at BRIN has yet to fully satisfy the expectations of ELSA application users. The study corroborates the findings of Sulwanto & Taufik (2022), affirming that users are not completely satisfied with the service management in the dimensions of tangibles, reliability, responsiveness, assurance, and empathy. In summary, while the ELSA application at BRIN exhibits commendable performance in various service quality dimensions, there remains a significant gap between the current service levels and the elevated expectations of its users. This gap calls for strategic improvements in quality management, particularly in aligning the performance more closely with user expectations in the identified dimensions [7].

4.7 Behavior and Intention to Use ELSA Application Service Technology at BRIN

The descriptive analysis of the ELSA service application at BRIN indicates a high level of "Intention to Use" among the majority of respondents, with an average score of 4.18. This suggests that respondents are inclined to use the ELSA application, primarily because they have access to it and foresee a continued use in the future [3]. This high intention to use is reflective of a positive user attitude towards the application, implying that once users have access, they are likely to engage with it consistently. Additionally, the majority of respondents rated "Usage Behavior" of the ELSA service technology at BRIN highly, with an average score of 4.09. This indicates that respondents frequently access the ELSA application and tend to use it over extended periods. Such a pattern in usage behavior demonstrates a significant level of user engagement with the application. Interestingly, the analysis using Structural Equation Modeling (SEM) with Partial Least Squares (PLS) revealed that "Perceived Ease of Use" does not significantly influence the "Intention to Use". However, there is a significant positive relationship between "Intention to Use" and "Usage Behavior". This means that as the intention to use the ELSA application at BRIN increases, there is a corresponding significant increase in the actual usage behavior of the application. This finding is in line with the research conducted by Ulung and Windarto [7], Purwandani et al. [6], which also affirm that the intention to use significantly influences usage behavior. In summary, the findings suggest that while the ease of using the ELSA application does not necessarily drive the intention to use it, once users decide to use the application, their actual usage is significantly high. This reflects a strong commitment and engagement with the application among its users at

BRIN, indicating the application's relevance and utility in their context [3].

4.8 ELSA Application Improvement at the National Research and Innovation Agency

The Importance-Performance Analysis (IPA) results suggest that the National Research and Innovation Agency (Badan Riset dan Inovasi Nasional - BRIN) should prioritize several aspects for improvement in the ELSA application [5]. These aspects include tangible elements such as the comfort and ease of use of the ELSA application and the responsiveness of the ELSA application's administration in handling system user inquiries, responding to system activities, and addressing user system issues promptly and effectively. Moreover, the empathy aspect, particularly the adequacy of tools needed to support the ELSA application and the prompt response of other users in the application, is highlighted for improvement. The reliability aspects, such as the accuracy and consistency of the service provided by the ELSA application, also require attention. Additionally, assurance aspects, especially the comprehensive system knowledge of the ELSA application administrators, are deemed crucial [3].

Although the performance of the ELSA application in providing services to its users is evaluated as satisfactory, the users have not yet reached a level of complete satisfaction. This is attributed to the performance not yet fully meeting their expectations. Thus, users feel that the highlighted aspects of the service still require enhancement. This indicates that, although BRIN may perceive these indicators as aspects that have not been managed optimally, the actual performance of the ELSA application is not yet delivering complete satisfaction to the users. The indicators identified require significant attention and improvement. These aspects, on average, are more important to ELSA application users but have underperformed in terms of actual service delivery and execution by the application. Therefore, these identified indicators should be prioritized in the management and enhancement strategy for the ELSA application at BRIN (Chu & Choi, 2000). Therefore, these results answer the question of the behaviors and intentions on the use of the ElLSA application service technology at BRIN.

The study presents valuable implications for practice, particularly in enhancing the ELSA application's service quality within the National Research and Innovation Agency (BRIN). The importance-performance analysis (IPA) suggests that BRIN should focus on aspects rated by consumers as high importance but currently with low performance, such as Responsiveness, empathy, and assurance. This indicates a need for improvements in areas like quick responses from application administrators, completeness of communication, and the adequacy of tools provided by the ELSA application. Moreover, the study's findings on user behavior and intentions, derived from the Technology Acceptance Model (TAM) 2, provide a roadmap for technological and service quality enhancements from 2023 to 2026, aiming to align with BRIN's mission as a hub of scientific collaboration [15]. Limitations of the study include the potential non-generalizability of findings due to cultural and organizational specificities at BRIN. Future research could expand the study's scope to include diverse institutions and cultural contexts to validate the model's applicability broadly. Additionally, the complexity of the TAM 2 model, with its extensive variables and relationships, suggests that future studies might explore simplified or alternative models to assess technology acceptance in government institutions. For further advancement, it's recommended to address the identified service quality gaps by prioritizing user expectations in the improvement efforts. This strategy involves enhancing operational ease, reliability, accuracy, consistency, responsiveness, and comprehensive communication as outlined in the ELSA Roadmap. The roadmap's implementation should focus on tangible improvements, technological upgrades, and fostering a user-centric approach to service provision. These recommendations provide a structured pathway for BRIN to enhance the ELSA application's effectiveness and user satisfaction, thereby contributing to the broader mission of promoting scientific collaboration and innovation.

4.9 ELSA's Roadmap

The question of how to improve the ELSA application service at the National Research and Innovation Agency is answered by this ELSA Roadmap. The ELSA Application Roadmap, as part of BRIN's strategic planning, is a structured approach to align the current state of the ELSA application with the organization's mission [21]. This roadmap, informed by a gap analysis utilizing the Servqual method and TAM 2 model, aims to refine ELSA's service quality and enhance its acceptance as a technology, ultimately contributing to national revenue growth. Central to the roadmap is the mission of BRIN to establish itself as a pivotal collaborator in scientific activities, thereby assuming a key role in the advancement of knowledge both in Indonesia and globally. The roadmap's primary objectives include promoting recommendations for ELSA's enhancement at the National Research and Innovation Agency, ensuring comprehensive service provision, and targeting an increase in national revenue. The plan spans from 2024 to 2026, focusing on ELSA's core services of analysis, computation, and calibration. The market projection for ELSA involves its current services, which range from analytical and calibration services to equipment rental and production of non-research infrastructure. The driving force behind ELSA's revenue generation is BRIN's commitment to providing top-tier research and development infrastructure and facilitating a creative environment

for scientific and technological endeavors. ELSA is expected to serve a wide array of users, including BRIN's community, academic institutions, industry partners, SMEs, and the general public, all requiring various forms of analytical and calibration services. However, the roadmap also acknowledges significant challenges and obstacles. For instance, researchers have faced issues in using ELSA effectively, and there's a gap between the demand for services and the application's capacity to meet these requests. To address these challenges, the roadmap outlines key technical requirements and capabilities needed for ELSA. This includes a focus on expanding research equipment and enhancing the application's features to align with BRIN's evolving research activities. The current technological capabilities, as indicated by TAM 2 analysis, show a high level of user acceptance, but there is still a need to expand services and improve equipment to meet all user demands. The strategy for technological development under this roadmap is multi-faceted. It involves an evaluation of priorities based on the findings from both Servqual and TAM 2 analyses. Key areas of improvement identified include reliability, responsiveness, assurance, empathy, and tangible elements. Additionally, factors influencing technology acceptance, such as Subjective Norm, Image, Job Relevance, Output Quality, Result Demonstrability, Perceived Ease of Use, and Perceived Usefulness, are also considered for enhancement. In conclusion, the ELSA Roadmap for 2024-2026 is a comprehensive plan that integrates service quality improvement with technological advancements [6]. It is designed to not only address the current challenges and gaps but also to anticipate future needs and changes, ensuring that ELSA remains a vital tool for BRIN and its stakeholders in fostering scientific collaboration and national development.

5. Conclusion

The service quality of ELSA, as assessed through the Servqual method, indicates that aspects like tangibility, reliability, responsiveness, assurance, and empathy are not fully satisfactory. Performance ratings are lower than the importance ratings, though still within the satisfactory range. Key improvement areas for ELSA's roadmap include ease of operation, reliability, consistent and accurate service, responsive administration, and proactive user engagement.

User behavior and intentions towards ELSA at BRIN are positive, with high ratings for usage intention and behavior. SEM PLS analysis shows significant relationships between perceived usefulness, intention to use, and usage behavior. For improving ELSA at BRIN, enhancements should focus on operational ease, reliability, accuracy, consistency, responsiveness, and comprehensive communication. Implementation of the ELSA Roadmap from 2023 to 2026 is recommended to enhance these aspects and align with BRIN's mission as a hub of scientific collaboration.

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