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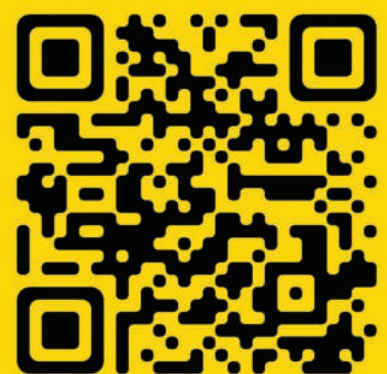
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Analytical study of the transport problem in the city of Constantine (North-East of Algeria)

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Abstract. The problem of urban transport is considered to be one of the major concerns facing cities today; this situation is due to several factors, notably the lack of harmony and compatibility between spatial expansion, population growth and the development of road infrastructure in these cities, which are growing at a rate that exceeds that of the road network. The effects are multiple, congestion and traffic jams, pollution, economic and social impacts. Constantine, the third metropolis of Algeria and capital of the eastern region of the country, represents an ideal case to study the subject; given its physical and human geographical specificities, as well as the different interventions in terms of land use planning during the post-independence period. What we are going to approach through the present paper.

Keywords. citie, metropolis, Constantine, mobility, transport, trafic, congestion, sustainability

1. Introduction

More than a place to live, the city gathers a set of interacting elements in a given physical space, it is therefore a dynamic system often compared to a living being, which is born, lives, grows and dies. It is obvious that the city represents an important human concentration; whatever his quality, resident, passenger or worker, the man has several needs: to be housed, to cultivate, to work, to look after himself, etc.; to satisfy them he needs to move. Today, the city faces several concerns such as the issue of housing, drinking water supply, sanitation, solid waste management and various risks, especially the issue of road congestion.

Transportation is one of the most complex issues facing city managers today, especially since it is considered the economic, social, and even political backbone of urban life. The maturity of urban governance is linked to several factors, including the efficiency of approved transport systems and the fluidity of road traffic. It can also be said that urban development is also linked to the transport strategy that mainly governs the movement of individuals, whether residents or visitors to the city, through plans and means to avoid traffic jams, which in turn generates many economic, social, psychological and even environmental problems in the form of air and noise pollution..

The transport sector is fundamental in the life of our societies where everyone is constantly on the move, where most of the products consumed come from elsewhere and where

money, images and information are constantly circulating. If transport stops (because of bad weather or strike), the whole economic life is put in lethargy

Today, the theme of transportation and the analysis of its networks, especially in urban areas, has become one of the recent trends in geographic studies. This is where our study draws its importance in the global context characterized by the speed and abundance of flows, whether for people, goods, merchandise or information, especially with scientific and technological progress.

In Algeria, as in third world countries, this question is posed and strongly imposed, particularly in large cities such as Algiers, Oran, Constantine and Annaba, which have a historical concentration of the population (all together nearly 16% of the total population) and economic activities. Efforts have been made since independence to remedy the situation essentially by adopting strategies based on the development and generalization of the use of public means of transport; several projects have been set up in this sense, such as tramway, metro and cable car lines, not to mention the renovation of the car fleet. Nevertheless, these efforts seem to be insufficient, and the question still persists.

Through this paper, we will address the case of the city of Constantine; our choice has several reasons:

- The administrative importance of Constantine as the historical capital of Eastern Algeria and the third third metropolis of the country;
- The city is a crucial node in the road network in the eastern region and the north of the country in general;
- The demographic weight of the city (more than one million in the whole grouping) ;

The city, and the wilaya in general, is characterized by an important road network with various means of transport, which leads us to wonder why the problem of transport is still posed in Constantine?

Before we begin our analysis, we suppose that the origin of the problem could be in the absence of a long-term vision and an integrated strategy to which all parties contribute from a sustainable perspective

1. Theoretical aspect and approach methodology

1.1. Research methodology and data source:

It is worth mentioning that the reflections developed in the present work were carried out by the author within the framework of a research program within the laboratory "history civilization and applied geography", ENS Bouzaréah, Algiers. These reflections are based on the analysis of data obtained from different sources and with different tools.

First of all and in order to identify the different aspects of our case, we opted to follow a strategy with a double approach, theoretical by the consultation and the collection of the different works in relation with the subject (essentially of the digital virtual world).

The acquisition of data is an essential step and a very sensitive phase in the research, and yet it should be noted that it is difficult to collect the reliable data necessary for the analysis. To do this, we resorted to several sources, including the directorates of the wilaya of Constantine where we were able to obtain essential documents such as the PDAU (Master Plan for the Development and Urban Planning of Constantine) and reports of the NOS (National Statistics Office).

However, as a geographer, the basic tool used must be field investigation aimed at collecting the maximum amount of data necessary to shed light on the problem of transportation

in the city of Constantine, which has become a congested city. This investigation had two components: observation component which helps in the progress of the findings, and investigation component to bring the evidence. Therefore, the city of Constantine by its roads, bus stops, bus stations, tramway line, cable car stations, constitute observation units and contain samples for the investigation.

Concerning the survey, it was difficult to carry it out by questionnaire, which obliged us to opt for the oral interview which represents a known technique in addition to the questionnaire and the observation in environmental geography [11] ; to do this, we were able to survey a random, heterogeneous sample of individuals varied by several criteria (age, civil status, place of residence (living in the city or not), professional situation (student, worker, civil servant, unemployed). Semi-directive interviews were carried out with about a hundred people (individuals), interviewed between 2021 and 2022. It should also be noted that the language used is dialectal Arabic, later translated into English.

The interviews were articulated on four axes: the personal and family characteristics of the respondent, his daily practices (essentially motives for travel, means of travel, the journey (shopping, social and leisure activities, spatial mobility), and the difficulties encountered for travel and congestion, the average duration of travel, and finally their point of view on the efficiency of public transport in the city of Constantine, what concerns and what efficiency for a sustainable city?

The use of new technologies was also our choice in order to support and give added value to our analysis; GIS via the software Arc Gis 10.3, satellite images (type ikom) of Google Earth Pro, and other Microsoft tools including Excel for the cartographic and graphic representation of the data obtained.

1.2. The city and mobility:

The city is the subject of research by several specialists, each of whom tries to give it a precise definition according to the essential principles of their discipline. Generally speaking, two types of definitions can be distinguished, quantitative (statistical) and qualitative [23]. Nevertheless, it is not easy to define the city, it is a complicated concept, it is a place of grouping for reasons of safety, efficiency and pleasure of the men, their activities and equipment which they need. It is thus translated by spatial concentration, but also by mobility, external mobility to escape the city or to communicate with other cities; internal mobility to take advantage of the multiple possibilities (employment, shopping, leisure, relationships) that the city offers to its inhabitants; Le Corbusier and the functionalist urban planners, authors of the Athens Charter (1933), proposed to divide space according to the four universal human needs: to live, to work, to orientate, and to cultivate body and mind.

Urban mobility represents a large and growing part of the time budget of city dwellers. It is therefore necessary to define a real urban transport policy, integrating space, time, money and quality. This policy must be closely linked to urban planning policy, for which it is the most effective lever for directing spontaneous trends.

Defining such a policy requires a good analysis of the current situation (demand and supply), an acute perception of the challenges (human, economic, environmental, spatial) and the mastery of planning methods. This policy engages the future in the very long term (several generations) and implies very costly investments. There is therefore no room for error for the urban transport planner [18]

It is often the case that transport choices have been made independently of urban planning policies, whereas travel patterns depend on urban form. In order to minimize daily mobility, which is a source of energy consumption and pollution, compact urban forms are

essential. Consequently, transport networks should be developed in a coherent way to meet the demand for mobility [17].

1.3. Description of the study area

Constantine, capital of the province of Constantine, known throughout history under several names: the city of suspension bridges (Sidi M'sid, Mellah, Bab Elkantra and Sidi Rachad), the city of the rock, and more recently the capital of the East, then the capital of Arab culture in 2015.

The wilaya of Constantine is located in eastern Algeria, about 400km from the capital Algiers. It extends on a rocky plateau at 649 meters above sea level; with a total area estimated at 23,163 km², it is bordered by Jijel and Skikda to the north, Guelma to the east, Oum Bouaghi to the south, and Mila to the west. Coordinates: 36° 17' 00" North, 6° 37' 00" East (Fig 1.).

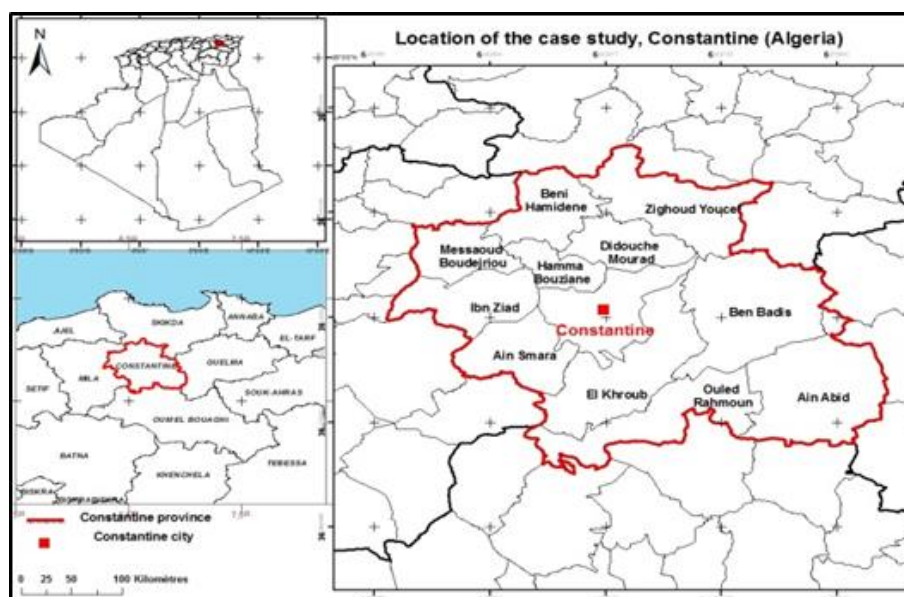


Fig 1. Location of the case study, Constantine (Algeria)

Source : realized by the author (Arcgis10.3 software)

With a population exceeding 1 million in 2018 (782420 hab. in 2008, including 418672 inhabitants for the center [4], it considers itself a metropolis in the sense of the law 2001-20, which considers a metropolis, any urban agglomeration whose population totals at least 300,000 inhabitants and which has the vocation, in addition to its regional and national functions, to develop international functions [22].

For each city its history, its monuments and its landmarks; Constantine, "historical metropolis" [13], an ancient city whose roots go back to 2500 B.C. a city built also by the Romans, something that cannot be denied given its ancient walls, high and thick, built in blackened cut stone. It is located at an important altitude (700m above sea level), on a rocky structure. The city was therefore born, in a commanding position, looking for a defensive site, in the form of a rock closed by gorges and escarpment [14] at an important altitude of about 700m above sea level.

Constantine, unlike Oran, or even Algiers, has a long history. It has been the city and capital of the East for more than 2000 years, and without discontinuity. It is that it has a remarkable position in the Algerian East, at the crossroads of two great axes: West-East axis of

the Tell-High plains contact; meridian axis which, from Skikda to Biskra, takes advantage of a great geological accident to connect - in spite of the unevenness - the coast to the Sahara [14].

Constantine, a major inland metropolis in the East, 100 km from the coast, organizes all the flows and networks inland.[14]. It constitutes a road crossroads for the network of the Algerian East (Fig 2.); a network remained for a long time in the form of a star or a tree whose branches cross in the center.

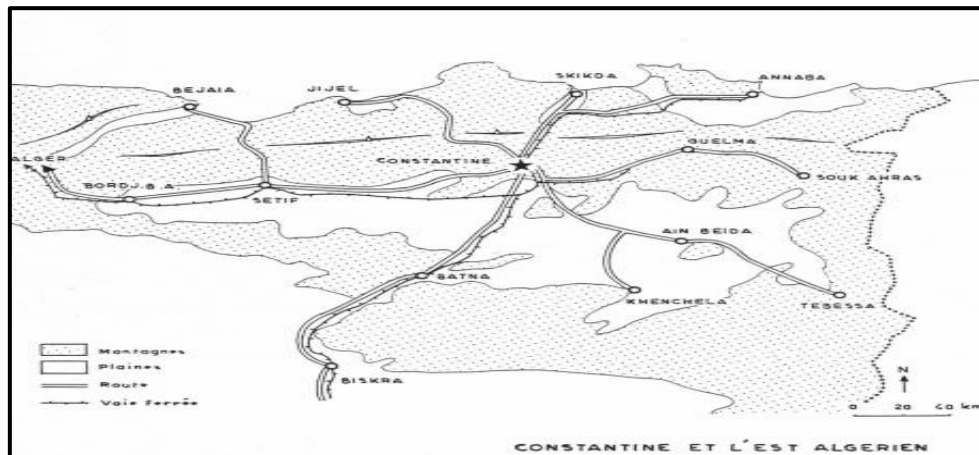


Fig 2. Constantine, carrefour routier dans l'Est algérien [13]

From the map above, we can easily see that the road network in eastern Algeria is "star network" [1]. It consists of a set of lines and communication routes joining different points of a space to go from one peak to another, it must pass through the center (Constantine). At the local wilayale level, the city of Constantine also constitutes a major road junction and hub.

1.4. urban transport in Algeria, global overview

Transport, especially in urban areas, has always been a cause of concern for managers in Algeria since independence; this sector is sensitive, strategic and pivotal to achieving economic and social development, especially with population growth in urban areas, which complicated matters with the high demand for transportation service (Table 1.).

Table 1. Evolution of the urban population (1966-2008)

année	Population totale (en milliers)	Pop. urbaine	
		En milliers	%
1966	12022	3778	31.43
1977	16948	6687	39.45
1987	23051	11420	49.54
1998	29113	16964	58.27
2008	34080	22471	65.94

Source: [17]

After independence, the structure inherited from the colonial period was not enough. So, the Algerian state, in order to achieve the integration of the national territory, worked to

expand this network towards the desert areas in the south, and this has encountered many obstacles, including natural and even human. In the mid-1980s, the total length of paved roads was estimated at 58000 km.

In 1987, the transition from the period of the directed regime to a new period was marked by privatization and the launch of major projects such as the East-West highway project, which connects Annaba with Tlemcen at a distance of 12000 km. Which was expected to be linked to the Moroccan and Tunisian project within the framework of the Maghreb highway project. The national car park at the time was estimated at 1 million cars. The road network used to guarantee 80% of the internal traffic [14].

In this context, many legal texts were issued to regulate the sector, the most important of which was Law 01-13 of 07/07/2001[21], which came with a number of recommendations that took into account territorial planning and development as a desired goal.

Consequently, the state sought to expand the infrastructure, especially from land roads, as it currently includes more than 127000 km of roads, of which more than 96000 km are paved; 1216 km of the east-west highway, of which 1100 km are in use for traffic, more than 10000 engineering structures. Of these, 3478 are available on the East-West highway (Fig 1.). Some of engineering structures are worth mentioning, because they constitute true masterpieces such as the Saleh Bey Bridge in Constantine[24].

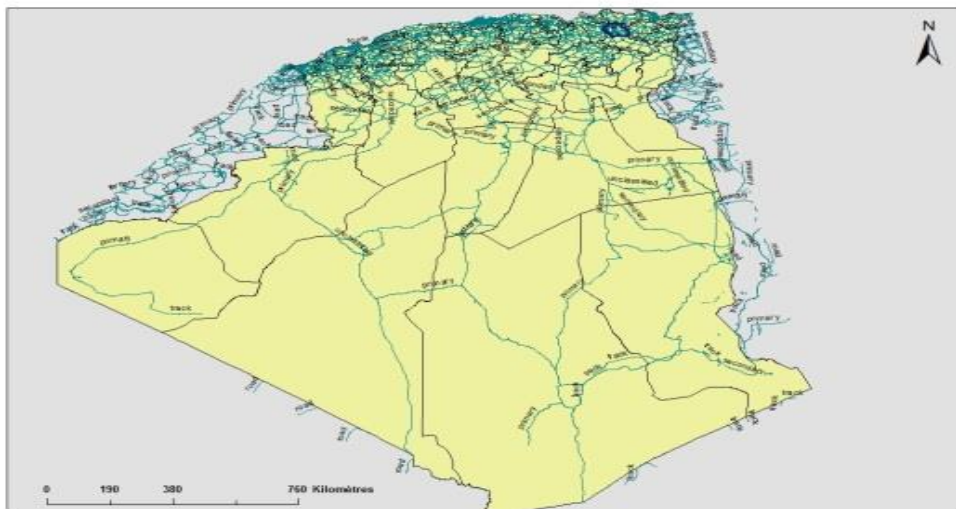


Fig 3. The road network in Algeria

Source: Realized by the author (Arcgis10.3 software, site of world Street Map)

From the map, we see a clear concentration of the road network in the North at the expense of the high plateaus and the desert. This corresponds to the concentration of population, economic and administrative institutions.

Different institutions supervise the conduct of urban transport in Algeria: the Ministry of Transport and Public Works, the Urban and Semi-Urban Transport Corporation, the Tramway Lines Management Company (Setram), and the Métro El Djazair Corporation.

While the urban rail transport in Algeria remains through simple lines so that we cannot talk about real networks, the metro is limited to the city of Algiers, and as for the tramway, we find it in only 7 other cities.

In terms of vehicles, Algeria has a park of 6418212 vehicles spread over the wilayas of the national territory (Fig 4.); it marks a considerable concentration in the capital Algiers (26.32%).

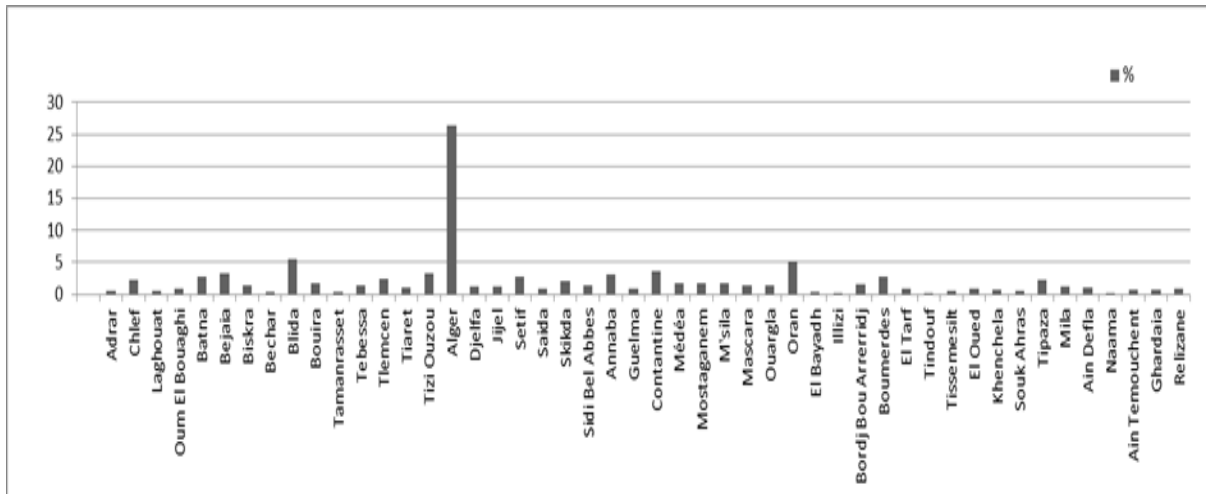


Fig 4. Distribution of the park of vehicles on the wilaya of Algeria (2018)

It is worth mentioning that the tourist vehicle occupies the first place; this may also reflect the place of the private vehicle in the structure of vehicles used in travel. (Fig 5).

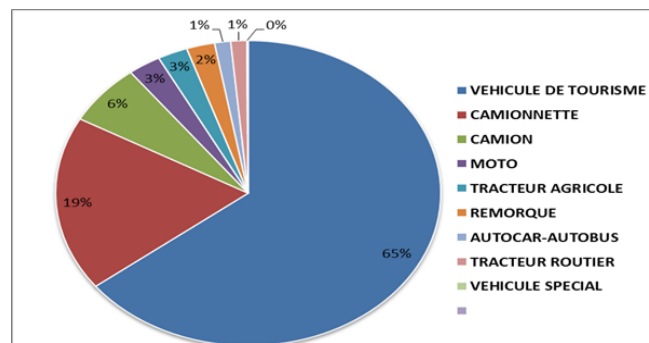


Fig 5. Composition of the vehicle park in Algeria (2019)

2. Results and discussion

In order to analyze and test the hypothesis, the demonstration is organized in three major parts. The first part deals with the reality of transport in the city of Constantine; the second part deals with the impacts of the sector on the different aspects of life in the city; and finally, identifying the solutions and the efforts made by the local authorities.

2.1. transport in the city of Constantine, complicated reality

2.1.1. important flows in Constantine, a city congested by its transport

Constantine, like the major Algerian cities, is marked by intense movements of its population; movements caused by the concentration of almost all functions in this urban center of local and regional importance. This domination leads to intense daily displacements for multiple reasons: shopping, studies, leisure, and others.

2.1.2. The road infrastructure, a relatively dense network

The road network in the city is very important, with a length of 468.744 km and an estimated area of 232 km², it can be said that the road network is relatively dense (2.02km of road for each one km² of area). The city is also crossed by the East-West highway (Fig. 6.), a project that will completely open up the study area and the region in general [4].



Fig 6. Road network, Constantine (Algeria)

Source : [24]

The road network is saturated and the evolution of the car fleet can lead to a complete blockage of the downtown area; traffic conflict points pose many problems.

2.1.3. The vehicle fleet in Constantine

The means of transport have an important role in the life of men in cities as elsewhere; the vehicle fleet in the province of Constantine is seen in continuous increase, it was estimated at 231 521 vehicles in 2018 (3.61% of the national fleet). This gives an estimated motorization rate of 0.25 vehicle for each inhabitant. A value higher than the national one (0.19) and Oran the second metropolis of the country (0.21). but it is inferior to that of the capital Algiers (0.56 veh./inhab) which monopolizes 26.32% of the national fleet of vehicles.

It should be mentioned that the motorization rate is expressed and calculated in number of vehicles / number of inhabitants [16].

$$\text{the motorization rate} = \frac{\text{number of vehicles}}{\text{number of inhabitants}}$$

Speaking of the city, the private car represents 87% of the traffic, it is considered the main source of traffic jams [4].

2.1.4. Population and mobility in Constantine; various motifs and destinations

On a pu distinguer trois catégories des individus interviewés selon le motif de déplacement et la destination aussi.

a. The first category: reason work

Concerning the over 30 years old, 75% of them use the personal vehicle for several reasons (work outside the city, outside the wilaya, having children to bring to school or to the

nursery, obliged to make the stopover, destination outside the tramway line zone). On the other hand, we found that only about 20% of the people use a collective means (private bus, tramway); and that for various reasons (not having a personal vehicle, possibility of using a collective means, bus or tramway).

On the other hand, it has been found that almost 5% prefer walking; this practice is encouraged by elements such as: the short distance between home and work (2-3 km maximum); health reasons (sport), as well as saving money and time lost in traffic in case of traffic jams.

b. **The second category:** particularly the reason for higher study mainly includes young people between 19 and 25 years old; the majority (85%) confirms the use of public means, including buses (private or university works) and the tramway which passes through several establishments (Constantine University 1, 2 and 3; University of Islamic Sciences, Biotechnology Research Center, ENSC) and university residences.

It is also worth mentioning that the extension of the tramway line in its part Zouaghi-Ali Medjeli, has also encouraged students coming from other communes and wilayas; the creation of an exchange pole (bus station, No. 01 Palma industrial zone wilaya of Constantine) which coincides with the tramway line (station Industrial Zone Palma).

Personal means of transportation are also present, widely used by students. The car for individual use but also for carpooling, as well as motorcycles that make it easier for them to get around in traffic jams. For the latter, the users claim the absence of bicycle lanes, with the exception of the emergency line (yellow line) often occupied by cars, especially during peak hours.

c. **The third category:** other reasons such as family visits, medical consultation, leisure.

This category presents diversity in terms of individuals (different age groups) as well as in terms of means used. Sometimes, they use several means to reach their destinations.

2.1.5. Other dysfunctions and deficiencies

Several malfunctions exist in this case of: the weak intermodality and the glaring lack of parking and parking system. The dilapidation of the roadway is also remarkable, despite the work done as part of the event of Constantine Capital of Arab Culture 2015, several sites for the rehabilitation of facades and streets have been set up. This often forces drivers to slow down and drive slowly (to avoid damage to their cars), which causes traffic jams on several sites. And in return, it also forces pedestrians to walk on the road and sometimes cross it to avoid holes and degraded parts.

The city of Constantine is also marked by the near absence of soft travel routes (pedestrian areas and bicycle paths), which hinders the development of a sustainable aptitude for mobility, especially among the younger generation.

2.1.6. factors impacting transport in Constantine

The development of transport (network and means of travel) is somewhat complicated and subject to several factors of a spatial, physical, historical, human and economic nature; in another way, the personality and geographical identity of the territory. These elements influence, individually or in combination, road networks by class, density, flows and mobility. we can regroup them into two categories of factors:

2.1.6.1. Physical Factors

a. The Site

The city of Constantine was born from a commanding position by seeking a defensive site in the form of a rock ending in gorges and escarpments (Fig 7.), which forced the

inhabitants of the city throughout history to build bridges in order to escape the isolation of their physical environment and cross to the other side of the Oued Rhumel; Bab Elkentra bridge (1863), Sidi Rached bridge (1912), Sidi M'sid bridge (1912), Mellah Slimane bridge (1925), and the giant bridge or Salah Bey bridge (2014).



Fig 7. The city of Constantine, the rock, Oued Rhumel and Sidi Rached bridge

b. The topography

The topography clearly influences transportation, which is reflected on the ground by the use of different facilities such as bridges and tunnels, as well as the diversification in terms of modes of circulation: by road (buses and cars), railroad (train and tramway), in addition to the cable car. In Constantine, the uneven nature of the ground has allowed all these types to exist; the city belongs, like the rest of the wilaya, to the domain of the Constantine High Plains where the relief is very varied between mountains, hills, valleys and plains. We can quote the hill of Coudiat, Bellevue, Sidi Mabrouk and the Plateau of Mansourah; the valley of Rhumel.

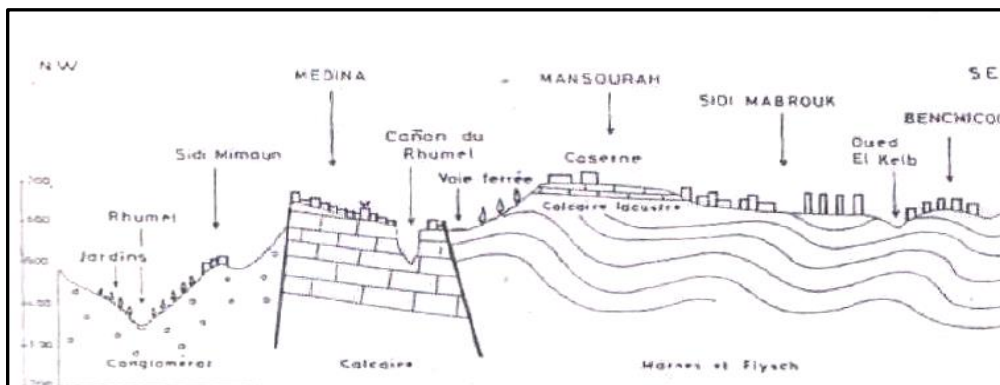


Fig 8. Schematic section through the city of Constantine

Source : [13]

2.1.6.2. Human factors

a. The spatial extension of the urban area and the development of transport in Constantine

The history of the formation of the Algerian urban system is more than a thousand years old, resulting from the superposition of several urban strata formed during four main periods of urbanization (pre-colonial, colonial, post-colonial and contemporary) [15].

The current space of the city of Constantine is the result of a diachronic expansion, created through several historical phases. First, from an area of nearly 30 ha at the beginning of the French colonization in 1837, the city grew a century later (1937) to 234 ha. In the early 1950s, it reached 1,800 ha. After independence (1962), Constantine has gradually expanded and land consumption has increased to reach 2,558 ha in 1977, 3,285 ha in 1987, 4,547 ha in 1993 and 5,138 ha in 2000. Today, it covers an area of 23,200 ha.

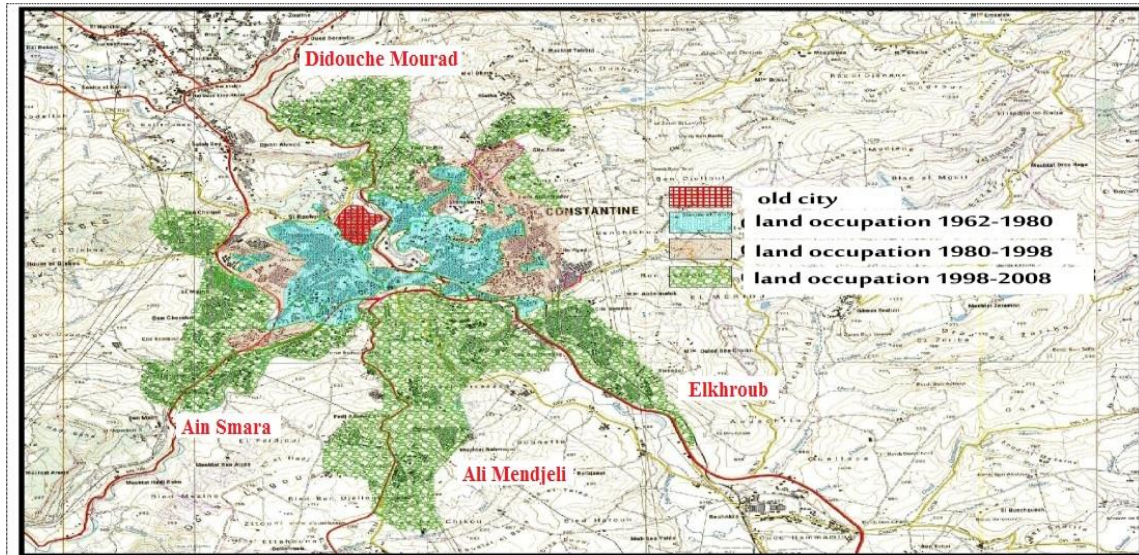


Fig 9. Spatial evolution of the city of Constantine

Source: [4]

According to the map above, we can note an urbanization along **the main roads**, especially towards the South; in order to meet the ever-increasing need for building land generated by the saturation of urbanizable sites following the rapid consumption of space and the unbridled and uncontrolled urban expansion in Constantine.

b. The historical importance and place of the city of Constantine

« Constantine, an inland metropolis, the only one in the country, the only one in the Maghreb that has retained its initial influence » [13]. This city has a position of a node in the center of the road network in the Eastern region; elements related to its geography and its historical depth are at the origin of the importance of the city, the place and the power endowed at the local and regional level for several decades. Inland capital, at equal distance from the coast and the Aures (100km), Constantine stands at the contact of two different domains: the coast and the Tellian mountain range, relatively humid and wooded in the North, and the high semi-arid plains in the South. Its location at the meeting point of two different domains has given rise to the creation and birth of trade nodes and crossroads at the intersection of roads.

Constantine is also in control of the meridian route, it is a key position, a hub of exchange. The city has always been a market town as well as a fortress town. This situation has been enhanced by two local assets: the oppidum site on the one hand; the existence of one of the largest springs in Algeria, that of Hamma, which has given the city the peri-urban gardens that have been indispensable throughout history to any Maghrebian city [13].

c. The current institutional and economic importance of Constantine

Constantine the city and the wilaya in general, occupies a central place in the Algerian East on the administrative and economic level. The preliminary results of the economic census of 2011, shows a large concentration of economic entities in the wilaya of Constantine. 25 893

entities out of a total of 141 909, divided by major sector of activity (industry, construction, trade and services). In this context, Constantine clearly marks the predominance of the commercial sector (13372 entities), the rest is shared between industry (2814) and services (9500), construction (207) [17].

On the other hand, Constantine is home for several years to the only university in the entire eastern region, founded in 1968; it has attracted new baccalaureate holders from the eastern wilayas because of the lack of a university establishment or the desired course of study. Today, it remains a university pole in the region despite the policy of the Algerian state tending towards the construction of new infrastructure and the promotion of others existing, in order to meet the growing demand for educational places; the number of enrolled in higher education goes from 400,000 in 2000 to nearly 1500,000 in 2017 [11].

It concentrates rare tertiary activities, industrial, economic, commercial and other functions controlled by its central power and attraction, such as research, training and culture.

2.2. *various impacts of the transport at Constantine city*

It is known that the development of urban transport networks represents an action to help the foundation of cities able to meet the objectives of sustainable development, defined by the Bruntland Commission in 1987 as follows: « Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs » [6]. This sustainability must be based on three essential pillars: economic, social and ecological.

a. *On a social level*

The various means of transport contribute to the opening up of marginal districts and give a chance for all the inhabitants of the city to benefit from the facilities and services. In the case of Constantine, the situation is still far from that, especially with the stop of the cable car and the limited service area of the tramway line.

In the same social aspect, the inefficiency of the collective means, in particular the buses, has often provoked a psychological pressure and nervousness for the users as well as for the transporters (drivers and receivers); this has caused several times traffic accidents.

b. *On the economic level*

Public transport means, especially the new modes (cable cars and tramway), help to save time and money; in Constantine, 87% of the individuals interviewed confirm the efficiency of the tramway, especially with the different subscription formulas (student, schoolboy, junior, senior, classic, single and weekly). The remaining 13% are not satisfied; they are often forced to make a stopover to reach their destinations (more time and expenses).

The economic impact is also remarkable in terms of delays at work, as the time to go to work coincides with the time to go to school and university, which generates traffic jams (peak times). It impacts without a doubt the profitability and efficiency of workers. It is in this sense that a solution was proposed in 2017 by an elected official at the APW Algiers¹, It consists in the rearrangement and the arrangement of the working hours in a way to avoid the school hours and to give the parents the time to bring their children to school. And this after noting the fluidity of road traffic in Algiers during the school vacations.

c. *On the ecological level*

Traffic is currently the most significant contributor to air pollution at the city level. The main problems related to air quality degradation are caused by human activities,

¹ The Wilayal Popular Assembly of Algiers

particularly transportation and industry. This degradation has resulted in harmful impacts on human health, vegetation, and the environment in general. To this end, these pollution problems require continuous efforts in order to achieve effective air quality control [17].

In fact, the impact of transport on the environment is continuously increasing; in France, for example, CO₂ emissions from road transport increased 6.4 times between 1960 and 2000. A trip from Paris to Nice emits 30 times more CO₂ than the same trip by TGV, a round trip from Paris to New York emits 500kg of CO₂ per passenger, which is the total amount that each individual should spend per year [15].

This impact depends mainly on the source of energy; in 2019, 29.22% of the cars in the wilaya of Constantine run on gasoil, that is 68137 cars out of a total of 233192 registered in this wilaya. The date of introduction of vehicles is also an impacting factor; the older the vehicle, the more important their atmospheric emissions are. In Constantine, we have seen the circulation of old vehicles, including buses of the private sector (Fig 10.).



Fig 10. Old bus still in use

It should be mentioned here that there are no precise measurements on air quality in all Algerian cities, only estimates based on social and economic data. The only project that has been launched in this area is the "Sama Safia". Supported by the World Bank, the experimental stage of the project "SAMA SAFIA" which consists in the monitoring of the quality of the air in the Algerian cities, this project did not see the day, the city of Algiers is the only one which lived the operation of a station placed in Ben Aknoun (Algiers), stopped in 2009 [23].

there is also an impact in terms of visual pollution on human beings, which is exposed to our public spaces in general and roads and streets in particular [3].

2.3. *Initiatives and efforts to solve the problem, how effective? What contribution?*

3.3.1 *The foundation of a new city independent of the mother city: Ali Mendjeli*

In front of the demographic growth which generated an unceasingly increasing need on the services, the habitat and the constructible grounds, the local authorities decided at the beginning of the 90s the creation of the city Ali Mendjeli. The project should allow the creation of a city independent of the mother city, which would extend over an area of urbanization of 1 500 hectares, and would receive about 300 000 inhabitants [2].

A large part of Constantine's population was transferred to this city in a hurry and without any development of the public space, which made it a city without a soul (according to

Marc Cote), a dormitory town. It has marked a flagrant lack of facilities, so the inhabitants remained dependent on the mother city to meet their needs. This will increase mobility, especially by using individual means with the lack of collective means of transport. It is only with the extension of the tramway line in its part Zouaghi- Ali Medjeli, (2019), that things will improve, and the flows are reversed, especially with the creation of shopping malls in the new city such Erritadj-mal and the coupole-mal.

3.3.2. *Introduction of intermodality and diversification of the public transport offer*

It allows for accessibility in urban areas with little travel time; according to the International Union of Public Transport (UITP), cities need a 175-meter wide road to transport 50,000 people by private car. However, it needs a 35-meter wide lane to transport them by bus, and a 9-meter wide lane only to transport the same number by surface metro [25].

a. *The creation and extension of the tramway line*

Launched in 2007, the project aimed to change the perception of urban transport in the capital of eastern Algeria, suffocated by traffic and air pollution. Commissioned in two phases, the first section Benabdelmalek - City Zouaghi in 2013, and the second, consists of the extension of the city Zouaghi - Constantine 2 university station in Ali Mendjeli in 2019.

Considering that the tramway is attractive within a radius of 500 m around the stations, the population served in this 500 m corridor on both sides of the line amounts in 2015 to 88500 inhabitants, a population density of 10000 h/km² of line. In reality, the tramway serves more people beyond this corridor [7]. Because it passes through dense housing areas (Boumedous Avenue, the new city Ali Mendjeli), business areas and universities (University of Islamic Sciences AEK, Constantine1 University, Constantine3 University, Constantine University2) in addition to several university residences, Nahas Nabil and Mentouri(Fig 11.).



Fig 11. tramway stations, universities of Constantine

1: station Université Emir AK, **2:** station Université Constantine1, **3:** station Université Constantine 3, **4:** station Université Constantine 2.

It should also be mentioned that the Constantine tramway serves all along its corridor of tourist facilities [8]. It ensures the transport of important flows and contributes to reduce traffic jams. Two other lines are planned for its extension to Mohamed Boudiaf airport and the city of El

Khroub (Fig 12). These extensions will serve several facilities and neighborhoods and improve the quality of public transportation in Constantine.

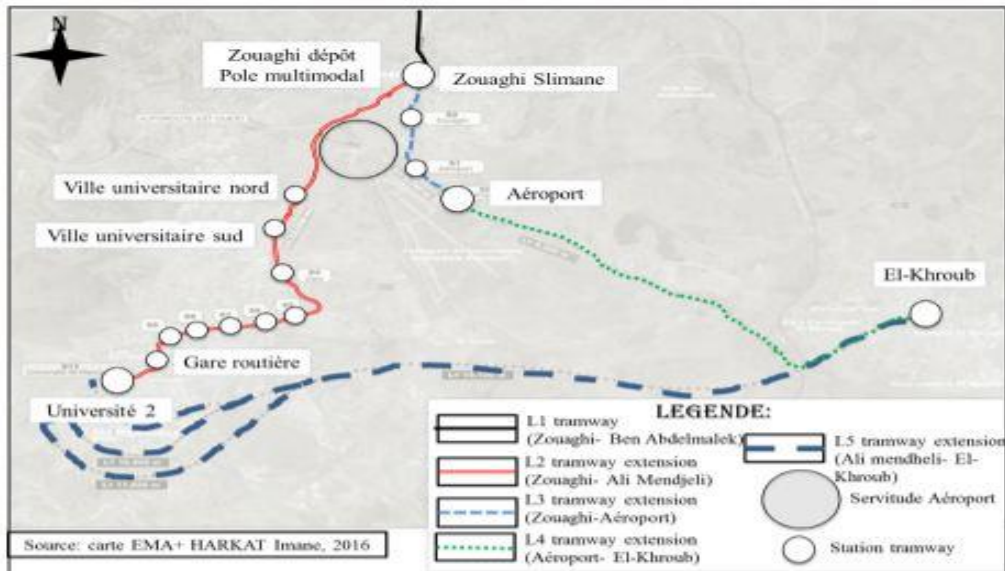


Fig 12. Projects to extend the Constantine tramway line
Source:[8]

b. The installation of the cable car

The cable car is a means of public transport that crosses the gorges of Oued Rhumel and connects the old city, from the place Tatache Belkacem, to the northeastern part of the medina at the level of the city Emir Abdelkader, passing by the hospital CHU Ben Badis (Fig 13.). It was put into service on June 5, 2008. The total length of the route is 1500m; the installation has 33 detachable cabins with a capacity of fifteen people. The duration of the trip is about 7 minutes, with an estimated average flow is 1200 passengers per hour.

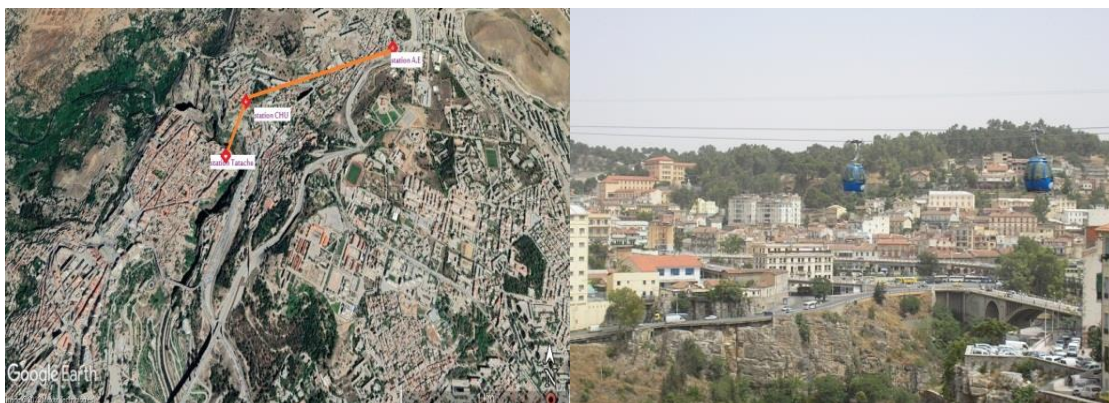


Fig 13. Route of the cable car in Constantine
Source : author + Google Earth Pro

The project was included in the framework of tourism development and enhancement of the image of the city of Constantine, however and since its commissioning in 2008, it has become a means of transport of remarkable success in relation to the growing attendance of the inhabitants, who suffered from a lack of means of travel in common from their places of residence to the downtown and vice versa.

It should be noted that this device has served nearly 100,000 inhabitants in the northern sector of the city, as well as 5,000 workers in the CHU, in addition to the thousands who daily frequent the various facilities (market, CHU, administrations ...).

Today, the machine is in a state of stoppage since April 2018 due to a breakdown. The period of its service for about ten years, has proven the sustainable dimension in this type of transport; economic-tourism, social and ecological component. To this end, the acceleration of repair work has become an urgent priority.

3.3.3. *The installation of engineering structures*

Many structures have been installed including:

a. *The giant bridge (Salah Bey bridge)*

With a length of 1119 meters, it connects two urban areas separated by the Rhumel gorge (Fig 14.). Work began in 2010 and was completed in July 2014.



Fig 14.the new Saleh By Bridge

b. *The interchange of Djenane Zitoune*

Recently completed (summer 2022), near the Roman aqueduct, the project consists of a bypass designed to eliminate congestion and traffic jams in this area which constitutes a crucial axis in the road network in the city of Constantine, a crossroads that leads to several directions: Boussouf, the city center, Sidi Mabrouk, El Khroub, the new city Ali Mendjeli, the universities of Constantine (1,2,3), and the airport (Fig 15.).



Fig 15. Djenane Zitoune interchange (Roman arches)

4. Conclusion

Our analysis has led us to the conviction that talking about sustainability and liveability in our cities necessarily leads us to reflect on concerns related to urban transport and the management of urban life in general. Transport has a real impact on the sustainability of cities and territories.

In the case of Constantine, it has become very clear that urban planning and transport planning have been conducted independently, something that has been at the origin of a complicated and sometimes chaotic situation, making Constantine, known by an important mobility of its population, a congested city that lacks road fluidity and parking spaces in front of a large use of personal vehicles despite the foundation of some public transport system, including the cable car and the tramway capable of improving the conditions of movement and quality of life in the city in general as well as reducing emissions of pollutants in the air.

The short period of service of the cable car, currently at a standstill due to a breakdown, has confirmed its place in the opening up of the North East zone of the city and the creation of a strong link between its different parts. It has become urgent to relaunch it and why not to widen the line along the Rhumel valley in order to connect its two banks on the whole North and East part of the city.

The tramway also, despite the limited area served, it is necessary to appreciate its place in solving the problem of transport and congestion in the city of Constantine, especially by promoting intermodality and encouraging people to use public transport. It is therefore recommended to extend this line to become a real network covering the entire southern part of the city and the communal grouping in general.

It is also recommended that existing road networks be improved to accommodate the large and growing number of vehicles. The reinforcement of the parking capacity by adopting models based on the principles of sustainability such as the cloverleaf model based on the connection between the road axes and the parking spaces.

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