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EVALUATION OF SOCIO-ECONOMIC VARIABLES FOR THE CONSTANTINE TRAMWAY LINE

Summary. The Constantine tramway line in Algeria has many variables that can be analysed to assess the impact of the line. These variables include social ones, such as the rational supply of transport between different modes of travel, the place of people with reduced mobility in the supply and interior and exterior design. Moreover, the economic variables that are the most dominant in relation to its importance in the development of the economy of the city are the reliability and comfort made to the regularity of the transport time in relation to time savings and intermodality at stopping points. To this end, this article examines these different variables during several commissioning periods in order to determine the impact of the introduction of the tramway line in the Constantine metropolitan area. Its approach is carried out through a field survey, interviews and on-site observations with a population made up of users of different travel modes. The results confirm that the tramway line linking the city of Constantine and the new town of Ali Mendjeli has a strong effect on ridership. On the other hand, its effects seem minimal in terms of rational supply and intermodality between different travel modes. Meanwhile, reliability and regularity are topics that deserve to be explored. The accessibility of people with reduced mobility is considered a primary objective of the tramway system.

1. INTRODUCTION

Public transit is considered an important factor in any social and economic development of a city because it is fundamental in the life of societies where there is continuous movement [4, p. 35; 10, p. 1; 13]. It allows the mobility of individuals in their social activities and brings together a plurality of different activities and services. When the means of transport do not exist or are minimised, as they are in many developing countries, economic activity remains in the substance and self-consumption stage. Hence, priority must be given to transport in order to promote the development of these regions.

Public transport is the key to sustainable mobility [1, p. 28; 3]. Over the past decade, various studies have shown a hierarchy of performance, such as speed of travel, while considering wait and transport times. From a social point of view, public transport must make most urban life functions accessible to

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all at a moderate cost. Transport networks can then set up high-occupancy express lines with a higher commercial speed to avoid wasting time at low-occupancy stops.

To this end, innovations in the field of public transport are necessary for their survival. Some of them, when implemented, respond to changes in demand and thus to concerns of cost optimisation. Public transport must not only adapt to new needs resulting from, for example, peri-urbanisation or the ageing of the population, but it must also follow current ideas.

Transport plays a vital role in the economic and commercial development of countries and, consequently, in the well-being of their people. Transport systems need to be sustainable from economic, social and environmental perspectives to meet the demands of enlargement and sustainable development. However, currently, the road transportation mode is being increasingly criticised because of its major negative impact on the environment and public health [9, p. 324].

Rationalising the supply of transport is done with the restructuring of transport networks and the development of alternative transport modes, especially in peri-urban areas. In the 1990s, when supply was the dominant idea of creating demand, clean-site public transit was developed to structure networks while giving communities an urban brand. Today, the need to link the choice of mode of transport to demand facilitates complementarity between the different modes of transport and reduces the premiums of each trip. This rational supply requires several measures that are likely to improve the productivity of the service at the level of the city centre and the periphery. For this purpose, the commissioning of a tramway line, cable car, metro, train and others consists of a new offer with a new infrastructure (x km of line) and new vehicles (y vehicles of z seats each, running at the frequency f) [16; 17].

The public transport industry does not meet the needs of people with reduced mobility (PRM) or the design or layout of parking lots (bus shelters and interior space of means of transport). To this end, it is necessary to concentrate efforts on costs and rising tariffs because rationalisation is key to the sustainable restoration of the financial balance of the networks. It is a matter of optimising the service by meeting the population's demands for mobility at a reasonable cost to the community of individuals of all social classes. In particular, PRM are a minority in the overall population. Disability is the result not only of the person's physical deficiencies but also of the unsuitable characteristics of a person's environment. Therefore, accessibility in the different modes of public transport for all takes into account the needs and constraints of everyone during the interior and exterior design process. Some developed countries have introduced full accessibility for PRMs to both facilities and habitats of the city. [15] wrote, "Accessibility requires the implementation of the complementary elements, necessary for any person permanently or temporarily incapacitated to move and freely and safely access the living environment and all places, services, products and activities".

The terms "regularity" and "reliability" have almost the same meaning [2, 19]. They refer to the notion that the reliability of transport time, temporal reliability and the capacity of transport systems allow users to arrive at their destinations at the scheduled times. For example, several research studies have found that the value of transport time reliability depends on the random nature of the arrival times, whether arriving early or late. As a result, the academic literature shows that the generalised costs of travel tend to increase with unreliability accompanying arrival times [2; 12, p. 5]. These increases are especially important considering that journeys require specific schedules (e.g., work trips, commuting trips). Moreover, at a given level of reliability, the costs associated with this phenomenon can increase even more when the frequency of services is low. These aspects have remained absent from socio-economic evaluations to date since [2; 5] did not propose quantitative valuation. Comfort is a multidimensional concept involving, for example, noise, temperature, vehicle filling rate and cleanliness, and the challenges in terms of comfort are most pronounced in public transport. Multiple dimensions indicate that comfort levels may be different for the same mode compared to traffic and vehicle quality [9]. However, comfort in pre/post routing and during a journey can weigh the characteristics of the journey in an equivalent journey time. Spending time in transport assumes that this time will be wasted on other travel or activities [18; 20]. Gains or losses in travel time are one of the main determinants of the choice of means of transport.

It is uncommon for various means of urban public transport to be associated with or complementary to the service of the same agglomeration, as is the case in several cities worldwide. To this end, transport systems are divided into transport modes with very different characteristics, of which the articulation of

the modes between them constitutes one of the essential questions of the general organisation of the transport system. In particular, travel management today integrates the principle of intermodality into a policy of urban travel that is especially strategic for agglomerations, as it is part of the crossroads of the areas of spatial planning, travel and the environment.

In that context, intermodality focuses on the transition from one mode to another. Thus, intermodal accessibility makes it possible to question the matching of modes within the transport chain and to describe the ways in which several modes of transport are combined to perform each trip, which can improve existing transport systems. However, intermodality exists with or without exchange poles. On the other hand, an exchange centre designed for this purpose facilitates intermodal practices [14; 11, p. 77]. As a result, intermodality makes it possible to coordinate several modes of transport by the specific management and layout of the interfaces.

Constantine is an important city in Algeria and, like many cities in the world, has been impacted by a continuous urban sprawl and car development since 2008 [22]. For this purpose, we are looking for the fastest and most comfortable way to link the different municipalities to each other. This period saw a predominance of cars in urban travel. The motorisation of households continues, as 35% of households owned at least one car in 2020. This observation confirms the place of the private car in travel.

The municipality of Constantine is at a high level of development due to its size. Indeed, it concentrates the whole range of modal choices in terms of urban public transport. Similarly, the agglomeration of Constantine has experienced significant population growth, which encourages the development and diversification of its urban and on-site public transport modes. For this purpose, the resident population at the level of the Constantine agglomeration was estimated at 1 million inhabitants in 2018 (compared to 1.23 million inhabitants at the level of the wilaya of Constantine), of which nearly 85.71% is concentrated at the level of the urban perimeter, generating 348,760 trips/day [21].

The Constantine cable car is considered an ephemeral project that has not been able to develop in the long term [8; 6]. On the other hand, the tramway is renowned for playing a major role in urban development and redevelopment in the agglomeration and the redevelopment of its urban environment. In addition, direct and indirect consequences highlight the influence of the Constantine tramway project on the economy, trade and the attractiveness of the Constantine agglomeration [6; 7].

2. CONSTANTINE TRAMWAY, ALGERIA

The agglomeration of Constantine is among the major Algerian cities that have equipped themselves with modern tramway systems. Since its introduction, the tramway network and all urban public transport modes have continued to develop within the agglomeration (Fig. 1). The issue of the Constantine tramway is of importance because it involves completely rethinking the city, redefining the relationship between the citizen and the city and requalifying the urban environment. The tramway is in line with a policy of urban cohesion which presents the added value of being a tool that makes it possible to make the most of the space it crosses.



Fig. 1. The Constantine tramway line (Source: Authors, 2018)

The route of the tram line reached the limits of the medina in connection with the Martyrs' Square, a few metres from the entrance to the old town. As a result of problems on the side of the medina, almost one kilometre of the line was removed, and the terminus was positioned on the former urban station of Ben Abdelmalek Ramadan. To this end, the extensions of the tramway line should provide a net increase in clientele compared to the first section, which serves only a population of about 25,000 inhabitants who live in the city of Zouaghi Slimane. Moreover, it is by extending the line to the new city of Ali Mendjeli, which already has about 300,000 inhabitants, through the university pole Salah Boubnider Constantine 3, which includes 60,000 students, that the tramway takes all its interest and becomes more profitable, as it has carried 16,000 to 20,000 passengers per day since 2014 (Table 1 and Fig. 2).

Table 1
Passengers/year on the 1st line of the Constantine tram (Source: DTWC, 2021)

Year	2013	2014	2015	2016	
Passengers N.	1,948,182	4,939,559	6,854,692	7,230,016	
Year	2017	2018	2019	2020	2021
Passengers N.	9,066,704	9,867,944	10,434,302	8,456,783	13,236,789

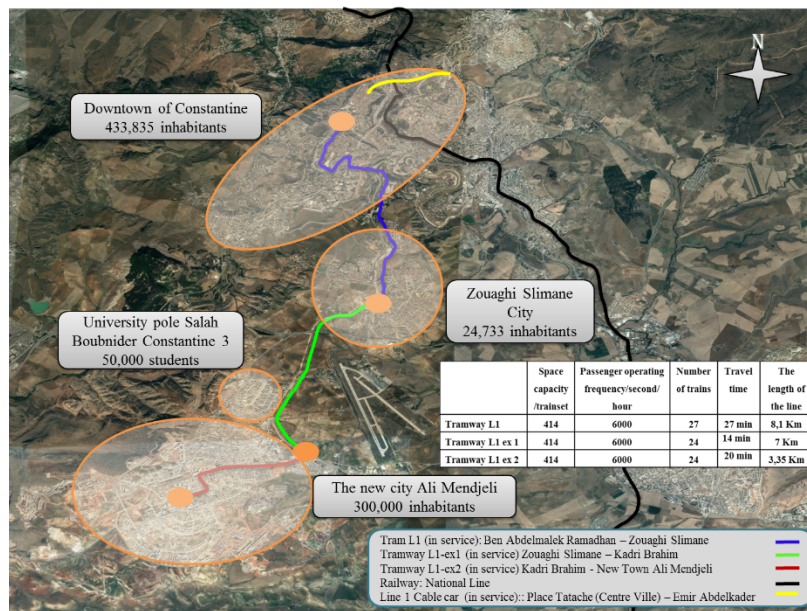


Fig. 2. Urban areas served by the Constantine tramway line (Source: Google Earth, 2019; SETRAM data; 2019) Map elaborated by the authors, 2021

The construction of a new public transport network in a dense city centre, such as Constantine's city centre, requires extensive organisation and communication. However, the agglomeration of Constantine was among the major Algerian cities to acquire a modern tramway.

The introduction of the tramway line on its own site had local economic repercussions. The sum spent for the realisation of the complete line, from Ben Abdelmalek Ramdane to the new city of Ali Mendjeli, was 78 billion Algerian dinars (500 million Euros). In fact, the construction of the tramway network required thoroughly reviewing the structure of the road network and upgrading certain lanes in the city centre in order to promote the use of soft and pedestrian modes. The tramway aligns with an urban cohesion policy that presents the added value of being a tool that makes it possible to value the space it crosses. This influence will be analysed in relation to the reflection of the image of the tramway vehicles around it. It will also identify the impacts that the tramway may have on its urban public planning environment with the road structure and public spaces produced, the construction of the building and its cohesion while acknowledging that they are to serve Constantine as a means of urban reorganisation.

Line L1 of the Constantine tramway was put into service on 4 July 2013 as a means of public transport on a clean site based on international standards. It crosses the city of Constantine with a section of 8.1 kilometres, including 10 stations from Zouaghi Slimane to Ben Abdelmalek Ramadan Stadium through Mentouri Constantine Brothers University 1. However, the realisation of this line within the city centre of Constantine intervened after many decades of local displacement policies in favour of automobiles. The existence of two large universities, as well as several shopping centres, encouraged local authorities to launch the extension of the tramway line to the new city to facilitate travel and encourage interconnection between them. In 2019, the extension of the first extension between Zouaghi Slimane and the new city of Ali Mendjeli was put into service to serve the university pole Salah Bounider Constantine 3. A second extension was put into service in September 2021, serving the urban centre of the city new Ali Mendjeli up to the University Abdelhamid Mehri Constantine 2 (Fig. 2). This extension line ensures improved regularity at a greater frequency (20 trains/h) in rush hour on the one hand, and it is a reinforcement line set up between faculties and shops on the other hand. Moreover, the number of passengers on the tramway line increased from about 2 million passengers in 2013 to more than 13 million passengers in 2020, with trains filled in peak hours.

3. METHODOLOGICAL APPROACH

The objective of this study was to evaluate the socio-economic variables of the tramway line operating in the agglomeration of Constantine. A specific survey was carried out in order to understand the tramway's users' points of view concerning the impacts of the new tramway line.

The space in which we carried out our survey is not homogeneous between the city centre of Constantine and neighbourhoods whose services and activities are distributed and organised in networks operating in various spatial and temporal scales. Individuals travel more or less frequently and for a variety of reasons, using a combination of individual and collective modes of transport.

We conducted our survey on several sites where different users of different modes of transport were targeted to respond to the questionnaires:

1. For the rail mode (tramway), Constantine city centre and the Zouaghi Slimane district (Ben Abdelmalek Ramadan in Zouaghi Slimane), including the interchange hub of the Palma industrial area, to assess intermodality and multi-modality;
2. For the cable mode (the gondola), the Constantine Medina (Place Tattache at CHU);
3. For the land mode (bus), the city centre of Constantine (Zaamouche station).

3.1. The Survey Methodology

A methodology was put in place for our questionnaire and the analysis of the results. For this purpose, our field survey was based on a statistical study, and we were able to ensure representativeness. We calculated the percentages of questionnaires to be recovered based on the relative importance of stations and time slots. The distribution of the questionnaires was done by hand at the level of each mode of transport.

The investigation was divided into two parts. The first part was a quantitative survey with a questionnaire intended to define the impact of the three modes of public transport (buses, taxis, trams and gondolas) on the urban dynamics of Constantine. The second part was an on-site observation at the Palma Industrial Zone trading hub. This hub was chosen because it is the only hub that encompasses multiple modes of transport, thus allowing the three criteria of intermodality and multi-modality to be assessed.

3.2. The survey data

The data were collected by means of a field survey using a questionnaire addressed to travellers, interviews with those responsible for the agencies concerned and on-site observations. We conducted

interviews and used data collected from different organisations. For sampling, we opted for a random survey; we could not conduct an exhaustive survey because of the size of our study space.

We were unable to detect all information on transport projects during the quantitative investigations. To this end, to complement our research work, we carried out two additional field missions with qualitative surveys of a few users.

The data used to carry out this survey represent the operation of each mode of transport, its attendance and its impact on its users. This is because they will evaluate them by answering the questions giving us the opportunity to assess the socio-economic impact of the tramway line.

Following an empirical approach, we began the quantitative field survey phase between October 2015 and March 2016 by means of a questionnaire based on a sample of 250 persons for each transport mode (tramway, gondola, taxis and buses) and meetings with the managers of transport agencies. We also conducted a qualitative field survey in March 2021 through a questionnaire based on a sample of 30 people for each extension of the tramway line (University Salah Boubnider Constantine 3 and the new city of Ali Mendjeli).

Also, interviews were conducted with the heads of the organisations concerned and on-site observations to assess the intermodality at the exchange pole of the industrial area Palma. For data processing and interpretation, IBM SPSS software and Excel software were adopted.

4. EVALUATING CONSTANTINE TRAMWAY LINE VARIABLES: MAIN RESULTS AND DISCUSSION

Many variables can be considered in the evaluation of each of the transit systems. Social variables include the rationalisation of transport supply between the different modes of transport required for a journey, the place of people with reduced mobility in the supply and the layout of the different modes. Moreover, economic variables are the most dominant in relation to their importance in the evolution of the city's economy.

4.1. Rationalising transportation supply across modes

Among the actors of the transport supply in Constantine, the operators are those who directly interact with users. As such, they are responsible for the proper functioning of the networks to ensure the services run smoothly in terms of security, comfort and performance. In particular, performance is handled in several aspects, including the management and maintenance of the equipment, the quality of service, the connection between the networks and the complementarity between the different directorates.

For this purpose, during interviews with persons responsible for different transport directions in Constantine (Tramway Company, Constantine Urban and Suburban Transport Facility, Cable Air Transport Company, direction of transport of Constantine), they replied that, currently, there is no rationalisation between the different modes of public transport, but medium- and long-term forecasts have been proposed to offer transport and rationalise the tickets of journeys for different modes. Moreover, the different modes of public transport, except the tram, have fixed prices for a single trip, depending on the desired stop station; the longer the journey, the more expensive it is.

In contrast, the cable car has a fixed price for the entire journey. Moreover, the institutions of these modes (Cable Air Transport Company and Constantine Urban and Suburban Transport Facility) have not developed offers for their users. To this end, it is interesting to note that with the commissioning of the Constantine tramway line, pricing has been developed from time to time, with the introduction of a varied range intended for different users.

During the 2013-2014 academic year, Salah Boubnider Constantine 3 University was inaugurated to accommodate thousands of students with a capacity of 44,000 teaching places. However, in the early years, students faced difficulties travelling there, as they had to pass through the stopping points at the new city of Ali Mendjeli, and they had to take several modes of transport. This posed the problem of creating a direct line going from a stopping point at Zouaghi Slimane to the university, passing through the ramp created at the East-West highway.

However, in 2016, Tramway Company and Constantine Urban and Suburban Transport Facility created a single multimodal monthly subscription of 1500 Algerian dinars (9.60 Euros and 10.79 American Dollar) for users with unlimited travel. Eight tram buses have been set up for the Zouaghi Slimane shuttle bus and the Salah Boubnider Constantine 3 University from 7:00 a.m. until 6:00 p.m. This line had a very high attendance among students and officials of the university compared to the speed of the journey and time savings at a rate of 20 Algerian Dinars (0.13 Euros and 0.14 American Dollar).

Fig. 3 below shows that users are satisfied with the new travel modes (cable car and tram), which offer a lower price than other means of travel. This shows that the new travel modes are the most suitable for the inhabitants’ needs, bearing in mind that the social class that frequents the means of transport on a daily basis is composed of many more students, active persons and the elderly.

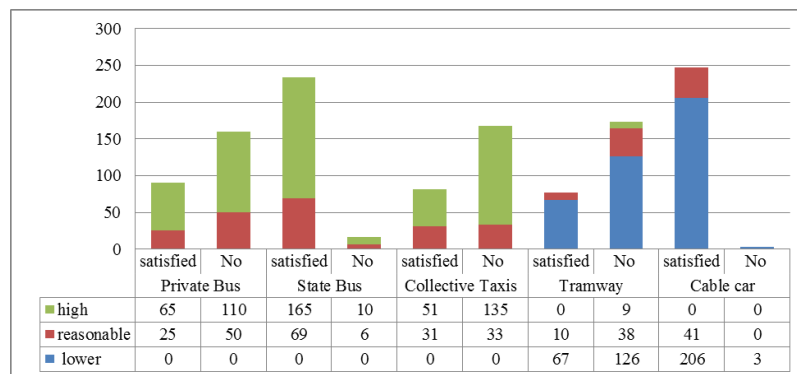


Fig. 3. Satisfaction of travel fares and assessment of fares between different modes of transport (Source: Field Survey, 2015-2016; 2021)

The Tramway Company is the only company that offers a range of fares for school students, university students, people with reduced mobility and seniors with a ticket for a single trip or a notebook for 10 trips and unlimited weekly and monthly *Tawassol* subscriptions.

In order to introduce this pattern of rational supply of transport, measures and efforts should be taken to facilitate the use of public transport, such as improving the quality of service and the services offered to users of different modes of transport in waiting places (e.g. ticketing, facilities offered to the stations, user information). Indeed, it would be ideal for travellers to be able to make each of their trips with a single ticket, regardless of the means of transport used. In practice, this objective is often difficult to achieve because of the multiplicity of transport management structures.

Although different services can be offered to users to allow them to make the best use of wait times (e.g. shops in urban stations, bus stations, interchange hubs and stopping points, displays of wait times for future crossings), this is only one of the solutions to improve the quality of service. It is important to make mandatory the establishment of mobility centres that offer all kinds of services.

4.2. Persons with Reduced Mobility (PRM): Supply and Fit-up

The official recognition of PRM as a specific target group in Algeria was marked by a law of promotion and protection on 9 January 2002, adopted by the National People’s Assembly. However, much remains to be done to properly integrate these people, starting with implementing various decrees established by the Algerian government and respecting the resolutions of the United Nations convention held on 13 December 2006.

The various means of public transport in the agglomeration of Constantine are not adapted to the needs of PRM in its interior design or in the initial accessibility through the entrance door. However, the accessibility to the new modes of transport for PRM was considered a priority. These modes of transport are adaptable to the different needs of PRM in their interior and exterior design, with an

entrance that has low floors with full-foot accessibility without the need to walk from the dock, which climbs gently.

This innovation is useful not only for people with disabilities but also for families with baby carriages, for the elderly and for those who are injured or carrying bulky packages. In addition, the tramway pavement contains *tactile paving slabs* for the blind and visually impaired, to help them follow their paths without any obstacles, including slabs with a visual and a tactile marker. As a result, this quality increases the number of tram users, and it can shorten the time of entry and exit of all users at the stations. Indeed, the tramway of Constantine has set up a free offer for PRM to support them. However, the tramway lines were designed from the outset to make the urban transport network more accessible to people with reduced mobility, namely through the following features:

4. visual and audible announcements can be used to locate yourself during the trip;
5. gently sloping access ramps facilitate tram station entry and exit;
6. a special strip allows to signal the proximity of the edge of the platform;
7. stations are level to facilitate access for PRM.

4.3. Reliability and comfort make transport time consistent with time-saving

The initial challenge faced by the various transport organisations in Constantine is reducing the time spent by users on public transport. In addition, the recurring demands of public transport users with regard to reliability (respect for timetables) and regularity (increased frequency of services) have become major problems for private buses. However, the reliability of the time of different modes of transport is considered a unitary value which should not be lacking in socio-economic analyses. The arduousness of travel with private buses and clandestine taxis in the agglomeration of Constantine tends to increase discomfort and non-compliance with the time of stoppages and travel times.

In relation to travel with private buses and Constantine Urban and Suburban Transport Facility, the respondents emphasised that private buses do not offer users safety or comfort of travel, while Constantine Urban and Suburban Transport Facility buses offer more comfort, whereas security is always reduced by these means of transport. In contrast, the new modes of transport (tramway and cable car) offer comfort in terms of the vehicle's interior design, punctuality, ease of travel and service of equipment. To this end, 50% of tram users are satisfied with the time savings of the tram, 25% are satisfied with the service of the equipment, and 22% are satisfied with the ease of travel. Moreover, 42% of cable car users are satisfied with the time savings, 28% are satisfied with punctuality, and 22% are satisfied with the ease of travel. Finally, the interviewees confirmed that security is guaranteed for both modes.

Only the tramway of Constantine uses a computer system to manage the traffic lights at crossings involving pedestrians and cars. These lights give priority to the tram over other means of travel. The average commercial speed of the tramway network is 20 km/h, depending on the urban insertion of the tramway according to the sections and on the reliability of the management of the crossing lights. As a result, this speed is comparable to that of individual cars and public transport on the same route.

Fig. 4 shows that the tram offers better travel time conditions than other means of travel. Overall, 67% of users appreciate the regularity of travel time in the tram, 54% for ETUSC buses and 32% for collective taxis, while 50% of users say that the regularity of travel time in private buses is non-existent. There is one device installed at each stop and another device inside the vehicle that allows users to load and validate their *Tawassol* subscriptions or buy tickets. These devices are intended to lighten counters during peak hours and facilitate users so they do not waste their time waiting at the counter, even though there is a counter at each stop.

A search for delays caused by congestion in these nodes and a comparison of the travel time of the tram, buses and taxis on this line show remarkable time savings for the tram (Table 2). The tram takes almost half as long as the bus and taxi, giving users more time to do something else.

The first extension of the L1 tram line is intended for the Salah Boubnider Constantine 3 University to facilitate the movement of students who had no travel difficulties before the introduction of the tram line in relation to the length of the road (heavy peak traffic) and high fare (they had to take two buses to get to university) (Table 3).

On 23 October 2016, the tramway operating company (SETRAM) and the urban and suburban transport establishment of Constantine (ETUSC) set up a means of transport called the Bus-Tram with a unit fare of 20 Algerian dinars (0.13 Euros, 0.14 American dollars) and a single monthly pass for both modes of transport. This approach is part of the measures taken by the city’s decision-makers to facilitate the movement of students and civil servants of the University Salah Boubnider Constantine 3 with time savings. The Bus-Tram route takes a maximum of 15 minutes to get from the bus stop at Zouaghi Slimane Tram Terminal to the university via the East-West motorway ramp for a five-kilometre ride without any stops. Meanwhile, other types of buses take a different long circuit with several stops, passing through the four paths and the clutter of the entrance to the new city of Ali Mendjeli, to reach the university in an hour or more over a journey of 18 kilometres.

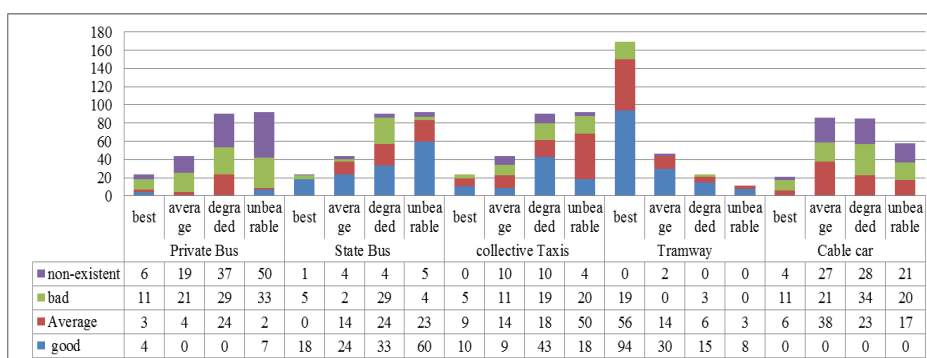


Fig. 4. Patterns and travel time conditions across modes. (Source: Field Survey, 2015-2016; 2021)

Table 2

Time savings in trams compared to other public transit modes.
Ben Abdelmalek Ramdane line in Zouaghi Slimane (Source: Authors, 2019)

Means of transport	Journey time		Number of stops	Loss of tram time during peak time
	Off-peak time	Peak time		
Tramway	27 min	27 min	10	/
Bus	1 h	1 h 35 min	11	1 h 8 min
Taxi	45 min	1 h 10 min	/	43 min

Table 3

Tram time savings compared to other public transit modes.
Zouaghi Slimane line at Salah Boubnider Constantine University 3 (Source: Authors, 2020)

Means of transport	Journey time		Number of stops	Loss of tram time, in Peak time
	Off-peak time	Peak time		
Tramway	12 min	12 min	3	/
Bus	1 h	1h 35min	10	1h 23min
Taxi	15 min	18 min	/	6 min

The transit times of the tram line are not displayed reliably at each station of the network. This does not allow users to know the waiting time for the next vehicle, which does not allow the user to organise their time for their various activities related to travel.

4.4. Intermodality and Multi-modality

The complementarity between different modes of transport was carried out according to three criteria: the type of practitioners of this complementarity, the reasons for the movement of users and the territories where this complementarity took place. When a user combines several modes of transport, he makes an intermodal journey, regardless of whether interchange poles exist to facilitate their journey (Fig. 5).

Based on a field survey and on-site observations, only the interchange hub in the Palma industrial area, which facilitates transfers between trams, buses and collective taxis, organises waiting times and coordinates schedules with management desks of each means and distributes services according to specific arrangements.

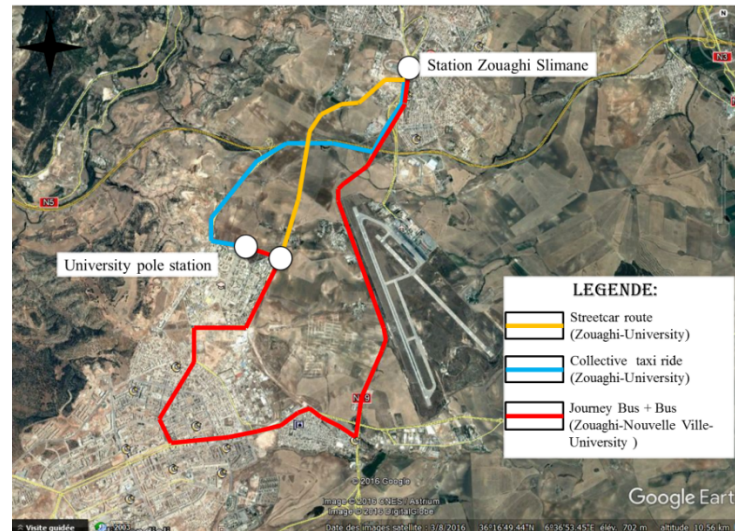


Fig. 5. Routes to Salah Boubnider Constantine University 3. (Source: Google Earth, 2016)
Elaboration by the authors, 2020

The complementarity between different modes of transport is based on territorial assessments, including three indicators necessary for its success: the culture of interconnection, the public transport network developed and the practices of complementarity. However, the passenger transport plan in the greater Constantine area directs communities to practice intermodality by coordinating and postponing modes of transport in relay parks and interchange hubs. Therefore, it implicitly highlights the links between travel practices, the proposed transport supply system and other urban policies. According to 62% of respondents, there is no interconnection between urban public transport and new modes of transport at stopping points, and 27% say that it is anarchic and not studying properly.

Indicators were highlighted to assess the effectiveness of intermodality along the corridor of the Constantine tramway line from Zouaghi Slimane to the new town of Ali Mendjeli. These indicators are multimodal information, integrated pricing, and the organisation of trading hubs. All along the tram line, it is noticed at each stopping point the existence of one or more parking points for buses, taxis or both, at distances that do not exceed 300 metres on either side of the line.

Several modes for exchanging travel at the station Zouaghi Slimane do not present any hierarchy in the movements, and the arrangements of spaces are simple, which presents a conflict between pedestrian flows and general traffic (Fig. 6).

The interchange hub of the Palma industrial area is the only one that meets the criteria of intermodality, as it contains several modes of transport (tramway, bus, taxis). To this end, the effectiveness of intermodality at the level of this exchange pole, according to the three criteria (multimodal information, integrated pricing and exchange poles), has given the following results:

1. Multimodal information

The main purpose of multimodal information is to help users choose between different modes of travel and to facilitate intermodal travel. To this end, the study of the implementation of multimodal information in relation to these indicators in the city of Constantine – and especially at this exchange centre – made it possible to obtain the results presented in the table below. It is noted that this does not provide enough criteria for the different modes of transport. Only the tram meets the majority of these criteria (Table 4).



Fig. 6. Physical organisation of intermodal exchanges at a tram station (Source: Authors, 11/2018)

Table 4

Evaluation of the effectiveness of intermodality for the Palma industrial zone trading hub.
(Source: On-site observation; interviews, 2019)

	Tramway		Bus		Taxi	
	Existing	Non-existent	Existing	Non-existent	Existing	Non-existent
Time guides		X		X		X
Display of stop stations in vehicles	X		X		X	
Electronic information kiosks	X			X		X
Internet sites	X			X		X
Mobile applications		X		X		X

2. Integrated pricing

The most important aspect of integrated pricing is the introduction of a combined transit fare that brings together several modes of travel (tramway, bus, taxi, etc.) into one. For the majority of transport services in Constantine, the implementation of these practices is too complicated, especially at the beginning of the design of an intermodal policy with a single ticketing method at the level of the capital of Algiers (tramway, cable car, metro, train, bus ETUSA). This is unlike in Constantine, where various organisations have not yet developed a common approach. However, it should be noted that recently \ tram subscribers can travel on the Bus-Tram on a small stretch of Zouaghi Slimane to Salah Boubnider Constantine 3 University (Table 5).

3. The exchange division

The exchange poles play an important role in the structuring of urban space. They also facilitate the transfer from one mode to another and ensure that the different modes of movement are combined. Meanwhile, Constantine's urban transit users generally perceive correspondence and fashion change as a waste of time and a nuisance. Indeed, the interchange hub of the Palma industrial area is considered a correspondence between several modes of travel (tramway, bus and taxi) and between several bus lines. Its study in relation to the indicators of this process yielded the results presented in the table below, in which all the indicators are present (Table 6).

According to our on-site observations at the East Sahraoui Tahar bus station and the urban station Zzaamouche, the first two criteria were applied to evaluate intermodality, a single existing intermodality between buses and collective taxis. The tramway line and the cable car line are far from these two points (Table 7).

Table 5

Evaluation of the effectiveness of intermodality for the Palma industrial zone trading hub.
(Source: On-site observation; interviews, 2019)

	Tramway		Bus-tram		Bus		Taxi	
	Existing	Non-existent	Existing	Non-existent	Existing	Non-existent	Existing	Non-existent
Single box office	Except users who make the monthly subscription to the tramway					X		X
Smart card	X			X		X		X
Ticket + credit card		X		X		X		X

Table 6

Evaluation of the effectiveness of intermodality for the Palma industrial zone trading hub.
(Source: On-site observation; interviews, 2019)

Convenience		Accessibility		Safety		Comfort	
Existing	Non-existent.	Existing	Non-existent	Existing	Non-existent	Existing	Non-existent
X		X		X		X	
Transfer between modes		Distance to travel less than 100 m		Centrality			
Existing	Non-existent	Existing	Non-existent	Existing	Non-existent		
X		X		X			

Table 7

Evaluation of the effectiveness of intermodality for the Palma industrial zone trading hub.
(Source: On-site observation; interviews, 2019)

Assessment criteria	Assessment variables	East Saharawi bus station Tahar		Zaamouche urban station	
		Existing	Non-existent	Existing	Non-existent
Multimodal information	Time Guides		X		X
	Display of stop stations in vehicles	X		X	
	Electronic information kiosks		X		X
	Internet sites		X		X
	Mobile applications		X		X
Integrated pricing	Single Box Office		X		X
	Smart card		X		X
	Ticketing combined with credit card		X		X

According to Table 7 above, the East Sahraoui Tahar Bus Station and the Zaamouche Urban Station do not present any intermodality criteria in relation to multimodal information, which presents a single variable in the display of stop stations on vehicles, as well as in relation to integrated pricing.

5. CONCLUSIONS

The implementation of new urban public transport modes fosters the modernisation of places and the valourisation of activities related to public transport. There has also been an increase in some activities,

notably on the main boulevard of the new city of Ali Mendjeli, which has changed with the operation of the tramway line. The project of the gondola and tramway of Constantine aims to preserve the mix of housing and employment and to create relations between the mother city and the new city of Ali Mendjeli, thereby facilitating the movement of students to different universities and the University Hospital Centre (CHU), which are very busy and strengthen the attractiveness of the city centre.

The establishment of the three tramway lines is the result of the policy pursued by the Constantinian elected representatives and aimed at prioritising public transport. Today, the tramway is inseparable from the Constantinian urban landscape, and it will become the basis of the public transport network, thereby structuring the territory in terms of travel, taking into account the importance of each line in relation to the connection between the different universities and the different facilities of each municipality as well as the large number of users transported daily.

The tram crisscrosses Constantine from north to south on the west bank of the Rhumel towards the new city of Ali Mendjeli to unify the urban landscape without standardising it and connecting the urban fragments between them. The tram has a modern shape. As regards rethinking the city, the tramway is a driving force of attractiveness for the population and is seen as a structuring element that favours travel in the city centre. These advantages may explain the expansion of the Constantine tramway, where there was a strong need for public transport, particularly in dense areas.

The speed of the tramway on urban roads, the regularity linked to the clean site and its priority at crossings reduce travel time. However, the electronic display of vehicle timetables is not reliable, which does not reassure the users about their journey times.

Public transport services should be further strengthened through the creation of a rational supply among the different modes of transport, as well as based on the complementarity between the different transport organisations. With the birth of new transport technologies, the public transport sector in Constantine has been revolutionised in recent years, allowing PRMs to move easily. This increases ridership potential and shortens entry and exit times.

The Constantinian urban public transport network consists of different modes (tram, gondola, bus and taxi). It regularly goes through major changes, including the creation or extension of lines and the creation of new poles of exchanges, bus stations and urban stations. To this end, improving intermodality and making infrastructure accessible to all is critical to investment and service policies.

Intermodality at stops, urban stations, bus stations and hubs is not structured to manage flows in an intelligent way. To this end, it is necessary to understand and control the functioning of the chain of displacement from origin to the final destination between the various municipalities of the agglomeration of Constantine. The health crisis that has been raging since 2020 has shown that urban public transport, which was far from reassuring some users who knew that the observed influx of users could be a vector in the transmission of the coronavirus, still had to be preserved.

Awareness campaigns are frequent, and measures are often implemented, particularly in the transport sector, to prevent any contamination or at least contain the pandemic, but the incivility displayed by several users is far from meeting current requirements. Indeed, non-compliance with hygiene rules (e.g. bibs, distancing) inside the bus or tram can worsen the pandemic.

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