

Citizen Perceptions of Intelligent Transportation Systems in Batna, Algeria: Insights From an Exploratory Survey

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ABSTRACT

Intelligent transportation systems (ITS) are increasingly viewed as promising tools for improving urban mobility. However, their relevance depends not only on technological availability but also on how citizens perceive them in specific local contexts. This study investigates citizens' perceptions of ITS in Batna, a medium-sized Algerian city facing congestion, deficiencies in public transport, and limited transport digitalization. It examines citizens' familiarity with ITS, their use of information and communication technologies (ICT) for daily mobility, their assessment of selected ITS services, and their willingness to adopt such services if introduced locally. An exploratory cross-sectional survey was conducted through an online self-administered questionnaire, distributed via social media between August and September 2023. After excluding incomplete responses, 390 questionnaires were analyzed using descriptive statistics and inductive thematic analysis of open-ended responses. Results show strong concern about congestion and public transport dysfunctions. Although the use of mobility-related applications remains irregular, respondents generally expressed positive attitudes toward digital mobility tools. The most valued services were real-time traffic information, real-time public transport information, and electronic payment. Participants also showed strong willingness to use ITS and supported citizen involvement in mobility-related decision-making. The findings suggest that Batna offers a favorable but conditional environment for ITS development where successful implementation will depend on service quality, digital accessibility, trust, and inclusive governance. The study contributes to a more socially grounded understanding of smart mobility in medium-sized cities of the Global South and provides evidence to inform context-sensitive mobility planning in Algeria.

KEYWORDS: intelligent transportation systems (ITS); citizen perception; smart mobility; urban mobility; ICT; Batna; Algeria; exploratory survey

1. INTRODUCTION

Urban population growth has intensified mobility demand and increased pressure on urban transport systems worldwide. This trend is particularly pronounced in developing countries, where rapid urbanization, population concentration, and expanding daily travel needs have amplified long-standing transport systems such as congestion, pollution, road insecurity, and uneven accessibility (Alam et al., 2024; Babu, 2025; Biyik et al., 2021; Faiyetole & Fulani, 2020). Addressing these complex problems has made the improvement of urban mobility a central challenge for sustainable urban development (Alam et al., 2024; Biyik et al., 2021).

In response, information and communication technologies (ICT) applied to transport; commonly referred to as intelligent transportation systems (ITS), have been increasingly promoted as key solutions. These systems integrate digital technologies into transport infrastructure, vehicles, traffic operations, and user information services in order to improve safety, efficiency, and sustainability (Alam et al., 2024; Elassy et al., 2024; Mangiaracina et al., 2017). Typical ITS applications include real-time passenger information, traffic management tools, route guidance, digital ticketing, and user-oriented mobile services. These technologies are now central to the broader smart mobility agenda and are widely presented as essential instruments for modernizing urban transport systems and improving the quality of everyday travel (Alam et al., 2024; Biyik et al., 2021; Mangiaracina et al., 2017; Paiva et al., 2021).

However, the effectiveness of ITS is not determined by technology alone. Recent research highlights that the success of smart mobility initiatives is also shaped by the human factors, particularly how citizens perceive, understand, and accept these systems (Aldona Podgórnai-Krzykacz & Przywojska, 2022; Alonso-González et al., 2020; Dirsehan & van Zoonen, 2022; Golbabaie et al., 2020; Savastano et al., 2023). Factors such as awareness, trust, perceived usefulness, digital access, and willingness to engage with new services all influence whether technological innovations can deliver meaningful improvements in mobility (Alonso-González et al., 2020; Golbabaie et al., 2020; Savastano et al., 2023). As a result, transitioning toward smart and sustainable mobility

requires more than technical deployment; it also demands careful attention to the social conditions under which these systems are introduced (Angarita-Lozano et al., 2025; Dirsehan & van Zoonen, 2022).

This issue is especially critical in developing-country cities where transport systems often operate under infrastructural constraints and where digital transitions are marked by unequal access to ICT, variable internet quality, and limited institutional capacity (Angarita-Lozano et al., 2025; Dodel & Hernandez, 2025; Lopes et al., 2023). In such contexts, citizens may express interest in digital mobility services while simultaneously facing practical barriers to their use; including affordability concerns and digital literacy gaps, which can hinder adoption and exacerbate existing inequalities (Angarita-Lozano et al., 2025; Dodel & Hernandez, 2025; Lopes et al., 2023). Understanding public perceptions at the pre-implementation stage is therefore essential. Such insights help identify priority services for local populations, reveal obstacles to adoption (such as cost or lack of awareness), and support more context-sensitive mobility planning that aligns with both technological opportunities and social realities (Butler et al., 2021).

In Algeria specifically, the transport sector has recently become part of a broader national effort toward digital transformation (Ministry of Transport of Algeria, 2020). However, despite this policy orientation, research on the social perception of ITS remains limited, particularly outside major metropolitan areas. Most existing studies have focused on technological or operational aspects of transport modernization rather than on citizen perspectives. This gap is particularly notable in medium-sized cities like Batna that play important regional roles but remain underrepresented in the literature on smart mobility adoption.

Against this background, this article examines citizens' perceptions of intelligent transportation systems in Batna, a medium-sized Algerian city experiencing growing mobility challenges alongside an ongoing but still limited process of transport digitalization. The study adopts an exploratory survey approach to investigate citizen's familiarity with ITS concepts; their current use of ICT in everyday mobility; their evaluation of selected ITS services; and their willingness to use such services if implemented locally. By focusing on citizen perspectives in an understudied urban context within the Global South, this article contributes to a more socially grounded understanding of smart mobility in medium-sized cities and provides empirical evidence that can inform more inclusive and context-sensitive mobility policies in Algeria (Angarita-Lozano et al., 2025; Mekhtoub & Baouni, 2022).

2. LITERATURE REVIEW

2.1. Intelligent transportation systems and sustainable urban mobility

Intelligent transportation systems (ITS) have become a core component of contemporary urban mobility strategies, as cities seek safer, more efficient and more sustainable transport solutions (Elassy et al., 2024; Mangiaracina et al., 2017; Paiva et al., 2021). By integrating information and communication technologies (ICT) into infrastructure, vehicles, traffic operations, and user services, ITS aim to improve transport efficiency, safety, and system responsiveness through applications such as real-time traffic control, passenger information, digital ticketing, route guidance and connected vehicles services (Elassy et al., 2024; Mahrez et al., 2022; Mangiaracina et al., 2017; Paiva et al., 2021). As such, ITS are widely seen as key enablers of smart and sustainable urban mobility (Paiva et al., 2021; Ribeiro, Paulo et al., 2021).

The literature indicates that ITS can support sustainable mobility in several ways. First, they can improve the operational performance of transport systems by reducing delays, optimizing traffic flows, and facilitating more efficient use of existing infrastructure (Elassy et al., 2024; Mangiaracina et al., 2017; Paiva et al., 2021). Second, they can enhance the attractiveness of public transport by providing more reliable, real-time information and improving travel predictability for users (Aldona Podgórnica-Krzykacz & Przywojska, 2022; Paiva et al., 2021). Third, they can contribute to broader environmental goals by enabling more efficient routing, supporting modal integration and, increasingly, facilitating low-emission or active mobility solutions (Papageorgiou et al., 2024; Patel et al., 2024). In this sense, ITS are not only technical tools for traffic control but part of broader efforts to make urban mobility more reliable, accessible, and sustainable (Angarita-Lozano et al., 2025; Patel et al., 2024; Ribeiro, Paulo et al., 2021).

2.2. Public perception, awareness, and barriers to smart mobility adoption

A growing body of research shows that the success of ITS depends not only on technical performance but also on how these systems are perceived and appropriated by citizens. Studies highlight the roles of public awareness, perceived usefulness, familiarity with digital tools, perceived risk, digital access, and willingness to use new mobility services in shaping acceptance and adoption of smart transport services, connected and automated vehicles and app-based ITS (Aldona Podgórnica-Krzykacz & Przywojska, 2022; Angarita Lozano et al., 2021;

Dodel & Hernandez, 2025). This is especially important at the early stages of implementation, when many smart mobility services are still unfamiliar to users and their benefits remain partly hypothetical from the citizen perspective.

Evidence from diverse contexts suggests that people tend to respond most positively to mobility technologies that address everyday needs, such as real-time information, easier trip planning, or simplified payment. Services that reduce uncertainty and improve convenience are often perceived as particularly valuable. However, the literature also makes clear that favorable attitudes do not necessarily translate into regular use. Citizens may recognize the potential benefits of ITS while still facing obstacles that prevent effective adoption (Angarita Lozano et al., 2021; Dodel & Hernandez, 2025; Lampkin et al., 2023).

Several barriers recur across the literature. These include limited awareness of available services, inadequate digital infrastructure, unstable internet access, low digital literacy, concerns about reliability, and affordability issues. Trust also emerges as an important dimension, especially when mobility services depend on real-time data, geolocation, and mobile transactions. In many cases, users are willing to engage with digital mobility services only if they consider them sufficiently accessible, understandable, and reliable in practice. These barriers are particularly significant in developing-country contexts. Unequal access to the internet, differences in smartphone use, and wider socioeconomic inequalities may create uneven capacities to benefit from ICT-based mobility services. As a result, the perception and potential use of ITS cannot be understood independently from the social and infrastructural conditions in which they are introduced. The literature therefore suggests that public perception of smart mobility is always context-dependent and shaped by the interaction between technological promise and everyday mobility realities.

2.3. Citizen participation in smart mobility planning

Citizen participation and governance have therefore emerged as central themes. Research on smart and sustainable mobility in “responsive” or Global South cities argues that inclusive planning, participatory evaluation and governance instruments are critical to align ITS and smart mobility with local needs and to avoid reproducing inequalities (Angarita-Lozano et al., 2025; Patel et al., 2024; Ribeiro, Paulo et al., 2021). Studies also note that much of the empirical and evaluative work remains focused on technological performance and on large or highly resourced cities, with fewer citizen-centered analyses for medium-sized cities in developing contexts (Angarita-Lozano et al., 2025; Dodel & Hernandez, 2025; Mangiaracina et al., 2017). This gap is particularly relevant for cities with significant mobility pressures and constrained resources, such as many intermediate urban centres in the Global South, including in North Africa, where social perceptions of ITS remain understudied (Angarita-Lozano et al., 2025; Dodel & Hernandez, 2025; Ribeiro, Paulo et al., 2021).

These gaps are especially visible in the Algerian context, where research has mainly addressed transport modernization from technical or operational angles, while the citizen perspective has received less attention. The present study contributes to this emerging strand by examining citizens’ perceptions of ITS in the medium-sized Algerian city of Batna through an exploratory survey.

3. Study context: Algeria and Batna

3.1. Transport digitalization in Algeria

In recent years, Algeria has shown increasing interest in the digital transformation of the transport sector, particularly in the post-pandemic period. This orientation is reflected in the national transport action plan for 2020-2024, which seeks to modernize transport management, improve governance, reduce congestion, and expand the use of digital tools in transport services. Among the actions announced are the development of mobile ticketing, real-time passenger information, traffic information applications, information screens in transport facilities, and digital tools designed to support citizens’ daily mobility. These measures indicate a growing policy recognition that transport digitalization is an important component of broader sustainability and modernization objectives.

At the same time, the implementation of these initiative remains uneven across the country. Major investments in urban transport modernization have primarily benefited large Algerian cities, especially those equipped with tramway or metro systems. Medium-sized cities have received less attention, both in terms of transport infrastructure diversification and in terms of digital mobility services. As a result, the transition toward intelligent and user-oriented transport systems remains spatially uneven and still limited in many urban contexts outside the largest metropolitan areas.

3.2. Batna as a study area

Batna, located in eastern Algeria (Fig. 1), is a medium-sized city that plays a major administrative, economic, and service role within its region. As the capital of Batna province, it concentrates a significant share of public institutions, commercial activities, and tertiary services, which reinforces its attractiveness and centrality (Bendib, 2022). This role makes Batna representative of many rapidly growing Algerian cities that function as regional hubs while facing increasing urban pressures.

The city has experienced strong urban growth and increasing metropolitan influence in recent decades. The concentration of activities and services in the provincial capital has generated important daily flows from surrounding communes, increasing travel demand within the city and between Batna and its peri-urban area. Urban expansion along the main road corridors, combined with the growing interaction with neighboring communes, has reinforced commuter flows and intensified pressure on the urban center. These dynamics have contributed to a mobility pattern that is increasingly shaped by congestion, spatial imbalance, and dependence on private cars.

Mobility pressures are further intensified by the internal spatial organization of the city. A large share of administrative and service functions remains concentrated in the city center, creating recurrent pressure on the road network. Batna's position at a major crossroads, particularly along the RN3 and RN31 national roads, also generates significant through-traffic, which adds to local circulation problems and contributes to persistent congestion.

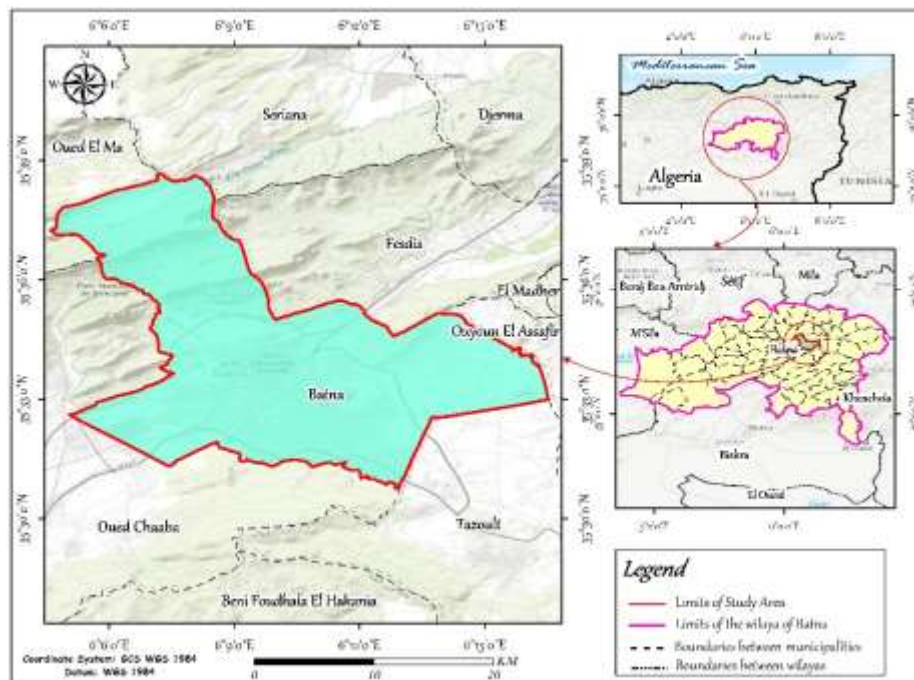


Fig. 1. Situation of Batna city (Source: Authors, 2024)

Public transport in Batna is dominated by the bus system, operated by both private providers and the public urban and suburban transport establishment. While private operators offer broader territorial coverage, service quality and management remain uneven. Public operators generally provide better service quality, but their network coverage is more limited. This dual structure reduces the overall efficiency and attractiveness of public transport and encourages greater reliance on private vehicles. Batna consequently has one of the largest vehicle fleets in the country and is among the most congested Algerian cities.

In terms of mobility digitalization, Batna remains at an early stage. Some information screens have been installed in the main stations, and the public operator ETUS Batna has launched a mobile application allowing users to consult urban routes and plan journeys. However, digital mobility services remain limited in scope and are not yet deeply integrated into everyday urban travel. This makes Batna a particularly relevant case for examining how citizens perceive ITS, which services they consider most useful, and under what conditions such tools may be accepted in a medium-sized Algerian city.

4. MATERIALS AND METHODS

This study adopted an exploratory cross-sectional survey design to examine citizen's perceptions of intelligent transportation systems in Batna, Algeria. Given the limited research on the social perception of ITS in medium-sized Algerian cities, an exploratory design was considered appropriate for generating context-specific evidence at a pre-implementation stage.

Data were collected through an online self-administered questionnaire created using Google Forms. The survey was conducted between August and September 2023 and disseminated through social media platforms, especially Facebook, which is widely used in the Algerian context. The questionnaire was prepared in Arabic and French in order to improve accessibility for respondents. It consisted mainly of closed-ended questions, including dichotomous items and 5-point Likert-scale questions, and also included open-ended questions to allow participants to elaborate on their views, expectations, and concerns.

The instrument was structured into four sections. The first section collected general sociodemographic information. The second explored daily travel practices and perceived mobility problems in Batna. The third examined the use of ICT in everyday life and during daily travel. The fourth investigated respondents' familiarity with ITS and related smart mobility concepts, their evaluation of selected ITS services, and their willingness to use such services if implemented locally.

The study relied on a non-probability online sampling strategy combining convenience and voluntary participation. A total of 401 responses were received, of which 390 complete questionnaires were retained for analysis after excluding incomplete submissions. Because participation was voluntary and internet-based, the sample should not be considered statically representative of the entire population of Batna. Rather, it provides exploratory evidence on the perceptions of a substantial group of citizens exposed to the city's mobility conditions and digital environment.

The analysis combined descriptive quantitative analysis with a qualitative reading of open-ended responses. Closed-ended questions were analyzed using descriptive statistics, including frequencies, percentages, means, and standard deviations, depending on the type of variable. The descriptive approach was consistent with the exploratory purpose of the study, which was to identify patterns of awareness, use, perceived priorities, and willingness to adopt ITS-related services rather than to test causal hypotheses.

Open-ended responses were analyzed through an inductive thematic analysis. Initial open codes were generated from the full corpus, then grouped into higher-order categories and refined into final themes and sub-themes. Representative quotations were selected to illustrate the main meanings expressed by respondents. Quotations were translated into English for reporting purposes, with attention to preserving their substantive meaning. This qualitative analysis made it possible to complement the descriptive results by identifying broader interpretive categories. Together, the quantitative and qualitative materials provided a richer understanding of citizens' perceptions of smart mobility in the study area.

5. RESULTS

5.1. Respondent profile

A total of 401 responses were collected, of which 390 complete questionnaires were retained for analysis. The sample was composed predominantly of women (68.7%), while men represented 31.3% of respondents. In terms of age, the largest groups were respondents aged 30-45 years (50.0%) and 18-29 years (43.8%), whereas older age groups were less represented. Most participants lived in Batna city itself (71.0%), while 29.0% resided in other communes of Batna province, which is relevant given the important commuter flows linking surrounding communes to the city. With regard to employment status, 44.6% of respondents were economically active, 30.5% were students, and the remainder were inactive, retired, or in other situations. Overall, the respondent profile reflects a population strongly exposed to the city's everyday mobility conditions. The sociodemographic characteristics are shown in Table 1.

Table 1. The structure of the sampling

Category		n	%
Gender	Women	268	68.7
	Man	122	31.3
Age	Under 18 years	4	1

	18-29	171	43.8
	30-45	195	50
	46-59	19	4.9
	Over 60 years	1	0.3
Habitat	Batna city	277	71
	Other communes	113	29
Job situation	Student	119	30.5
	Active	174	44.6
	Inactive	73	18.7
	Retired	9	2.3
	Other	15	3.8
Total		390	100

source: authors

5.2. Assessment of current urban mobility conditions

The survey results indicate that respondents perceive Batna's current mobility system as highly problematic. Traffic congestion emerged as the most pressing issue, selected by 78.4% (Fig. 2), of respondents, followed by public transport dysfunction, parking problems, and road accidents. These results confirm that mobility problems in Batna are not perceived as isolated operational inconveniences, but as structural constraints affecting daily urban life.

The evaluation of the bus system (Fig. 3), further highlights the weak performance of public transport. The most frequently reported problems were long waiting times, the lack and inadequacy of bus stops and shelters, and unreliable service, including irregular schedules and the tendency of some buses to skip stops. Reckless driving and speeding were also widely mentioned, as were overcrowding, hygiene problems, poor vehicle condition, limited accessibility, and inappropriate behavior by conductors or fare collectors. Taken together, these findings show that dissatisfaction with public transport concerns both service availability and service quality.

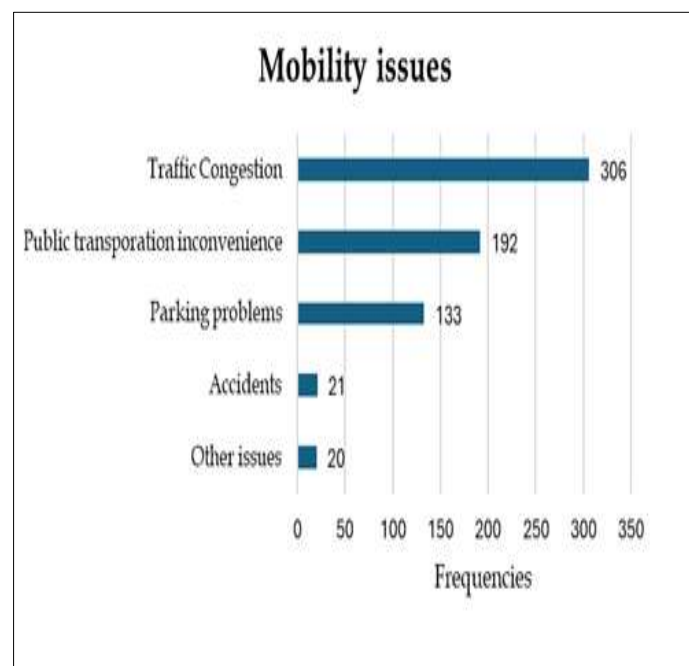


Fig. 2. Assessment of transport issues in Batna (Source: Authors, 2024).

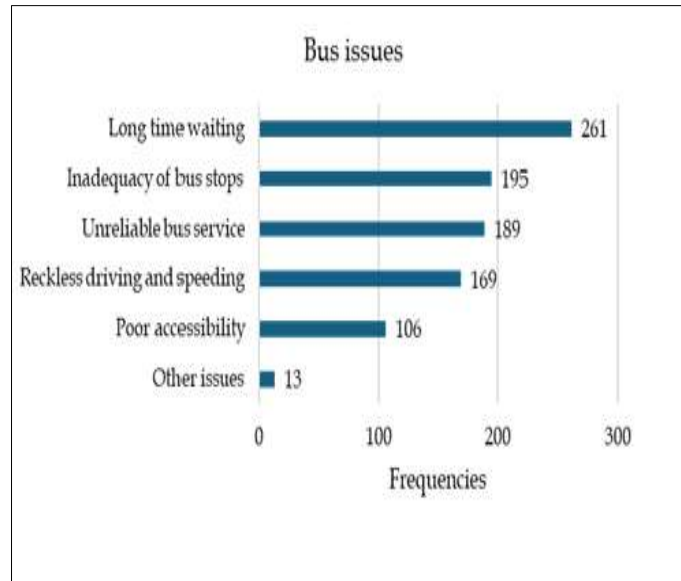


Fig. 3. Assessment of public bus transport in Batna (Source: Authors, 2024).

5.3. ICT access, daily digital practices, and mobility app use

Despite the difficulties affecting the mobility system, respondents reported relatively widespread access to digital tools (Table 2). Permanent internet access was reported by 67.9% of participants, while 85.6% indicated using at least one ICT-based service in everyday life, such as online shopping, delivery services, teleworking, videoconferencing, online medical consultations, or digital financial transactions. This suggests that the population is already familiar with digital practices beyond the transport sector.

Category		n	%
Internet access	Yes	265	67.9
	No	125	32.1
Usage of ITC	Yes	334	85.6
	No	56	14.4
Usage of Mobile apps when traveling	Yes	326	83.6
	No	64	16.4
Total		390	100

Source: authors

In the field of mobility, 83.6% of respondents stated that they use mobile applications when travelling in the city. Respondents also expressed positive views regarding the role of such applications in improving mobility and encouraging public transport use (Table 3). The perceived usefulness of mobile applications for improving urban mobility was rated highly ($M = 4.48$, $SD = 0.694$), and their role in encouraging public transport use also received a high evaluation ($M = 4.47$, $SD = 0.800$). However, actual use remained less consistent than these positive perceptions might suggest. When asked about the frequency of using mobility-related apps during urban travel, only 12.6% reported very regular use, while the largest group indicated occasional use (50.5%). This gap between favorable attitudes and irregular practice points to a context in which digital mobility tools are appreciated in principle but not yet fully integrated into everyday travel routines.

Table 3. Assessment of Mobile Apps Usage Benefits

Mobile apps assessment	%					Statistics		
	1	2	3	4	5	M	ME	SD

Assessment of mobile apps importance In the encouragement of the use of Public transport	1.5	1.5	5.6	31.3	60	4.47	5.00	0.800
Assessment of the utility of mobile apps Usage to improve mobility	0.3	1.5	5.4	35.1	57.7	4.48	5.00	0.694
Frequency of mobile apps used for mobility	10.3	18.2	50.5	8.5	12.6	2.95	3.00	1.086

M-mean, Me-median, SD-Standard deviation

Source: authors

The most commonly used applications were related to mapping, navigation, and ride-hailing. By contrast, local public transport applications, such as the ETUSB app, appeared to be less established in everyday practice. This result suggests that citizens tend to favor services that provide immediate, individualized utility, especially when formal public transport information remains limited or unreliable.

5.4. Familiarity with smart city, smart mobility, and ITS

The survey shows a moderate to relatively high level of familiarity with digital mobility concepts (Table 4).

Category		n	%
Familiarity with smart city	Yes	247	63.3
	No	143	36.7
Familiarity with smart mobility	Yes	227	58.2
	No	163	41.8
Familiarity with ITS	Yes	203	52.1
	No	187	47.9
Total		390	100

Source: authors

A majority of respondents reported being familiar with the notion of smart city (63.3%), while 58.2% indicated familiarity with smart mobility and 52.1% with intelligent transportation systems. These figures suggest that the vocabulary and general idea of smart mobility have already entered public awareness among a substantial share of respondents.

At the same time, this familiarity appears uneven across groups and does not necessarily imply an in-depth understanding of ITS. The descriptive results suggest lower familiarity among some categories, particularly women in the sample, some younger adults aged 18-29, and inactive respondents. More broadly, qualitative comments and response patterns indicate that some respondents associate STI mainly with GPS navigation or ride-hailing services, rather than with a broader range of urban mobility management and information systems. This suggests that awareness is present, but that the concept remains only partially stabilized in public understanding.

5.5. Priority ITS services from the citizen perspective

Respondents were asked to identify the ITS services they considered most useful for improving travel conditions in Batna (Table 5).

Table 5. The priority of ITS systems uses as perceived by the citizens of Batna ,

Group	ITS systems	Selection (%)	Classification
Electronic payment	Electronic payment for public transport	59.6 %	3
	Electronic payment for transportation facility fee	27.0%	10
Real time information	Real-time information on traffic conditions	64.6%	1

	Real-time information on expected delays due to traffic accidents and roadworks	54.1%	4
	Real-time information for public transport users	63.5 %	2
In-vehicle systems	Real-time guidance to vacant parking spaces	45.7%	6
	In-vehicle intelligent transport systems (a message sent to a vehicle or driver to inform them that they have violated a standard: speeding, failure to obey a sign)	39.6%	7
Traffic management	Priority traffic light for public transport	27.3%	9
	Intelligent systems to give priority to pedestrians and vulnerable road users	36.2%	8
Internet connectivity	Internet connectivity for public transport (e.g., intelligent buses)	53.8%	5

Source: authors

The most highly prioritized services were real-time traffic information (64.6%), real-time public transport information (63.5%), and electronic payment for public transport (59.6%). These were followed by real-time information on delays caused by accidents or roadworks (54.1%) and internet connectivity in public transport (53.8%).

These preferences reveal a clear orientation toward user-facing, information-based, and practical services. Citizens appear to prioritize technologies that reduce uncertainty, improve journey planning, and make everyday public transport use more manageable. By contrast, lower-priority services included traffic-light prioritization for public transport (27.3%), electronic payment for transport-related facility fees (27.0%), and intelligent systems prioritizing pedestrians and vulnerable users (36.2%). This does not necessarily indicate rejection of such services, but rather that, under current conditions, respondents give precedence to those applications that address the most immediate and visible deficiencies of Batna’s mobility system.

5.6. Willingness to use ITS and support for citizen involvement

The results also indicate a high degree of openness toward the future implementation of ITS in Batna. Respondents showed a strong predisposition to use ITS services (Table 6) if they were introduced locally (M = 4.49, SD = 0.675), and 95.6% believed that such services could contribute significantly to solving mobility problems. Support was also particularly strong for the role of advanced public transport systems, with 80.8% strongly agreeing that the tramway project could help improve urban mobility in Batna (Table 7).

Citizen participation in mobility-related decision-making was also overwhelmingly supported. A total of 97.4% of respondents agreed that citizens should be involved in decisions concerning mobility and urban transport in Batna. This result is especially important because it shows that respondents do not only express expectations regarding technical solutions. They also see mobility governance as a matter in which public involvement is both legitimate and necessary.

Table 6. Citizen’s predisposition to use ITS

Urban mobility assessment items	%					Statistics		
	1	2	3	4	5	M	ME	SD
Citizen predisposition for using ITS	0.8	0.8	3.3	38.7	56.4	4.49	5.00	0.675

M-mean, Me-median, SD-Standard deviation

Source: authors

Table 7. Assessment of tramway’s role in enhancing urban mobility

Urban mobility assessment items	%					Statistics		
	1	2	3	4	5	M	ME	SD

Tramway's role in enhancing urban mobility	0.8	0.5	4.4	13.6	80.8	4.73	5.00	0.639

M-mean, Me-median, SD-Standard deviation

Source: authors

5.7. Thematic analysis of open-ended responses

The thematic analysis (Table 8) of the open-ended responses suggests that citizens' support for intelligent transportation systems in Batna is conditional rather than unconditional. Across the corpus, respondents generally expressed favorable attitudes toward smart mobility and transport modernization, but they consistently framed these expectations within broader concerns about transport system dysfunction, governance capacity, social readiness, and equity.

A first dominant theme concerns the perceived need for structural modernization of the urban transport system, with the tramway repeatedly presented as a priority solution for congestion relief, service modernization, and improved territorial connectivity. In many responses, the tramway was described not only as a transport project but also as a symbol of urban progress and an essential prerequisite for more efficient mobility in Batna. Several respondents linked its implementation to the replacement of old buses, the improvement of travel conditions for students, and the reduction of traffic pressure on major corridors.

A second theme relates to everyday service injustice and declining transport quality. Respondents frequently referred to overcrowded and aging buses, unsafe or disrespectful driver behavior, arbitrary taxi pricing, insufficient service regulation, and the absence of mechanisms through which users could report abuse or claim their rights. These comments show that the mobility problem is experienced not only as a technical issue, but also as a problem of service dignity, accountability, and ordinary justice in daily travel.

A third theme highlights the demand for practical and user-oriented smart services. Rather than referring to abstract notions of digital modernization, respondents prioritized systems likely to improve daily travel experience directly, including smart traffic signals, surveillance cameras, public transport information, route maps, internet-connected stops, and applications facilitating trip planning and reservations. This suggests that support for ITS is strongest when technologies are perceived as concrete tools for reducing uncertainty and making mobility more legible and manageable.

A fourth theme concerns social and cultural readiness for smart mobility. Many responses emphasized that the successful implementation of ITS would require awareness-raising campaigns, behavioral change, citizen education, and stronger involvement of civil society. In this respect, respondents framed smart mobility not simply as a technical shift, but as a socio-cultural transition requiring collective preparation and shared responsibility between public authorities and citizens.

A fifth them relates to inclusion and unequal access. Respondents repeatedly drew attention to the needs of low-income groups, elderly people, persons with reduced mobility, peripheral neighborhoods, and users with limited digital access. Comments also pointed to inadequate evening and weekend services, poor coverage in some neighborhoods, and concerns that ITS might remain inaccessible if associated with extra costs or unreliable internet. This indicates that citizen's support for digital mobility is closely tied to expectations of territorial, social, and technological inclusion.

A sixth theme concerns governance and implementation credibility. Numerous comments called for stricter law enforcement, stronger regulation of operators, better traffic policing, clearer legal frameworks, adequate budgeting, and more serious implementation of existing transport plans. These responses suggest that, for many citizens, the future success of ITS depends as much on institutional credibility and enforcement capacity as on the technologies themselves.

Finally, a minority of responses expressed skepticism about the relevance or feasibility of ITS in Batna. Some respondents argues that Batna is too small for such systems, that basic road and transport infrastructure should be prioritized first, or that citizens are not yet ready to use advanced mobility technologies. Although less frequent, these dissenting views are analytically important because they nuance the broader pattern of support and underscore that public acceptance remains contingent on local conditions and implementation realism.

Taken together, the open-ended responses confirm that citizens in Batna are not opposed to smart mobility. However, they do not perceive ITS as isolated technological fixes. Instead, they expect them to be embedded in a broader and more credible process of transport reform involving structural modernization, better service quality, stronger regulation, greater social inclusion, and meaningful communication with users. In that sense,

the qualitative findings reinforce the broader interpretation of the study: public support for ITS in Batna is real, but conditional.

Overall, the results reveal a coherent pattern. Respondents clearly identify major mobility problems in Batna, especially congestion and public transport dysfunction. At the same time, they show relatively high familiarity with smart mobility concepts, strong interest in practical ITS services, and a marked willingness to use these systems if implemented. However, the qualitative responses indicate that support for ITS is not unconditional. It is tied to expectations regarding better public transport, stronger regulation, improved digital access, and meaningful citizen involvement. The results therefore suggest that Batna offers a favorable but conditional environment for ITS deployment, one in which technological solutions are welcomed provided they are socially inclusive, operationally useful, and institutionally credible.

6. DISCUSSION

This study examined citizens' perceptions of intelligent transportation systems (ITS) in Batna, a medium-sized Algerian city facing persistent mobility challenges and limited digitalization. Overall, the findings reveal a generally favorable but conditional social environment for ITS development. Respondents expressed strong concern about current mobility problems, especially congestion and public transport dysfunction, while also showing substantial interest in digital mobility services and a marked willingness to use them if implemented locally. However, both quantitative and qualitative results indicate that public support for ITS is shaped by practical factors such as service quality, internet access, institutional credibility, and social inclusion.

A key finding is the gap between positive attitudes toward digital mobility tools and their still limited integration into everyday travel practices. Although many respondents reported using mobile applications when travelling and rated their usefulness highly, regular use remained relatively low. This discrepancy suggests that citizens in Batna do not reject smart mobility tools *per se*; rather, they appear to operate in a context where digital services are not yet sufficiently reliable or embedded in a supportive transport environment. This aligns with broader literature showing that awareness and favorable attitudes do not automatically translate into sustained adoption, especially when transport systems remain operationally weak or digitally fragmented (Alonso-González et al., 2020; Dirsehan & van Zoonen, 2022; Matowicki et al., 2022; Šurdonja et al., 2020). In Batna, mobility apps seem to be appreciated more as promising aids than as fully institutionalized components of everyday mobility. Another major finding concerns the types of ITS services most valued by respondents. The strongest preferences were expressed for real-time traffic information, real-time public transport information, and electronic payment for public transport. These priorities directly reflect the everyday deficiencies of Batna's mobility system as identified by respondents: congestion, uncertainty, irregular bus service, and cumbersome transport use. Citizens thus appear to prioritize user-facing and information-based services that can reduce uncertainty and improve the predictability of daily travel; a pattern also observed in other contexts (McIlroy, 2024; Polydoropoulou et al., 2020; Prabowo et al., 2024; Ramirez-Guerrero et al., 2022). In this sense, the demand for ITS in Batna is not primarily driven by technological enthusiasm, but by the search for practical solutions to concrete mobility problems. The survey therefore confirms that the perceived relevance of ITS is strongest when the technology addresses immediate constraints rather than abstract system-level objectives.

The results further highlight the close relationship between digital mobility expectations and broader weaknesses of the public transport system. Dissatisfaction with the bus network concerned multiple dimensions of service quality, including waiting time, reliability, comfort, accessibility, and passenger information. The high value attached to real-time information systems and electronic ticketing suggests that citizens see ITS as tools to enhance intelligibility and usability of public transport (Ramirez-Guerrero et al., 2022; Savastano et al., 2023). However, qualitative findings indicate that digital solutions alone are unlikely to resolve Batna's mobility challenges if not accompanied by broader service improvements; a point echoed in international research (Angarita-Lozano et al., 2025; McIlroy, 2024). The recurrent emphasis on structural improvements such as tramway development illustrates this complementarity.

Thematic analysis of the open-ended responses further reinforces this interpretation. Citizens do not discuss ITS solely in technical terms; instead, they situate digital mobility tools within broader agendas of transport reorganization, service regulation, and urban modernization (Angarita-Lozano et al., 2025). Notably, the notion of 'service dignity' emerges from comments on unsafe driving, overcrowding, disrespectful behavior, and arbitrary pricing, indicating that mobility problems are experienced as issues of fairness, accountability, and everyday justice as much as technical shortcomings.

Another important result concerns citizen participation. The survey showed overwhelming support for involving citizens in mobility-related decision-making, and this was strongly echoed in the open-ended responses, where respondents repeatedly called for public awareness campaigns, consultation, and stronger communication with users. This finding is particularly relevant because it suggests that the social acceptability of ITS in Batna is tied not only to perceived usefulness of services, but also to the governance process through which they are introduced. Respondents appear to regard mobility reform as a matter that should involve users, civil society, and local actors rather than being driven exclusively by top-down institutional decisions. This supports recent arguments in the smart mobility literature that citizen participation is not simply an additional democratic layer, but a practical condition for designing context-sensitive and socially legitimate mobility solutions (Angarita-Lozano et al., 2025; McIlroy, 2024). In Batna, participation may also be especially important for identifying priority services, anticipating obstacles to adoption, and increasing trust in future ITS deployment.

The issue of inequality and digital exclusion emerges as another central implication of the study. Respondents repeatedly referred to elderly people, low-income groups, persons with reduced mobility, and residents of peripheral areas as potentially disadvantaged by expanding digital transport services. These concerns are consistent with studies emphasizing that smart mobility can inadvertently reproduce or deepen existing inequalities if it depends too heavily on smartphones, mobile data, or digital literacy (Butler et al., 2020; Golub et al., 2019; Shin et al., 2021). This is particularly important in a city such as Batna, where public transport deficiencies already create unequal access to urban opportunities (Fantous & Naceur, 2022). The results therefore support the argument that ITS implementation should remain multimodal and multi-channel, combining digital interfaces with non-digital information and access options. In Batna's context, support for ITS appears conditional upon their inclusiveness.

The study also underscores the importance of governance capacity, regulatory clarity and implementation ability, all of which were frequently cited as essential conditions for future success. Many comments called for stricter enforcement mechanisms, stronger operator control, clearer legal frameworks, and more realistic implementation plans (Angarita-Lozano et al., 2025; Docherty et al., 2018). This underscores that technological readiness alone is insufficient, effective governance structures are equally critical.

Theme	Sub-theme	Brief definition	Example quote
Structural modernization as a prerequisite for smart mobility	Tramway as priority solution	Respondents identify the tramway as the most urgent structural solution to congestion and weak public transport.	<i>"The tramway project is an initial solution to the mobility problem within Batna municipality"</i>
	Tramway as urban modernization	The tramway is associated with modernization, city image, and wider territorial development.	<i>"... the tramway project offers major solutions and gives the city a smart image..."</i>
	Replacement of old buses	Smart mobility is linked to the need to renew the existing, aging bus fleet.	<i>"Old buses must be eliminated and replaced with new buses and a tramway."</i>
	Service to strategic destinations	Respondents connect major transport improvements to student mobility and peripheral growth areas.	<i>"...especially for university students..."</i>
Everyday service injustice and	Unsafe and disrespectful behavior	Comments highlight rude conduct, aggressive behavior,	<i>"...bus drivers drive recklessly..."</i>

declining transport quality		and unsafe driving by transport operators.	
	Overcrowding and discomfort	Respondents stress overcrowding and poor travel conditions in buses.	<i>"Buses in Batna carry so many passengers that the door cannot even close."</i>
	Arbitrary taxi pricing	Concerns are raised about the absence of meter use and lack of fare control.	<i>"...taxi fares are not fixed; each driver sets his own fare..."</i>
	Need for complaint mechanisms	Citizens call for channels to report abuse and defend users' rights.	<i>"...it would be better to have an office we could go to in such cases to file complaints..."</i>
Preference for practical, user-facing smart services	Smart traffic management	Respondents support intelligent traffic lights, cameras, and traffic regulation systems.	<i>"An intelligent traffic-light system connected to a smart system that detects which road has more cars so that the green light turns on faster for it."</i>
	Passenger information tools	Respondents value route maps, timetables, and real-time information for users.	<i>"I hope maps will be available for each bus, either at the station or electronically..."</i>
	Digital access at stops	The idea of connected stops and easier access to mobility apps is positively received.	<i>"Bus or taxi stops with internet connection to make reservations easier and provide easy access to transport applications and schedules."</i>
	Concrete usefulness over abstract smartness	Smart mobility is appreciated mainly when it solves everyday travel problems.	<i>"Accelerating smart transport."</i>
Social readiness and digital culture as conditions of success	Awareness campaigns	Respondents stress the need to educate the public before implementation.	<i>"Awareness campaigns for the public in general, and for drivers and vehicle owners, are necessary."</i>
	Behavioral and cultural change	The success of ITS is linked to changing attitudes and road culture.	<i>"Awareness must be raised, because even if technology is available, there will still be a problem if people's mindsets have not kept pace with technological change."</i>
	Role of civil society	Civil society and local actors are seen as key	<i>"...it is necessary to activate civil society and</i>

		mediators of smart mobility adoption.	<i>spread a culture of intelligent systems...</i>
	Continuous communication with citizens	Respondents emphasize the importance of sharing information with the public.	<i>"Information must always be shared with citizens because they are first responsible for their living environment."</i>
Inclusive, territorially fair, and affordable mobility	Vulnerable users and exclusion risks	Respondents mention elderly people, low-income groups, and people with reduced mobility.	<i>"...elderly people who do not use ICT..."</i>
	Affordability concerns	Smart mobility should remain accessible to economically vulnerable groups.	<i>"...the vulnerable social class may be prevented from using intelligent transport systems unless they are free of additional charges."</i>
	Peripheral and underserved areas	Respondents highlight mobility difficulties in villages, peripheral neighborhoods, and weakly served zones.	<i>"...especially in villages and small settlements..."</i>
	Temporal inequality of service	Comments mention insufficient transport in evenings, weekends, holidays, and Fridays.	<i>"Transport should be provided more frequently, especially in the evening, in remote areas, on holidays, and on Fridays."</i>
Governance credibility, regulation, and implementation capacity	Stronger regulation and sanctions	Citizens call for stricter rules and sanctions for operators and violators.	<i>"Deterrent laws should be imposed by the transport authority on transport owners who insult citizens through their behavior."</i>
	Weak enforcement and institutional failure	Respondents point to poor implementation, favoritism, and weak institutional follow-through.	<i>"Mindsets must change and favoritism must be eliminated."</i>
	Budget and feasibility concerns	Implementation is seen as dependent on adequate resources and realistic planning.	<i>"A sufficient budget must be provided, along with good use of Batna province's space."</i>
	Legal framework for apps and services	Respondents see legal clarity as necessary for transport apps and new services.	<i>"A complete legal solution must be found between the relevant authorities to facilitate the work of app operators..."</i>

Dissenting or skeptical views	Batna perceived as too small for ITS	A minority argue that Batna does not yet require advanced ITS.	<i>“Batna does not need intelligent transport systems; it is a small city and has not reached the level of major cities.”</i>
	Infrastructure-first perspective	Some respondents prioritize roads, interchange, and basic traffic engineering before digitalization.	<i>“...the city simply needs traffic bottlenecks to be relieved first...”</i>
	Doubts about social readiness	Some comments suggest that only a minority of citizens are ready to use such technologies.	<i>“Batna is a dead city; even the citizens are not able to use this kind of technology expect for a minority.”</i>
	Doubts about implementation realism	Skepticism is expressed about whether proposed reforms can be implemented in practice.	<i>“I think these proposals need to be translated into a plan that can actually be implemented on the ground.”</i>

Table 8. Thematic analysis of open-ended questions (**Source:** authors)

From a broader perspective, the Batna case contributes to current debates on smart mobility in medium-sized cities of the Global South. Much of the literature has focused on large metropolitan areas, where digital infrastructure, modal diversity, and institutional resources tend to be more developed. By contrast, Batna illustrates a context in which mobility challenges are acute, digitalization is partial, and citizens are already able to articulate nuanced expectations toward ITS. The findings show that medium-sized cities should not be treated as secondary or derivative cases in the study of smart mobility. On the contrary, they provide important insight into how digital mobility transitions are negotiated under conditions of infrastructural limitation, uneven service provision, and strong citizen demand for practical improvement. These findings should be interpreted considering several limitations. First, the study relied on a non-probability online sample and therefore does not claim statistical representativeness. The findings should be read as exploratory evidence rather than as population-level estimates. Second, the online mode of data collection may have favored participation by respondents who are already more digitally connected, which is especially relevant in a study dealing with ICT and ITS. Third, some age categories, particularly older and minors, were less represented in the sample, which may limit the visibility of certain barriers to adoption. Despite these limitations; which are common in exploratory studies, the research provides valuable insight into citizens perceptions of smart mobility in an understudied urban context, offering an empirical basis for future research and planning.

7. CONCLUSION

This article examined citizens’ perceptions of intelligent transportation systems (ITS) in Batna, a medium-sized Algerian city facing congestion, public transport deficiencies, and a still limited process of transport digitalization. Using an exploratory survey, the study investigated citizens’ familiarity with ITS, their use of ICT in everyday mobility, their evaluation of selected ITS services, and their willingness to use such services if implemented locally.

The findings show that respondents perceive Batna’s mobility system as highly constrained, especially by congestion and the weak performance of public transport. At the same time, they express generally positive attitudes toward digital mobility tools and strong interest in practical, user-oriented ITS services,

particularly real-time traffic information, real-time public transport information, and electronic payment for public transport. This suggests that citizens value ITS primarily when they address immediate and visible mobility problems.

The study also reveals that support for ITS in Batna is favorable but conditional. While respondents show clear willingness to use such services, their acceptability depends on broader conditions, including service quality, internet access, institutional credibility, and social inclusion. The thematic analysis of open-ended responses further shows that citizens expect mobility digitalization to be accompanied by better public transport, clearer regulation, and meaningful citizen involvement in decision-making.

Overall, the article contributes to the literature by highlighting the importance of the citizen perspective in understanding the potential of ITS in medium-sized cities of the Global South. In Batna, smart mobility appears promising not as an isolated technological project, but as part of a broader strategy of transport improvement, inclusive governance, and context-sensitive urban planning. Future research could extend this work by examining specific ITS services in greater detail and by incorporating the perspectives of transport operators, planners, and policymakers.

REFERENCES

1. Alam, T., Gupta, R., Nasurudeen Ahamed, N., Ullah, A., & Almaghthwi, A. (2024). Smart mobility adoption in sustainable smart cities to establish a growing ecosystem : Challenges and opportunities. *MRS Energy & Sustainability*, *11*(2), 304-316. <https://doi.org/10.1557/s43581-024-00092-4>
2. Aldona Podgórnai-Krzykacz, & Przywojska, J. (2022). Public Policy and Citizens' Attitudes towards Intelligent and Sustainable Transportation Solutions in the City—The Example of Lodz, Poland. *Energies*, *16*(1), 143. <https://doi.org/10.3390/en16010143>
3. Alonso-González, M. J., Hoogendoorn-Lanser, S., Van Oort, N., Cats, O., & Hoogendoorn, S. (2020). Drivers and barriers in adopting Mobility as a Service (MaaS) – A latent class cluster analysis of attitudes. *Transportation Research Part A: Policy and Practice*, *132*, 378-401. <https://doi.org/10.1016/j.tra.2019.11.022>
4. Angarita Lozano, D. L., Díaz Márquez, S. E., & Morales Puentes, M. E. (2021). Sustainable and smart mobility evaluation since citizen participation in responsive cities. *Transportation Research Procedia*, *58*, 519-526. <https://doi.org/10.1016/j.trpro.2021.11.069>
5. Angarita-Lozano, D., Hidalgo-Guerrero, D., Díaz-Márquez, S., Morales-Puentes, M., & Mendoza-Moreno, M. A. (2025). Multidimensional Evaluation Model for Sustainable and Smart Urban Mobility in Global South Cities: A Citizen-Centred Comprehensive Framework. *Sustainability*, *17*(10), 4684. <https://doi.org/10.3390/su17104684>
6. Babu, D. B. S. (2025). Sustainable Urban Mobility and Smart Infrastructure: Evaluating Policy Impact in Emerging Economies. *Edulogic International Journal for Multi Disciplinary Research P-ISSN: 3051-2395 E-ISSN: 3051-2409*, *1*(01), 27-38. <https://doi.org/10.63665/eijmr.v01i01.3>
7. Bendib, A. (2022). Analysis of the compatibility of the urban network with the distribution of public facilities and trade in the city of Batna (Algeria). *GeoJournal*. <https://doi.org/10.1007/s10708-021-10373-x>
8. Bıyık, C., Abareshi, A., Paz, A., Ruiz, R. A., Battarra, R., Rogers, C. D. F., & Lizarraga, C. (2021). Smart Mobility Adoption : A Review of the Literature. *Journal of Open Innovation: Technology, Market, and Complexity*, *7*(2), 146. <https://doi.org/10.3390/joitmc7020146>
9. Butler, L., Yigitcanlar, T., & Paz, A. (2020). How Can Smart Mobility Innovations Alleviate Transportation Disadvantage? Assembling a Conceptual Framework through a Systematic Review. *Applied Sciences*, *10*(18), Article 18. <https://doi.org/10.3390/app10186306>
10. Butler, L., Yigitcanlar, T., & Paz, A. (2021). Barriers and risks of Mobility-as-a-Service (MaaS) adoption in cities : A systematic review of the literature. *Cities*, *109*, 103036. <https://doi.org/10.1016/j.cities.2020.103036>
11. Dirsehan, T., & van Zoonen, L. (2022). Smart city technologies from the perspective of technology acceptance. *IET Smart Cities*, *4*(3), 197-210. <https://doi.org/10.1049/smc2.12040>
12. Docherty, I., Marsden, G., & Anable, J. (2018). The governance of smart mobility. *Transportation Research Part A: Policy and Practice*, *115*, 114-125. <https://doi.org/10.1016/j.tra.2017.09.012>
13. Dodel, M., & Hernandez, D. (2025). Smarter but more unequal transport? How socioeconomic and digital inequalities hinder adoption of mobility apps in the Global South. *Travel Behaviour and Society*, *38*, 100911. <https://doi.org/10.1016/j.tbs.2024.100911>
14. Elassy, M., Al-Hattab, M., Takruri, M., & Badawi, S. (2024). Intelligent transportation systems for sustainable smart cities. *Transportation Engineering*, *16*, 100252. <https://doi.org/10.1016/j.treng.2024.100252>
15. Faiyetole, A. A., & Fulani, E. O. (2020). Consideration of Users' Needs in Regard to Planning of Intelligent Transport Solutions in an African Metropolis. *Transportation in Developing Economies*, *6*(1), 7. <https://doi.org/10.1007/s40890-020-0097-1>
16. Fantous, A., & Naceur, F. (2022). L'impact des inégalités d'accès aux transports collectifs dans les quartiers informels sur le quotidien des habitants : Cas de Batna. *Cybergeo: European Journal of Geography*. <https://doi.org/10.4000/cybergeo.39044>

17. Golbabaei, F., Yigitcanlar, T., Paz, A., & Bunker, J. (2020). Individual Predictors of Autonomous Vehicle Public Acceptance and Intention to Use : A Systematic Review of the Literature. *Journal of Open Innovation: Technology, Market, and Complexity*, 6(4), 106. <https://doi.org/10.3390/joitmc6040106>
18. Golub, A., Satterfield, V., Serritella, M., Singh, J., & Phillips, S. (2019). Assessing the barriers to equity in smart mobility systems : A case study of Portland, Oregon. *Case Studies on Transport Policy*, 7(4), 689-697. <https://doi.org/10.1016/j.cstp.2019.10.002>
19. Lampkin, S. R., Barr, S., Williamson, D. B., & Dawkins, L. C. (2023). Engaging publics in the transition to smart mobilities. *GeoJournal*, 88(5), 4953-4970. <https://doi.org/10.1007/s10708-023-10906-6>
20. Lopes, A. S., Orozco-Fontalvo, M., Moura, F., & Vale, D. (2023). Mobility as a service and socio-territorial inequalities : A systematic literature review. *Journal of Transport and Land Use*, 16(1), 215-240. <https://doi.org/10.5198/jtlu.2023.2273>
21. Mahrez, Z., Sabir, E., Badidi, E., Saad, W., & Sadik, M. (2022). Smart Urban Mobility : When Mobility Systems Meet Smart Data. *IEEE Transactions on Intelligent Transportation Systems*, 23(7), 6222-6239. <https://doi.org/10.1109/TITS.2021.3084907>
22. Mangiaracina, R., Perego, A., Salvadori, G., & Tumino, A. (2017). A comprehensive view of intelligent transport systems for urban smart mobility. *International Journal of Logistics Research and Applications*, 20(1), 39-52. <https://doi.org/10.1080/13675567.2016.1241220>
23. Matowicki, M., Amorim, M., Kern, M., Pecherkova, P., Motzer, N., & Pribyl, O. (2022). Understanding the potential of MaaS - An European survey on attitudes. *Travel Behaviour and Society*, 27, 204-215. <https://doi.org/10.1016/j.tbs.2022.01.009>
24. McIlroy, R. C. (2024). "A reservation I have is that presumably no travel app will improve the actual services" : Place based perspectives of mobility as a service. *Transportation Research Part F: Traffic Psychology and Behaviour*, 102, 424-448. <https://doi.org/10.1016/j.trf.2024.03.010>
25. Mekhtoub, Y. K., & Baouni, T. (2022). Impact of the COVID-19 Pandemic on Citizen Travel Rules Related to Intelligent Mobility Use in Algeria : The Influence of Personal Factors and Health Restrictions. *International Journal of E-Planning Research (IJEPR)*, 11(1), 1-27.
26. Paiva, S., Ahad, M., Tripathi, G., Feroz, N., & Casalino, G. (2021). Enabling Technologies for Urban Smart Mobility : Recent Trends, Opportunities and Challenges. *Sensors*, 21(6), 2143. <https://doi.org/10.3390/s21062143>
27. Papageorgiou, G., Tsappi, E., & Wang, T. (2024). Smart Urban Systems Planning for Active Mobility and Sustainability. *IFAC-PapersOnLine*, 58(10), 261-266. <https://doi.org/10.1016/j.ifacol.2024.07.350>
28. Patel, A. R., Ahuja, R., & Roscia, M. (2024). Facilitating Citizen Engagement in Smart City Mobility. *2024 IEEE 4th International Conference on Sustainable Energy and Future Electric Transportation (SEFET)*, 1-6. <https://doi.org/10.1109/SEFET61574.2024.10717973>
29. Polydoropoulou, A., Pagoni, I., & Tsirimpa, A. (2020). Ready for Mobility as a Service? Insights from stakeholders and end-users. *Travel Behaviour and Society*, 21, 295-306. <https://doi.org/10.1016/j.tbs.2018.11.003>
30. Prabowo, D., Pamurti, A. A., Urban and Regional Planning, Semarang University, Semarang, Indonesia, Wahjoerini, W., & Urban and Regional Planning, Semarang University, Semarang, Indonesia. (2024). Citizens needs for smart transportation services in Indonesia : A sentiment analysis approach. *International Journal of ADVANCED AND APPLIED SCIENCES*, 11(6), 156-162. <https://doi.org/10.21833/ijaas.2024.06.017>
31. Ramirez-Guerrero, T., Toro, M., Tabares, M. S., Salazar-Cabrera, R., & Cruz, Á. P. de la. (2022). Key Aspects for IT-Services Integration in Urban Transit Service of Medium-Sized Cities : A Qualitative Exploratory Study in Colombia. *Sustainability*, 14(5). <https://doi.org/10.3390/su14052478>
32. Ribeiro, Paulo, Dias, G., & Pereira, P. (2021). *Transport Systems and Mobility for Smart Cities | MDPI*. <https://www.mdpi.com/2571-5577/4/3/61>
33. Savastano, M., Suci, M.-C., Gorelova, I., & Stăvilă, G.-A. (2023). How smart is mobility in smart cities? An analysis of citizens' value perceptions through ICT applications. *Cities*, 132, 104071. <https://doi.org/10.1016/j.cities.2022.104071>
34. Shin, S.-Y., Kim, D., & Chun, S. A. (2021). Digital Divide in Advanced Smart City Innovations. *Sustainability*, 13(7). <https://doi.org/10.3390/su13074076>
35. Šurdonja, S., Giuffrè, T., & Deluka-Tibljaš, A. (2020). Smart mobility solutions - necessary precondition for a well-functioning smart city. *Transportation Research Procedia*, 45, 604-611. <https://doi.org/10.1016/j.trpro.2020.03.051>