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Improvement of User Experience Evaluation For SMEs Digital Application Using TRI, TAM, SUS Integration

Ivan Ismanto [1]*, Indra Gamayanto [2]*, Gabriello Klavin Sanyoto [3]*
[1,2,3]Faculty of computer science, Information system department, Dian Nuswantoro University, Semarang
112202206763@mhs.dinus.ac.id [1], indra.gamayanto@dsn.dinus.ac.id [2], klavinsanyoto@gmail.com [3]

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ABSTRACT

Micro, Small, and Medium Enterprises (MSMEs) in the service sector, particularly vehicle wash services, continue to face challenges related to queue management, service transparency, and operational efficiency, which negatively affect user experience. This study aims to develop and evaluate a mobile-based service booking and management application prototype by integrating the Design Science Research (DSR) approach with the Technology Readiness Index (TRI), Technology Acceptance Model (TAM), and System Usability Scale (SUS) as an evaluation framework. The artifact was developed through DSR stages, including problem identification, design, demonstration, and evaluation. Qualitative data were collected through interviews with MSME owners, employees, and customers and analyzed using Thematic Analysis. Quantitative evaluation involved 106 respondents to measure technology readiness, user acceptance, and usability quality, accompanied by a descriptive analysis of relationships among the constructs. The results indicate a high level of technology readiness (TRI = 3.53) and very strong user acceptance (TAM = 4.27). However, the usability score falls within the marginal acceptable category (SUS = 62.95), indicating a gap between conceptual acceptance and actual interaction quality. These findings demonstrate that integrating TRI–TAM–SUS within the DSR framework effectively identifies critical contradictions that can serve as a basis for refining UI/UX design and implementation strategies for digital applications in service-based MSMEs.

I. INTRODUCTION

Micro, Small, and Medium Enterprises (MSMEs), particularly in the vehicle wash service sector, play an important role yet often face operational challenges that hinder efficiency. Operational processes that are still performed manually, such as queue recording and estimating service duration, frequently lead to long waiting times and a lack of transparency in service progress [1]. This condition stands in contrast to the importance of digital entrepreneurship and digitalization as key drivers of innovation and competitiveness among MSMEs [2], [3]. Therefore, the adoption of digital solutions is essential. The success of this transformation strongly depends on the User Experience (UX), in which interface design and ease of use become critical determinants [4]. The quality of user experience is emphasized through design principles that minimize users' cognitive load [5].

Despite the increasing need for digital solutions, previous literature highlights significant limitations in artifact evaluation frameworks. The primary research gap is identified through three patterns of partial evaluation in related studies:

1. Evaluation Using Only TAM: Studies focusing on system acceptance often limit their evaluation to the Technology Acceptance Model (TAM) to measure conceptual acceptance. While this approach successfully measures behavioral intention and functional acceptance, it fails to assess users' initial psychological readiness (TRI) and the quality of actual interaction experience (SUS) [6]. Studies such as the evaluation of the MasjidLink application [5] and research in higher

education contexts show that evaluations frequently stop at TAM alone [7].

2. Incomplete Integration of TRI and TAM: Efforts to strengthen models have been undertaken, such as integrating TRI and TAM within DSR frameworks for application development [8], and in BIM adoption studies [9]. However, more advanced models—such as those examining digital literacy in MSMEs (TRI + TAM + TRAM)—consistently omit objective interaction quality validation through SUS [10]. The absence of SUS leaves a diagnostic gap, because although adoption intention can be predicted, these studies cannot provide the quantitative metrics necessary for UI/UX improvement [11].
3. Usability-Focused Studies Only: Conversely, usability-focused studies such as the evaluation of the Sampingan application using SUS successfully identified detailed design issues and produced a quantitative usability score (SUS score 59.63) [12]. However, these studies did not relate the SUS findings to readiness (TRI) or adoption intention (TAM) [13], thus failing to provide a holistic understanding of why the usability issues occurred.

The novelty of this research lies in addressing that gap by presenting a DSR framework enhanced with the holistic integration of TRI, TAM, and SUS simultaneously [14], [15]. This integration aims to validate the artifact across three dimensions: readiness (TRI), acceptance (TAM), and interaction quality (SUS).

The main methodological goal is to achieve a higher degree of diagnostic accuracy, which is necessary because previous studies were unable to detect conflicts between intention and practical experience [16]. This integrated approach is more accurate as it is capable of detecting critical contradictions.

The results of this research show that the proposed methodology successfully revealed a key contradiction: users demonstrated high technological readiness (TRI score 3.53) and very high application acceptance (TAM score 4.27), yet the SUS score was in the Marginal Acceptable category at 62.95. These findings validate the superiority of the integrative methodology; the contradiction highlights the need for UI/UX refinement so that usability quality aligns with the high level of acceptance. Overall, the integration of DSR, TRI, TAM, and SUS provide a comprehensive approach for designing digital solutions that are relevant to MSMEs.

II. METHOD

This research uses the Design Science Research (DSR) approach as a methodological framework for designing and evaluating a mobile-based SME service application. DSR was chosen because it is suitable for research that aims to produce an artifact in the form of a prototype capable of solving real problems, while also providing a theoretical contribution in the field of information systems [14]. Furthermore, DSR encourages a co-creation process between researchers and stakeholders, ensuring that the developed solution is genuinely based on the operational conditions of the SMEs [15].

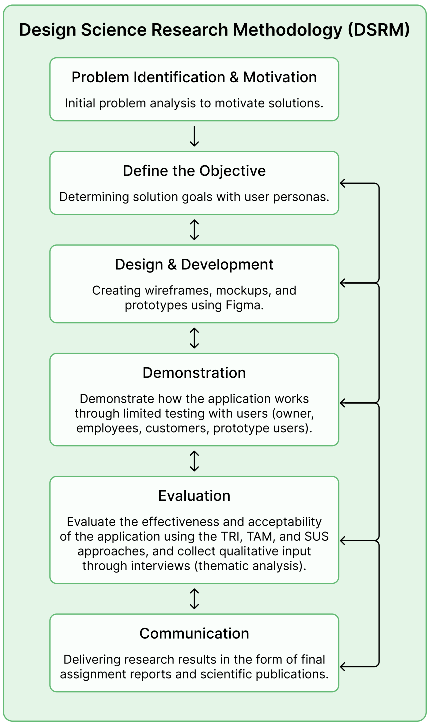


Figure 1 Stages of Design Science Research Methodology (DSRM)

SMEs in the car wash service sector face challenges such as unstructured queues, unclear estimated completion times, and errors in service logging. Digital transformation is necessary to improve the effectiveness and quality of service [2], [3]. However, the success of this transformation is heavily influenced by the user experience factor when interacting with the digital system [4], [16]. Therefore, this study combines aspects of system development and user experience evaluation.

A. *Problem Identification and Motivation*

This stage aims to identify the main problems occurring in the service process at car wash SMEs, as well as to provide the foundational motivation for developing a relevant digital solution. Based on field observations and qualitative interviews with owners, employees, and customers at three SMEs (Rocket Car Wash, Alvin Car Wash, and Clean.id), it was found that the service booking process is still carried out manually, where customers must come directly to obtain a queue number. The absence of a reservation system means customers cannot estimate the service time, and queue build-up often occurs during busy hours.

This problem potentially leads to customer dissatisfaction and loss of sales opportunities, as some customers choose to leave the location when the queue is too long. This aligns with the view of Kraus et al. (2023) [2] who state that digital unpreparedness in services can hinder efficiency and customer experience. Furthermore, the manual recording of services and transactions makes it difficult for owners to perform data recapitulation, income reporting, and business performance monitoring [3].

From the operational side, employees have to manage queues, record the services chosen by customers, and verbally confirm whether a vehicle is finished or not, which poses a risk of recording errors, miscommunication, and service delays. The absence of this operational support system also impacts the low efficiency and certainty of service [1].

From the customer perspective, the lack of an online reservation system and transparency of the completion status reduces control and convenience in using the service. This contradicts user experience principles that emphasize clarity, predictability, and ease of interaction [14], [16].

The main motivation of this research is to develop a digital solution in the form of a mobile application capable of:

1. Managing reservations and queues in real-time,
2. Providing information on vehicle service status,
3. Facilitating digital payments, and
4. Providing a simple, clear, and efficient user experience [4], [17].

The Design Science Research (DSR) approach is used because it is suitable for research that produces technology artifacts and evaluates user acceptance and readiness [6], [7]. Acceptance evaluation is performed using TRI for technology readiness, TAM for user acceptance, and SUS for usability, ensuring that the developed solution not only functions but can also be accepted and used comfortably [8], [11], [15].

By identifying these problems and needs, this research attempts to present an application capable of improving operational efficiency, enhancing customer experience, as well as supporting the digital transformation of car wash service SMEs.

B. Define the Objective

This stage aims to set the objectives for solution development based on the results of problem identification and user needs from the previous stage. Information was obtained through a combination of qualitative approaches (interviews and observation) and quantitative approaches (measurements using TRI, TAM, and SUS) across four main user roles: owner, employee, customer, and prototype user.

The results of the Technology Readiness Index (TRI) analysis showed that users are in the ready category to adopt the technology, with an average score of 3.93. This indicates that users have good levels of optimism and readiness to transition to a digital-based service system.

Furthermore, the Technology Acceptance Model (TAM) measurement showed an average score of 4.27, meaning users have a very positive perception of the application's usefulness (Perceived Usefulness) and ease of use (Perceived Ease of Use) [8]. This indicates that the application has a high chance of being accepted in service operations.

However, in the System Usability Scale (SUS) measurement, the prototype obtained a score of 62.9, which is in the marginal acceptable category, thus requiring improvement in aspects of the interface display, navigation, and interaction comfort [6], [11]. This aligns with the views of Norman and Krug that a good user experience must provide clarity, consistency, and minimize cognitive load during use [4].

Based on these findings, the objectives for solution development in this research are as follows:

1. Designing a mobile-based car wash service booking application that is easy to use and aligns with user-centered design principles.
2. Increasing queue transparency and efficiency through real-time service status and order of completion display.
3. Integrating digital payment methods (QRIS and e-wallet) to support practical, fast, and secure transactions.
4. Implementing a service status tracking feature, allowing customers to monitor vehicle progress without having to wait on-site.
5. Evaluating the application's acceptance and usability using a quantitative approach (TRI, TAM, SUS) as well as qualitative feedback from users.

By setting these objectives, the research aims to ensure that the developed solution not only functions from a technical perspective but is also relevant to user needs, supports operational efficiency, and provides a better service experience in line with the digital transformation direction of SMEs [2], [3].

C. Design & Development

The Design & Development stage represents the core phase of the Design Science Research (DSR) methodology. At this stage, the solution is conceptualized and constructed based on the problem definition and user requirements that were identified previously. The design process emphasizes the creation of a functional and usable artifact that supports service transparency and operational effectiveness for owners, employees, and customers.

The development process begins with constructing the service flow (user journey) to model how users interact with the system at each touchpoint. This step ensures that the application supports users' real operational needs, and places user experience (UX) as the central consideration in all design decisions [4], [5].

In terms of visual layout and interaction, the interface design refers to the following usability principles:

1. Clarity, ensuring that presented information is easy to read and reduces cognitive load.
2. Consistency, maintaining uniformity in visual elements such as colors, icons, typography, and layout.
3. Ease of Navigation, enabling users to complete service-related tasks efficiently without confusion [17].

An interactive prototype was then developed to allow users to directly test and interact with the system. This prototype acted as an early representation of the final application and was used to validate whether the concept aligns with the needs and expectations of users, particularly within the operational environment of MSME service businesses [1].

The prototype development was carried out iteratively. Each iteration involved gathering feedback, evaluating usability issues, and refining the interface and functionality. This cyclical process ensured that the artifact evolved based on real user input and remained aligned with actual workflow requirements [6], [18].

Through this iterative refinement process, the resulting artifact is expected not only to function correctly but also to deliver a pleasant, intuitive, and efficient user experience that suits the service operations context of vehicle cleaning and detailing MSMEs.

D. Demonstration

The Demonstration stage aims to show that the developed artifact is capable of addressing the real problem that has been identified. At this stage, the prototype is tested by involving four primary user roles, namely the owner, employees, customers, and general users. The goal is to observe how the system supports the execution of real service processes from the perspective of each stakeholder involved.

The demonstration was conducted using the Cognitive Walkthrough method, where users were asked to perform usage scenarios that reflect real operational conditions, such as:

1. Selecting vehicle wash service types.
2. Placing a service order and viewing the service queue.
3. Monitoring the progress status of the vehicle being handled.
4. Completing payment using the QRIS digital payment method.

This method allows the researcher to observe the users' thought processes while interacting with the application, enabling direct identification of potential difficulties in understanding button functions, icon meanings, or navigation structure [6]. In addition, this approach is relevant because employees and customers have diverse levels of technological familiarity, meaning the application must be easy to understand without additional explanation [5].

The demonstration results show that most users were able to perform service ordering and queue monitoring activities smoothly. However, several usability issues were found during interaction, including:

1. Some icons were perceived as not sufficiently representative.
2. Navigation between pages required simplification to avoid confusion.
3. Certain interface elements required improved visibility and clearer visual hierarchy.

These inputs were used as the basis for the next development iteration, aligned with the principles of Lean UX, which emphasize rapid user testing and continuous refinement based on user feedback [18]. Thus, the demonstration stage not only validates the feasibility of the artifact but also ensures that the artifact continues to evolve according to real user needs [19].

E. Evaluation

The Evaluation stage within the Design Science Research (DSR) framework aims to validate the quality and effectiveness of the developed artifact (application prototype). This evaluation was conducted using a mixed-method approach, combining both qualitative and quantitative analysis techniques.

1. Thematic Analysis

Thematic Analysis was applied during the early phase (needs identification) and at the final stage of the research (UI/UX feedback validation) to process qualitative interview data.

TABEL I
THEMATIC ANALYSIS DESCRIPTION

Component	Description
Definition	A method used to identify, analyze, and report patterns (themes) within qualitative data. This method provides in-depth insights into respondents' views, experiences, and perceptions.
Purpose	- System Requirements Identification: Obtaining essential features and system requirements from Owners, Employees, and Customers. - Design Validation: Analyzing prototype user feedback to identify UI/UX improvement areas.
Process	Consists of six essential steps: Familiarization, Coding, Generating Themes, Reviewing Themes, Defining and Naming Themes, and Producing the Report.

2. Technology Readiness Index (TRI)

Definition: The Technology Readiness Index (TRI) measures an individual's psychological readiness to adopt or use new technology. TRI consists of four dimensions: Drivers (Optimism and Innovativeness) and Inhibitors (Discomfort and Insecurity).

Scoring Formula:
The Technology Readiness Index (TRI) measures an individual's psychological readiness to adopt or use new technology. TRI consists of four dimensions: Drivers (Optimism and Innovativeness) and Inhibitors (Discomfort and Insecurity).

Score Adjustment (5-poin Scale):

- Positive Item (O & I): Item Score = Rating
- Negative Item (D & S): Item Score = 6 - Rating

Final TRI Score Calculation:

$$TRI = \frac{\sum(\text{Adjusted Item Score})}{4} \quad (1)$$

TABEL II
TRI RESULT CATEGORIES

Readiness Category	Average Score Range
High	Score > 3.51
Medium	2.90 ≤ score ≤ 3.51
Low	Score ≤ 2.89

3. Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) is a model designed to predict end-user acceptance of an information system and to explain the factors that influence users' decisions to adopt new technology. This model focuses on the causal relationship between user beliefs, attitudes, and behavioral intentions.

Dimention Used: This research utilizes four key dimensions, consisting of the core TAM constructs (PU and PEOU) and the main derived variables (ATU and BI).

TABEL III
TAM DIMENSIONS

TAM Dimension	Description
Perceived Usefulness (PU)	The degree to which an individual believes that using a particular system (artifact) will enhance their job performance (e.g., allowing tasks to be completed more quickly or efficiently).
Perceived Ease of Use (PEOU)	The degree to which an individual believes that using the system will be free from effort or difficulty and is easy to learn.
Attitude Toward Using (ATU)	The user's positive or negative feelings toward using the system (influenced by PU and PEOU), acting as a mediator between beliefs and behavioural intention.
Behavioral Intention (BI)	The subjective likelihood that an individual will perform the behaviour of using the system in the future (e.g., continuing to use and recommend the system).

Calculation Formula:
TAM is measured as the average score for each dimension

$$TAM\ Dimension = \frac{\sum \text{Item Ratings in the Dimension}}{\text{Number of Items in the Dimension}} \quad (2)$$

4. System Usability Scale (SUS)

Definition: The System Usability Scale (SUS) is a simple, effective, and widely used instrument for evaluating system usability, producing a single overall usability score ranging from 0 to 100.

Score Adjustment Rules:
- Odd-Numbered Items (Positive): Item Score = Rating - 1
- Even-Numbered Items (Negative): Item Score = 5 - Rating

Final SUS Score Calculation:

$$SUS = \left(\sum Individual\ Item\ Scores\ (0-4)\right)\ x\ 2.5 \quad (3)$$

TABEL IV
SUS SCORE INTERPRETATION

Usability Category	SUS Score Range (0–100)
Good to Excellent	≥ 68
Marginal (Acceptable)	51.0 - 68.0
Poor	≤ 51.0

F. Communication

The Communication stage is the final and critical step in the Design Science Research (DSR) methodology, aimed at disseminating the research outcomes effectively to two primary audiences: the practitioner community and the academic community. This stage ensures that the developed artifact provides tangible value and measurable scientific contribution.

Communication to the Practitioner Community

Communication to practitioners, particularly vehicle wash MSME owners and prospective users, focuses on the functional validity and practical benefits of the artifact (application). The quantitative evaluation results from TRI (3.5271, High category) and TAM (average ≥ 4.25) indicate a high level of readiness and strong conceptual acceptance of the application.

- Improved Operational Efficiency: The application offers a solution to major operational issues identified from interviews (such as accumulated queues and internal miscommunication), particularly through the Live Queue and Status Tracking features.
- Enhanced Service Professionalism: By providing a transparent booking and tracking system, the application helps MSMEs improve customer service quality and professionalism, which are essential for maintaining customer loyalty.

Communication to the Academic Community

Communication to the academic community aims to articulate the scientific contributions of this research to the knowledge base within the Information Systems field. The theoretical contributions include:

- Multidimensional Model Integration: This research provides a mixed-method DSR evaluation framework by integrating TRI, TAM, and SUS simultaneously. This integration uniquely examines prerequisite factors (TRI:

readiness), acceptance factors (TAM: intention to adopt), and experiential quality (SUS: usability).

- Contextual Validation of TRI: This study offers empirical evidence demonstrating the strong relevance of Technology Readiness (TRI) as an important predictor of Technology Acceptance (TAM) in the context of Indonesian MSMEs undergoing digital transition, a context that still requires further exploration.
- Evaluation Contradiction Analysis: The finding of a High TAM score contrasted with a Marginal SUS score (62.95) is communicated as a significant design implication. This contradiction shows that although users have a strong intention to use the application (TAM), there are specific usability barriers (SUS), which serve as a strong basis for iterative refinement in subsequent DSR cycles.

Through this communication process, the research not only delivers a tested practical solution but also enriches theoretical understanding by providing new insights into the interaction between user readiness, technology acceptance, and usability quality within the MSME context.

III. Result and Discussion

A. Respondent Characteristics and Distribution

This study involved 106 respondents selected using a purposive sampling technique, with the criterion that respondents had either previously used or were directly involved in the simulation of the vehicle wash service application prototype. The respondents were selected to represent all key stakeholders in MSME service operations, ensuring that the evaluation results reflect a comprehensive range of perspectives.

TABEL V
Respondent distribution by Role

Respondent Role	Number	Percentage
MSME Owner	3	2,8%
Employees	9	8,5%
Customers	15	14,2%
Prototype Users	79	74,5%
Total	106	100%

The respondents consisted of four role-based groups, namely MSME owners, operational employees, customers, and prototype users. The distribution of respondents by role is presented in Table V. The respondent distribution indicates that 79 respondents (74.53%) were prototype users, 15 respondents (14.15%) were customers, 9 respondents (8.49%) were employees, and 3 respondents (2.83%) were MSME owners. This composition reflects a dominance of end-user perspectives while still incorporating the viewpoints of service managers and operational staff.

The diversity of respondent roles enables a holistic system evaluation, as each group possesses distinct needs and expectations regarding the system, particularly in terms of operational efficiency, ease of use, and service transparency.

B. Results of Needs Analysis and Artifact Development

Respondents were selected using a purposive sampling technique, with the criterion that they had either used or were directly involved in the simulation of the application prototype.

The results of the problem identification and solution design stages within the Design Science Research (DSR) framework were used to guide the development of the application prototype as the solution artifact. Qualitative data collected from Owners, Employees, and Customers were analysed to formulate the functional system requirements, which subsequently became the foundation for the prototype design.

System Needs Analysis Based on Thematic Analysis

Thematic analysis was conducted to identify patterns of problems and needs from the stakeholders. The results indicate that all services are still dependent on walk-in processes and manual record-keeping, which lead to three major issues and define the core functional requirements that the application must address:

1. Queue and Time Management Issues: Owners, Employees, and Customers consistently reported long queues and uncertainty regarding waiting times. Many customers opted to cancel their service because they did not want to wait on-site (Customer, Analytical Narrative). This issue creates an urgent need for a Live Queue System and Status Tracking features to provide users with transparency and control over service waiting times (Owner, Key Conclusion).
2. Internal Coordination and Transparency Issues: Employees frequently face risks of service mis recording and confusion related to queue order due to reliance on verbal communication or manual notebooks. This creates the need for a centralized system that provides a Consistent Service and Price List and Status Tracking that can be accessed across all operational roles (Employee, Findings Narrative).
3. Basic Usability Requirements: Although stakeholders show strong enthusiasm toward digitalization, both Employees and Customers emphasized that the application must be simple, visual, quick to access, and require minimal interaction steps to be easily adopted in a busy work environment (Employee, Key Summary).

Application Prototype Design and Implementation

Based on the identified requirements, the application prototype was developed with a primary focus on the Live Queue and Status Tracking solutions.

Application Architecture and User Flow:

1. Architecture: The application was designed using a client-server architecture, where the mobile application is used by customers (for ordering, payment, and tracking), while the web-based dashboard is used by employees (for queue management and status updates).
2. Core User Flow: The booking flow is designed to be minimalistic, starting with service selection.

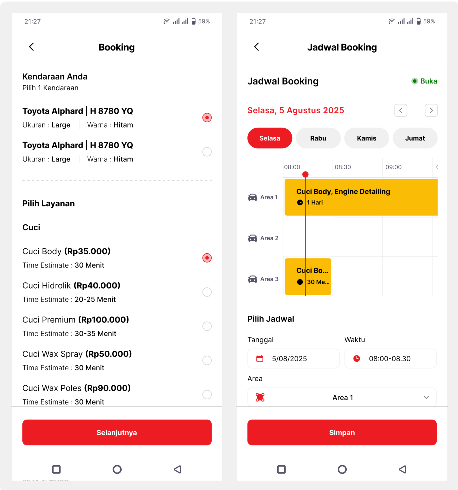


Figure 2 Core User Flow

This is followed by automatic system confirmation.

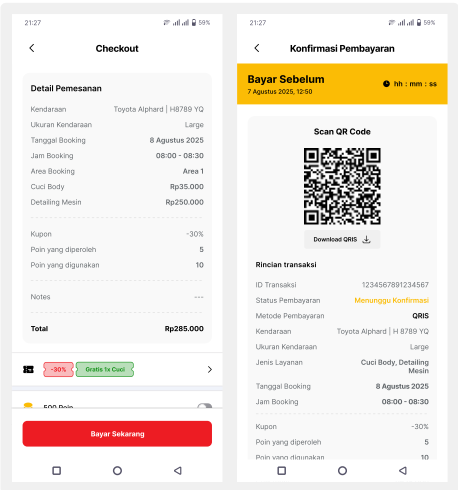


Figure 3. User Flow – Payment Process

Afterward, users enter the queue → track service status.

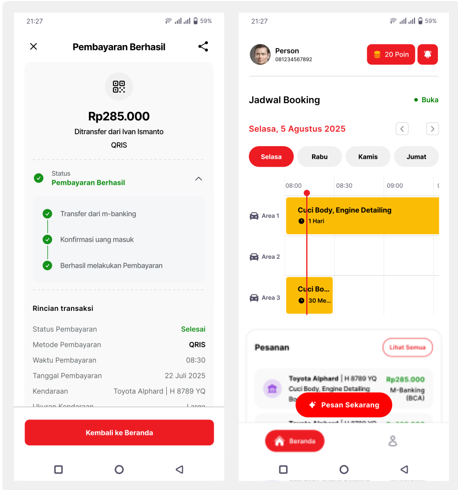


Figure 4. User Flow – Queue Entry and Status Tracking

This flow ensures that users can immediately access the primary features without going through unnecessary steps, fulfilling the Employees' and Customers' needs for a fast and uncomplicated system.

User Interface Implementation:

1. The interface design was implemented by emphasizing simplicity and directness, supported by early feedback from Prototype Users (qualitative feedback).
2. Main Feature Aspects: The tracking page was made visually prominent, displaying the real-time status of the vehicle (from *Washing & Drying* to *Completed*), which serves as the key value proposition of the application (Prototype Users, Final Narrative).

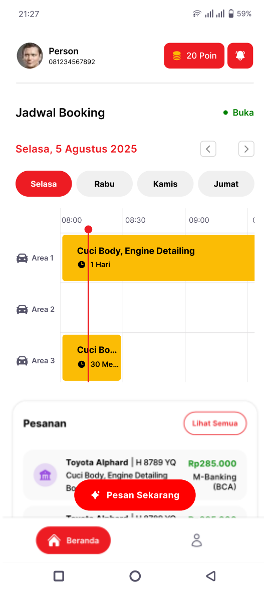
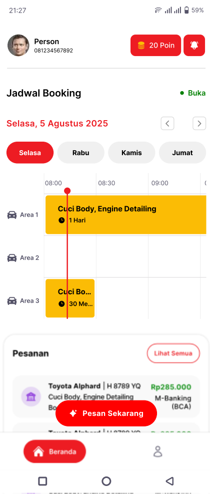


Figure 3 Home Screen UI

3. Initial UI/UX Aspects: Although the design was perceived as “professional and neat,” initial prototype user feedback identified several areas for improvement, such as increasing text contrast, adjusting the font size of the bottom navigation menu, and emphasizing the order confirmation call-to-action (CTA) button. This initial feedback became the basis for prototype refinement before quantitative evaluation.

4. Core Feature Focus: The tracking page is designed as a prominent feature, visually displaying the real-time status of the vehicle (Washing & Drying → Completed), which represents the main value proposition of the application (Prototype Users, Final Narrative).



Gambar 5 Home Page UI

5. Initial UI/UX Aspects: Although the design was perceived as “professional and well-structured,” early feedback from prototype users identified several areas requiring improvement, such as enhancing text contrast, increasing font size in the bottom navigation menu, and improving the visibility of the order confirmation call-to-action (CTA) button (Prototype Users, First Impression and Color Combination). This initial feedback served as the basis for finalizing the prototype that was subsequently evaluated in the quantitative evaluation stage.

Instrument Reliability and Validity Testing

The research instruments used in evaluating the artifact consisted of the Technology Readiness Index (TRI), Technology Acceptance Model (TAM), and System Usability Scale (SUS). All instruments were adapted from prior studies that have been empirically validated and widely applied in technology adoption and user experience evaluation research. The adaptation process involved minor wording adjustments to align with the context of MSME service applications, without altering the core constructs or the intended meaning of each measurement item.

Instrument reliability testing was conducted to ensure the internal consistency of each construct using Cronbach’s Alpha coefficient. A Cronbach’s Alpha value greater than 0.70 indicates acceptable reliability and confirms that the instrument is suitable for use in social science and information systems research.

The reliability test results indicate that all instruments meet the reliability criteria. The Technology Readiness Index (TRI) achieved Cronbach’s Alpha values above 0.70, demonstrating good internal consistency across the dimensions of optimism, innovativeness, discomfort, and insecurity. Similarly, the Technology Acceptance Model (TAM) exhibited Cronbach’s Alpha values exceeding 0.70 for all its dimensions, including perceived usefulness, perceived ease of use, attitude toward using, and behavioral intention. Meanwhile, the System Usability Scale (SUS) also obtained a Cronbach’s Alpha value indicating adequate reliability in measuring the usability quality of the application prototype.

In terms of validity, this study employed a content validity approach by ensuring alignment between the instrument items and the theoretical constructs they are intended to measure, as established in prior literature. The application of TRI, TAM, and SUS within the MSME service context was conducted by considering user characteristics, service processes, and operational environments, thereby ensuring that the instruments remain relevant and representative for assessing technology readiness, user acceptance, and application usability. Accordingly, the instruments used in this study are considered both reliable and valid for supporting the evaluation analysis.

C. Artifact Evaluation Results and User Feedback

This section presents the results of the Evaluation stage in the DSR framework, aimed at validating the quality of the artifact (application prototype) from the perspectives of user readiness (TRI), technology acceptance (TAM), and usability (SUS).

Quantitative Evaluation Results (TRI, TAM, and SUS)
The quantitative evaluation involved 106 respondents to obtain statistical insights regarding user readiness and system acceptance.

Technology Readiness Analysis (Technology Readiness Index - TRI)

The TRI calculation results indicate that respondents have a strong readiness to adopt new technology.

The overall TRI score of 3.5271 exceeds the threshold of 3.51, confirming that respondents fall into the High Readiness category. The high scores for Optimism and Innovativeness (average > 4.45) are the dominant factors indicating that users are mentally prepared and enthusiastic about transitioning to digital service solutions.

TABEL IV
TRI RESULTS

TRI Dimension	Average Score (1-5)	Contribution	Category
Optimism	4.48	Driver (Strong)	Very High
Innovativeness	4.45	Driver (Strong)	Very High
Discomfort (Reversed)	2.90	Inhibitor (Neutral)	Neutral
Insecurity (Reversed)	2.28	Inhibitor (Low)	Low
TRI Score	3.5271		High Readiness

Technology Acceptance Analysis (Technology Acceptance Model - TAM)

The TAM evaluation measures the respondents' tendency to use the application. All TAM dimensions show very high average scores (above 4.25), indicating a strong positive acceptance of the application concept.

TABEL V
TAM DIMENSION RESULTS

TAM Dimension	Average Score (1-5)	Interpretation
Perceived Usefulness (PU)	4.30	Very High
Perceived Ease of Use (PEOU)	4.25	Very High
Attitude Toward Using (ATU)	4.31	Very High
Behavioral Intention (BI)	4.28	Very High

These consistently high scores validate that the application successfully meets essential user needs. Respondents collectively believe that the application is useful (PU) in improving service ordering efficiency and time management, and easy to use (PEOU), which directly drives a strong intention to use (BI) the system in the future.

Usability Quality Analysis (System Usability Scale - SUS)

SUS was used to measure the quality of users' interaction experience. The results show a notable contrast with the TRI and TAM findings.

TABEL VI
SUS AVERAGE SCORE

Model	Average Score (0-100)	Quality Category
SUS Score	62.95	Marginal / Acceptable (Grade D)

The SUS score of 62.95 is below the general acceptable threshold of 68. This indicates that even though respondents are willing and ready to use the application (high TAM and TRI), there are frictions in the interaction experience that affect comfort and efficiency. These results highlight the need for improvements in the user interface (UI) and user experience (UX) to align usability quality with the strong level of acceptance.

Qualitative Feedback from Prototype Users

To explain the contrast between the high TAM scores and the Marginal SUS score, an in-depth thematic analysis of qualitative feedback from prototype users was conducted. This analysis identified both the conceptual strengths of the application and specific UI/UX enhancement needs.

Strengthened Conceptual Advantage: Qualitative respondents provided positive feedback, noting that the ordering flow was intuitive and the information structure was effective. The most appreciated features were the Service Status Tracking and Time Estimation, which were perceived as providing transparency and control to users, thereby validating the problem-solving alignment that had been previously identified.

Specific UI/UX Issues (Root Cause of Lower SUS Score):

1. Visual Aspects: Text size, color contrast, and the footer menu typography were considered suboptimal, affecting readability and visual comfort. (Respondent Snippet: "The text contrast in some sections is not strong enough.")
2. Interaction Aspects: The Order Confirmation (CTA) button and back navigation need stronger visual emphasis to ensure smoother and clearer task flows. (Respondent Snippet: "The order confirmation button could be made more prominent.")

Conclusion of Qualitative Feedback: These findings illustrate that the application's core usability potential has not yet been fully realized due to deficiencies in visual and micro-interaction elements. This is critical because it provides clear and actionable guidance for the next design iteration phase.

Analysis of Relationships among TRI, TAM, and SUS Constructs

The evaluation of user experience in this study was not limited to reporting separate scores of the Technology Readiness Index (TRI), Technology Acceptance Model (TAM), and System Usability Scale (SUS), but also included a conceptual and descriptive analysis of the relationships among these three constructs. This analysis aims to explain how users' psychological readiness, conceptual acceptance of the system, and actual interaction quality are interrelated within the context of MSME application adoption.

This study employed a descriptive–conceptual relationship analysis to emphasize the distinct roles and functions of each construct within a Design Science Research–based evaluation framework. This approach was not intended to test causal relationships or statistical significance among variables, but rather to identify evaluative contradictions between technology readiness, conceptual acceptance, and usability quality at the prototype stage. Therefore, inferential analyses such as statistical correlation tests or structural modeling are recommended as future research once the system has been fully implemented.

Relationship between Technology Readiness and User Acceptance (TRI → TAM)

The evaluation results indicate that the TRI score falls within the high category (3.53), suggesting that respondents possess strong psychological readiness to adopt digital technology. This readiness is reflected in the high TAM score (mean = 4.27) across all dimensions, including perceived usefulness, perceived ease of use, attitude toward using, and behavioral intention. These findings suggest that technology readiness serves as an important prerequisite for the formation of conceptual acceptance of the application. In other words, users who are optimistic and innovative tend to hold more positive perceptions regarding the system's usefulness and ease of use.

Relationship between User Acceptance and Usability Quality (TAM → SUS)

Despite the very high level of user acceptance, the usability evaluation produced a SUS score of 62.95, which falls within the marginal acceptable category. This result indicates that conceptual acceptance, as measured by TAM, does not automatically translate into optimal interaction quality. Users may perceive the application as useful and express intention to use it, yet still encounter obstacles at the design execution level, such as visual clarity, navigation, and interaction efficiency.

Analysis of Contradictions among Constructs

The contrast between the high TAM score and the marginal SUS score reveals a gap between adoption intention and actual usage experience. This finding highlights the distinct roles of each construct: TRI represents users' initial psychological readiness, TAM reflects conceptual acceptance of the system's functionality and benefits, while SUS measures the quality of interface execution during actual use. Consequently, usability emerges as a critical factor in determining implementation success, even when user readiness and acceptance are already high.

Implications of the Integrative TRI–TAM–SUS Analysis

This relationship analysis confirms that the integration of TRI, TAM, and SUS goes beyond simple instrument aggregation, forming a layered evaluation framework capable of identifying critical contradictions in system development. These findings provide a strong basis for UI/UX design iteration in subsequent DSR phases and strengthen the study's theoretical contribution by demonstrating that successful MSME technology adoption is determined not only by readiness and acceptance, but also by the quality of user interaction experience.

D. Artifact Evaluation Results and User Feedback

Relationship Between Readiness, Acceptance, and Usability

The DSR evaluation results show an interesting and simultaneously contrasting relationship between the constructs:

Rreadiness Supporting Acceptance (TRI → TAM):

1. The respondents' High Technology Readiness (TRI score = 3.5271) acts as a strong prerequisite supporting acceptance. The very high scores in the driver dimensions (Optimism and Innovativeness) indicate that users are psychologically open and enthusiastic toward digital solutions. This readiness is reflected in the Very High Acceptance scores across all TAM dimensions (PU, PEOU, ATU, BI, averages ≥ 4.25).
2. Implication: The prototype has successfully met the users' fundamental expectations regarding usefulness and conceptual ease of use, supported by their already high technological readiness mindset.

Contradiction Between Acceptance and Interaction Quality (TAM vs. SUS):

1. Although the Behavioural Intention to use the application is very high (TAM), the SUS score (62.95) falls within the Marginal category. This contradiction indicates that users are willing and intend to use the application, but their current interaction experience is not yet efficient or comfortable.
2. Contradiction Analysis: This gap suggests that conceptual acceptance (belief in the application's benefits) is higher than the perceived interaction quality. The issue does not lie in the core idea or main features (Live Queue and Status Tracking), but rather in the execution of the UI/UX design.

Design Implications (Iteration Recommendations)

The findings of this study reflect users' perceptions of the developed system; therefore, the interpretation of the results focuses on technology adoption potential and the quality of user experience. The evaluation did not include measurements of actual operational performance, such as service waiting time or queue efficiency. Accordingly, the discussion of implications is limited to design aspects and system implementation readiness, rather than empirical claims of operational performance improvement.

Based on the TAM vs. SUS contradiction, these findings serve as the most critical input for the next iteration phase in the DSR cycle. Design recommendations are focused on increasing the SUS score from Marginal to Acceptable or Good (≥ 68).

Artifact Validation Against Initial Problems

The prototype successfully addresses the core problems identified in the Needs Analysis and Artifact Development stage. The Status Tracking and Live Queue features are conceptually well-received (supported by high PU scores and qualitative feedback) because they provide transparency and time control, which were absent in the manual service process.

Iteration Recommendations Based on Qualitative Feedback (to Improve SUS):

1. Visual and Accessibility Improvements: Adjust text color contrast (especially against visually dense backgrounds) and increase font size for minor navigation elements (e.g., bottom navigation menu) to improve readability and reduce eye strain.
2. Improving Affordance and Micro User Flow: Enhance visibility of key Call-to-Action (CTA) buttons such as "Confirm Order" using more prominent color or size choices, and ensure that back navigation operates intuitively and consistently. These improvements are necessary to simplify micro-interactions and create a smoother and faster user flow, aligning with the demands of both Employees and Customers.

Overall, the application prototype has been validated as a needed and accepted solution (high TRI and TAM), and now requires targeted design iteration based on SUS data and thematic feedback to achieve optimal usability quality.

Research Limitations and Future Research Directions

This study has not yet incorporated actual usage data from a fully implemented system. The evaluation remains perceptual in nature, relying on questionnaire-based instruments to assess system readiness, acceptance, and usability at the prototype stage. Consequently, the findings cannot be used to empirically conclude the system's impact on operational efficiency or queue reduction.

Although this study successfully developed and evaluated an MSME service application prototype through the integration of the Design Science Research (DSR) framework with the Technology Readiness Index (TRI), Technology Acceptance Model (TAM), and System Usability Scale (SUS), several limitations must be explicitly acknowledged to maintain scientific transparency.

First, this research adopted a case study approach limited to a vehicle wash service MSME. Focusing on a single service sector restricts the generalizability of the findings to other MSME sectors that may exhibit different operational characteristics and user interaction patterns. Therefore, the results should be interpreted within the context of service-based MSMEs with similar operational workflows.

Second, the developed artifact remains at the prototype stage and has not been fully deployed in a real operational environment. As a result, the evaluation does not include actual usage data such as service duration, queue efficiency, or impacts on MSME operational performance, and the findings are therefore based on user perceptions and simulated usage scenarios.

Third, the usability evaluation using the System Usability Scale (SUS) was conducted in a single testing cycle. This approach does not fully reflect the ideal iterative UI/UX design improvement process advocated in the DSR methodology, where repeated evaluations are conducted following successive artifact refinements.

Based on these limitations, future research is recommended to conduct longitudinal studies to observe changes in user readiness, acceptance, and usability over time after the application has been fully implemented. In addition, post-deployment evaluations should be performed using actual usage data to measure the application's impact on service efficiency and user experience. Future studies may also develop a more context-specific UX evaluation model for service-based MSMEs by considering operational characteristics, interaction intensity, and the resource constraints commonly faced by MSMEs.

IV. Conclusion

This research was conducted using the Design Science Research (DSR) methodology with the primary objective of developing and evaluating a service ordering and management application prototype for a vehicle wash MSME, while integrating the Technology Readiness Index (TRI), Technology Acceptance Model (TAM), and System Usability Scale (SUS). Based on the needs analysis and artifact evaluation, this study concludes that the developed prototype is valid as a solution but requires final design iteration to optimize usability.

1. Artifact Effectiveness in Solving the Core Problem:

The initial qualitative analysis successfully identified operational inefficiencies—particularly unpredictable queues and lack of transparency in service progress—as the main issues faced by the MSME. The developed prototype, with its core features Live Queue and Service Status Tracking, has conceptually succeeded in addressing these issues. These features provide the transparency and control needed by both customers and employees.

2. Strong User Readiness and Application Acceptance:

Quantitative evaluation demonstrates a strong foundation for adoption:

- Technology Readiness (TRI): Respondents showed High Readiness, with an overall TRI score of 3.5271, driven by high levels of Optimism and Innovativeness. This confirms that the target market is psychologically open to adopting digital solutions.
- Application Acceptance (TAM): Functional acceptance is categorized as Very High, with all TAM dimensions (PU, PEOU, ATU, BI) achieving

averages ≥ 4.25. These results validate that the application is perceived as beneficial for improving process efficiency (PU) and conceptually easy to understand (PEOU).

3. Usability Contradiction as a Key Driver for Design Iteration:

Despite the high acceptance (TAM), the SUS score falls within the Marginal category at 62.95, below the 68 thresholds. This contradiction is a critical finding: users want to use the application, but their current interaction experience is not yet optimal. The Thematic Analysis of prototype user feedback explains this gap, pointing to specific User Interface (UI) and micro-level User Experience (UX) deficiencies, such as text contrast, font sizing, and prominence of Call-to-Action (CTA) buttons.

4. Scientific Contribution:

This research contributes theoretically by integrating TRI, TAM, and SUS within a DSR framework. This integration offers a holistic understanding that readiness (TRI) is a strong prerequisite for adoption, but usability (SUS) remains a decisive factor that cannot be overlooked in practical implementation. This finding highlights the necessity of a focused design iteration phase before the application can be optimally deployed in real operational contexts.

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