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Special Issue 1.2018

URBAN TRAVEL BEHAVIOR IN THE MIDDLE EAST AND NORTH AFRICA

ISSN 1970-9889
University of Naples Federico II

TeMA Journal of
Land Use, Mobility and Environment

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Published by
Laboratory of Land Use Mobility and Environment
DICEA - Department of Civil, Architectural and Environmental Engineering
University of Naples "Federico II"

TeMA is realized by CAB - Center for Libraries at “Federico II” University of Naples using Open Journal System

Editor-in-chief: Rocco Papa
print ISSN 1970-9889 | on line ISSN 1970-9870
Licence: Cancelleria del Tribunale di Napoli, n° 6 of 29/01/2008

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Cover Image by Houshmand E. Masoumi of landscape in Teheran

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TeMA Journal of
Land Use, Mobility and Environment

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TeMA
Journal of
Land Use, Mobility and Environment

TeMA Urban Travel Behavior in the Middle East and North Africa
SPECIAL ISSUE 1.2018 | 67-82
print ISSN 1970-9889, e- ISSN 1970-9870
doi: http://dx.doi.org/10.6092/1970-9870/5455

review paper received 30 January 2018, accepted 29 April 2018

Baouni, T., De Ona, R., Merad, B., Tahraoui, L., Machado Leon, J.L., De Ona, J. (2018). Analysis of the main service quality dimensions affecting satisfaction of the metropolitan rail public transit Users in Algiers. *Tema Journal of Land Use, Mobility and Environment* .67-82.
doi: http://dx.doi.org/10.6092/1970-9870/5455

ANALYSIS OF THE MAIN SERVICE QUALITY DIMENSIONS AFFECTING SATISFACTION OF THE METROPOLITAN RAIL PUBLIC TRANSIT USERS IN ALGIERS

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ABSTRACT
The improvement in public transit is one of the basic and essential pillars to promote sustainable urban and metropolitan mobility everywhere. Algeria´s transportation system primarily relies on private vehicle, which causes innumerable problems such as congestion, emissions, traffic accidents, social inequalities, gender inequalities, and deterioration of the environment. Given that, the Algerian Government has recently carried out some transportation projects such as the Algiers metro and tramway service to promote collective public transportation in the country. Therefore, it becomes essential to provide public administrations and technicians with relevant information and efficient analytical tools to help enhance and develop this mass transit. In this line, the first Customer Satisfaction Survey was designed and implemented in November 2014 at the three railways transit services of Algiers: the light rail, the underground heavy rail (both started into operation in 2011) and the commuter rail. Thanks to this survey instrument, users' profiles and travel patterns were found out. Moreover, an analytical framework based on a principal component analysis and an ordered probit model identified service quality dimensions and their impact on users' overall satisfaction. In addition, the effect of socio-economic variables and travel patterns on the previously identified quality dimensions was obtained through multiple linear regression models. The results presented in this paper could help Algerian transport authorities towards elaborate specific proposals to increase transit ridership.

KEYWORDS:
Public transport; Users; mobility; Service quality; Regression models; Algiers.

1 INTRODUCTION

Public transport (PT) usage is a world-wide priority of sustainable mobility policies. Over recent years, the quality of PT has become a critical factor for considering these more efficient transport modes as a suitable alternative to travelling by private car. Therefore, since the end of the 20th century, the number of studies analysing quality in this sector has grown significantly. A big amount of practices has been carried out around the world, most of them based on passengers' point of view, as it is considered the most relevant for service performance evaluation (Berry et al., 1990). It is possible to identify some differences between the quality analysis carried out in different geo-social contexts. In fact, transport users have different requirements from their service that differ between individuals, periods of time and geographical contexts. The analysis of service quality in PT started at different times in different locations around the world. According to a classification developed by the World Bank in 2014based on the GNI per capita of the countries, high income countries (GNI per capita >= $12,736) began to evaluate service quality at the end of the 20th century. In the countries defined as having middle and low incomes, quality studies started to be widespread after 2010.However, these last studies are predominantly only being done by academics because the operators, managers and public administrations have yet to introduce this tool into their operating strategies. The most commonly used survey type around the world is the paper based with face to face Customer Satisfaction Survey (CSS). However, in the higher income countries (mainly in the USA and Europe) stated preferences surveys (e.g., Román et al., 2014; dell'Olio et al., 2011) and attitudinal surveys (de Oña et al., 2016; Diab et al., 2017) are also used. The more developed countries also use new technology for data collection, on-line surveys (de Oña et al., 2016), on-line surveys using QR codes (Guirao et al., 2016), face to face interviews supported by tablet or laptop (Román et al., 2014), etc.

According to the methodology used to analyse service quality, high income countries have introduced more sophisticated analysis models, predominantly discrete choice models (Diab et al., 2017; Román et al., 2014), structural equation models (de Oña et al., 2016; Park et al., 2004) and data mining algorithms (de Oña et al., 2012; Garrido et al., 2014). In medium and low-income countries simpler analysis tools are normally used based on the SERVQUAL scale (Irfan et al., 2012; Ojo et al., 2014), factorial analysis and/or regression analysis (Alpu, 2015), or simple structural equation models (Hadiuzzman et al., 2017; Irfan et al., 2012).

Therefore, the main objective of this paper is to describe and analyze the results of the first CSS of users carried out forall rail PT services in the metropolitan area of Alger (Algiers): light rail, underground heavy rail and commuter rail. This paper also aims to achieve the following secondary objectives: a) identify the existing profiles of users of the three rail public transit services; (b) identify travel patterns of rail public transit users; (c) identify the main dimensions/constructs that affect the perceptions of service quality of these rail public transit modes; (d) analyze the relationships between the service quality dimensions and the overall satisfaction; and e) analyze the effect of socio-economic variables and travel patterns on the previously identified quality dimensions. This research contributes to the literature with interesting and useful information about the quality of the rail PT services of Alger (upper middle GNI per capita country group, $4,126–$12,735, according to the World Bank 2014 classification). The organization of the paper is as follows. Section 2 describes the Algerians' mobility and the existing metropolitan rail public transit modes. In Section 3, we introduce the methodology applied, that is, the survey implementation and data collection procedure and the methods used for modeling the survey data: Principal Component Analysis and Ordered Probit model. The results of the analysis are reported in Section 4. Last, Section 5 summarizes the main conclusions of the paper.

2 BACKGROUND OF URBAN TRANSPORT IN ALGIERS

Algerian cities are characterized by extremely rapid urban growth with an imbalance increasingly marked between the center stagnating and peripheral areas experiencing major socio-economic changes which generate, as a consequence a demand for travel more and more growing and diverse. The agglomeration of Algiers, a perfect illustration of the problem of transport in Algeria, is characterized by a strong urban sprawl, high residential density, road and motorway network at the limit of saturation, particularly during peak hours, which results in congestion of transport networks and environmental damage reaching alarming levels. In recent decades, Alger has developed considerably and has become a major metropolis with almost 3 million inhabitants and an annual growth rate of 1.7% (DAL-Wilaya of Algiers, 2016). In addition to all this, the sharp acceleration in industrial and commercial activities has led that the urbanization has spread widely in the periphery (East, North West and South East). The huge acceleration shows that there is a clear need of transport infrastructures in order to support this development. Less than 2% of the area of the town, the center of Algiers, comprises six towns and concentrates (Berchache, 2011): 23% of the population; 33% of jobs; 15% of school and university enrolment; and 40% of motorized flow. The result of this growing spaces are for instance: grabbing the traffic and parking, difficulty in walking, the almost permanent congestion, fatigue, loss of time, noise and air pollution and other threats. Roughly speaking we can say that urban transport is increasing sharply from 3.4 million trips per day in 1990, 4.8 million trips in 2004, and 6.5 million trips in 2014 (BETUR-CNEAP, 2004; Baouni, 2015a). Knowing that the movements for mandatory reasons (work, studies) are the main source of daily mobility of the capital (70.6%), these factors, although not exhaustive, suggest an overall increase in mobility needs every day. Therefore, this suggests a worsening of traffic conditions in the central areas of the capital, which are still the major trip generators (employment, education, services) (Charton, 2010). Regarding the modal split of these movements, most of them are made through walking (56%) and only 44% using motorized modes, which may be considered as a low figure for a city with the size of Algiers, whereas the shared public transport in motorized fashion is around 65% (BETUR-CENEAP, 2004). Besides this, public transport represents about 54.0% and the remainder of trips is on foot (36.5%) or by car (9.5%) (Dessau et al, 2006). In motorized modes (Collective Transport Car + Particular), student mobility is generally higher than that of the other inhabitants, however private cars are much lower (15 to 20% instead of 31.6% for residents). The urban transport organization in Algiers' city is particularly complex. First, this complexity is partially due to the fact that the perimeter of urban transport in Algiers does not coincide with the administrative boundaries of Algiers' city. This urban transport perimeter, which remains to be defined, extends far beyond the metropolitan area and extends over the neighboring provinces of Blida, Boumerdes and Tipasa. Second, several companies provide the public transport services: ETUSA, TRANSUB, SNTF, RATP El Djazair, SETRAM and private operators. The Urban Transport Company and Suburban Algiers (ETUSA) is a public company that provides public transport to the Algiers suburbs. Its business is mainly concentrated in inner city stations that goes from the First of May, up to Audin, Martyrs Square, and to the east and the heights of Algiers. It affects up to 10 buses on the busiest lines. ETUSA daily transports some 100,000 passengers. However, the company's productivity is very low: it carries only 220 passengers per bus per day, while the international recommendations are about 800 passengers per bus per day. ETUSA also operates five cable transport systems, two elevators and an escalator (ETUSA, 2014). In terms of service quality, the company's difficulties may due to the average speed evolution, which fluctuate between 7 and 10 km/h. Similarly, the loss in traffic mileage is estimated at 30%. All these problems give an unattractive image of the network and impose huge operating costs. In addition to the ETUSA's services, 3,300 private operators have increased very significantly the facilities of public transport in the capital. They have a 3,405 vehicles fleet with 94,820 seats available, representing about 80% of the total supply of bus public transit. In July 2014, private

operators provided 68% of the total public transportation network in Algiers' city (140 lines over 216 lines). However, despite the important role of private operators in the provision of public transport services in Algiers, ETUSA maintains a monopoly in the city center. In the absence of physical and fare integration between different operators (private or public) travelers are forced to pay two or three rates, depending on the origins and destinations of their trips. In addition to regular public transport services provided by public or private operators, there are other public companies and some private agencies that provide specialized transportation services: Government provides transportation services on grounds "home-work" with 1,359 vehicles and a total capacity of 38,480 seats available, representing 7.6% of trips by public transport.

The university transportation responds to a request for transport of students from their residences to educational structures. For this purpose, 588 vehicles are available (328 on the urban network and 260 on the regional network) with a capacity of 58,800 seats that supports 10% of urban mass movement.

These two types of transport are highly subsidized, either directly in the case of university transport, where the Office National des Oeuvres Universitaires contracts with private operators, or indirectly, when a government provides free transportation services to his employees. The recent modernization of the suburban railway (2009) and the metro and tram entering in operation in 2011 should result, in the short term, of the spread the shared trips on public transport (Figure 1). Indeed, the railway suburban Algiers operates a network of 45 km of railway line consisting of two lines that share a common core (12 km) between Gare Central El Harrach and Algiers, where they are divided into two: one serving the eastern suburbs, from El Harrach Until Réghaia station, over a length of 19 km; and the other serving the West Island, from El Harrach Birtouta to the station, a distance of 14 km. The suburban railway network electrification in 2009 allowed the rail network in the suburbs of Algiers to carry a total of 28.3 million passengers in 2014 with130 trains a day and offering a nominal capacity of 198,000 seats (Talamali, 2015). The National Rail Transport Company (SNTF) is the main rail operator (public) in Algeria, and its program for 2025includes a number of projects in Algiers: the new link OuedSmar-Gué de Constantine; the link Birtouta New city of SidiAbdellah / Zéralda over a length of 23 km; the construction of the Central Station Travellers; regional rail yard Dar El Beida;and, the rail service from the airport. These programs will be complemented by projects for serving the future port and the construction of the Hamma's central station. The tram and the subway's priority section start up, which became effective in 2011 allowed, besides meeting the expectations of the population in terms of mobility in terms of comfort, safety and significant speed, improve Algerians' life quality and create new urban development zones. The tram commissioning of the priority section of the subway, which became effective in 2011 will allow, besides meeting the expectations of the population in terms of mobility in terms of comfort, safety and significant speed, improve quality of life of Algiers and create new urban development zones. The subway extends from the Grande Poste to El Harrach over a length of 13.5 km with twelve stations. It entered in operation in November 2011, and it will be extended by 2016, on the one hand to Martyrs' Square (1.7 km) and, secondly, to El AinNaadja (3.5 km). Other extensions are under study:from El Harrach Intl lines, with a length of 10 km ; and AinNaadja – Baraki, about 4 km (by 2020). At the beginning, metro was managed by RATP El Djazair, andlater by the Algiers Metro Company, the public concessionaire of the metro infrastructure. The Algiers metro, which runs from 5am to11pmeveryday, is not working to its full capacity and the number of passengers carried in 2014 is around 16.1 million passengers (EMA-RATP El Djazair, 2014). This lowamount of people could be justified because of the line design, as the line does not cover all areas of the capital. The first line (Fusilliés East to Dergana, via Bordj El-Kiffan) entered into operation in 2011 and I waslater extended to the southwest side (to Birmandrais from the Fusillés' station).

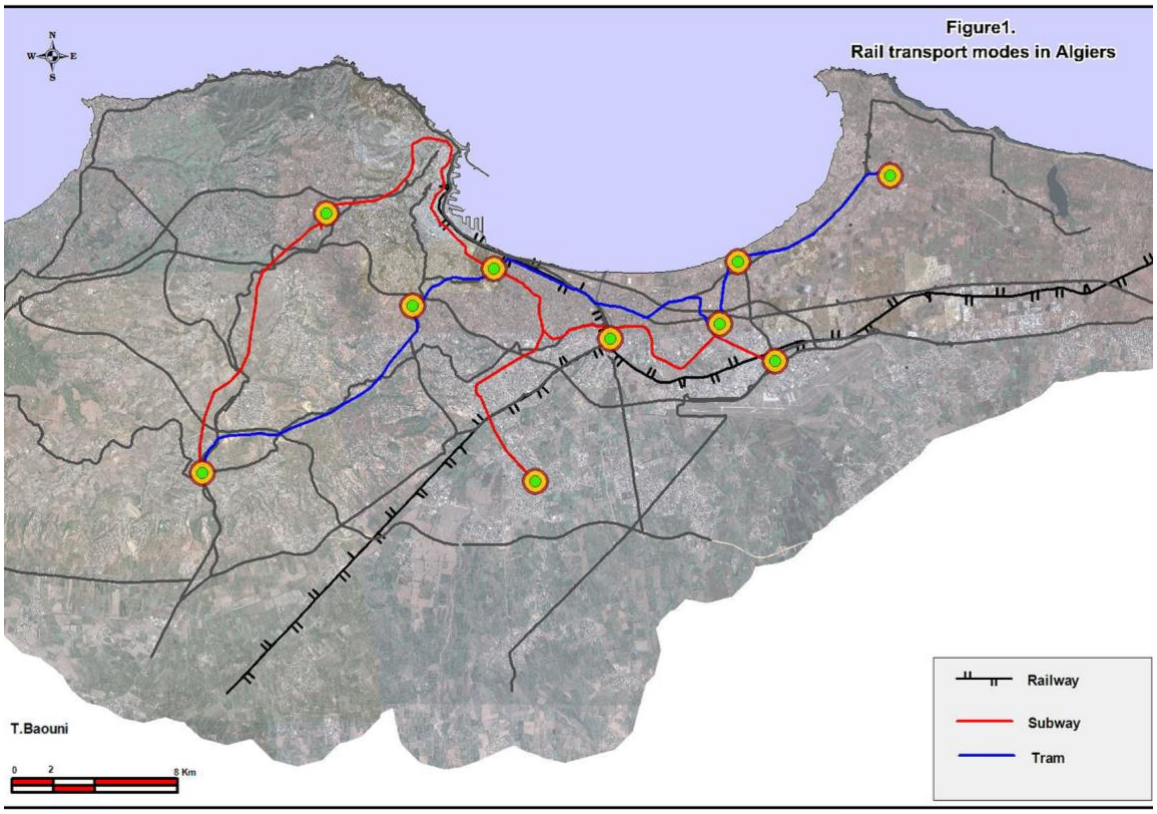

Fig. 1 Rail transport modes in Algiers

Bordj El Kiffan - Dergana has been operational since 2014. ETUSA initially assured the tramway management. Now, SETRAM (Society Algerian Tramways), a joint venture with three companies (Enterprise Metro d'Alger, RATP Développement and ETUSA), manage the tramway. According to study's forecasts, the number of customers should reach 185,000 passengers a day. However, SETRAM's statistics showed 8,821,527 passengers per yearin 2014. Finally, in theory the taxi should be considered as complementary to the major public transport. However, it has substituted it, particularly in the inner city, where ETUSA is unable to meet demand on the lines for which it has exclusivity. This mode offers 42,348 available seats using 10,587 vehicles. Urban taxis carry about 6% of motorized trips (DTW, 2014). For a long time, they have addressed the weaknesses and shortcomings raised by the transit system; especially in terms of speed, comfort and safety, but they are an element that promotes traffic conditions degradation, especially in the inner city, because of their large number, the practice of twinning causing untimely stoppages on roads and lack of parking spaces on street reserved for them.

3 METHODOLOGY

3.1 SURVEY İMPLEMENTATİON AND DATA COLLECTİON

Based on the local context, an ad-hoc CSS was designed and implemented based on a thorough literature review of service quality measurement and evaluation (De Oña et al., 2015; De Oña & De Oña, 2014) and similar PT services in developed countries (De Oña et al., 2013). The CSS consisted on three different questionnaires adapted to each of the three railway transit services in Algiers. The data collection procedure was conducted face-to-face during three days between November 24th and November 26th, 2014, in different areas of the transportation services (different stations, in vehicles, and more). A total of 358 surveys were collected, which 347 were valid. The number of respondents was fairly evenly distributed (104, 108 and 135 respectively) across the three modes (light rail, underground heavy rail, and commuter rail).

The language chosen to conduct the data collection was French. Additionally, the interviewers were able to translate the question to Arabic in a closed form for non-French speaking respondents.

The survey instrument consisted of three parts: Part A, gathered users' perceptions about the quality of the service and their overall satisfaction; Part B collected the characteristics of the trip made by the respondent; and Part Casked the socio-demographic characteristics of the interviewed passengers. Users' perceptions were measured with an 11-point scale (0-lowest quality and 10-highest quality), while users' overall satisfaction was measured with a 5-point Likert scale (1-lowest level of satisfaction, 5-highest level of satisfaction). The number of service attributes evaluated varied between 28 and 30 depending on the questionnaire used for each PT service (i.e., metro, tramway and commuter rail); 25 of them were equal for the three transit modes. These service attributes were related to Availability of the service, Accessibility, Information, Time, Customer Service, Comfort and Safety.

3.2 METHODS

Principal Component Analysis (PCA)

PCA analyzes interrelationships among a large number of variables and explains these variables in terms of their common underlying factors (Hair et al., 2010). Additionally, this technique allows to make estimates of the factors themselves (factor scores), which then replace the original variables in the subsequent analysis (Hair et al., 2010). Several statistical criteria must be met before a correct application of this analytical technique for ensuring data consistency (Hernandez & Monzón, 2016): sample size, reliability, sampling adequacy, and Bartlett's test sphericity. Field (2009) defined as a proper sample size having at least 10–15 participants per observed variable. Cronbach's alpha is the measure of internal consistency reliability and a value from 0.7 is generally considered to represent an acceptable scale. The index used to measure the sampling adequacy is Kaiser-Meyer-Olkin (KMO) index. The KMO statistic varies between 0 and 1. Hutcheson and Sofroniou (1999) defined values between 0.5–0.7 as mediocre, values between 0.7–0.8 as good, values between 0.8–0.9 as great and values above 0.9 as superb. Finally, significant Bartlett's test indicates if the correlations among the observed variables are sufficiently large to apply a PCA. A criterion of an eigenvalue greater than or equal to 1.0 was used for factor extraction and a VARIMAX orthogonal-rotation method was used as it simplifies factor interpretation.

Order Proibit (OP) Model

The OP model was originally developed by McKelvey and Zavoina (1975). In the OP model there is an observed ordinal variable Y, which is, in turn, a function of another variable Y* that is not measured. Specifically, in the ordered model there is a continuous unmeasured latent variable Y*, whose values determine what the observed ordinal variable Y matches. The continuous latent variable Y* has various threshold points. The value Y_i of the observed variable depends on whether or not the value of Y* crossed a particular threshold, as showed by the following equations (1).

$$Y_i = 1 \ \ if \ \ Y_i^* \leq \mu_1$$

$$Y_i = 2 \ \ if \ \ \mu_1 < Y_i^* \leq \mu_2$$

$$(\dots)$$

$$Y_i = j \ \ if \ \ \mu_{j-1} < Y_i^* \leq \mu_j \qquad (1)$$

$$(\dots)$$

$$Y_i = m \quad if \quad Y_i^* > \mu_{m-1}$$

In the population, the continuous latent variable Y^* is equal to Eq. 2:

$$Y_i^* = \sum_{k=1}^{K} \beta_k X_{ki} + \epsilon_i = Z_i + \epsilon_i \quad (2)$$

where there is a random disturbance term ε_i normally distributed. The error term reflects the fact that the variables may not be perfectly measured, and some relevant variables may be not introduced in the equation.

By means of the OP we can estimate the expected average value of the Y_i^*(Eq. 3):

$$E(Y_i^*) = Z_i = \sum_{k=1}^{K} \beta_k X_{ki} \quad (3)$$

Once we have estimated β coefficients and the (m-1) k cutoff terms, we can estimate the probability that Y will have a particular value. The formulas are the following (4):

$$P(Y_i = j) = \Phi(\mu_j - \boldsymbol{x}_i\boldsymbol{\beta}) - \Phi(\mu_{j-1} - \boldsymbol{x}_i\boldsymbol{\beta}) \quad (4)$$

$$P(Y_i = m) = \Phi(\mu_m - \boldsymbol{x}_i\boldsymbol{\beta}) - \Phi(\mu_{m-1} - \boldsymbol{x}_i\boldsymbol{\beta}) = 1 - \Phi(\mu_{m-1} - \boldsymbol{x}_i\boldsymbol{\beta})$$

Finally, the OP model can be used to estimate the probability that the unobserved variable Y^* falls within the various threshold limits. Users' overall satisfaction is used as dependent variable of the proposed model and the service quality dimensions extracted with the PCA are introduced as independent variables.

Multiple Linear Regression Model

Multiple regression is a method used to model the linear relationship between a dependent variable and one or more independent variables. The model is estimated by least squares, which yields parameter estimates such that the sum of squares of errors is minimized. The resulting prediction equation is

$$Y_i = (b_0 + b_1 X_{i1} + b_2 X_{i2} + \ldots + b_n X_{in}) + \varepsilon_i \quad (5)$$

Where Y is the dependent variable, b_1 is the coefficient of the first predictor (X_1), b_2 is the coefficient of the second predictor (X_2), b_n is the coefficient of the n_{th} predictor (X_n), and ε_i is the difference between the predicted and the observed value of Y for the i_{th} observation. One regression model is calibrated for each service quality dimension extracted from the PCA, whereas the trips and socioeconomic characteristics are used as independent variables at each model. A stepwise procedure was used by adding variables in the regression model, if they made a significant contribution to the predictive power of the equation.

4 RESULTS AND DISCUSSION

The conditions and nature of mobility needs have evolved with the changing pace of life of the population and this is an important element that has affected the mobility of Algerians with the tram and metro start up. First, we want to emphasize that the results indicate that the gender distribution of respondents is roughly speaking 49.3% respectively of the male and 50.7% of female.

Table 1 shows that the gender distribution of respondents is roughly speaking 49.3% respectively of the male and 50.7% of female; and consisted of 39% of employees, 31.7% of students, 11.2% of the liberal function, 6.3 % women in the home and 10.4% belonging to categories other than those already mentioned (retired, unemployed, housewives, etc.). It is therefore quite normal that the results show a predominance

of the category of civil servants and students on the part of the socio-professional categories using the rail mode Algiers.

Variable / Category / Specifications	Cases	%
Sample Size	347	
Transportation Mode		
Metro	108	31.1
Commuter Rail	135	38.9
Tramway	104	30.0
B1. Reason to do your trip by metro?		
Comfort	135	16.0
Congestion	108	12.8
Frequency	63	7.4
No private vehicle	67	7.9
Lack of parking	62	7.3
Price	66	7.8
Safety	79	9.3
Speed	201	23.8
Another reason	27	3.2
Missing Values	38	4.5
B2. Trip purpose		
Shopping	29	8.4
Studies	90	25.9
Leisure	7	2.0
Work	138	39.8
Doctor	2	0.6
Others	47	13.5
Missing Values	34	9.8
B3. Mode taken to get from origin to station		
Bus	106	27.1
Walk	168	43.0
Metro	11	2.8
Motorcycle	1	0.3
Taxi	32	8.2
Commuter rail	8	2.0
Tramway	14	3.6
Private Car	50	12.8
Missing Values	1	0.3
B4. Time trip origin-station (min)		
Average	24,3	
Standard Deviation	30,6	
Minimum	1	
Maximum	240	
Q1 (25%)	8,0	
Q2 (50%)	15,0	
Q3 (75%)	30,0	
Missing Values	1	
B5. Mode taken to get to destination from station		
Bus	68	18.3
Walk	237	63.7
Metro	4	1.1
Taxi	22	5.9

Tramway	8	2.2
Motorcycle	1	0.3
Commuter rail	2	0.5
Private Car	23	6.2
Missing Values	7	1.9
B6. Time trip station-Destination (min)		
Average	22,1	
Standard Deviation	25,7	
Minimum	1	
Maximum	180	
Q1 (25%)	8,0	
Q2 (50%)	15,0	
Q3 (75%)	25,0	
Missing Values	16	
B7. Frequency of use		
> 4 days/week	165	47.6
3-4 days/week	78	22.5
1-2 days/week	41	11.8
Occasionally	61	17.6
Missing Values	2	0.6
B8. Transport mode alternative to this PT service		
Bus	201	50.9
Walk	16	4.1
Metro	5	1.3
Taxi	79	20.0
Commuter rail	11	2.8
Tramway	10	2.5
Private Car	68	17.2
Missing Values	5	1.3
C1. Availability of:		
Driver license	222	64.0
Access to private vehicle	114	32.9
Access to motorcycle	7	2.0
Access to bicycle	12	3.5
None	100	28.8
C2. Level of studies completed		
Without studies	16	4.6
Mandatory school	61	17.6
High School or Professional Education	59	17.0
Bachelor's degree or higher	206	59.4
Missing Values	5	1.4
C3. Employment Status		
Employed	137	39.5
Unemployed	12	3.5
Student	110	31.7
Homemaker	22	6.3
Liberal Profession	39	11.2
Retired	18	5.2
Other	6	1.7
Missing Values	3	0.9
C4. Age (years of age)		

<18	6	1.7
18-25	139	40.1
26-40	97	28.0
41-65	82	23.6
>65	14	4.0
Missing Values	9	2.6
C5. Household monthly income		
< 36001DA	63	18.2
36.001-54.000DA	74	21.3
54.001-72.000DA	30	8.6
> 72.000DA	23	6.6
Missing Values	157	45.2
C6. Gender		
Female	176	50.7
Male	171	49.3

Tab. 1 Trip and socio-demographic characteristics

Our survey shows that the surveyed population is quite as motorized (32.9%) as reported before. This figure actually seems okay and can be explained by the evolution of individual car ownership in recent years according to what we have observed in Algerian households. In addition, it should also be noted that 64% of respondents say they have a driving license. However, the results for the two-wheel (motorcycle and bicycle) are to be handled with great care because they do not reflect what is going on and the data collected in recent years show that the two are still very low and represent only 0.2% of motorized modes (Baouni et al, 2014; BETUR-CENEAP, 2004). Furthermore, the results for the level of study seem to be quite significant because the 59.4% represents the population of employees and liberal function of the respondent sample. Finally, to complete the analysis of the results on the socio-economic profile of the sample, it is interesting to note that the field survey showed that the age of 18-25 category comes in first place with 40.1% followed by the class of 26-40 years with 28% and, finally, the age group of 41-65 years with 23.6%. These figures show that the rail modes (metro, tram and suburban railway) are relatively popular among the young. Table 1 also shows that 23% of respondents mainly use rail modes for reasons of speed, while the frequency, the ticket price, security and others are weakly significant and seem to have the same value estimated at 7%. Furthermore, the low value of around 4.5% is allocated for other reasons. As the results show, in fact, that 65.7% of trips related to mandatory reasons (39.4% and 25.9% work studies).

Results clearly reflect that walking is the dominant mode (43%) for reaching stations, followed by bus (27%). Although the car is the preferred travel mode in Algiers, the survey's results show that the private car only represents 12.8% of the share market for reaching the stations. This can be explained by the lack of parking areas near the stations. The modes for reaching the final destination from the rail station follow the same patterns as from origin to the rail station. Table 1 shows that the highest values are for walking (63.7%) and buses (18.3%). Also, suburban railway and tram are poorly used in trips from origin to the station and from the station to the final destination. The average time from origin to the station is 24.3 min; while from the station to the final destination is 22.1 min. This lets us conclude that the average duration is substantially identical in both directions. Indeed, the rail modes are highly use by customers: 47.6% use them more than 4 times per week. The survey reveals that 50.9% of the people would use the bus as an alternative method in case of interruption of rail services, while taxi and private car fashion show 20% and 17.2% respectively. PCA identifies five dimensions that have a fairly significant impact on the quality of rail service in Algiers (see Table 2). These dimensions are related to the service operation, infrastructural comfort, safety and customer service, accessibility and personal comfort. The fairly extensive interpretation

of variables in each dimension gives a more or less correct picture of the overall quality of service, which translates into an average variance extracted of 0.59.

		PCA Factor loadings	PCA Factor scores weights
SQ1	SERVICE OPERATION (Cronbach´s Alpha: 0,87)		
Q130	Punctuality	0.79	0.30
Q14	Waiting time on the platform	0.78	0.28
Q2	Number of trains per day (frequency of the service)	0.76	0.28
Q1	Operating hours of the service	0.66	0.28
Q12	Updated, precise and reliable information in stations (price. operating hours. stops. service interruptions. etc.)	0.55	0.13
Q11	Updated, precise and reliable information on vehicles (operating hours, stops, service interruptions, etc.)	0.51	0.11
Q4	Regularity of the service (absence of interruptions caused by breakdown or incidents	0.47	0.13
SQ2	INFRASTRUCTURAL COMFORT (Cronbach´s Alpha: 0,82)		
Q18	Lightning on vehicles	0.78	0.35
Q17	Cleanliness of the vehicle	0.77	0.32
Q23	Lightning in stations	0.68	0.26
Q20	Temperature and ventilation system on vehicle and in stations	0.68	0.30
Q22	Cleanliness of the stations	0.64	0.23
SQ3	SAFETY AND CUSTOMER SERVICE (Cronbach´s Alpha: 0,80)		
Q253	Sense of security against slipping, falling and accidents at vehicle doors and escalators.	0.75	0.39
Q25	Sense of security against theft and aggression in stations and on vehicles	0.66	0.31
Q251	Sense of security against accidents while traveling (crash/vehicle derailment)	0.66	0.31
Q15	Effectiveness and speed of employees to respond, give information and deal with user´s daily problems	0.65	0.28
Q16	Performance of the Customer Service (offices, web site, contact by phone, deal with complaints, etc.)	0.49	0.14
SQ4	ACCESSIBILITY (Cronbach´s Alpha: 0,59)		
Q6	Easy access to satiations and platforms from the street	0.70	0.44
Q3	Proximity of stations to origin/destination	0.69	0.46
Q5	Easy connection with other transportation modes such as taxis, bus, tramway, metro, commuter rail, cable car, etc.	0.58	0.34
Q13	Speed of the trip	0.39	0.17
SQ5	PERSONAL CONFORT (Cronbach´s Alpha: 0,67)		
Q24	Seat availability in stations and on platforms	0.69	0.47
Q19	Level of comfort on vehicle (enough room seating/standing up)	0.62	0.38
Q21	Appropriate driving	0.41	0.21
Goodness-of-fit Indices			
Bartlett test (p<0.001)		3835	
Measure of Sampling Adequacy		0.86	
Average Variance Extracted		0.59	

Tab. 2 Principal Component Analysis results

Also, it should be noted that the value of Cronbach's Alpha is quite high (between 0.59 and 0.87) for service operation dimensions, infrastructure comfort, safety and customer service and personal comfort as to the dimension accessibility speed which is considered according to the Cronbach's Alpha to be acceptable (value equal to 0.59). It was noted that the permissible limit value is in the range of 0.6-0.7 (Hair et al, 2010).

Table 3 shows that the dimensions relating to "service operation", "safety and customer service" and "personal comfort" present a p-value lower than 0.05. This reflects a significant impact on the overall quality

of service. Also, Algerian rail public transport generally has a better image than the bus or private car. Satisfaction factors are the frequency, time of waiting in the docks, security, and punctuality. The latter two are the two most important elements for users regarding the service quality of public transport before the comfort, which remains an important dimension of quality of service (cleanliness, more space, etc.).

Explanatory Variable	Coefficient	Robust Standard Error	P-value
SQ1	0.227	0.042	0.000
SQ2	0.115	0.064	0.075
SQ3	0.171	0.042	0.000
SQ4	0.093	0.049	0.057
SQ5	0.098	0.044	0.026
cut1	1.335	0.560	0.017
Cut2	2.572	0.510	0.000
Cut3	4.619	0.543	0.000
Cut4	6.404	0.593	0.000
Goodness-of-fit Indices			
Sample Size	347		
Chi squared (p<0.001)	135.670		
Log-likelihood function	-311.193		
McFadden Pseudo R-squared	0.239		

Tab.3 Ordered Probit Model of Customer Satisfaction with the PT services

Model	Dimension	Explanatory Variables	Non-standardised coef. (B)	Typical error	Standardised coef. (B)	t	Sig.
			B		Beta		
		(Constant)	8,059	.286		28.140	.000
		B6	-.16	.006	-.198	-2.710	.007
1	SQ1	B1_Prix	-.941	.361	-.192	-2.609	.010
		B8_bus	-.841	.298	-.206	-2.825	.005
		B1_Frequence	.848	.367	.170	2.310	.022
		(Constant)	7.703	.272		28.362	.000
		B1_Confort	.438	.198	.163	2.216	.028
		B1_Vitesse	.508	.211	.182	2.404	.017
2	SQ2	B1_Securite	.605	.224	.198	2.698	.008
		B6	-.010	.004	-.186	-2.550	.012
		C1_permis	.371	.201	.134	1.848	.066
		B1_Prix	-.439	.245	-.135	-1.792	.075
		(Constant)	6.304	.358		17.585	.000
		B1_Prix	-.835	.382	-.168	-2.189	.030
		C2_obligatoire	.702	.402	.132	1.749	.082
3	SQ3	B1_Securite	.708	.348	.151	2.034	.044
		B6	-.011	.006	-.142	-1.914	.057
		C4_plus40	.654	.342	,144	1.914	.057
		B1_Vitesse	.626	.329	.146	1.901	.059
		(Constant)	8.251	.291		28.394	.000
		B3_pied	.678	.239	.213	2.833	.005

		C5_54o72DA	-.994	.330	-.228	-3.014	.003
4	SQ4	B8_bus	-.623	.242	-.193	-2.573	.011
		B1_Congestion	-.576	.246	-.173	-2.341	.020
		B6	-.009	.005	-.144	-1.921	.057
		B1_Prix	-.544	.290	-.140	-1.875	.063
		(Constant)	6.566	.224		29.369	.000
		C4_plus40	.909	.321	.212	2.832	.005
5	SQ5	B8_taxi	.913	.342	.199	2.672	.008
		C5_plus72DA	-.926	.443	-.156	-2.089	.038
		B6	-.010	.006	-.132	-1.772	.078
Godness-of-fit Indices (ANOVA)							
			Sum of Squares	Degrees of Freedom	Mean Square	F	P-value
		Regression	101.128	4	25.282	7,149	.000
1	SQ1	Residual	569.394	161	3.537		
		Total	670.522	165			
		Regression	50.899	6	8.483	5,550	.000
2	SQ2	Residual	243.042	159	1.529		
		Total	293.941	165			
		Regression	100.184	6	16.697	4,488	.000
3	SQ3	Residual	591.513	159	3.720		
		Total	691.697	165			
		Regression	69.006	6	11.501	5,228	.000
4	SQ4	Residual	349.762	159	2.200		
		Total	418.768	165			
		Regression	71.476	4	17.869	5,262	.001
5	SQ5	Residual	546.762	161	3.396		
		Total	618.238	165			

Tab. 4 Multiple Linear Regression Analysis of Service Quality Dimensions and Socio-demographic Characteristics

Table 4 shows the effect of socio-economic variables and travel patterns on the main service quality dimensions: service operation (SQ1), infrastructural comfort (SQ2), safety and customer service (SQ3), accessibility (SQ4) and personal comfort (SQ5). The socio-economic variables and travel patterns that do not show a significant influence (p-value>0.10) on each service quality dimension have not been included in Table 4. The trip time from the station to destination (-0.198), the ticket price (-0.192), and considering the bus as an alternative to the rail public transportation (-0.206) play a negative influence over the dimension of service operation. However, the rail transit's frequency has a positive impact (0.170) on this dimension.

The trip time from the station to destination (-0.186) and the ticket price (-0.135) play a negative influence over the dimension of infrastructural comfort. However, other reasons for using the rail transit, such as comfort (0.163), speed (0.182), safety (0.198); and the availability of a driver license (0.134) have a positive impact on this dimension. In the case of safety and customer service (SQ3), also the trip time to destination (-0.142) and the ticket price (-0.168) play a negative role. However, speed (0.146) and safety (0.151), and a low level of studies (0.132) and an age over 40 years old (0.144) have a positive impact on this dimension.

The trip time from the station to destination (-0.144), the ticket price (-0.140), the congestion (-0.173), considering the bus as an alternative to the rail public transportation (-0.193) and a high (54-72 kDA)

household monthly income (-0.228) play a negative influence over the dimension of accessibility. However, the possibility of accessing the station from origin walking has a positive impact on this dimension (0.213). And finally, the trip time from the station to destination (-0.132) and a very high (over 72 kDA) household monthly income (-0.156) play a negative influence over the personal comfort. However, an age over 40 years old (0.212) and considering the taxi as an alternative to the rail public transportation (0.199) have a positive impact on this dimension.

6 CONCLUSION

This paper presents the results of the first customer satisfaction survey of users of all rail public transit services (light rail, underground rail and commuter rail) in Alger. Some interesting results are extracted from this survey. Regarding the users' profile and travel patterns the main results are the following:
The three most important reasons for using rail transit services are speed, comfort and congestion of the road network. Work and studies are the main trip purposes. Access to and egress from stations are mainly based on walking and bus. The average trip time from origin to the stations and from the station to the final destination is 24.3 min and 22.1 min respectively. The users of these transport modes are mainly frequent users (more than 70% use the rail transit services more than 3 days/week). The main alternatives to the rail transit services are bus (51%) and taxi (20%).Most of the users (64%) have a driver license. However, only half of them (32.9%) have access to a private vehicle. Most of the users are employed (39.5%) or students (31.7%) and have a bachelor's degree or higher education (59.4%). Principal Component Analysis allows identifying five service quality dimensions (service operation, infrastructural comfort, safety and customer service, accessibility and personal comfort). However, only three of them (service operation, safety and customer service and personal comfort) present a significant influence (p-value<0.05) on the overall service quality. Service operation presents the highest influence (0.227), followed by safety and customer service (0.171) and, finally, personal comfort (0.098). Finally, the socio-economic variables and travel patterns that present a highest influence on the service quality dimensions are the trip time from station to destination and the ticket price. The trip time has a negative influence on all the service quality dimensions and the ticket price also has a negative influence in four of the dimensions (all except the personal comfort). These results could be explained because the price of rail services is high if compared with buses in Alger, and because the rail network is undeveloped (see Figure 1). Although the results of this paper help in understanding the situation of the rail transit service in Alger, we only have a general overview of all rail transit modes. More studies should be done in order to improve the data collection and analysis of the situation by transport mode.

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IMAGE SOURCES. Railway Algiers (setram-algiers)

Fig. 1: Baouni,2015b

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