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A Review of Usability Evaluation Research on Land-Based Transport-Related Information Systems

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Abstract

The utilization of land-based transport information systems depends significantly on their usability, as it influences user satisfaction, decision-making and system adoption. However, the literature suggests that there is limited current knowledge regarding the state of usability research on these systems. This study examined recent research on the usability evaluation of land-based transport information systems, highlighting trends across various system categories, including public transportation applications, ride-sharing systems, mobile ticketing and booking applications and in-vehicle information systems. The study categorizes the evaluation methods employed in different transport contexts ranging from heuristic analyses and user testing to cognitive walkthroughs and surveys. Key usability challenges are identified, including interface complexity, information overload and real-time data accuracy. Furthermore, the review uncovers how qualitative analysis is vital to the identification of usability issues. Further research is recommended for underexplored and emerging land-based transport-related information systems, using diverse and complementary usability evaluation methods. Overall, this study highlights the importance of integrating usability evaluations early and continuously within the TRIS development lifecycle. It also provides a foundation for improving the design and assessment of transport information systems.

Keywords: Usability; usability evaluation methods; usability issues; land-based transport-related information systems.

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Introduction

Land-based transport-related information systems refer to a broad range of digital platforms and technologies designed to facilitate, enhance and manage the movement of people and goods (Dabiri & Heaslip, 2018). These systems have become increasingly important in improving mobility, commuter experiences and transport efficiency in terms of cost and time. They include technologies such as electronic ticketing applications, real-time tracking systems and Mobility-as-a-Service (MaaS) platforms. These technologies support diverse users, including commuters, transport operators, logistics professionals, transport authorities and urban planners. With the rapid digitalization of mobility services, transport-related information systems have become integral to urban and interurban transportation ecosystems (Bartin et al., 2018).

Public transportation applications enable users to buy tickets, plan journeys, contact customer service and find general information about public transportation (Glad et al., 2024; Macedo et al., 2021). Fleet management systems, which are often used by companies promote safety, real time reporting, routing and tracking, staff management, preventive maintenance and diagnostics (Falco et al., 2019). These systems are responsible for assigning drivers, tracking vehicles, observing the drivers, planning for maintenance and monitoring of fuel, ensuring optimized use of resources that ultimately lead to reduction of unnecessary costs (Nowacki et al., 2019).

While mobile Ticketing and Fare Collection systems allow users to purchase and validate tickets electronically (Mesoraca & Brakewood, 2018), automatic fare collection systems make use of Internet of Things by integrating with Radio Frequency ID (RFID) tags, Near Field Communication (NFC), GPS, Bluetooth and Real Time Data Analytics (Couto et al., 2015; de Amorim et al., 2019; Mehta & Aneja, 2024) to detect when a passenger enters and exits from a bus while calculating and processing fare.

A review done by Witvoet et al. (2024) shows that automatic fare collection has been accomplished by using smart cards employing RFID, mobile ticketing through smartphones as well as Bluetooth Low Energy and WiFi beacons. Specific cases can be seen, such as that of Lakhan et al. (2024) who created a ticketing system that used a combination of biometric (fingerprint and face) and QR (Quick Response) code.

Mobile ticketing systems can also be in the form of Online booking applications. Usually integrated in a transport company's website or app, a booking system is a system used to reserve a seat, pay for transportation and collect an electronic ticket (Chen et al., 2022). Intelligent Transport Systems (ITS) is another category of transport-related systems that relies on the Internet of Things to manage traffic, allow for smart parking and detect incidents, such as accidents and drowsiness (Khan et al., 2023). They include traffic management platforms that use sensors, cameras and data analytics to manage congestion and improve road safety (Burger & Guna, 2024). Furthermore, passengers use them through passenger density systems that show how congested public transport is (Meghana et al., 2020; Zhang-Kennedy et al., 2023). Knowledge of congestion levels is important in helping passengers make informed decisions about whether and when to board a particular mode of transport. Such information is also essential for monitoring passenger safety, particularly during public health emergencies such as the COVID-19 pandemic, when social distancing was necessary (Darsena et al., 2025).

Overall transport related information systems reduce costs, save time and optimize the transportation process (Ilchenko et al., 2021). However, despite their growing adoption, the effectiveness of these systems still largely depends on their usability (Stiegemeier et al., 2022). Usability can be regarded as how easily and efficiently users can learn and use a system to achieve their goals. Formally, by the International Organization for Standardization, usability has been defined based on Efficiency, Effectiveness and Satisfaction (ISO, 2018). While it is important to consider safety when transporting people and goods from one point to another, it is also important that users are satisfied with systems associated with transportation (Perrier et al., 2023).

A system that is difficult to use, inefficient or prone to errors can lead to frustration, delay, reduced adoption and safety concerns, particularly in high-stakes environments (Burger & Guna, 2024). In reality if a system is hard to use, people simply do not use it and rather find simpler alternatives (de Amorim et al., 2019). Stiegemeier et al. (2022) investigated how many drivers can use a transport related information system, and found that the perceived ease of use was a critical factor in the use or otherwise lack of use. Given these trends and the role transport related systems play in daily life and economic activity, it becomes necessary to evaluate the usability of Transport Related Information Systems.

Usability evaluations are activities that aim to uncover the degree of usability of a system. They can be conducted while the system is under development, after development but before deployment and after deployment (Hasan & Al-Sarayreh, 2015). Usability evaluations are implemented through methods that have been categorized into testing, inspection and inquiry methods (Gupta, 2015).

According to de Amorim et al. (2019), system usability is critical to user acceptance. However, at the time of their study, no previous review studies had evaluated the usability of mobile ticketing solutions for public transport, revealing a significant gap in transport-related usability research. Similarly, Hussain et al. (2017) examined usability evaluation of transport-related systems but focused exclusively on public transport systems, particularly the metrics and methods applied in usability evaluation. Consequently, existing research remains limited in scope, with insufficient attention given to usability evaluation across the broader range of land-based transport-related information systems, creating a need for a more comprehensive investigation.

Given these limitations in the scope of existing research, this study synthesized recent studies on the usability evaluation of land-based transport-related information systems. Specifically, it compared usability evaluation methods, identified common usability challenges and other key findings and highlighted existing research gaps. Through this synthesis, the study sought to provide a broader understanding of usability evaluation across land-based transport technologies and inform future design and assessment practices aimed at improving system usability and user experience.

Literature Review

Although numerous literature reviews have examined usability evaluation in sectors such as healthcare and education, relatively few have focused on transportation systems, particularly land-based transport information systems. For instance, Ahmed et al. (2022) looked into the acceptance of road transport technologies, using usability, acceptance and adoption as keywords to uncover how different information system theories have been used to measure acceptance. Theories observed included Diffusion of Innovation Theory, Technology Acceptance Model, Theory of Planned Behavior and Unified Theory of Acceptance and Use of Technology, where only the first two contained elements related to usability. Diffusion of Innovation Theory is used to explain how an innovation is accepted in the society, whereby one of the factors affecting this adoption is complexity, also referred to as learnability in the usability context (Masele & Rwehukiza, 2024). On the other hand, Technology Acceptance Model helps to measure the level of acceptance of a user by means of perceived usefulness and perceived ease of use, which constitutes usability (Davis, 1989).

Another study was conducted by Hussain et al. (2017) in form of systematic literature review on metrics and methods used to evaluate public transport information systems. In this study, the metrics most used to measure usability were ISO metrics satisfaction, effectiveness and efficiency while the most adopted method of evaluation was survey. The study also observed that other metrics, such as memorability were not used at all. Furthermore, methods such as heuristic evaluation which is among the popular evaluation methods was also not mentioned which may indicate the lack of maturity of the domain.

A more recent review was by Bhalalusesa et al. (2026), who studied the usability of fleet management systems for the purpose of heuristics development. The study reviewed the current status of usability research related to fleet management systems while particularly focusing on usability issues and heuristic evaluation. The results showed that there were only 23 studies dedicated to the area which adds evidence to the slow progression of usability studies.

Although the reviewed studies show advancement towards usability studies, there are still some gaps that could be addressed. The review study of Hussain et al. (2017) was particularly for public transportation systems, hence giving insight to the state of usability studies in that area. Usability of other transport-related systems remains unaddressed. Similarly, the study of Bhalalusesa et al. (2026) focused on one type of transport related information system, leaving the gap to study other information systems. While Ahmed et al. (2022) looked into all road transport technologies, the review was confined to studies utilizing information system theories, many of which were not related to usability. In order to bridge the research gaps identified, this study entails the usability research done on all land-based transport-related information systems without limitations of usage of particular information system theories.

Methodology

This study presents an analysis of usability evaluations in land-based transport-related information systems, highlighting which systems have been studied, the usability evaluation methods used and the key findings from these studies by adopting a Systematic Literature Review.

Search Strategy

A vertical search for recent articles from 2015 to 2025 was conducted on IEEE Xplore, Scopus, ScienceDirect, Taylor & Francis and ACM Digital Library, using the following terms: usability, user experience, transport systems, vehicle systems and mobility systems. The search resulted in 4,807 publications as seen in Table 1, which were then screened using the inclusion and exclusion criteria. Snow balling was applied whereby references in selected papers were used for backward searching; papers that cited selected publications were used for forward snowballing. The review was confined to land transport related systems only.

Table 1: Literature Sources

SN	Source	Initial Results
1	ACM Digital Library	141
2	IEEE Xplore	469
3	ScienceDirect	2090
4	Scopus	1880
5	Taylor & Francis	227
	Total	4807

Inclusion and Exclusion Criteria

The review included peer reviewed primary studies that were published in English language from 2015 to 2025. These papers must contain information regarding usability of transport related systems that are used for land transport, such as rail and road while clearly showing the method used for usability evaluation and how it was applied. On the other hand, studies were excluded if they were not within the time range specified or contained information regarding usability of transport systems beyond those used on land, such as air and water-based transport related systems. Studies whose methods were not clearly defined or which were discussing land-based transport system but not in the context of usability, were excluded.

Study Selection

The first stage of screening involved removing duplicate studies, where 94 studies were found duplicate and excluded, leaving 4,713 publications. After removal of the duplicates, the papers were screened for language, whereby five were removed because they were written in Indonesian, Danish and Chinese languages, remaining with 4708 papers in English. The titles and abstracts of the selected publications were then screened for the inclusion and exclusion criteria, whereby 4612 were removed because they did not discuss usability of land-based transport-related information systems but rather they discussed sustainability of electric vehicles, road safety, traffic patterns, machine learning and mobility, air mobility, strategies used in ride hailing applications, technology used in TRIS and implementation of transport systems as well as other subjects not in the inclusion criteria. The complete texts of the remaining 96 publications were examined to produce a list of 25 studies, which were thus used to address the research questions.

Results and Discussions

This section presents the results and discussion of the study. Particularly, it discusses the different systems that have been evaluated for usability, the methods used to evaluate these system, key findings and insights within the usability research conducted. The section further determines any gaps present in current research. It is guided by the four research questions.

Research Question 1: What types of land-based transport-related information systems have been evaluated for usability?

There are numerous land-based transport-related information systems spanning from mobile applications, dashboards and panels to embedded systems. These systems serve different purposes in both public and private transport sector. In Figure 1, the review conducted uncovered different systems, which can overlap into different categories among those identified. These include Public Transportation Information Systems, Mobile Ticketing and Fare Collection Systems, Fleet Management Systems, Ride-Sharing and On-demand Mobility Platforms, Mobility-as-a-Service (MaaS) Platforms, In-Vehicle Information Systems and Autonomous Vehicle Interfaces.

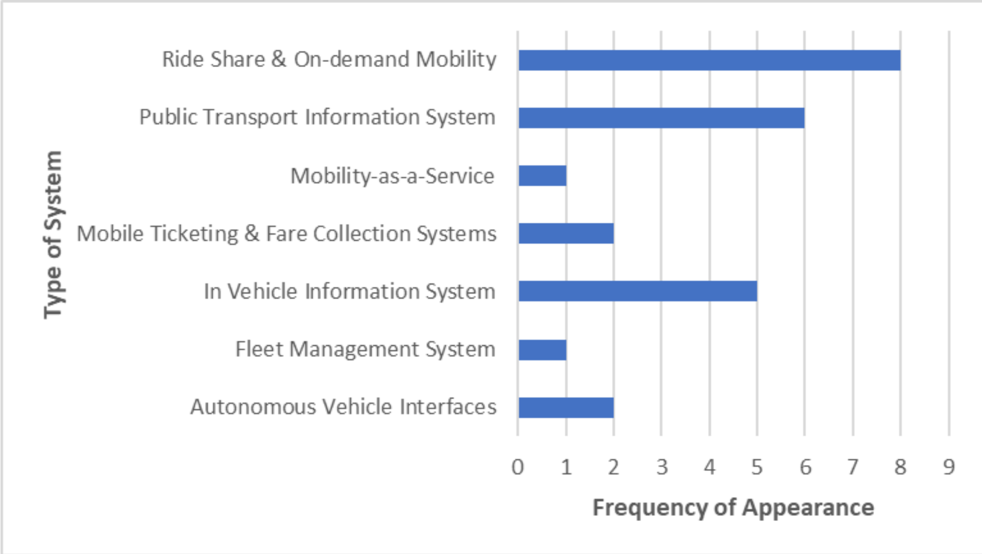

Figure 1: Land-Based Transport Related Information Systems Evaluated for Usability

Figure 1 shows the number of times a Land-Based Transport Related Information System has been evaluated in recent literatureIt can be seen that Ride share (8) and Public Transport (6) are the most evaluated systems. This may be due to their wide spread and usage in the general population. Vanderschuren and Baufeldt (2018) attributed this usage to a high number of people in low- and mid-income status, who do not have their own transport or choose to not use their own transport. It is worth noting that several transport-related information systems, including fleet management systems, autonomous vehicle interfaces and ride-sharing systems, incorporate GPS technologies for navigation and location tracking (Alhwety & Elfadil, 2024; Mancino, 2022; Zaigham et al., 2022). Travel and navigation systems were excluded as a separate category because their navigational functions are implicitly covered within the other identified categories.

Public Transport Information Systems

Usability studies on public transport information systems are found to begin in 2019 by de Amorim et al. (2019) and take prevalence in the 2020s. Attributes used to measure usability included efficiency, ease of use, satisfaction, learnability and utility. However, the most popular attribute was effectiveness (Burger & Guna, 2024; Cardoso et al., 2020; de Amorim et al., 2019; Glad et al., 2024; Putri & Subiyakto, 2021; Zhang-Kennedy et al., 2023). Most of the authors used more than one usability evaluation method (see Table 2). Cardoso et al. (2020) was the only study that used one method of standardized questionnaire to evaluate usability. Among other things the studies revealed that first time users required more time to get acquainted with the systems (de Amorim et al., 2019), suggesting that improvements could be made to the learnability of the systems. This may be due to unclear and incomplete information and items on the system as found by Glad et al. (2024) and Putri and Subiyakto (2021).

Ride-Sharing and On-Demand Mobility Platforms

The findings in Figure 1 show that research on ride-sharing and on-demand mobility systems has gained considerable traction. These systems, sometimes referred to as online taxi systems, facilitate the booking and management of rides using two, three and four-wheeled vehicles for the transportation of people and goods. They also include vehicle rental systems, such as the web-based system proposed by Sahu et al. (2024), which allows users to log in and rent vehicles. Research on the usability of these systems can be traced to Widyanti and Ainizzamani (2017), although no subsequent article was identified until 2020. Since then, seven additional publications have emerged, indicating growing research interest in this area. Most of these studies assessed the usability of specific applications while others examined broader usability-related issues. For instance, Rahman et al. (2020) compared the usability of Uber, Pathao and Obhai mobile applications while Jing et al. (2021) investigated the effects of age and user experience on the usability of ride-sharing applications.

In-Vehicle Information Systems

In-Vehicle Information Systems (IVIS) are integrated into vehicle dashboards through screens, control panels, or interactive interfaces to provide drivers with access to traffic and navigation information, entertainment, communication and broadcasting services (Jiang, 2025). One common type of IVIS is the infotainment system, which combines information and entertainment functions to enhance the driving experience. These systems can be connected to smartphones through technologies, such as Bluetooth, Wi-Fi and USB, enabling drivers to access selected mobile applications and data and device functionalities directly from the vehicle interface while minimizing the need to handle the phone (Cho et al., 2025). Safety appeared to be one of the usability attributes that were published in relation to usability of IVIS (Quiñones et al., 2024). Because these systems require user interaction within the vehicle, their design impacts safety and driving performance; therefore, the time for interaction needs to be reduced as much as possible (Li et al., 2017; Wu et al., 2025b). Safety was also mentioned by Quiñones et al. (2024) whose study included safety as a usability attribute.

Mobile Ticketing and Fare Collection Systems

Mobile Ticketing and Fare Collection systems are widely used; however, the review uncovered that only two studies have addressed their usability. Both studies used dual methods for evaluation, where Bartin et al. (2018) used thinking aloud and User Experience Questionnaire to evaluate a mobile ticketing app for trains in Indonesia while Tobing (2023) used field studies and usability testing to evaluate MyTix mobile ticketing application.

Fleet Management Systems

Another category of land-based transport-related information systems is Fleet management systems, which are used to manage and monitor fleet and personnel handling the fleet. Like the booking systems, usability studies on fleet management systems have not been extensive. This study found only 1 study in 2019 and since nothing else has been published, it shows a diminish in attempts to research the system. Unlike mobile ticketing systems, fleet management systems are less common and this may account for the low rate of usability studies.

Mobility-as-a-Service (MaaS) Platforms

Another system that has been less studied is Mobility-as-a-service platform. Mobility is the ability to move, integrating various forms of transport into a single accessible service, often through an app or dashboard (Chen et al., 2023; Wu et al., 2025a). UrbanFlow Milano is an example of a desktop applications that aims to analyze spatiotemporal mobility data for mobility flow in Milan. It consists of four interfaces, whereby one is a welcoming page, containing a brief description of the application and the three other pages are responsible for visualizing and analyzing movement from the center to different points along the boundaries of Milan, including routes, types of transport, number of trips, time and distance traveled. Delfini et al. (2024) investigated the usability of UrbanFlow Milano, specifically exploring its ease of use and learnability, due to the system's broadness and complexity. Results show that while the platform was easy to use with only aesthetic improvements needed, it was not immediately that way as users required guides in order to familiarize themselves with different operations of the platform. This shows that learnability was still an issue in this system.

Autonomous Vehicle Interfaces

Autonomous Vehicle Interfaces are human-machine interfaces (HMIs) for self-driving cars. A self-driving car or otherwise known as an autonomous vehicle is one that takes advantage of technology to operate safely without the driver. This area is also poorly researched with only two studies by Perrier et al. (2023) and Stange et al. (2025), assessing intuitiveness, efficiency, errors, effectiveness, satisfaction and memorability. It was found that these interfaces should provide comprehensive information to enable drivers to clearly understand the vehicle's status and surrounding conditions while presenting the information in a manner that minimizes distraction. This is particularly important in semi-automated driving, where the driver's primary role shifts from actively controlling the vehicle to supervising the driving process (Perrier et al., 2023; Stange et al., 2025).

Research Question 2: How has usability evaluation for Land-based transport-related Information Systems been Conducted?

There are various usability evaluation methods. However, in the context of land-based transport-related information systems during the time period of the review, the study used only those in Table 2, which appear in recent literature.

Table 2: Summary of Usability Evaluation Methods in Land-Based Transport-Related Information Systems

Usability Evaluation Method	Type of TRIS	Usability Attributes	Source
Heuristic Evaluation	IVIS	Ease of use, safety	Quiñones et al. (2024)
	Public Transport Information System	efficiency, effectiveness, satisfaction	Putri and Subiyakto (2021)
	Ride Share & on-demand Mobility	Unspecified	Firmansyah & Riskinanto (2024); Rahman et al. (2020)
Usability Testing	Ride Share & on-demand Mobility	Efficiency, satisfaction, errors, learnability	Jing et al. (2021); Puspitasari et al. (2023)
	Public Transport Information System	Effectiveness, efficiency	Putri & Subiyakto (2021)
	Mobile Ticketing and Fare Collection Systems	Learnability, memorability, efficiency, errors	Tobing (2023)
	Autonomous Vehicle Interfaces	Learnability (intuitiveness), memorability, errors, efficiency, Effectiveness,	Perrier et al. (2023); Stange et al. (2025).
Thinking Aloud	IVIS	Efficiency, errors, effectiveness	Wu et al. (2025b); Xu et al. (2018); Li et al. (2017)
	Mobile Ticketing and Fare Collection Systems	Efficiency, effectiveness	Bartin et al. (2018)
	MaaS	Effectiveness, learnability	Delfini et al. (2024)
	Ride Share & on-demand Mobility	Efficiency, effectiveness	Widyanti & Ainizzamani (2017)
	Public Transport Information System	Ease of use, learnability (comprehensibility), utility, Efficiency, effectiveness	de Amorim et al. (2019); Glad et al. (2024)
Standardized Questionnaire	Mobile Ticketing and Fare Collection Systems	Satisfaction	Bartin et al. (2018)
	Ride Share & on-demand Mobility	Satisfaction	Hsu & Chen (2023); Liao et al. (2024); Puspitasari et al. (2023); Putra et al. (2024)
	Public Transport Information System	Satisfaction, Ease of Use	Putri and Subiyakto (2021); Glad et al. (2024); Cardoso et al. (2020); Burger & Guna (2024)
	Autonomous Vehicle Interfaces	Satisfaction	Perrier et al. (2023)
	IVIS	Satisfaction	Li et al. (2017)
Field Study and User Survey (Interviews and Questionnaires)	Ride Share & on-demand Mobility	Efficiency, Satisfaction, Errors, Learnability	Puspitasari et al. (2023); Putra et al. (2024)
	Public Transport Information System	Effectiveness, satisfaction, Ease of use, learnability (comprehensibility), utility	Burger & Guna (2024); de Amorim et al. (2019); Zhang-Kennedy et al. (2023)
	Mobile Ticketing and Fare Collection Systems	Satisfaction	Tobing (2023)
	Autonomous Vehicle Interfaces	Intuitiveness(learnability), memorability, errors, efficiency; Satisfaction	Perrier et al. (2023); Stange et al. (2025)
	IVIS	Satisfaction	Payre & Diels (2020)
Cognitive Walkthrough	Fleet Management System	Learnability	Falco et al. (2019)

The reviewed studies demonstrate that researchers have employed a range of expert-based, user-based and field-based evaluation methods, depending on the nature of the system, the evaluation context and the usability attributes of interest. the main approaches identified include heuristic evaluation, usability testing, thinking aloud, standardized questionnaires, field studies and user surveys and cognitive walkthroughs. These methods differ considerably in the type of usability evidence they generate. For instance, Heuristic evaluation and cognitive walkthrough are primarily inspection-based approaches that allow evaluators to identify potential usability problems without relying entirely on direct user performance data. In contrast, usability testing and thinking aloud involve users interacting with the system and therefore provide direct evidence of difficulties encountered during task performance. Standardized questionnaires primarily capture users' subjective perceptions and experiences while field studies and user surveys extend the evaluation into actual or contextually relevant transport environments. Consequently, the methods identified in the literature provide complementary perspectives to usability evaluation.

From the Table 3, it can be noted that standardized questionnaire method has been widely used for usability evaluation across all types of systems, whereby it has been used 11 times while some methods, such as cognitive walkthrough (1) and heuristic evaluation (3) have been less used. Other methods include usability testing (8), thinking aloud (5) and field study (8).

Table 3: Usage of Evaluation Methods

SN	Usability Evaluation Method	Frequency of Usage
1	Cognitive Walkthrough	1
2	Field Studies	8
3	Heuristic Evaluation	3
4	Standardized Questionnaires	11
5	Thinking Aloud	5
6	Usability Testing	8

Heuristic Evaluation

Heuristic evaluation is a method where experts assess the system against established usability principles otherwise known as heuristics. The most commonly used heuristics are Nielsen's 10 heuristics for system interfaces (Jimenez et al., 2016). In transport, both Nielsen and other heuristics have been applied to systems ranging from mobile ticketing solutions, ride sharing systems to IVIS. Specifically, Firmansyah and Riskinanto (2024) compared SMART and Nielsen's heuristics in the usability evaluation of Maxim ride sharing application.

Quiñones et al. (2024) evaluated the usability of in-vehicle infotainment systems using tailored heuristics to ensure that the systems are easy to use and safe, minimizing distractions to the driver. Putri and Subiyakto (2021) used the traditional Nielsen's heuristics to evaluate KRL Access application, which provides train information to users.

Usability Testing

A usability test is one where a user is given a task to complete on the system under observation in controlled environment while researchers observe and record performance metrics, such as task time and errors (Tobing, 2023). Some call it performance evaluation because it focuses mainly on obtaining efficiency and effectiveness of a system (Widyanti & Ainizzamani, 2017; Glad et al., 2024) used this method to evaluate public transport application in Indonesia with ten participants, observing and calculating efficiency and effectiveness after the test. Similarly, Putri and Subiyakto (2021) used 23 participants to conduct usability testing of the KRL Access application, which provides train information to passengers. Tobing (2023) also evaluated the same application, focusing on five usability aspects: efficiency, learnability, memorability, errors and satisfaction. While the first four aspects were assessed through usability testing, satisfaction was measured separately using a questionnaire. Usability testing has also been applied to compare alternative interfaces. For instance, Xu et al. (2018) compared a smartphone-like in-vehicle information system (IVIS) with a traditional IVIS. Within the same category of systems, Wu et al. (2025b) valuated the efficiency and error rate of a touchscreen interface using the "Ease to Use Star Simulator."

Think-Aloud Protocols

When the user verbalizes their thoughts about the interface issues in a usability test, it is called the thinking aloud method (Delfini et al., 2024). In Transportation, several authors have used the thinking aloud protocol, such as de Amorim et al. (2019), who evaluated the usability of a public transport mobile ticketing application called Anda. The authors used eight subjects, where by four were novice and four had experiences with earlier versions of the app. Delfini et al., 2024) used Thinking-Aloud to evaluate the learnability and effectiveness of the UrbanFlow Milano application to determine how expert and non-expert users behave with the system with and without prior direction. A version of this method called retrospective think aloud was used by Widyanti and Ainizzamani (2017), where test subjects completed the test and verbalized their thoughts afterwards.

Interviews and Questionnaires

Results show that previous research has used field studies in the form of interviews and questionnaires to evaluate usability of land-based transport-related systems. In some cases, standardized tools (questionnaires and interview questions) were used while in others, the authors created their own tools. Standardized questionnaires are those that have been deemed as a benchmark for evaluation of usability. This review found several articles that used standardized questionnaires in the evaluation of land-based transport-related information systems. Maxim ride hailing app was evaluated using System Usability Scale (SUS), which measures the satisfaction of a user (Puspitasari et al., 2023). Although the app was assessed as efficient, learnable and less error prone, it still scored lowly in satisfaction.

Payre and Diels (2020) used the System Usability Scale (SUS) to evaluate the usability and acceptance of a warning-based IVIS designed to alert drivers to emergency vehicles, traffic conditions, road signs and sudden braking by other vehicles. SUS was not the only standardized usability instrument employed. Widyanti and Ainizzamani (2017), for instance, used the Questionnaire for User Interface Satisfaction (QUIS) to assess users' satisfaction with a ride-sharing application. Burger and Guna (2024) appraised DARS Traffic Plus mobile application, which receives information from a public cooperative intelligent transport system. The application was scrutinized by the meCUE2.0 standard questionnaire for its effectiveness and satisfaction. Falco et al. (2019) adopted a Mobile Phone Usability Questionnaire (MPUQ) to determine Learnability, efficiency and memorability of a mobile version of Fleet Management System. In some cases, the tools for these surveys were created from existing standard questionnaires. This can be seen in the study by Anghelacheet al. (2025), whereby a route optimizer for a fleet management system was evaluated by a survey that consisted of items adopted from the Website Analysis Measurement Inventory (WAMMI) and Website Usability Evaluation (WEBUSE) tool. Puspitasari et al. (2023) adopted three methods, whereby one of them was interview, which gave qualitative insights to the usability issues in the application, such as the lack of sufficient payment methods. Zhang-Kennedy et al. (2023) used surveys to obtain the user perspective of three intelligent transport systems that showed the crowd condition of public transport; however, the majority of the survey was for assessment of aspects other than usability, whereas only three statements were concerned with usability.

Cognitive Walkthrough

A cognitive walkthrough is an expert-based inspection method that aims to determine how easy it is to learn a system and accomplish tasks (Khajouei et al., 2017). Experts simulate user interactions, especially first-time use, to identify potential stumbling blocks in navigation and comprehension (Farzandipour et al., 2022). Falco et al. (2019) assessed the web-based version of a Fleet Management System using this method with questions to determine if the users can locate what is needed in order to accomplish their task.

Research Question 3: What are the key findings from the usability evaluations conducted in these Studies?

The review revealed different usability needs, depending on the type of system being used/evaluated. The key findings for the Autonomous Vehicle Interfaces, for example, show that users prefer comprehensive information, especially for speed, tire pressure and temperature. Symbols and icons that are difficult to understand can hinder a system's ability to meet users' needs (Perrier et al., 2023). Cognitive load was also highlighted by Cardoso et al. (2020), who found that although gamified transport applications enhanced user engagement, excessive visual elements could distract users from core navigation tasks. In the context of in-vehicle information systems (IVIS), however, usability is influenced not only by interface design but also by driving conditions. Wu et al. (2025b) found that vehicle speed affected usability while Ahmad et al. (2015) similarly demonstrated that road conditions and vehicle speed influenced users' ability to interact easily with IVIS touchscreen interfaces.

Overall, the literature highlights effective visualization and reduced cognitive load as fundamental design principles, particularly for supporting the usability needs of elderly users, who may experience age-related cognitive and perceptual limitations (Li et al., 2021).

The findings by Puspitasari et al. (2023) revolve around timeliness of information, especially that involving routing, arrival and departure time as well as delays and real time information updates in locations and incidents. Furthermore, slow app response times, lag in GPS updates and poor feedback loops were among the top complaints in ticketing and ride-hailing apps. Inaccurate or unreliable real-time data significantly diminishes usability and user trust.

Along with usability, it is clear that for some systems, there is a need for consideration of safety, especially those involving driver interaction with the system while operating the vehicle. Therefore, it may be important to include safety as one of the usability criteria in a usability evaluation. Kalra and Groves (2017) stated that improving usability has positive implications on road safety. Otherwise, it may be useful to evaluate usability of safety features as done by Stange et al. (2025).

In addition, the literature highlights the importance of qualitative evaluations in providing deeper insights into usability issues, as they offer detailed explanations and contextual understanding that help interpret quantitative findings (Zhang-Kennedy et al., 2023; Glad et al., 2024). Cases can be seen from the studies that involved interviews, where users stated the issues they faced. In a study by Perrier et al. (2023), for example, users responded that they found the advance HMI difficult to use because its visualization was too disorderly.

Finally, as stated in earlier sections, a usable system is one that people are satisfied with. It was observed that when researches conducted usability studies, the most researched attribute was user satisfaction (see Figure 2). The prominence of satisfaction can further be attributed to the frequent use of questionnaires and user surveys in the reviewed literature, which are particularly suited to capturing users' perceived satisfaction. Efficiency and effectiveness, on the other hand, reflect a stronger performance-oriented perspective by considering how well users accomplish their intended tasks and the resources or effort required to do so. Together, the prominence of satisfaction, effectiveness and efficiency attributes indicates that the literature broadly reflects the conventional dimensions of usability concerned with users being able to achieve their goals effectively, efficiently and with satisfactory experiences. On the other hand, ease of use, memorability, utility and safety are considerably less represented.

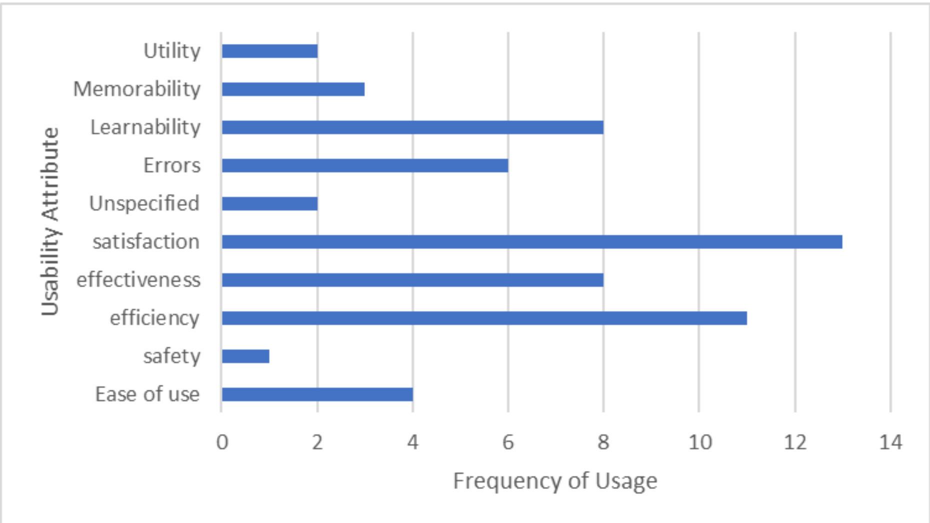

Figure 2: Status of Evaluated Usability Attributes

The limited attention to memorability and utility may indicate that these dimensions have not been consistently incorporated into usability evaluation frameworks within the domain. More notably, safety is the least frequently evaluated specified attribute, despite the safety-critical nature of some land-based transport systems.

While safety may not traditionally be treated as a core usability attribute in all usability models, its relationship with usability becomes particularly important, where interaction difficulties, distraction, misunderstanding or delayed responses can potentially affect transport safety. This is especially relevant to systems, such as in-vehicle information systems and autonomous vehicle interfaces.

Conclusions And Recommendations

This study has uncovered that usability research has been conducted on several land-based transport-related information systems, using user-centered and expert-based evaluation methods to identify and address issues related to information clarity, real-time data reliability, contextual adaptability, and accessibility. While usability research in land-based transport-related information systems exists, there are still gaps stemming from the low number of existing studies. Usability research in land-based transport-related information systems is growing but remains limited and uneven across different types of systems. Existing studies demonstrate the applicability of both user-based and expert-based usability evaluation methods; however, the range of methods applied across transport systems remains limited. Additionally, usability requirements are context-dependent and vary according to the characteristics, users and operational demands of different transport related information systems.

This study recommends that future research broaden usability investigation to less-studied and emerging systems, particularly Fleet Management Systems, Intelligent Transport Systems and Autonomous Vehicle Interfaces while including longitudinal studies and diverse user populations. Furthermore, future studies should employ a wider range and combination of evaluation methods, including heuristic evaluation and cognitive walkthrough, to provide more comprehensive usability assessments. Usability evaluation and design should consider domain-specific requirements alongside established usability attributes, with particular attention to safety, where interaction with the system can affect transport operations and users.

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