

Designing a Voice User Interface for Accessible Campus Mobility Services at Telkom University: A Double Diamond Approach

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ABSTRACT

This study aims to design and evaluate a technology-based campus transportation service to improve accessibility and information delivery at Telkom University. The research employs a design-based research approach using the Double Diamond model, with data collected through observations, interviews, questionnaires, and literature review. The design process resulted in a service prototype that was evaluated using the User Experience Questionnaire (UEQ). The evaluation results show positive scores across all UEQ dimensions, including attractiveness, clarity, efficiency, stimulation, and novelty. These findings indicate that the proposed service provides a good user experience and supports the development of an innovative and sustainable campus transportation system.

KEYWORDS

Double Diamond, Design Approach, Service Design, Campus Transportation, Voice Assistant

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INTRODUCTION

Transportation plays a critical role in enabling economic activity, social engagement, and population mobility, including within university environments. Advances in automation, electrification, and digitalization have driven major shifts in transportation systems (McAslan et al., 2024). Within a campus setting, transportation functions as an essential service that facilitates movement between diverse facilities such as classrooms, laboratories, and libraries. Because a campus operates much like a compact district, it requires transportation solutions capable of supporting the community's mobility needs throughout the day, particularly during morning and afternoon peak hours (Pakdeewanich et al., 2023). Understanding the mobility patterns of university members is therefore fundamental when designing effective transportation systems (Hamad et al., 2021).

Telkom University, covering an area of 50 hectares and experiencing continuous population growth, faces increasing challenges in maintaining efficient internal mobility. As an institution with "Excellent" accreditation, the university places strong emphasis on sustainability and innovation, including in its transportation services. Although modes such as TelU Car (TUC-TUC) and Beam electric bicycles are available, users still encounter significant issues, including limited route information, unclear scheduling, and discomfort during use. With the university's target of 10%

annual student growth, improving campus transportation has become even more urgent. Innovative service solutions are therefore required to deliver better accessibility and enhance mobility efficiency.

Effective campus mobility relies not only on physical transportation modes but also on supporting technological infrastructure, management policies, and service ecosystems (Göçer & Göçer, 2019). Modern technologies such as the Internet of Things (IoT) and Voice User Interface (VUI) offer promising opportunities to address these challenges. These technologies enable real-time tracking, automated service processes, and voice-based interactions that simplify user engagement (Hsiao & Chang, 2019; Moore & Urakami, 2022). However, the adoption of such advanced technologies in educational settings remains limited, underscoring the need for solutions that integrate technological innovation with user-centered design.

This study adopts the Double Diamond design approach to explore user needs, define key problems, develop solutions, and test prototypes (Farhantama & Miksa Mardhia, 2024). Methods such as observation, interviews, and questionnaires are used to support the design of a campus transportation service that is efficient, inclusive, and environmentally friendly. Previous research shows that technology-based transportation systems can improve mobility and support sustainability, although their effectiveness depends on how well they are designed and implemented (Sener et al., 2023). In addition, studies on mobile transportation applications highlight the importance of user experience—such as ease of use and interface clarity—in influencing adoption, while also pointing out ongoing challenges related to inclusivity (Husnina et al., 2022).

Despite these findings, most studies still examine technology and user experience separately. This creates a gap in developing more integrated solutions, especially in the context of campus transportation. This research aims to address that gap by combining a human-centered design approach with IoT and Voice User Interface (VUI) technologies. The goal is to develop a transportation service that improves accessibility, efficiency, and overall user experience. The main contribution of this study lies in bringing these elements together into a more holistic and practical solution for sustainable campus mobility.

METHOD

This study employs a design-based approach using the Double Diamond model, beginning with the Discover phase to analyze user needs, focusing on constraints, complaints, and mobility difficulties on campus. This phase serves as the foundation for identifying the main problems that need to be addressed. The approach is relevant for generating innovative design solutions that align with user needs, as practice-based research supports iterative design processes in which design exploration and prototyping become central to addressing contextual challenges, including accessibility and interaction design in service-based systems (Akbar & Bayu, 2025; Soewardikoen, 2021).

The sample in this study was selected using purposive sampling, involving members of the campus community who are actively engaged in on-campus mobility. This method ensures that the data collected are in-depth and relevant, in accordance with the criteria of a campus population that moves from an origin location to a specific destination (Ahmed, 2024; Gorga et al., 2025). Data validity was tested through triangulation, involving three main sources: visual observation and documentation, user interviews, and questionnaires. This triangulation process ensured that the collected data were accurate and comprehensive, providing a thorough understanding of user needs and innovations in campus transportation services.

The data were analyzed using the PEST method, 360-degree data analysis, and SWOT analysis. PEST helps identify external influences from political, economic, social, technological, and legal aspects. The 360-degree data evaluate the strengths and weaknesses of transportation services (Alanzi, n.d.; Soewardikoen, D.W, 2024). Meanwhile, SWOT analysis was used to formulate strategies that optimize strengths and opportunities or address weaknesses and threats, including SO, ST, WO, and WT strategies (Puyt et al., 2023).

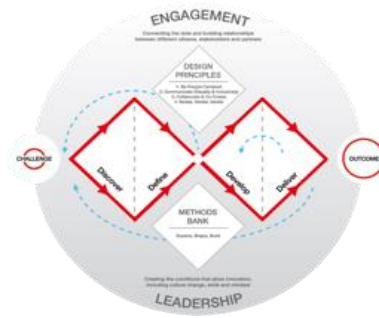


Figure 1. Double Diamond Framework
 source: (Design Council, 2025)

In the design process, the Double Diamond approach is applied, consisting of two key phases: divergence and convergence. In the divergent phase, ideas are gathered broadly without restriction to explore a wide range of potential solutions. In the convergent phase, the collected ideas are filtered and selected for further development (Gustafsson, 2019).

RESULT AND DISCUSSION

1. Discover

Observations at various touchpoints revealed differing pain and gain points (Weidig et al., 2024). Pain points emerged during periods of high mobility and rainy weather, particularly related to the lack of transparency in schedules and routes for public transportation such as Tuc-Tuc. While Beam helps support mobility, its effectiveness is limited during rainy conditions. User emotions showed instability, especially during planning, waiting for transportation, and upon arrival at the destination, due to the lack of accessible feedback channels, which are essential for service evaluation and improvement.

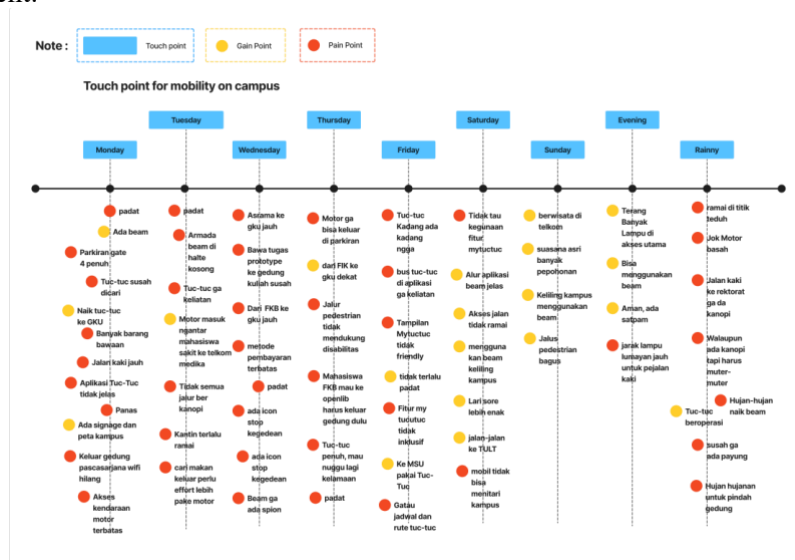


Figure 2. Pain and Gain User
 source: (Alazhari, 2025)

Most respondents agreed with the proposed campus transportation service features, particularly the integration of transportation modes (Q1) and real-time tracking (Q4), which received the highest scores. Navigation features (Q3) and interactive maps (Q8) were also well received, indicating a strong need for clear and accessible information. In contrast, the digital payment system (Q5) received a lower score, suggesting some uncertainty about its importance. Overall, the findings show strong interest in an application-based service focused on real-time information, navigation, and user convenience.

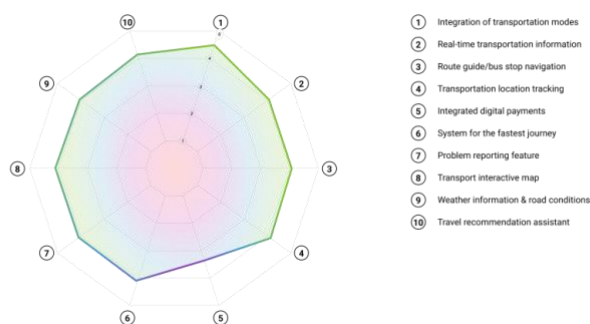


Figure 3. Graph of average questionnaire results
 source: (Alazhari, 2025)

Various perspectives from experts and members of the academic community highlighted both challenges and opportunities in transportation services at Telkom University and other campuses. Mr. Sunarya from VKTR emphasized the importance of digital service integration, such as an intuitive application, an integrated payment system, and feedback features. Mr. Ridha highlighted information accessibility, the limited number of TUC-TUC vehicles, and the importance of electric energy in Insights from interviews and benchmarking highlight several key points for developing campus transportation services. Regular evaluation is needed to improve service quality, supported by regulations that align with existing infrastructure. There is strong potential for integrating AI and IoT to drive innovation, although current services still lack proper evaluation. Issues such as route inconsistencies and the absence of user feedback systems also need to be addressed. Benchmarking from universities such as UI, IPB, and Universitas Padjadjaran, along with precedent technologies like Google Maps Assistant and Siri Navigation, provides useful references for designing a more effective and user-oriented transportation system.

2. Define

This stage sorts data from the first step by making problem statements (Andany et al., 2025). Table 1 compares the user interface design features of the MyTUC-TUC, Bikun Tracker, IPB Bus Tracking, and Lacak Aku (Unpad) applications based on eight aspects such as responsive design, navigation, and automation features. The assessment includes the categories poor (bad), fair (medium), and good to evaluate the quality of each feature. This analysis is useful for understanding the weaknesses and strengths of each application in the development of campus transportation UI/UX.

Table 1. UI Design Feature Comparison Matrix

Design Feature	Mytuctuc	Bikun Tracker	IPB Bis Tracking	Lacak Aku Unpad
Type of responsive design	Medium	Good	Medium	Medium
Navigation menu	Bad	Medium	Medium	Bad
Division of content	Bad	Good	Medium	Medium
Presentation of content	Bad	Good	Good	Bad
Exercises	Hard	Easy	Medium	Medium
Instructions	Bad	Medium	Bad	Bad
Examples and suggestions	Bad	Good	Medium	Medium
Automated features	Bad	Good	Medium	Medium

Furthermore, based on the results of the 360-degree data analysis, it was found that in order to provide optimal services to end users, several supporting systems must be evenly available for each respective task. For example, when a policy is established, the existing facilities must support its implementation effectively.

To ensure that the facilities operate at their maximum potential, appropriate technology is required so that operations become more effective and efficient. In addition, other internal strengths are needed, such as competent human resources and strong financial support, to ensure that the service can run consistently and sustainably.

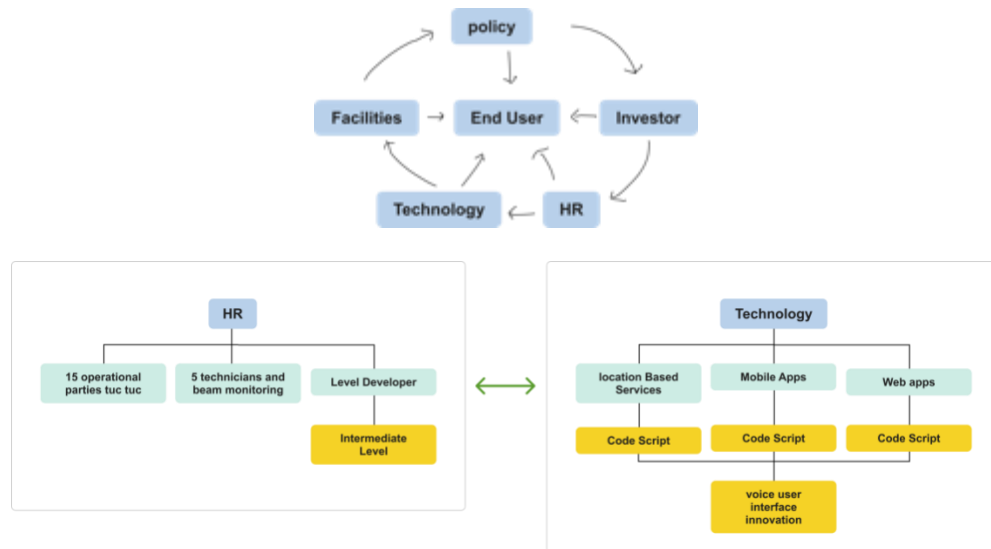


Figure 4. Results of Internal Analysis
 source: (Alazhari, 2025)

In Table 2, each internal and external data point that has been analyzed and from which insights have been obtained can then be further processed using a SWOT analysis to identify appropriate strategies in the ideation stage (Nurdiani et al., 2025).

Table 2. PEST Analysis Insight

Opportunities	Threats
<ul style="list-style-type: none"> Advances in technology (AI, IoT, 5G) enable smarter transportation systems. Students are accustomed to digital services, supporting the adoption of technology-based transportation applications. Campus policy support for environmentally friendly vehicles. Opportunities to partner with technology companies in developing IoT- and AI-based services. 	<ul style="list-style-type: none"> Implementation of advanced technology requires large investments. Regulations regarding data security and user privacy. Competition from external transportation services and third-party applications. Technical disruptions or network instability may hinder application performance.
Strengths	Weakness
<ul style="list-style-type: none"> Existing fleet and route management, although further development is needed. Strong technological infrastructure to support IoT and AI. Collected data on customer journeys, touchpoints, and pain points. Campus community is ready to adopt new technologies. Development of transportation features in the MyTelU application. 	<ul style="list-style-type: none"> The TUC-TUC does not yet fully support the system. Inconsistent schedules and route information. Lack of notifications, maps, and guidance. Limited physical information facilities.

The SO (Strength–Opportunity) strategy was selected as the primary strategy. To leverage technological advancements such as AI, IoT, and 5G, supported by Telkom University’s

infrastructure, an application-based transportation system that is responsive and innovative can be developed. This finding is consistent with service design theory, which emphasizes that user experience is shaped by interactions across multiple touchpoints and becomes vulnerable when information transparency is lacking, particularly in public transportation services (Stickdorn et al., 2018).

By optimizing customer journey data and the MyTelU application features, digital services can be adopted more widely through an engaging user experience. This strategy focuses on developing a Voice User Interface (VUI) to enhance accessibility, deliver an inclusive UI/UX, and support the university's branding.

Table 3. SO Strategy Results

SO Strengths	Design Strategy
<ul style="list-style-type: none"> • Leveraging robust technological infrastructure for a responsive system. • Increasing digital service adoption through an engaging user experience. • Integrating advanced technologies to enhance user experience. • Optimizing existing features through user data. • Designing applications based on inclusive principles for all users. • Technology-driven innovation for a better user experience 	<ul style="list-style-type: none"> • VUI (Voice User Interface) design strategy to enhance technology-based transportation services and create a more inclusive design. • Providing a good User Interface and User Experience for users.

3. Develop

From the collaboration carried out in designing an on-campus transportation mode, the result was an innovative, environmentally friendly cable car fleet that can be used on a mass scale.

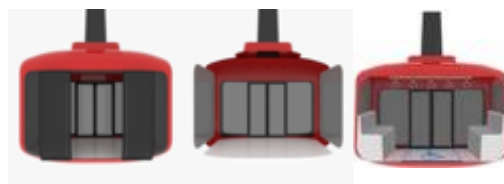


Figure 5. Results of Fleet Design Collaboration
 source: (Alazhari, 2025)






Based on the SWOT analysis and the data collected, the SO strategy was formulated. The campus mobility service design solution focuses on utilizing technology to create a responsive and sustainable system while encouraging the adoption of attractive digital services. The integration of advanced technology, feature optimization, and inclusive design will improve the user experience and support long-term service sustainability (Falahi & Larasati, 2024). A well-designed VUI and UI/UX will ensure that campus transportation services are more accessible, efficient, and aligned with user needs, thereby enhancing overall service performance.

Furthermore, the strategy is executed into a High-Fidelity Prototype. Several visual design aspects are focused on in the application development (Alazhari et al., n.d.), including:

- **Color:** Dark red, in accordance with Telkom University's identity; it is striking and conveys a sense of urgency for transportation services.
- **Font:** Hind font, with high readability, modern, clean, and suitable for a tidy application interface.
- **Assets:** Simple icons, with a minimum size of 20×20 px and a maximum of 36×26 px (Hasanah et al., n.d.); some are sourced from Figma plugins with free licenses.
- **Navigation:** Intuitive, with a bottom navigation menu and clear CTA buttons for main

- **Layout:** Well-organized, sufficient spacing between elements, using a consistent grid system, with padding and component spacing in multiples of 4 and 8.

Table 4. Interface of Design Results

Page	User Interface	Information
On boarding Page		Although the system is functionally designed to produce expected outputs without redundancy(Gorga Alhaq Bukharla, n.d.), an onboarding menu is required to clearly communicate this efficiency to users, ensuring that system workflows are understood as streamlined rather than repetitive.
Push notification		Notifications provide important information such as updated weather news, so that certain transportation modes such as Beam and the cable car cannot operate normally during extreme weather conditions.
Move Assistant		The Move Assistant menu is the main feature of this service. It is designed with intelligent assistance to support a smoother and more enjoyable journey, as visual consistency and clear navigation direction reduce cognitive load and enhance the user experience, particularly for users with visual, motor, or mild cognitive limitations (Sofia Napitupulu, 2025)
Live Map		In the Live Map menu, users can view their current location and determine their travel destination directly through the live map.
Profile		The Profile menu is currently designed to be as simple as possible to maintain system intuitiveness. It serves as a solution for managing user preferences and viewing daily mobility activity history, reflecting the principle that user comfort is shaped more by control over sensory and privacy-related factors than by structural layout alone (Syakira & Saphiranti, 2025)

4. Deliver

Testing refines design through user feedback (Putra et al., 2025). The User Experience Questionnaire (UEQ) testing was conducted with 10 respondents from different backgrounds within the academic community, including lecturers, staff, and students. The testing process was carried out directly, where respondents were given the designed application prototype and asked to explore the application independently without any assistance .

Table 5. UEQ Respondent Data

Time	Respondent Name	Age
29/11/2024 15:40:53	Rafi Raihan Kholid	23
29/11/2024 15:46:41	M.Alait S	25
29/11/2024 15:51:22	Rafi Hafizhni Anggia	28
29/11/2024 17:38:30	Aqillah Rizky	24

29/11/2024 19:32:16	Pratama Putra	25
01/01/2025 17:26:34	Alifian Rahmansyah	32
01/01/2025 18:06:30	Indra Fadhil	32
02/01/2025 16:28:46	Ryan Lingga	33
02/01/2025 16:33:05	Wicaksono	41
02/01/2025 16:33:12	Ricky Indrawan	25
	Muhammad Ridha	25
	Muhammad Rakha	25

After assigning the tasks and questionnaires to the respondents, the data obtained from the completed questionnaires were then analyzed using the User Experience Questionnaire (UEQ). This measurement tool was used to assess the level of user experience satisfaction with the Move Assistant application.

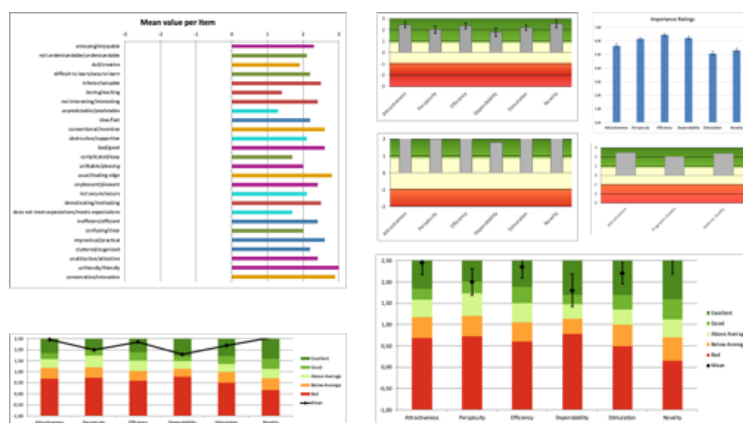


Figure 6. UEQ test results graph
 source: (Alazhari, 2025)

Based on the analysis of the user experience questionnaire results, it can be concluded that the average score per item shows a positive pattern. In addition, the UEQ scale (mean and variance) also produced favorable results. The quality aspects of Attractiveness, Pragmatic, and Hedonic received satisfactory evaluations, with importance ratings above the average. Therefore, this study can be temporarily accepted by users; however, it still requires testing with a larger number of respondents to obtain a more objective assessment.

CONCLUSION

This study concludes that campus mobility services at Telkom University are affected by infrastructure accessibility, fleet quality, information integration, and user satisfaction. Existing services still face limitations in route information, payment flexibility, and fleet capacity, indicating the need for technology-based innovation. To address these issues, the Move Assistant application was developed using the Double Diamond approach, integrating Voice User Interface (VUI) and Internet of Things (IoT) features to provide real-time routes, schedules, and smart navigation. UEQ evaluation results show positive user experience scores across all dimensions, confirming the effectiveness of the proposed solution. However, this study is limited by the number of test participants, and future research should involve more diverse users and explore advanced features for large-scale and sustainable implementation.

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