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THE PERFORMANCE OF TRAMWAY SERVICE FROM THE USERS' VIEWPOINT: A COMPARATIVE ANALYSIS BETWEEN TWO MOROCCAN CITIES

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Abstract:

The Moroccan government has recently promoted sustainable public transport projects such as tramway services namely in the two largest cities of country, Casablanca and Rabat-Salé. Since its launch, the tramway service is increasingly present in citizens' daily lives in both cities. To maintain its attractiveness, operators and transport authorities should examine the performance of tramway service from user's point of view. That is, an in-depth understanding of how passengers perceive service quality and what make them satisfied. The purpose of this study is to compare the performance of tramway service in the two cities based on the opinions of a sample size of 613 and 435 individuals in each city. The outcome of this peer comparison allows to determine the strengths and weaknesses of provided service and identify priorities for improvement in each city. Regarding the methodology, we adopted a two-step approach to achieve our research purpose. The first stage intends to compare users' perceptions regarding Service Quality Attributes (SQAs) and overall satisfaction and to identify any significant differences between the two cities. To this end, we applied, in the first stage, a student t-test of two independent samples. The second stage employs an ordered probit regression model to identify the most important SQA; i.e., which most influence the overall satisfaction, and improvements priorities for the current service tramway. The results showed that, in average, passengers found service quality as good and are satisfied with tramway service in both cities. Tram vehicles' is the best appreciated service attribute in both cities while Comfort in Rabat-Salé and Lines' connectivity in Casablanca are the least appreciated. Moreover, the service performance of Rabat-Salé tramway exceeds that of Casablanca tramway in terms of service Availability, service Reliability, Fares level, Tram vehicle, Drivers' competence, Lines' connectivity, and overall satisfaction. On the other hand, we found that among top six important attributes, Reliability and Administrators should be prioritized for improvement in Casablanca; and staff, Lines, Comfort, and Administrators in Rabat-Salé. Results showed that improvements in all these service aspects would increase significantly overall user's satisfaction.

Keywords: *performance, perceived quality, overall satisfaction, tramway service*

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1. Introduction

Morocco's major cities have experienced rapid urbanization, population growth, and dispersion of facilities and activities in recent decades. These factors have led to increased demand for individual motorized transport, which has led to congestion, traffic accidents, environmental degradation, etc. These problems are more pronounced in the country's two largest cities, Casablanca and Rabat-Salé.

The development of rail transit is the common choice of the world's big cities to improve the traffic environment and solve urban traffic congestion (Cai Yan, 2018). With this in mind, the national government and cities have designed a vast investment program for sustainable transport projects. This political and financial effort resulted in the commissioning of the first tramway system in Rabat-Salé in May 2011 and the second one in Casablanca in December 2012. In this context, it is obvious that tramway is increasingly present in citizens' daily lives in both cities. However, its modal share is still low. According to the general population and housing survey (2014), the tramway is the least used mode to get to work and study. Its modal share represents, respectively, in Casablanca and Rabat-Salé, only 1.3% and 1.1% for the active population and 1.2% and 1.6% for the school population.

Maintaining attractive and high-quality tramway services requires an in-depth understanding of how passengers perceive service quality and what make them satisfied. In the Moroccan context, little is known about the service's performance from the users' point of view, as it has not yet been the subject of academic studies. Ait Boubkr, (2018) was the only author that examined the impact of the first tramway line in Casablanca on the quality of life and general satisfaction of disadvantaged people. However, the author did not focus on users' perception regarding provided quality and satisfaction, but it did focus on the concept of vertical equity.

Using customer satisfaction survey (CSS) data, this paper aims to answer the following questions: What is the level of perception of the tramway service quality and satisfaction? Are there significant differences between the two cities? What are the most important SQA in this mode? What attributes should be prioritized for improvement in both cities?

The rest of the paper is organized as follows: section 2 gives a brief overview of the literature, section 3 describes the methodology. Section 4 presents and discusses the main results. Finally, conclusions are drawn in section 5.

2. Literature review

2.1. Theoretical background

Performance measurement can be defined as the evaluation of an organization's results as a product of the management of its internal resources (money, people, vehicles, facilities) and the environment in which it operates (Transportation Research Board, 1994). It involves collecting, evaluating, and reporting data on how well an organization performs its functions and meets its goals and objectives (Transportation Research Board, 2010).

What is important in measuring the performance of urban public transport (UPT) services depends significantly on the perspective from which the measurement is conducted (Transportation Research Board, 2003). The measurement of UPT performance can be based on 4 different perspectives; the users' perspective, the operator perspective, the community perspective and the combined perspective (Karim and Fouad, 2018). The users' viewpoint refers to their perceptions of service quality and satisfaction. In practice, passenger judgments are qualitative measures that usually come from CSS (Eboli and Mazzulla, 2011). Many researchers consider the client's perspective to be the most relevant in assessing UPT services' performance. For example, Berry et al. (1990) consider that "*customers are the sole judge of service quality*"). Also, Grisé (2019) claims that "*retaining satisfied customers is becoming a priority for various agencies around the world due to various political and environmental reasons*".

Measurement of performance from users' perspective allows the development of target strategies for service improvement. An improved and high-quality UPT service encourages people to use public transport instead of private cars. This modal shift reduces many problems such as traffic congestion, air and noise pollution, and energy consumption (Eboli and Mazzulla, 2008). On the other hand, improved passenger satisfaction translates into many benefits for operators, including the increased market share and financial profitability. For these reasons, quality of service and passenger satisfaction has become, in recent years, a topic of great interest to both public transport managers and researchers.

In most studies of UPT, service quality is associated with the assessment of specific Service Quality Attributes (SQA) (De Oña, 2021). These latter refer to

instrumental measures that characterize and describe public transport service (Abenoza, 2014). Indeed, many SQAs have been proposed in the UPT literature. For example, Eboli and Mazzulla, (2008) and Cirillo et al., (2011) considered nine attributes, De Oña et al., (2014) used 14 attributes, and Murray et al., (2010) eventually considered 166 attributes. However, many SQAs are repeated, regardless of transport mode and context, because of their general importance. For instance, frequency of service, punctuality, comfort, cleanliness, safety, availability of information, courtesy of staff, fare, and others (De Oña and De Oña, 2015).

On the other hand, De Oña, (2021) argued that satisfaction is associated with more elaborated perceptions and affective judgments, and "overall satisfaction" is the indicator most often used to assess this construct. Hensher et al., (2003) have assumed that the overall level of user satisfaction is best measured by how an individual evaluates the whole package of services offered. This conception of satisfaction recognizes respondents' ability, through their cognitive and affective elaboration, to express a comprehensive assessment of overall satisfaction with the service (Cappelli et al., 2010).

The relationship between service quality and user satisfaction is not apparent in marketing literature. However, there is a tendency among authors of UPT literature to consider service quality as an antecedent to satisfaction (e.g., (Eboli and Mazzulla, 2007); (Andreassen, 1995); (Brons and Rietveld, 2009); (Stuart et al., 2000)). From this relationship, it is possible to infer the importance of SQAs by modeling the implicit contribution of each SQA to overall satisfaction. The weights of the SQAs correspond to the derived importance that users attach to them.

2.2. Benchmarking performance across geographic contexts

Public transport users have service requirements that differ across individuals, periods, and geographical contexts (Dell'Olio et al., 2018). Indeed, some researchers have studied the variation of users' perceptions from region to region. Van't Hart, (2012) found that transportation services have a moderately lower appreciation in the four largest agglomerations of the Netherlands. However, the differences are more evident when looking at perceptions for the four main service attributes (safety, speed, ease, and comfort) than when comparing overall satisfaction. Similarly, Friman and Fellesson, (2009) found significant differences between six European cities regarding overall satisfaction and perceptions of travel time and seat availability on public transport. Besides, Diana, (2012), in a study of multimodal traveler satisfaction in different urban contexts, concludes that satisfaction is higher in smaller municipalities. Abenoza et al., (2017) confirmed this result in the Sweden context.

It is also assumed that the derived importance of SQA will change from place to place since there are different transportation networks, socio-political, cultural, climatic, and attitudinal differences between different regions (Trompet et al., 2013). Abenoza, (2014) examined whether the importance of SQAs changes between five regions in Sweden. His result shows that satisfaction with the customer interface, travel time, operation, and absence of crime are the elements that have the most impact on overall satisfaction. However, travel time and customer interface are the most important for the country's three largest counties. For the small and medium counties, operation, followed by customer interface, are the most important. Nkurunziza et al., (2012) spatially analyzed the preferences of potential users for the duration, price, and comfort of BRT service and identified variations between areas in Dar-es-Salaam, Tanzania. Similarly, Eboli et al., (2018) examined the spatial relationships between satisfaction with overall service quality (dependent variable) and each attribute of rail transport service quality (explanatory variables) in the Milan region, Italy. They found that the coefficients show considerable spatial variation in the region and that one SQA may have more influence than another on overall satisfaction at each station.

It is worthy to note that most previous research has focused on UPT in general (All modes combined). The few studies that focused on tramway performance variability have been conducted in the same geographical environment. Some of them dealt with differences in perceptions between user segments (e.g., (Machado et al., 2018), (Obsie et al., 2020)), others compared the importance of SQA across several modes, including the tramway (e.g., (Andreassen, 1995); (Tyrinopoulos and Antoniou, 2008); (Machado-León et al., 2017)).

In the Moroccan context, some studies have carried out a comparative analysis of the performance of public bus transport between cities from the

operator's point of view (e.g, (Zehmed and Jawab, 2019)). However, no study, to our knowledge, has focused on comparative analysis of tramway service performance from user's point of view. Therefore, this research aims to fill this gap by comparing the perceived quality and its effect on overall user's satisfaction in the two largest Morocco cities, Casablanca and Rabat-Salé.

3. Methodology

3.1. Description of the two tramway systems

3.1.1. Rabat-Salé tramway

The Rabat-Salé tramway was put into service on May 23, 2011. This network comprises two lines that serve the Rabat-Salé agglomeration over a length of 20km (Figure 1). The first line extends over a length of 11.7 km linking Hay Karima (Salé) to the Agdal district (Rabat). This line comprises 21 stations with an interstation distance of 560m. The travel time is estimated at 36 minutes on average with a commercial speed of 18.5 km/hr. The second line extends over 7.8 km, linking the Yaacoub Al Mansour district (Rabat) to the Bettana district (Salé). This line consists of 14 stations with an interstation distance of 600 m. The travel time is 25 minutes on average with a commercial speed of 19 km/h. A common trunk between the two lines with a length of 2.9 comprising four stations. The span of service on the Rabat-Salé Tramway network extends from 06:00 am to 11:00 pm.

Since its commissioning in May 2011, the Rabat-Salé tramway has carried more than 273 million passengers. On average, 110,000 passengers are transported each working day, while Saturday and Sunday ridership reaches, on average, 70,000, and the average annual ridership is 32.9 million passengers (L'Economiste, 2020). Tickets' revenue is always the most important revenue source and represents 73% of the overall revenue. Active subscriptions reach 17 341 of which 54% come from students (L'Economiste, 2020). For the year 2016, the availability rate shows that 97% of the trains are available on time when the accident rate does not exceed 0.51% per 10,000 km. Finally, the fraud rate remains low, averaging 1.12% (STRS, 2016). As for users' profiles, the average user population is young (26 years old). 48% of travelers are women, and 52% are men. 47% of users travel at least once a day. The main reasons for travel are work and study (Boutaleb, 2017). Students and high school students represent nearly 67% of tramway users (El Aissi, 2019).

Line 2 is currently being extended over 2.4 km from My Youssef hospital to the Yaacoub El Mansour Rabat district via four stations. It is also extended by 2.6 km to serve Moulay Ismail and Al Quaria Districts through eight stations on The Salé side. This extension's commissioning will allow 40,000 additional passengers' daily transport, bringing the number of passengers transported on the network to 150,000 per day.

Fig. 1. Map of the Rabat-Salé tramway network (source: Tram-way.ma)

3.1.2. Casablanca tramway

The Casablanca tramway was commissioned on December 12, 2012. The network consisted of a single line 31 km long at the launch date, made up of a common trunk and two branches. This line crosses Casablanca from East to West, linking the Sidi Moumen district to the Lissassafa district via 48 stations with an inter-station of 600m. The journey time is 72 minutes with a commercial speed of 18km/h. The service time range is from 5:30 am to 10:30 pm with a frequency of 5 minutes in peak hours (AODU, 2014).

As soon as it went into service, the first line was a resounding success with citizens. The line increased from 22 million passengers in 2013 to nearly 35 million in 2017, with an average of more than 30 million passengers carried in five years. Subscribers, especially students, make more than 40% of trips (CasaTransports, 2017a). The majority of users are active people (67%), and a significant proportion is students (15%). The main reasons for traveling on tramway line are work (43%) and study (31%) (CasaTransports, 2017b).

A second line was put into service on January 23, 2019, over a length of 22.5 km serving nine boroughs and a direct corridor of 450,000 inhabitants (CasaTransport, 2019). This line is composed of 33 stations, three of which are transfer points with the first line (Figure 2). The latter has also been extended by 1.8 km to serve the Laymoun, Florida, and Lissasfa districts from the Faculties terminus.

The second line's commissioning has optimized the first line's contours, which then becomes a 23.5 km branchless line with 37 passenger stations with a travel time of approximately 1 hour 03 minutes and a frequency stabilized at 6 minutes (CasaTransport, 2019).

3.2. Survey data and variables

The data come from an online survey conducted as part of a research project about the governance and performance of UPT in Morocco. For the current study, we included the survey part that focused on the overall satisfaction of tramway users in the Casablanca and Rabat-salé cities and their perception about the following 12 SQAs:

(1) Service availability (*Availability*);
(2) Availability of information (*Information*);
(3) Comfort on board and Tramway stations (*Comfort*);
(4) Service reliability (*Reliability*);
(5) Safety and Security onboard/at stations (*Security and Safety*);
(6) The fares level (*Fares*);
(7) Accessibility to tram vehicles (*Accessibility*);
(8) The physical condition of the tram vehicles (*Tram vehicles*);
(9) The connectivity of the lines (*Lines*);
(10) The competence of the drivers (*Drivers*);
(11) The professionalism of the administrators (*Administrators*);
(12) The behavior of the field staff (*Staff*).

We used a five-point Likert scale to measure users' perception of SQAs and overall satisfaction (i.e., 1=Very bad; 2= Bad; 3= Average; 4=Good; 5= Very Good for service quality and 1=Very Unsatisfied; 2=Unsatisfied; 3=Neutral; 4=Satisfied; 5=Very Satisfied for overall satisfaction).

Fig. 2. Map of the Casablanca tramway network (source: casatramway.ma)

The literature distinguishes between two categories of methods to constitute a sample, i.e., probabilistic and non-probabilistic (Gavard-Perret et al., 2008). The former requires the availability of an exhaustive list of the population from which to construct representative samples. It is difficult to identify all passengers of the tramway in our context. Therefore, we choose to build a non-probability sample for convenience. This technique involves interviewing respondents who are accessible or retaining those who have agreed to (Gavard-Perret et al., 2008).
Due to an online survey's uncontrolled nature, we conducted a careful verification of responses to provide a credible final sample. Firstly, the software used did not permit multiple participation by the same respondent. We also eliminated biased responses like incomplete responses, abnormally fast responses (less than 2 seconds per question), and thoughtless answers (same answer for all questions). Data collection was conducted from April 3 to May 23, 2019. It resulted in 1106 responses, of which 1045 were valid, 613 for Casablanca and 435 for Rabat-Salé.

3.3. Data analysis methods

In order to answer the questions asked in the introduction, two stages of analysis were conducted: In the first stage, we used a parametric student's t test for two independent samples. In the second stage, we applied an ordered probit regression model. Data analysis has been made using STATA software.

3.3.1. The Student t-test for independent samples

There has been much debate about whether Likert-scale data can be subjected to parametric statistical tests. Likert data are ordinal, discrete, and limited in scope. These properties violate the assumptions of most parametric tests. However, previous studies have shown that the results of parametric tests with ordinal data are reasonably reliable (e.g.; (Carifio and Perla, 2008); (Norman, 2010); (de Winter and Dodou, 2010)). Notably, for 5-point Likert scale data. de Winter and Dodou, (2010) found that the Student test and the Mann-Whitney test have the same power. Therefore, this study applied the Independent Student t-test (unpaired) to compare whether there are significant differences in perceptions of service quality and overall satisfaction between tramway users in the cities of Rabat-Salé and Casablanca.

Let x_i (i=1,.. n_A) and x_j (j=1,.. n_B) be two sets of values constituting A and B samples, respectively. The t-test value, comparing the two groups, can be calculated according to formula (1). The mathematical formula for the test is given as follows:

$$t = \frac{m_A - m_B}{\sqrt{\frac{S^2}{n_A} + \frac{S^2}{n_B}}} \tag{1}$$

Where:
t – students t-value;
m_A, m_B – the means value of group *A* and *B*;
n_A, n_B – the sizes of group *A* and *B*;
S^2 – the common variance of the two groups.
For both groups, the common variance S^2 is calculated by the following formula (2):

$$S^2 = \frac{\sum(x_i - m_A)^2 + \sum(x_j - m_B)^2}{n_A + n_B - 2} \tag{2}$$

Where:
x_i – set of values constituting A samples (*i*=1,.. n_A);
x_j – set of values constituting B samples (*j*=1,.. n_B).
To determine whether the difference between two groups is statistically significant, one have to compare the calculated t value to the critical value of Student's t distribution table corresponding to the significance level alpha of 5% with degrees of freedom (df):

$$df = n_A + n_B - 2 \tag{3}$$

If the absolute value of t test statistics (|t|) is greater than the critical value, then the difference is significant. Otherwise, it is not. The degree of significance or (p-value) corresponds to the risk indicated by the t-test table for calculated |t| value.

3.3.2. Multiple regression: ordered probit model

To measure the relative importance of the SQAs, we applied a multiple regression model in which the 12 SQAs are the explanatory (independent) variables, and overall satisfaction is the dependent variable. The model's coefficients correspond to the derived importance that clients attach to the SQAs. We estimated two regression models, one for each sample.
Given the ordered nature of the dependent variable (1=Very unsatisfied to 5=Very satisfied), an ordered probit regression model is most appropriate in this

case. In general, the ordered probit model can be expressed as follows (4):

$$OS_i^* = X_i\beta + \varepsilon_i \quad (4)$$

Where:
i – specified user $i = 1 \dots n$;
OS_i^* – a latent (unobservable) variable for user i;
X_i – the set of explanatory variables, corresponding to the 12 SQAs, judged by user i;
β – is the unknown parameter to be estimated.
ε_i – is the error term that is assumed to follow a standard normal distribution.
The latent variable is therefore associated with the observable dependent variable, OS_i (Overall satisfaction according to a 5-level Likert scale), with $m = 1, \dots 5$, defined as follows (5):

$$OS_i = \begin{cases} OS = 1, & if\ OS_i^* \le \mu_1; \\ OS = 2 & if\ \mu_1 < OS_i^* \le \mu_2; \\ & \dots \\ OS = m, & if\ OS_i^* > \mu_{m-1}; \end{cases} \quad (5)$$

Where:
μ_m – the threshold value to be estimated for each pair of adjacent levels with $\mu_1 < \dots < \mu_{m-1}$.
From equation (4), the probabilities that OS_i take each of the values of $m = 1, \dots 5$, are determined as follows (6, 7, 8):

$$P(OS_i = 1) = \phi(\mu_1 - X_i\beta); \quad (6)$$
$$P(OS_i = 2) = \phi(\mu_2 - X_i\beta) - \phi(\mu_1 - X_i\beta); \quad (7)$$
$$\dots$$
$$P(OS_i = m) = 1 - \phi(\mu_{m-1} - X_i\beta); \quad (8)$$

Where:
$P(OS_i = m)$ – the probability that the response variable OS_i of individual i takes a specific level m;
ϕ – the standard normal cumulative distribution function;
β;μ_m– both unknown parameters to be jointly estimated based on the maximum likelihood method.
The independent variables, SQAs, are treated in the models as continuous variables. It is beneficial since the classes of variables do not lose their order, so "4" is greater than "1". Moreover, it's assumed that the independent variables have a linear effect on their increments. Hence, the incremental changes between SQA classes, from "1" to "2" or "3" to "4" will also be the same. Furthermore, the treatment of independent variables as continuous variables creates an average incremental change that shows the general trend, which is relevant for the practical implications (Abenoza et al., 2017). However, some caution is needed, as this assumption may not hold if the SQA classes' distance is not the same.
In the ordered probit model, the estimated parameters' numerical value is of little interest in itself. The explanatory variables' coefficients are not directly interpretable: the only information that can be used is the sign of the parameters insofar as it indicates whether the associated variables influence the probability of the event upwards or downwards. However, to measure this probability's sensitivity in relation to the explanatory variables, the marginal effects should be calculated. In other words, a marginal effect measures the change (increase/decrease) in the probability that the response variable OS_i takes a specific level m for a change in X, holding all other independent variables constant. The marginal effect of a continuous variable for level of satisfaction *m* is computed as follows (9) (Kwon et al., 2019):

$$\frac{P(OS_i = m)}{\partial X} = [\,\phi(u_m - X_i\beta) - \phi(\mu_{m-1} - X_i\beta)]\beta \quad (9)$$

4. Analysis and discussion of results

4.1. Sample characteristics

The results are presented as follows. Firstly, we introduced the respondents' demographic profile and their tramway use habits. Next, we compared evaluations between users in the two cities. Finally, we examined the relationship between SQA and overall user satisfaction with tramway service and presented the priorities for improvement.
Regarding respondents' gender, there were more male respondents (55,79% in Casablanca, 52,78% in Rabat-Salé) than female respondents (44,21% in Casablanca, 47,22% in Rabat-Salé) for both samples. The great majority of respondents (97,55% in Casablanca, 98.84% in Rabat-Salé) were aged less than 45, followed by a minority of those aged more than 45 (2,45% in Casabalanca, 1,16% in Rabat-Salé). Not surprisingly, most respondents were working people (63,46%) in Casablanca, as it is the country's economic capital. Students also make up a significant portion of the sample (32,14%). The rest is made up of an inactive population (4,40%). On the contrary, more than half of the respondents in Rabat-

Salé sample were students (53,94%), followed by about half of working people (40,97%), and a minority is made up of an inactive population (5,09%). Regarding the frequency of use, the majority of both samples is constituted of daily users (55,46% in Casabalanca, 58,56% in Rabat-Salé), followed by a significant proportion of weekly users (26,43% in Casablanca, 27,08% in Rabat-salé) and the rest is constituted of occasional users (18,11% in Casablanca, 14,35% in Rabat-Salé). Finally, the main reasons for using the tramway is going to study in Casablanca (28, 6%) and work in Rabat-Salé (26,02%). The other reasons are distributed in similar proportions in both cities (Table 1).

From the above characteristics, we notice that both samples are representative of the general profile of users of the two-tramway systems, as discussed in section 3.1.

4.2. The Student t-test results

This section presents the comparative analysis of evaluations between users of the tramway service in Casablanca and Rabat-Salé. We conducted a student t-test analysis for independent samples to compare the average perception score of SQA and the average score of overall satisfaction. Table 2 presents the descriptive statistics of twelve SQAs and overall satisfaction, and Table 3 shows the student t-test results. On average, the level of perceived quality for most service attributes is between "Good" and "Very Good" and the overall satisfaction level falls between the "Satisfied" and "Very satisfied" scales. This result is not impressive due to the fact that tramway passengers still enjoying a significant improvement in service compared to conventional bus systems. These latter have collapsed due to short in supply, poor coverage and poor quality of service (Karim and Jawab, 2017).

The *Tram vehicles* attribute showed the highest level of perceived quality in both cities. Tramway vehicles are still considered new even if they are 8 or 9 years old in service. This is due to the effectiveness of cleanliness, technical control and maintenance policy on the one hand, and the firm legal response against any acts of vandalism on the other. The perception of users can also be explained by the comparison that they make with buses which are considered “dirty, old, dilapidated, uncomfortable” (World Bank, 2012, p.13). Buses are exposed to vandalism and lack of maintenance and repairs, which leads to their serious deterioration over time.

On the other hand, the *Comfort* attribute ranks last among 12 all service attributes in Rabat-Salé. The discomfort, generally experienced by users during peak hours, could be attributed to the crowdedness, the malfunction of some air conditioners and noise. The *Lines'* attribute is also positioned in the last rank in Casablanca. This result is not surprising because of absence of an intermodality policy. Indeed, the Casablanca and Rabat-Salé tramway projects were decided and then implemented in a manner that was totally separate from the transport policy initiated in the early 2000s (implementation of an urban transport plan, investment scenarios, etc.). Moreover, in both cities, not only are the different modes of transport not articulated, but the inhabitants have also developed the habit of walking and avoiding connections, which are too uncertain and costly in the absence of fare integration.

The results of Table 3 mean that, from a user point of view, the service performance of Rabat-Salé tramway is slightly exceeds that of Casablanca tramway. However, this difference is only statistically significant in terms of *Availability*, *Reliability*, *Fares*, *Tram vehicles*, *Drivers*, *Lines* and *Overall satisfaction*.

Tramway service *Availability* is better appreciated in Rabat-Salé than Casablanca. This can be explained in particular by the improved accessibility to jobs and services. Actually, the tramway allows a greater number of inhabitants of Salé or Rabat to get to their work in half an hour (if their destination is in the same city and on the tramway corridor). The total trip is shorter (Madinat Al-Irfane to Hay Karima takes 40 minutes) and the gains are better spread over the territory. In contrast, Casablanca tramway takes 40 minutes to get from Terminus Sidi Moumen to the city center. Its gains in accessibility are therefore not spread over its entire corridor, because other modes (notably collective taxis) can reach the destination more quickly, by going more directly.

Furthermore, Casablanca tramway service was disrupted many times because of traffic accident, technical issues and acts of vandalism. This often deprives users for several hours of regularity, which may impact their perception about the *Reliability* of service. In 2019 for instance, the cumulated lost time due to accidents, resulted in a total of 36 hours of downtime (CasaTransport, 2020). Additionally, the

tramway agency has declared that abusive pulling of alarm handles has resulted in more than 10 hours of cumulative delays during the same year.

It is worth noting that students represent a much larger share of the ridership in Rabat-Salé who benefit from favorable subscription rates that make the tramway even more affordable for daily travel. In contrast, the Casablanca tramway ridership's is made up of a higher proportion of popular classes. For the poorest, the cost of the tramway is high, and daily use is unaffordable. They necessarily will use tramway occasionally and only buy their titles individually, which is more expensive for them (the cost of an individual ticket is higher in Casablanca (8 DH; 1 DH = 0.11USD) compared to Rabat-Salé (6 DH)). Accordingly, these elements could explain why the *Fares* level is less appreciated in Casablanca than Rabat-Salé.

Table 1. Characteristics of the two samples (Casablanca and Rabat-Salé)

Categories		Casablanca (N=613)		Rabat-Salé (N=432)	
		Number	**%**	**Number**	**%**
Sex	Male	342	55,79%	228	52,78%
	Female	271	44,21%	204	47,22%
Age	Less than 25	249	40,62%	230	53,24%
	Between 25-45	349	56,93%	197	45,60%
	More than 45	15	2,45%	5	1,16%
Principal Activity	Student	197	32,14%	233	53,94%
	Working people (Employee, liberal profession etc.)	389	63,46%	177	40,97%
	Inactive people (Unemployed, Retired, Housewife etc.)	27	4,40%	22	5,09%
Use frequency	At least 1/day	340	55,46%	253	58,56%
	At least 1/ Week	162	26,43%	117	27,08%
	At least 1/ month to 1/year	111	18,11%	62	14,35%
Reasons of use	Study	28,6%		18,38%	
	Work	17,8%		26,02%	
	Entertainment	18,9%		20,93%	
	Shopping	19,8%		20,60%	
	Health	7,0%		7,42%	
	Other	7,9%		6,64%	

Table 2. SQA, OS and their average perception level

SQA and OS	Casablanca			Rabat-Salé		
	Mean Score	**Standard deviation**	**Rank**	**Mean Score**	**Standard deviation**	**Rank**
Availability	3,62	1,085	6	3,94	0,851	3
Comfort	3,24	1,228	9	3,32	1,226	12
Information	3,54	1,201	7	3,67	1,164	8
Security and Safety	3,89	1,040	2	3,91	1,118	4
Reliability	3,28	1,280	8	3,69	1,101	6
Fares	3,21	1,327	11	3,68	1,202	7
Accessibility	3,69	1,179	4	3,82	1,130	5
Tram vehicles	4,16	0,899	1	4,47	0,639	1
Administrators	3,23	1,124	10	3,37	1,107	11
Drivers	3,86	0,977	3	4,03	0,947	2
Lines	3,04	1,213	12	3,39	1,178	10
Staff	3,69	1,061	5	3,61	1,161	9
Overall Satisfaction	3.77	0.945	---	3.95	0.802	---

Table 3. The Student t-test results

SQA and OS	Cities	t-value	Degree of freedom	p-value
Availability	Casablanca # Rabat-Salé	-5,044	1043	0,000*
Comfort	Casablanca # Rabat-Salé	-1,021	1043	0,308
Information	Casablanca # Rabat-Salé	-1,689	1043	0,092
Security and Safety	Casablanca # Rabat-Salé	-0,389	1043	0,697
Reliability	Casablanca # Rabat-Salé	-5,377	1043	0,000*
Fares	Casablanca # Rabat-Salé	-5,782	1043	0,000*
Accessibility	Casablanca # Rabat-Salé	-1,840	1043	0,066
Tramway vehicles	Casablanca # Rabat-Salé	-6,152	1043	0,000*
Administrators	Casablanca # Rabat-Salé	-1,981	1043	0,048
Drivers	Casablanca # Rabat-Salé	-2,888	1043	0,004*
Lines	Casablanca # Rabat-Salé	-4,613	1043	0,000*
Staff	Casablanca # Rabat-Salé	1,081	1043	0,280
Overall Satisfaction	Casablanca # Rabat-Salé	-3,319	1043	0,001*

Although *Tram vehicles* and *Drivers'* attributes rank in the top three in Casablanca, they are less appreciated than Rabat-Salé. This difference may be due to issues that occur from time to time which affect their perceptions. Users in Casablanca complain about the deficiency of some air conditioners, ticket validation machines and the lack of light inside of some vehicles. They also complain about the behavior of some drivers such as sudden acceleration and brakes, the use of the mobile phone while driving and the non-respect of the stopping time in the stations.

Finally, the appreciation of the *Line's* connectivity is low in both cities, with a slight advantage in favor of the city of Rabat-Salé. This can be related to the level of availability on the one hand and the fact that there are few transport alternatives (less informal transport) on the other.

4.3. Importance of SQAs and their effects on overall satisfaction

Table 4 presents the results of the ordered probit model for the Casablanca and Rabat-Salé samples. Both models are significant, with a degree of freedom of 12. According to the Pseudo R2 indicator, SQAs explain 26.68% and 33.59% in overall satisfaction variability in the Casablanca and the Rabat-Salé models, respectively.

Among the 12 SQAs, nine have a significant effect on the Casablanca model, and only six are significant for the Rabat-Salé model. In terms of practical importance, *Availability, Staff, Drivers, Reliability, Security and Safety* and *Administrators* are the top six attributes influencing Casablanca tramway satisfaction. As for Rabat-Salé, it is *Availability, Tram vehicles, Staff, Lines, Comfort* and *Administrators.*

Tramway users highly value the service *Availability* because this mode has been lunched in a context where the transport offer, and in particular the bus systems, is chronically inadequate, and does not meet the mobility needs of the inhabitants. The tramway service has been a qualitative and quantitative change, in many respects, for the populations that can benefit from it namely students, young workers and women. This is why users also highly value the tangible and intangible components of the service namely *Staff* behavior, *Drivers and Tram vehicles.*

If tramway agencies have a limited budget for improving quality of service in both cities, which SQAs should be prioritized? The agencies should, generally, improve the most important service attributes to overall user's satisfaction. However, improving an important service attribute with highly appreciation tends to have a higher marginal cost and a diminishing return, compared to improving ones that are less appreciated by users (Cao et al., 2015; Zhen et al., 2018). This is why service managers should first consider the SQAs that are relatively more important according to the models in Table 4 and are relatively less appreciated based on the ranking in Table 2. These attributes are regarded as critical by users but their quality does not much passenger's expectation; and their ignorance may contribute greatly to user's dissatisfaction. Thus, if we use the mean as threshold (6.5), tramway agencies should first improve *Reliability*

Table 4. The results of the ordered probit model

Dependent Variable: Overall Satisfaction	**Casablanca**		**Rabat-Salé**	
	Coefficients	**Rank**	**Coefficients**	**Rank**
Availability	0,375***	1	0,496***	1
Comfort	0,120**	7	0,209***	5
Information	0,009	12	0,078	9
Security and Safety	0,141***	5	0,014	11
Reliability	0,150***	4	0,090	8
Fares	0,090**	8	-0,027	12
Accessibility	0,021	10	0,019	10
Tram Vehicles	0,016	11	0,428***	2
Administrators	0,128**	6	0,179***	6
Drivers	0,169***	3	0,126	7
Lines	0,088*	9	0,220***	4
Staff	0,298***	2	0,295***	3
Model fit information				
Number of obs	613		432	
Log-likelihood	-499.33753		-292.51739	
LR chi2(12)	363.321		295.97	
df	12		12	
Prob > chi2	0.000		0.000	
Pseudo R2	0.2668		0.3359	

***, **,* significant at a 1%, 5%, 10% confidence level

and *Administrators* in Casablanca while *Staff, Lines, Comfort,* and *Administrators* require high-priority improvement in Rabat-Salé. By contrast, service managers should maintain the level of important and a well appreciated attributes as they are drivers to user's overall satisfaction. Namely, *Security and Safety, Drivers, Staff and Availability* in Casablanca; and *Availability* and *Tram vehicles* in Rabat-Salé.

To improve *Staff* and *Administrators* attributes, we recommend that operators, in both cities, organize training workshops dealing with customer service and problem solving. Additionally, increase the effectiveness of the *Staff* when attending users, reduce time of processing complaints and provide precise information in case of service disruption could be effective actions.

Improving *Reliability* could undoubtedly improve current customers' satisfaction and attract other potential users. So, Casablanca tramway agency should improve traffic safety, develop traffic signal priorities and made maintenance more efficient as this could improve *Reliability* of service and shortening journey times. In Rabat-Salé, the logic of intermodality should be at the heart of future or ongoing plans to extend tramway *Lines* to enhance their connectivity with those of the bus network, which in turn should be restructured in a manner to extend tramway *Lines*. Moreover, improving peak hour frequencies and fixing non-operating air conditioners could increase user's perception of *Comfort.*

Marginal effects (Table 5) provide a more practical interpretation of results. They inform us about changes (partly per unit) in the probability of rating overall satisfaction (very dissatisfied (1) to very satisfied (5)) as a result of improvements in each of the SQAs. A positive sign indicates an increase in the probability, and a negative sign indicates a decrease in the probability. For instance, improvements in each of these SQAs would increase the probability that users rate the overall service as very satisfactory by the following percentages: 5.3% for *Staff*, 3.9% for *Lines*, 3.7% for *Comfort* and 3.2% for *Administrators* in Rabat-Salé; and 2.6% for *Reliability* and 2.2% for *Administrators* in Casablanca.

Table 5. Marginal effects of ordred probit model

SQA	Casablanca					Rabat-Salé				
	1	2	3	4	**5**	1	2	3	4	**5**
Availability	-0,017	-0,037	-0,016	0,005	**0,065**	-0,002	-0,044	-0,023	-0,018	**0,089**
Comfort	-0,005	-0,012	-0,005	0,001	**0,021**	-0,001	-0,018	-0,010	-0,007	**0,037**
Information	0,000	-0,001	0,000	0,000	**0,002**	-0,000	-0,007	-0,003	-0,002	**0,014**
Security and Safety	-0,006	-0,014	-0,006	0,002	**0,025**	-0,000	-0,001	-0,000	-0,000	**0,002**
Reliability	-0,007	-0,015	-0,007	0,002	**0,026**	-0,000	-0,008	-0,004	-0,003	**0,016**
Fare	-0,004	-0,009	-0,004	0,001	**0,016**	0,000	0,002	0,001	0,001	**-0,004**
Accessibility	-0,001	-0,002	-0,001	0,000	**0,004**	-0,000	-0,001	-0,000	-0,000	**0,003**
Tram Vehicles	-0,001	-0,002	-0,001	0,000	**0,003**	-0,002	-0,038	-0,020	-0,015	**0,077**
Administrators	-0,006	-0,013	-0,006	0,002	**0,022**	-0,001	-0,016	-0,008	-0,006	**0,032**
Drivers	-0,007	-0,017	-0,007	0,002	**0,029**	-0,000	-0,011	-0,006	-0,004	**0,022**
Lines	-0,004	-0,009	-0,004	0,001	**0,015**	-0,001	-0,019	-0,010	-0,008	**0,039**
Staff	-0,013	-0,029	-0,013	0,004	**0,052**	-0,001	-0,026	-0,014	-0,010	**0,053**

5. Conclusions

This paper focuses on the comparative analysis of the tramway service's performance in the two largest Moroccan Cities, Casablanca and Rabat-Salé. The evaluation is conducted from the users' viewpoint and used a sample size of 613 and 435 individuals in each city. The first stage of the study compared users' perceptions regarding Service Quality Attributes (SQAs) and overall satisfaction and identified the service elements that make significant difference between the two cities. To this end, a student t-test of two independent samples was applied. In the second stage, an ordered probit model was developed to examine the effects of various SQA on overall user's satisfaction and identify service improvement priorities.

The results showed that, for both cities, the average level of perceived quality is between "Good" and "Very Good" for most SQAs, and the overall satisfaction level falls between the "Satisfied" and "Very satisfied" scales. Furthermore, *Tram vehicle* is the best appreciated attribute in both cities while *Comfort* in Rabat-Salé and *Lines'* connectivity in Casablanca are the less appreciated ones. The average level of perceived quality and overall satisfaction is slightly higher for the Rabat-Salé tramway than for the Casablanca tramway. However, this difference is statistically significant only for service *Availability*, service *Reliability*, *Fares* level, *Tram vehicles*, *Drivers'* competence, *Lines'* connectivity, and *overall satisfaction*. On the other side, we found that among the top-six important attributes to overall user's satisfaction, *Reliability*, *Administrators* should be prioritized for improvement in Casablanca and *Staff*, *Lines*, *Comfort*, and *Administrators* in Rabat-Salé. Results showed that improvements in all these service aspects would increase significatively overall user's satisfaction.

The contribution of this research is twofold. First, it provides an understanding of user perceptions of tramway service performance in two comparable cities. In particular, this peer comparison allowed to determine the strengths and weaknesses of the provided service in each city. Second, the study highlights the most important SQAs to overall user's satisfaction and identify service improvement priorities. Overall, the results of this research are of significant importance to policy makers and operators of tramway.

Although it is based on online CSS, this study represents a first in-depth analysis of tramway services' performance in Casablanca and Rabat-Salé. It would be interesting that future research uses a field customer satisfaction survey and compare results with the current study. Furthermore, more research should be carried out on intermodality in both cities from the user perspective, as this is a vital issue for sustainable mobility in large cities. Finally, the perceptions of non-users deserve to be studied in the future, as they represent a high percentage of the population and should be considered as potential users.

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