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A METHODOLOGICAL FRAMEWORK FOR EVALUATING SMART TRANSPORT APPLICABILITY IN ALGIERS

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Resume

Intelligent transport systems (ITS), deriving from smart mobility concept, are emerging as a solution to transportation problems using information and communication technologies (ICT) to improve the transport performance and quality. The authors of this work aimed to propose a framework that evaluates applicability of ITS in the public transport sector, using Algiers as a case study and to discover eventual barriers to their implementation. The proposed framework is supported by literature contributing to the question of what barriers are encountered in developing versus developed countries when implementing ITS, this type of ignorance of contextual difficulties leads to calls for conceptual research in this regard. The methodology was illustrated using a matrix of indicators and measuring the applicability index. The result highlighted several barriers to technology adoption in Algiers public transport system and requires acting as a priority on governance and performance indicators according to Algiers context as a North African city.

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1 Introduction

"Transportation systems are of strategic importance, for several reasons: they are the first tool of social cohesion, a powerful element in promoting economic and employment development and establishing an equilibrium between territorial areas with different levels of accessibility". [1] "The basis of its good functioning is to have enough adequate and timely information" [2]. The slightest problem that may affect them will impact negatively the quality of life of citizens and risk of compromising sustainable development objectives [3], which defines that, by 2030, governments should provide access for all to safe, effective, efficient and sustainable transport through the development of a digital environment or context [4].

Digital environment makes us think automatically of "Smart city, which is probably the most in vogue, debated and analyzed concept among researchers and governmental representatives from all over the world" [5].

The ICT enabled smart cities can play a key role in improving transport sustainability through controlling the systems more efficiently, facilitating behavioral changes and reducing energy consumption [6]. They are the source of fundamental changes in terms of travel, transport infrastructure and access to travel data providing the public stakeholders with new knowledge and new tools for control and management in favor of users as their journey can be better programmed in terms of time and combinations of modes, particularly at peak times.

"Intelligent Transport Systems (ITS) is the most common expression used to indicate the integrated application of ICTs to transport" [7] as one of the key tenets of mobility solutions, specialized for data collection, storage and processing and provide expertise in the planning, execution and assessment of the integrated initiatives and policies of smart mobility [8].

"They can be applied to all modes of transport, that is, air, ship, rail and road and to every element of a transport system, that is, the vehicle, the infrastructure and the driver or user, interacting together dynamically" [9]. "Their overall function is to support transport network controllers and other users (citizens, companies and city governments) in the decision-making process"

[10] by providing innovative services enabling them, to be better informed and to make safer, more coordinated and "intelligent" use of transport networks" [11].

"They include a large number of technologies and systems in various stages of development from research prototypes or even concepts, to commercially available products and applications" [12]. Their benefits are perceived significantly through their application particularly in the field of public transport [13].

In parallel with the commitment of the Algiers smart city project aiming to make the capital city smart by 2035, to achieve sustainability and to solve the major problems concerning Algiers, in order to transform it into a cleaner, safer, more modern, more accessible and more attractive city. Several actions have emerged, especially in the public transport, including the launch of the metro, tramway, the modernization of the commuter train and the upgrade of bus network [14]. The question to ask is the context of the transport sector in Algiers sufficiently favorable to the applicability of a smart transportation project? Which barriers need to be addressed for this challenge?

Authors were interested in this work, in exploring the question of technology in public transport in Algiers with an objective to design a framework to evaluate its applicability and draw up, to decision-makers, the priority dimension to be addressed and the conditions to be ensured for planning the transition toward its implementation. The importance of this work is to provide decision makers with a tool to guide their decisions; it should be specified that the framework established is adapted to Algiers as it eliminates obstacles that could affect technology implementation given its particularities, it is based on a comparative analysis between the two contexts (a developed and a developing context) to build up a tool for assessing the smart public transport policy that can be applied to other study cases while adapting it, depending on the objective of the study, by adding or removing indicators or variables. On the other hand, the transport sector is of the major importance in the urban policy in Algiers and the issue of technologies applied to public transport has rarely been addressed before.

2 Literature review

The objective of this step is to provide additional knowledge on the current state of smart mobility and its frameworks, considering the significant gaps in research, as it is still in its early stages [8].

Authors of [8] summarized smart mobility definitions and benefits. Many smart mobility initiatives have been noticed since its implementation, as well as in Germany, Spain, Netherlands, Italy, United Kingdom and France [8]. Intelligent transport system (ITS), as confirmed by previous scientific research, supports the urban smart mobility [9, 15-16]. They have been developed over the years, as a means to solve a variety of transportation problems [17]; particularly in Public Transport they can play a primary role to guarantee a high level of performance and quality of services [18].

For technology deployment in transportation, is highlighted in [18], that it implies appropriate knowledge and prior feasibility and applicability studies aiming to analyze if and how a certain application can be realized additively. Cambpell [19] explained the importance of putting IT in the hands of users who understand it, leveraging learning and mastering following its permanent evolution. However, technology alone does not guarantee successful results by itself; where the solution should extend beyond technology as its accompaniment [18], by an appropriate and functional organization on a permanent basis and by an effective day-by-day operation [20]. Another factor discussed in [18], is regarding the risks of the achievement of intelligent transportation, requiring an adapted approach by political leaders to support planning, transition and implementation process [21] or [22].

As stated in [23], some disappointment was noted according to smart mobility with regards to its techno-centric aspect that refers to the simple application of technology to the mobility system, confirmed also by [9] and its aspect centered on the user as a potential consumer of the services, making the concept too far from the reality of urban mobility in cities. Authors of [8] affirmed that there remains a large gap between the sustainability objectives of smart mobility and their study finds that the range of social, behavioral and cultural issues associated with smart mobility remain understudied. Authors of this article believe that reflection should be more focused on the citizen not just as user and his interaction with the digital world, a smart mobility solution is not just about using less energy or making use of ITC, it is about being able to function as an integral part of a larger system that also regards participation, urban and space quality, human capital, education and learning in urban environments [24], especially the community needs [25]. Then, it is recommended to develop an integrated approach of smart transportation, through the integration between technological and social innovations [26] and sustainability [27]. There are several transportation resources and procedures for intelligent cities that can be considered and adopted by urban centers, such as frameworks, which is a common methodology for the planning and assessment of smart mobility initiatives. With such a growing demand for urban travel comes the need for the scientific community to create tools that they can use to evaluate how practical, effective and safe these new modalities of transportation will be for the general public [8]. Such evaluations will protect different stakeholders involved in the process of developing smart transportation options. Success indicates the effectiveness of the framework put in place by the stakeholders when they see the project come to

fruition -from the planning phase of the project to its completion, confirming already the importance of the regulatory framework' [8].

Authors in [25-29] have adopted this methodology in their work. In [30] are defined six evaluation indicators and their acceptance rankings in the context of a feasibility study on the implementation of smart transportation, a methodological framework highlighting the smartness indicators derived from the capabilities of a smart system has been set up; the matrix of indicators is based on the 6 major criteria of a smart system. Authors of [31] developed a framework for evaluating smart mobility implementation and ranking initiatives in 11 Italian cities, based in three categories of smart mobility, which are accessibility, sustainability and ICT developed in 28 indicators. On the other hand, researchers in [32] introduced a taxonomy of 46 different smart mobility indicators to define the extent of ICT use and the related benefits. Indicators have become common elements in transport planning and policy making. So far, much research on transport indicators has been concerned with their function as suitable measurement tools for various planning and monitoring task, [33]. From the above it can be noticed that the choice of indicators reflects mainly the principles of a smart system, moreover it reflects the existence of an efficient urban transport system in terms of performance and that we are trying to make more efficient through technologies, which makes it very feasible and easy to implement, while in a context where there are constraints of different kinds, relating to urban transportation and ICT deployment, the environment becomes necessarily less favorable, such an environment characterizes the developing countries. It is precisely those constraints that constitute risks to compromise the expected results, as concluded by [18] affirming the need to consider and to deal with them, especially regarding the smart transportation investments.

Benchmarking is a widely used method of learning practices and performances from the best [34], this method is very common as a tool to promote urban policies and to learn from the experiences how to address the challenge of smart mobility on the condition of facing the limitations that may exist according to the contextual differences between the cities. Authors of [18] suggest to define ITS functionalities according to the specific objectives of PT Operators or Authorities and adapt them to the specific context, in particular

Table 1 *Matrix of indicators - part I*

Indicators		Extent of variables	Score
Governance	G1	Availability of legal framework /NA, TP, PC, FC	
	G2	Availability of strategic instruments / NA, TP, PC, FC	NA
	G3	Availability of organising committee / NA, TP, PC, FC	NA
	G4	Cooperation between actors and committee / NA, TP,	NA
	G5	PC, FC	NA
	G6	Periodic evaluation of committee actions / NA, TP, PC,	NA
	G7	FC	NA
	G8	Availability of standards and common language /NA,	NA
	G9	TP, PC, FC	NA
	G10	Coordination /NA, TP, PC, FC	(0)
	G11	Consistency with existing laws /NA, TP, PC, FC	NA
	G12	Return on investments	NA
		Territorial coordination	NA
		Development of specifications and standards	NA
		Practice standards	
Social	S1	Accessibility rate (all modes combined)/ NA, TP, PC, FC	PC
	S2	Respect travel data's privacy / NA, TP, PC, FC	NA
	S3	Availability of equipment at stations/ NA, TP, PC, FC	PC
	S3	Availability of equipment at terminal / NA, TP, PC, FC	PC
	S4	Security on board / NA, TP, PC, FC	PC
	S4	Security at stations/ NA, TP, PC, FC	PC
	S4	Security at terminals/ NA, TP, PC, FC	PC
	S5	Safety against accidents/ NA, TP, PC, FC	TP
	S6	Urgent interventions level at stations / NA, TP, PC, FC	TP
	S6	Urgent interventions level on board/ NA, TP, PC, FC	TP
	S7	Quality of services provided NA, TP, PC, FC	PC
	S8	Comfort on board/ NA, TP, PC, FC	PC
	S8	Comfort at stations/ NA, TP, PC, FC	PC
	S8	Comfort at terminal/ NA, TP, PC, FC	PC

Table 2 *Matrix of indicators - part II*

Indicators		Extent of variables	Score
Performance	P1	Availability of exchange data between actors	TP
	P2	Availability of real-time information for users at stations	TP
	P2	Availability of real-time information for users on board	TP
	P3	Reliability of real-time information for users at stations	TP
	P3	Continuity of services at urban scale	TP
	P4	Continuity of services at regional scale	TP
	P4	Supply absorption	TP
	P5	Energy efficiency	TP
	P5	Feasibility study / (only for tramway, normal panels for the rest),	NA
	P6	Risks study (only for tramway, normal panels for the rest)	NA
	P7	Functional compatibility with existing public transport system	NA
	P8	Functional compatibility with future perspectives of public transport system	NA
	P8	Proportionality with urban planning context (land use planning)	NA
	P8	Intermodality terminals availability	PC
	P9	Integrated pricing and ticketing availability	PC
	P10	Synchronization between modes	TP
	P11	Cost efficiency	TP
	P12	Data sharing and updating	TP
	P13	Extent of coverage	TP
Smartness	I1	Centralized system of controlling PT and data	PC
	I2	Stations equipped with camera	PC
	I2	Public vehicle equipped with camera	PC
	I3	Stations equipped with electrical info device	PC
	I3	Public vehicle equipped with electrical info device	PC
	I4	Public vehicle equipped with sensors	NA
	I4	Stations equipped with sensors	NA
	I5	Terminals equipped with automatic ticket machine	PC
	I5	Stations equipped with ticket validation device	PC
	I5	public vehicle equipped with ticket validation device	PC
	I6	Use of smart card	TP
	I6	Track passenger's movement	NA
	I7	Use of cellular application	TP
	I8	Public vehicle equipped with functioning GPS	PC

with regard to the role of the actors involved and the characteristics of the existing transport services.

Thus, this work is an opportunity to propose a framework that deals with those limitations to eliminate the barriers imposed by the context, especially when there is no an "one size fits-all" solution framework for smart cities [35] and each nation has its unique techniques to meet this challenge, [8].

3 Materials and methods

3.1 Measuring applicability index of smart transportation in Algiers

Using the matrix of indicators and variables (Table 1 and Table 2), appropriate scores for each variable of indicator were assigned. Then, we proceed to the measurement of the applicability index [30], according to:

$$Al_i = \frac{\sum_{i=1}^{J} Si}{V_i} \times 100\%, \quad (1)$$

where Al_i is the applicability index of sub-system i, S_i is score of indicators and V_i is the total number of variables.

The variables are quantified by means of a qualitative scale of four categories [30], the values adopted are 0, 0.33, 0.67 and 1 and they reflect, respectively, the following data of variables of each indicator: NA - Not available (0), TP - Trail phase (0.33), PC - Partial coverage (0.67), FC - Full coverage (1)

It should be noted that variables, derived from the social, performance and smartness indicators, concern all the modes of transport combined (metro, tramway, train and bus); governance indicator reflects variables that concern transport public sector in general.

4 Results

The work is based, with the opinions of experts, on development of a framework with a matrix of indicators and variables to the calculation of the applicability index. It is then proceeded, using the Analytic Hierarchy Process method (AHP method), to prioritize the indicators selected for the framework to define the weights and rank the indicators.

Smart Transportation Framework: This framework was developed based on a depth analysis of the existing literature concerning intelligent transportation system, smart mobility and smart city as well as the experiences of other cities and experts' recommendations

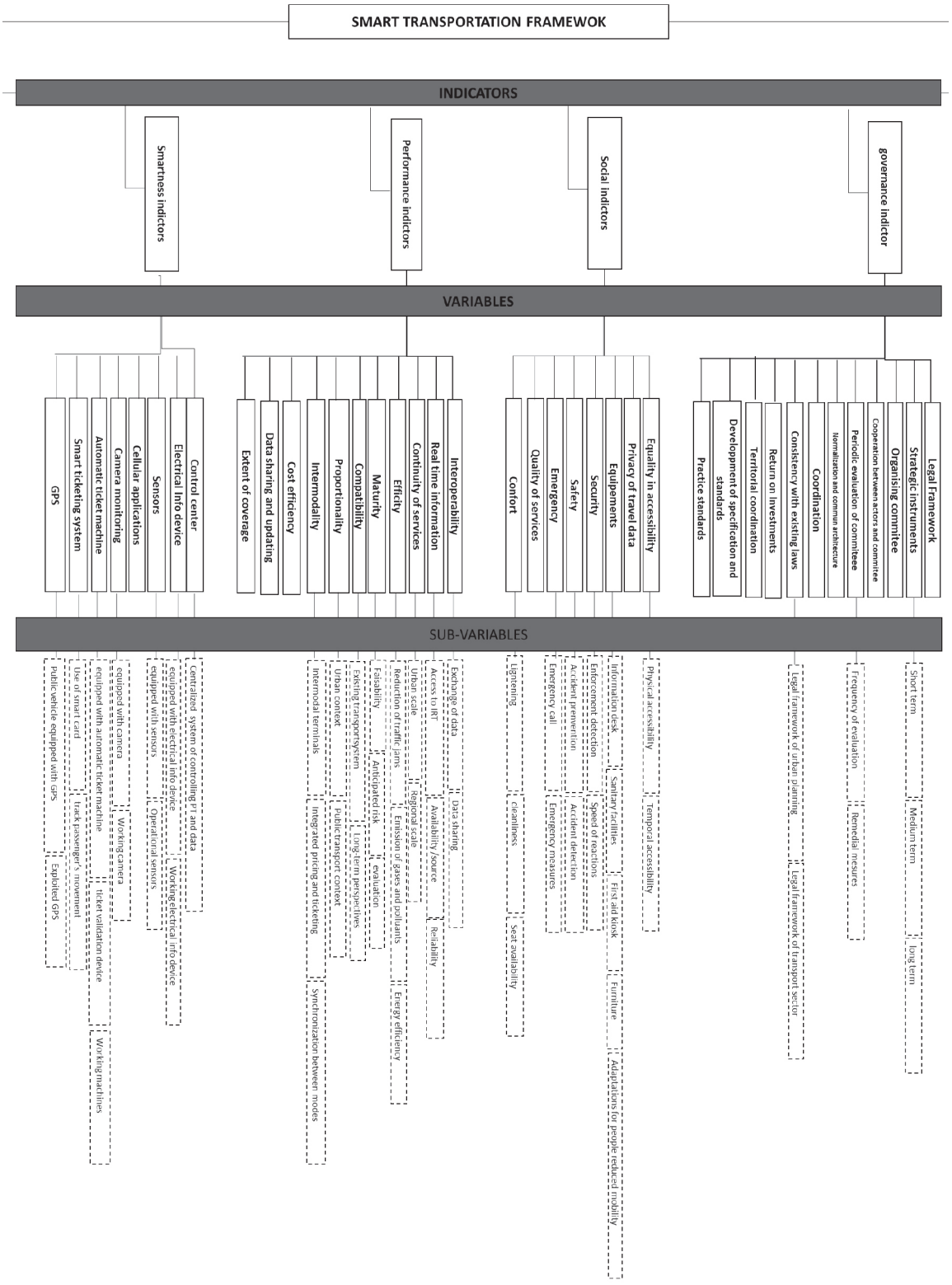

Figure 1 *Framework's structure*

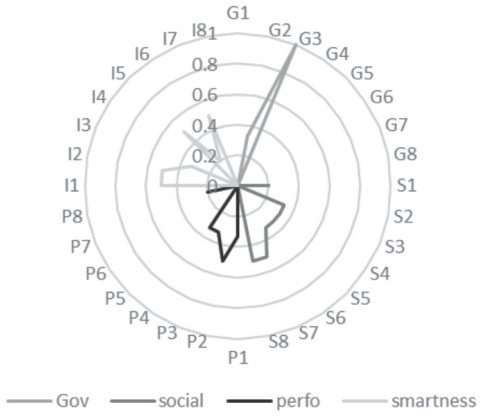

Figure 2 *Indicators share*

on the subject, it considers the particularities of the case study as a developing city. Beyond the technological aspects; authors were interested to find out what is the planning process within, since, it is nearly impossible to provide a framework for smart transportation deployment that can be applied everywhere, as there are differences that exist between cities, particularly in terms of transportation (the level of development, the level of transport infrastructure and the priorities set within the policy of each city) , the most important point to remember is that cities can learn from the experiences of others, as long as they take into account possible contextual differences and thus accelerate their own plans. The framework is based on chosen indicators, which are important tools for policymaking and revealing elements towards the key objectives [36]. The indicators that were chosen cover the essential dimensions of smart transportation integration and implementation that should be considered in terms of planning, management and functioning listed below. Each indicator has its own set of variables covering both quantitative and qualitative aspects leaving a final set of 39 variables as shown in Figure 1.

Governance indicator: referring to the policy and management principles of the transport system that should accompany the deployment of smart transportation in order to frame it, organize it, govern its operation and adapt it to the urban context, particularly on the social level, where solutions must be adopted in order to reward responsible behavior and punish the wrong attitude from users [37].

Social indicators: refer to characteristics that particularly affect the transport users, as long as they are the first concerned to be involved, informed and aware since they are the departure point and the purpose of any smart city project [38].

Performance indicators: refer to the functional characteristics of the transport system to ensure its performance in meeting current needs and its ability to make a change or transition to a technology-based strategy.

Smartness indicators: related to ICT technologies assigned to transport infrastructure as stated by [30], that the availability of a good level of infrastructure would indicate that the city has the potential to deploy the smart technologies.

4.1 Applicability index of smart transportation in Algiers

The result obtained through this work is presented below, a very low rate of applicability of technologies on public transport in Algiers (25.25 %), the parts of different indicators expressed by qualitative scale is very small, as shown in Figure 2. The indicator with the lowest share is governance followed by performance indicator, the social and smartness indicators have registered a slightly higher share than the previous ones, but in general remain low.

4.2 Prioritization of indicators

Using the Analytic Hierarchy Process method (AHP), [39] the binary comparison matrix was formed

Table 3 *Indicator weights*

Indicators	Governance indicator	Performance indicators	Social indicator	Smartness indicator	Weights
Governance indicator	0.800	0.662	0.535	0.096	0.4482
Performance indicators	0.277	0.220	0.321	0.872	0.4225
Social indicator	0.166	0.072	0.107	0.193	0.1345
Smartness indicator	0.055	0.906	0.035	0.010	0.2512

Table 4 *Classification of indicators*

Indicators	Classification
Governance indicator	2
Performance indicators	1
Social indicator	3
Smartness indicator	4

Coherence index = 0.0553

consistency ratio = 0.058 < 0.1(acceptable)

and then the weights of the different indicators were calculated (Table 3) considering the opinion of various researchers and experts working mainly in the transport sector in Algiers and researchers in this theme.

According to the results in Table 4, performance is the priority indicator for public transport to optimize the applicability of intelligent transport in Algiers, followed by governance, then social and smartness indicators.

5 Discussion

After getting the result of measuring the applicability of intelligent transportation system in Algiers and the share of each indicator, we opted to discuss the related causes behind that we will call barriers through investigations. The database of Algiers, relating to public transport, was not at our disposal, so we had to create one.

The low rate of governance indicator is related to the non-existence, in Algeria, of laws governing ITS deployment in the transport sector, as stated by [38] that current legislation is a major obstacle to ICT expansion in Algeria.

The low performance rate of public transport can be explained by the following realities gathered from our on-site investigations:

- A very limited radius of the multimodal offer of PT in Algiers has been noted, where only one municipality benefits from the four modes combined, 34 municipalities have access to only one mode, the bus. As previously discussed by [40] that the transport plan, defined in the Master plan for urban development and planning [41], is supposed to be multimodal, based on the metro, tramway and bus network in common areas. However, the rail network has not been integrated and services to new interior urban areas have not been considered. On the other hand, we also evoke the new city of Sidi Abdallah located in the southern suburbs of Algiers and designed to receive 320,000 inhabitants, leaving us to reflect on the flows to be generated and travel needs to be managed.
- The degree of interconnection between the four modes combined is very low and their synchronization in time is almost non-existent. It presents a problem previously studied by several researchers, including [40], who highlighted the lack of connections between the public transport lines and the inadequacy of multimodal services (ticketing, interoperability) applied to all the operators.
- The low territorial coverage of metro, tramway and train, explains the limited physical connection between them. To date, the bus is the dominant mode of transport in Algiers covering 62 % of the territory, including 59 municipalities and this is mainly due to the integration of private buses, which have improved the quantity but not the quality of the bus offer expected by users.
- Real-time information is indispensable nowadays, it offers the possibility to access the information system online via smartphones [5], we have noticed for the case of Algiers, restrictions in the sharing of data to users, as well as the inexistence of a smartphone application that provides data concerning public transport traffic. For this reason, users, once at stations, will be able to get information from signs or service agents.
- On board the train, metro and tramway, the information provided through micro-speaker concerns the route and the stations covered, while at stations only the tramway indicates reliable information concerning the arrival and departure times of vehicles. The routes and train schedules are fixed, but reflect a low level of reliability. There is no information about buses traffic and schedule either inside the vehicle or at stations, except the destination panels.

Social indicators are negatively impacted by endogenous and exogenous factors to the transport system affect users in terms of their interactions and exchanges in the ICT deployment process without losing sight of the risks resulting from their involvement. Authors of [38] found that, there can be no smart city without citizen involvement and participation. To discuss of the social indicators, share, a survey was conducted in this research, as a crowdsourcing technique for getting ideas and content from citizen through the internet-based platforms, [42]. It is increasingly used in academic research according to its easy access mode [43], known by many terminologies such as social search [44]. This method of survey research is widely used in Algiers by scholars due to the unavailability of comprehensive and up-to-date data and statistics in several public sectors, obliging researchers to remedy this either through field investigations or online surveys. The content analysis

is direct and qualitative and was carried out using SPHYNX IQ2 software, which allows to understand the data and clearly visualize the significant elements of the survey. The URL of surveys was distributed through social media in July 2019 concerning only Algiers. The public transport services analyzed were tramway, metro, commuter train and bus. (As for the rest of these modes, their share of urban travel is minimal compared to the modes mentioned above). The survey contained some questions related to users' travel habits and socio-economic characteristics: age, socio-professional category, reason for travel. Some changes have been made as removing inappropriate responses, changing the order of sections, reformulating the way some of them were introduced and so on. It led to the following findings:

- A large proportion of users have not been made aware of such deployment and are not yet familiar with technologies and have a poor grasp of the integration, to the digital world, whether through ignorance or lack of mastery, or they require access. Especially since the term, smart mobility, is still utopian for citizens who consider it far from the reality of the Algiers context, exactly as the case of the Smart City project, [38].
- To this end, the in-situ observation revealed public transport stations equipped with unattended ticketing machines where users prefer, due to a lack of mastering, to waste their time queuing, many machines have been out of order for a long time. According to authors' vision, it is believed that a significant portion of users do not trust the technology because they have not perceived its true benefits up to date.
- Accessibility (Physical and temporal accessibility): Another determining factor concerns the inequalities in terms of access to public transport; it is noted that bus is the only accessible mode in terms of time and distance, despite of other modes.
- Safety and security: Public transport systems can use ITS solutions to improve actions to prevent road accidents and fatalities, which are particularly common in developing cities such as Algiers [45]. Users have attested to the insecurity of public transport in Algiers particularly buses. The tramway with its easy physical access (without validation barriers and absence of security guards at all stations), has become more vulnerable to incidents, there have recently been traffic accidents that involved the tram and private vehicles, similarly, the commuter rail experienced an accident in November 2014 that resulted in one death and 63 injured people [46]. In addition, the fact that the traffic lights at intersections with the mechanical tracks are not checked and respected increases the risk of accidents.
- According to users, the safest mode of PT is the metro, since its access is conditional on the payment and validation of tickets and the permanent presence of security guards. As regards its safety against accidents, it is more satisfactory since it requires a dedicated site (no physical connection with other modes).
- Supply and services quality: The improvement of service quality does not only mean to invest money in advanced technologies, but to prioritize actions that influence the level of quality perceived by customers, as well, [47]. The entry into service of private bus operators in 2013 has increased the capacity to accommodate users, leaving a common handcrafted nature of their services [48-49], such as the appearance of a multitude of inexperienced operators; the heterogeneity of equipment (types and size of vehicles); the inadequacy of reception infrastructure for a good care of the users; the non-respect of stops, frequencies and schedules [50].
- Regarding users' satisfaction, metro users are more satisfied than tramway and commuter train users in all the common attributes characterizing the services.

The share of the smartness indicator can be explained by the current level of public transport infrastructures where we highlighted difficulties with the integration of technologies into public transport infrastructures regarding vehicles, stations and terminals detailed below. According to the on-site investigations and research, the following realities have been identified:

- Public buses have no functional GPS, cameras and sensors (15,000 buses in much deteriorated condition,) which are key elements providing users with the real-time data on arrivals and departures of public transport, [37].
- Bus stations have no ticket machine, cameras, receivers or electrical info devices and the sale of tickets is only done by agents inside public buses and by unqualified individuals inside private buses, sometimes or, as underlined in [37] that from a user's perspective, smart ticketing solutions may use smart cards or mobile phones to make ticketing more efficient. In some bus stations in Algiers, intelligent bus shelters were recently installed, whose interaction with buses for the display of IRT is not functional since buses are not adapted. It should be noted that there is a lack of cooperation by some users in terms of purchasing and validating tickets, the only mode in which tickets are validated is the metro, following the installation of validation barriers at the entrance, obliging users to buy and validate tickets to get there.
- For the tramway, there are no access barriers, the validation machines at the stations are no longer functional and users have become accustomed to not validating their tickets by using them for several journeys until counters have been installed at each station selling validated tickets valid only

for a single journey. There no internet applications in the public transport sector in Algiers, except for train.

- There are some applications developed by private individuals for example of TEMTEM, YASSIR and COURSA, conceived as UBER principle without a legal basis and concerning private transport, that are widely used, according to the survey, which accentuates the problems by further increasing the traffic as an alternative to public transportation. Some users make use of social media where administrators of some Facebook pages, for example of INFO TRAFIC ALGER, where subscribers share information about traffic during their travel (critical traffic points, accidents, siding in case of public works on the road…etc.).

After measuring the applicability index of smart transportation in Algiers and the scores of the selected indicators, the data collected from these investigations just confirmed the existence of barriers hindering Algiers' transition to a smart public transportation system, the most critical of them are:

- no laws, conventions or standards covering the deployment of smart transportation or ICT in transportation,
- The inexistence of equipment related to the smartness, such as detectors and sensors responsible for the reception and the detection,
- The existence of cognitive difficulties of the citizens related to the knowledge acquisition in terms of ICT deployment applied to transport,
- The existence of technical difficulties related to existing public transportation infrastructure that impact their synergy with smart technologies.

6 Conclusions

The overall objective of this article is to demonstrate the need for smart transportation integration in public transport in Algiers and to give importance to how it should be deployed by focusing on the adapted framework to be prepared for their implementation giving each constraint its right estimate.

To evaluate smart transportation applicability in public transports in Algiers, authors highlighted an adapted framework by benchmarking ITS deployment and then calculated its applicability index, which showed a very low rate.

Authors were then interested in ranking the indicators in order to decide on priorities for the coordinated adoption of smart transportation in public transport in Algiers, which highlighted public transport governance and performance as priorities that should be addressed first.

The main conclusion of the study is that the implementation of smart transportation should be included in the sector's priorities. Nonetheless, it may constitute a risk since many strategical objectives are not achieved acting as a barrier and making their achievement as important as smart transportation deployment particularly on the governance and performance plan.

The result of this study emphasizes the requirement of remedial priority actions related to governance and performance indicators in favor of preparation of a transition framework that accompanies smart transportation implementation in Algiers.

Authors suggest, to give priority firstly to the issues, as previously found by [49], at the institutional, organizational and regulatory level that hinder the current development of the transport system and secondly to the risks of smart transportation integration, particularly at the social level, since they condition the success of smart transportation and risks compromising their expected benefits. Thus, the confrontation of these barriers becomes a priority, such as the commitment to deployment of technologies in public transport, where technology cannot solve current problems but rather optimize their solutions, in other terms; they are more likely to complement each other.

The particularity of this work lies in the fact that it does not seek to propose intermediate or palliative solutions to transport problems, but rather to reflect on the process of adopting new technologies, especially with Algeria's commitment to a Smart City project where transport and mobility are key dimensions to be integrated into this project. In authors' opinion, these technologies can optimize definitive long-term solutions, while benefiting users primarily.

Another important aspect that was taken into consideration in this work is public participation through the survey recognizing the different views of public transport users in order to identify the cultural context, such as their attitudes and perception towards the transport technologies [51], as long as they constitute the basic element in the transport chain.

After being acquainted with the ITS deployment at the theoretical level, it would be opportune to direct the research perspective towards the most used technologies ICT [52], in order to define, in the case of Algiers, the applications most adapted to its context and try to customize them as they have an unavoidable contribution in the transportation sector.

One of the limitations in this study is the non-elaborative simulation and modelling exercise to predict the positive impact that the coordinated deployment of intelligent transport systems would have on public transport in Algiers and this is mainly due to the unavailability of sufficient data.

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