Users' Satisfaction Evolution of a Metropolitan Transit System in a Context of Economic Downturn

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ABSTRACT

As the worldwide financial crisis is directly connected to the transport sector, public transport systems become a central player to support economic recovery. Transit services are facing a number of challenges as a consequence of this severe crisis. However, each attribute characterizing transit services have evolved in a different manner, arising some chances and opportunities at some specific areas. This study investigates the evolution of service quality on a metropolitan transit system under economic crisis conditions. We used data from three customer satisfaction surveys (2008, 2011 and 2014) conducted at the bus transit service of the Metropolitan Area of Granada (Spain). Principal Component Analysis (PCA) and Structural Equation Modeling (SEM) approaches were applied. PCA results show that the attributes describing the service were grouped into two levels of dimensions according to their impact on users' overall satisfaction (Transport Service Factors and Comfort and Convenience Factors). Subsequently, following a competing model strategy, the existing relationships between users' satisfaction and the perception of service quality dimensions were ascertained. Finally, three SEM were calibrated, one for each year under study, and were subjected to a multigroup analysis to test for equivalence between the three models. The outcomes shown that Fare of the ticket has lost importance as the financial crisis has become more noticeable and that Transport Service Factors had a lower influence and users' satisfaction in 2011, when downturn was more intense.

Keywords: service quality; bus transit; economic crisis; structural equation model; passengers' perceptions; customer satisfaction surveys

INTRODUCTION

The current worldwide financial crisis has hit national economies everywhere and led to declining economic performance and a considerable reduction of growth (International Transport Forum, 2009). In Europe, some southern countries, such as Greece, Portugal, Spain and Italy, have been heavily affected by this global financial crisis. However, this is not an isolated phenomenon. Economic downturns have occurred several times throughout the years, although the strength and extension of their impacts (e.g., negative GDP growth, high unemployment ratio, low household incomes, and so on) are not uniform.

There is a direct connection between the financial crisis and the transport sector. A contracting global economy, frozen credit and increased operating costs have led to economic difficulties and job losses across the sector (International Transport Forum, 2009). The global economic crisis has reduced the flow of passengers and goods worldwide. This has had consequences for the many millions who work in, and depend on, the transport sector. Credit is lacking for maintenance and for the development of new infrastructure and equipment in all modes of transport. Lack of liquidity remains a problem for financing transport system improvements (International Transport Forum, 2009).

Additionally, Public Transport (PT) represents a critical factor to a nation, and must be assured access to investment capital at reasonable cost (American Public Transportation Asociation, 2009). This sector is facing a number of serious challenges caused by the current downturn: a strong decrease of demand, lower company profits, worse companies' financial situation, a dramatic reduction of supply, changed transport flows, changed strategies, and so on (Macário and Van de Voorde, 2009).

However, the financial crisis brings some positive effects on the operation of services from the passengers' point of view: transit service operates with higher commercial speeds due to a traffic congestion reduction, this generates shorter travel times, more space available for users and therefore more comfortable services, etc. On the contrary, other service attributes could be harmed, such as service frequency if the number of runs are cut down or a fares increase whether the company wants to guarantee the operation incomes when demand is reduced. According to how the economic crisis affects each attribute of a PT system, the overall perception about the service quality can evolve in a positive or negative manner.

Some authors have indicated that there are different categories of attributes that have a greater or lesser effect on users' satisfaction (Philip and Hazlett, 1997; European Committee for Standardization, 2002; Transportation Research Board, 2013; Eboli and Mazzulla, 2008; Garrido et al., 2014). Philip and Hazlett (1997) proposed a model with a hierarchical structure, based on three classes of attributes: pivotal, core and peripheral attributes. The pivotal attributes exert the greatest influence on the satisfaction levels. The UNE-EN 13186 standard (European Committee for Standardization, 2002) classifies the service's characteristics into basic, proportional and attractive, depending on how compliance and non-compliance affects customer satisfaction. The Transit Capacity and Quality of Service Manual (Transportation Research Board, 2013) groups attributes into availability factors (more important to passengers), and comfort and convenience factors (less important); whether service is not available for users, other aspects related with the quality of the service lack of importance. Eboli and Mazzulla (2008) empirically demonstrated the existence of two categories of attributes (basic and not basic) from the preferences showed by users. And Garrido et al. (2014) identified 5 and 7 levels of attributes after applying three different neural network algorithms and a statistical analysis based on the data variance.

In the last years, numerous studies about PT service quality are found in the literature (de Oña and de Oña, 2014), as it is the vehicle to users' satisfaction, users' loyalty and a way of attracting new passengers to the service. Most of them assesses satisfaction based on a cross sectional data, using the collected data from a particular year. For example, Wen et al. (2005) hypothesized and tested the relationships between passenger loyalty, satisfaction, service value, service quality, sacrifice, switching costs, attractiveness of competitors, and trust through a Structural Equation Model and a survey conducted in 2003 to the passengers of an intercity bus service in Taiwan. Diana (2012) employed a correspondence analysis to determine how each service quality attribute of light urban transit systems in Italy (urban buses, trolleybuses and tramways) are related to the level of use of public transport in 2007. Rojo et al. (2011; 2013) modeled the quality of interurban bus services using ordered logit and ordered probit models with data of 2009. They analyzed the most relevant variables globally for all users as well as by user segments (i.e., males and females, young and elderly, and so on). However, attributes' importance could change across the years, because of changes on the system or because passengers can change their opinions along the time, showing new concerns or mitigating the previous ones.

Recently, a study was published (de Oña et al., 2016) which proposes the use of index numbers to monitor transit service quality through time. The analyzed time period was established from 2007 to 2013, considering passengers' perceptions and importance rates. This methodology informed, not only on the satisfaction tendencies but also on the trend on customers' priorities, by using two kind of index numbers (simple and composite) and two base methods (fixed and chain base). However, this research has not analyzed the relationship between satisfaction evolution and the existing economic context.

Efthymiou et al. (2017) analyzed the effects of the economic crisis on the satisfaction and demand of four public transport passengers (metro, bus, electric railway and trolleybus services) in Athens (Greece). They calibrated a hybrid choice and latent variable model and the results showed that the environmental consciousness, public transport service improvement, and high car use and maintenance costs turned some people towards public transport; while on the other hand, increased ticket prices, as well as increased preference to use other modes (car, bike and walk) turned other people to use it less. Moreover, service quality had a positive impact on the demand, despite the overall decline of quality of service in 2013 comparing with 2008.

Likewise, Cordera et al. (2015) proved how the state of the economy, measured using per capita income levels and unemployment rates, influenced the demand for public transport by bus with data from the city of Santander (Spain) from 2001 to 2012. The results showed that an increase in the unemployment rate coincided with a significant increase in the demand for public transport by bus, and when the per capita income levels rose, the demand of bus transit service fell. These results suggested that transport operators could take advantage of recessionary periods to increase the public transport demand.

Therefore, the main purpose of this study is to investigate the evolution that satisfaction has experienced along a series of years under the economic crisis, on the basis of users' perceptions. First, attributes more related to overall satisfaction and attributes exerting a lower influence were identified as grouped on underlying dimensions (main attributes and secondary attributes). Subsequently, the existing relationship between users' satisfaction and service quality dimensions was deduced. And finally, changes on the relationships between constructs along the crisis were determined.

The analysis was conducted using the Structural Equation Modeling (SEM) approach with data from the bus metropolitan public service of Granada (Spain). Data from this transit system were used due to the following reason: i) there is available data from a series of Customer Satisfaction Surveys (CSS) that have not changed along a long period of time (from 2008 to 2014); ii) this period of time coincides with the important economic crisis gone through Spain. In 2007-2008 it started the economic crisis, although in Spain, the effects produced by this downturn still were not strong (positive GDP growth of 3.8% in 2007 and 1.1% in 2008). Since 2009 the GDP growth has been negative or null. Just in 2014 it started again a positive growth (1.4%).

The rest of the paper is organized as follows: the Data section briefly introduces the surveys used in this study, as well as the sample characteristics and perception rates; the Methodology section describes the analytical procedure followed and the techniques applied; the Results and Discussion section summarizes the main results obtained with the analysis; and finally, last section presents the main Conclusions.

DATA

The metropolitan area of Granada is a medium sized area in the southern Spain with a population of around 500,000 inhabitants. The Granada Area Transport Consortium was created in 2003 to coordinate transit bus service in the metropolitan area. Since 2007, the PT service is provided by a bus system in which 15 bus companies operate in 18 transport corridors. The metropolitan PT system carries around 10 million passengers per year. The network has a radial structure focused on two entrances to Granada – one in the north of the city and the other in the south – owing to the fact that 90% of the trips take place between the nearby municipalities and the city of Granada.

Surveys selection

The Granada Area Transport Consortium uses CSS to evaluate the quality of the metropolitan PT system. Since 2006, an annual face-to-face CSS is developed to analyze changes in the quality perceived by the passengers. Each year, more than a thousand users are interviewed in March or April, providing a confidence level higher than 95%. The CSS is structured into two main sections. The first section has the aim to collect general information about the service (e.g., operator, line, etc.), demographic characteristics of the users (e.g., sex, age) and their travel habits (e.g., reason for travelling, frequency of use, type of ticket, etc.). The second section of the CSS includes users' perception about the service quality (passengers are asked to state their perceptions about the quality of each attribute by expressing rates of satisfaction, from 0 to 10). The service attributes considered are: "frequency", "punctuality", "speed of the trip", "proximity of the stops to/from the origin/destination", "fare of the ticket", "cleanliness of the vehicle", "space inside the vehicle", "temperature in the vehicle", "available information", "safety on board", "courtesy or kindness of the personnel", "easiness to get on/off the bus or accessibility" and "timetable of the service" (since 2009). Finally, they have to express a satisfaction rate about the quality of the overall service (according to a scale from 1 to 5) and a satisfaction rate about the public transportation management (according to a scale from 1 to 5).

For the analysis, we have chosen the 2008, 2011 and 2014 CSS for the following reasons:

- 2008 was the last year with a positive GDP growth in Spain (+1.1%), so it can be considered as the beginning of the economic downturn. Since then, 2014 was the first year holding again a positive GDP growth (+1.4%)
- The Granada Area Transport Consortium carried out the majority of service improvement actions from 2004 to 2007.
- Previously, using data from the period 2007-2013, de Oña et al. *(10)* identified a minimum of perception in 2008 and a maximum in 2011.

TABLE 1 Sample characteristics

		2008	2011	2014
N. of interviews		1278	1625	1730
Gender	Male	28.2%	37.4%	42.5%
	Female	71.8%	62.6%	57.5%
Age	{ 18-30 Years Old}	51.2%	41.4%	46.9%
	{ 31-60 Years Old}	39.0%	45.6%	45.4%
	{ > 60 Years Old}	9.8%	13.0%	7.7%
Frequency of Use	Almost Daily	53.4%	58.4%	52.5%
	Frequently	21.8%	22.3%	23.4%
	Occasionally	14.1%	13.1%	14.2%
	Sporadic	10.7%	6.2%	9.9%
Travel Reason	Work	29.7%	28.5%	26.3%
	Study	22.0%	22.9%	29.5%
	Other	48.3%	48.6%	44.2%
Mode from origin to the bus stop	Walking	67.6%	79.2%	76.9%
	Urban bus	23.5%	17.2%	15.7%
	Interurban bus	6.0%	1.0%	2.0%
	Car	1.5%	1.7%	3.6%
	Others	1.4%	0.9%	1.8%
Type of Ticket	Standard Ticket	40.2%	14.9%	15.2%
	Consortium Card	52.7%	73.1%	77.6%
	Senior Citizen Pass	6.6%	9.7%	7.2%
	Other	0.5%	2.3%	0%

Sample characteristics and service quality evaluation

Table 1 shows the characterization of the samples. For the three samples we can observe that around two thirds of the users are females, although the gap between males and females has decreased in recent years (2011 and 2014). The samples are mostly composed of users aged between 18 and 30 years old and between 31 and 60 years old; only a small percentage of users are older than 60 years old. The major part of users travel almost every day by bus (4 or more times in a week), and about a fifth of the sample takes frequently the bus (from 1 to 3 times a week). Most of the users travel for purposes different from work or study, such as health related purposes, shopping, leisure or other personal activities; more than one fourth of the sample takes the bus for reaching the work place, while another important percentage for reaching the study place. Most of the entire sample accesses the bus stop by walking; a significant amount of the

sample accesses the bus stop by the urban bus, and less than 10% of the sample reaches the bus stops by other modes (e.g., car, interurban bus, motorbike, bicycle, etc.). We can observe that passengers mostly use the Consortium Card, especially in the most recent years (73.1% in 2011 and 77.6% in 2014). The Consortium Card is a unique card valid for all the buses operating in the consortium territorial context. It permits transfers between interurban and urban buses and benefits from a discount relative to the standard ticket. It can be recharged at any distribution point. Another important group of users travelled with the Standard ticket (valid for only one trip and transfers are not permitted) but, in the most recent years, this percentage is only around 15%. Finally, a very small part of the sample uses the Senior citizen pass (with a 50% discount on the standard ticket price for interurban buses) or another type of ticket.

The average rates calculated from the perceptions about the service quality attributes over the years are reported in Table 2. Also the average rates about the satisfaction with the overall quality of the service and the satisfaction with the public transport management (rates according to a 5-point scale) are shown.

TABLE 2 Perception of service quality attributes

	2008	**2011**	**2014**
Frequency	5.65 ±0.16	6.46 ±0.11	6.05 ±0.10
Punctuality	6.69 ±0.13	7.73 ±0.09	7.37 ±0.08
Speed of the trip	6.62 ±0.12	7.20 ±0.11	6.96 ±0.08
Proximity of the stops	6.93 ±0.14	7.21 ±0.10	7.14 ±0.09
Fare of the ticket	5.84 ±0.14	6.37 ±0.12	4.76 ±0.11
Cleanliness of the vehicle	7.28 ±0.11	7.66 ±0.08	7.14 ±0.08
Space in the vehicle	6.54 ±0.13	7.39 ±0.09	6.97 ±0.08
Temperature in the vehicle	6.83 ±0.11	7.68 ±0.08	7.17 ±0.08
Available information	5.97 ±0.14	6.73 ±0.10	6.68 ±0.09
Safety on board	7.48 ±0.11	7.70 ±0.09	7.50 ±0.08
Courtesy of personnel	7.70 ±0.11	7.98 ±0.08	7.96 ±0.08
Easiness to get on/off the bus	6.99 ±0.13	7.39 ±0.09	7.11 ±0.08
Timetable of the service		6.43 ±0.11	6.26 ±0.10
Satisfaction with the quality of the overall service*	3.44 ±0.05	3.73 ±0.03	3.52 ±0.04
Satisfaction with the public transport management*	2.94 ±0.04	3.06 ±0.03	2.91 ±0.03

*Note: * These questions used a 5 point scale*

Passengers were mostly satisfied with the attribute “Courtesy of the personnel”, which received rates close to 8 every year, and “Safety on board” that showed perception average rates close to 7.5. Passengers were not very satisfied with “Fare of the ticket”, “Frequency” and “Timetable of the service” (perceptions under 6.5 in the three years). Also “Available information” did not receive high rates in 2008. The rest of attributes registered good opinions (values above 6.5).

The major part of the attributes shows a minimum value of perception in 2008 and the highest perception rates in 2011, as it was already pointed out (de Oña et al., 2015). It is worth noting that a light rail transit (LRT) system was projected in Granada, and the construction works started in April 2007 (still on-going). The LRT construction works caused some disturbances on

the ordinary performance of the bus service (e.g., frequency, timetable, itinerary, etc.). Then, not only economic crisis should be considered for explaining service quality evolution, but also the LRT construction works. In 2011, the LRT works generated the major disturbances.

Moreover, financial crisis heavily hit economies (negative GDP growth), although austerity measures only started to be strongly felt by mid-2011. Nonetheless, as it was stated before, this year the service quality obtained the highest quality perception rates. In addition, "Fare of the ticket" suffered a great fall between 2011 and 2014. This fall could be motivated by the various increases in ticket prices in a period where, due to austerity measures, household incomes were stagnant or even decreasing. Table 3 shows the Standard Ticket and Consortium Card prices for the years under study (2008, 2011 and 2014). The ticket prices at the transit services of Athens (Greece) also increased during this period (2008-2013) as a result of the economic crisis, as it is possible to see in Efthymiou et al. (2017) research work.

TABLE 3 Ticket prices at 2008, 2011 and 2014

	Standard Ticket			Consortium Card		
Jumps*	**2008**	**2011**	**2014**	**2008**	**2011**	**2014**
0	1.00 €	1.30 €	1.50 €	0.77 €	0.86 €	1.00 €
1	1.00 €	1.30 €	1.50 €	0.77 €	0.86 €	1.00 €
2	1.20 €	1.50 €	1.70 €	0.88 €	0.98 €	1.18 €
3		2.35 €	2.90 €		1.64 €	2.02 €

* Granada Metropolitan Area presents a concentric zones fare and the ticket prices increase based on the number of jumps between zones.

Concerning the Satisfaction rates about the overall service quality and PT service management, we can observe again an increase of the passengers' satisfaction in 2011. It is worth noting that users are substantially more satisfied with overall service quality than with service management at the three years under study.

METHODOLOGY

This research consists on the following analytical steps. First, the service attributes used for the analysis were selected; that is the attributes that were kept equal at the three surveys under study (all attributes, except "Timetable of the service"). Second, a Principal Component Analysis (PCA) was conducted in order to identify the latent constructs underlying the service quality perceptions. Subsequently, by following a competing model strategy, five different SEM models were estimated to ascertain the existing relationship between users' satisfaction and service quality dimensions. Lastly, a SEM model was calibrated for each year under study. A multigroup analysis was also carried out in order to test if the models where invariant between the three periods. Then, a comparative analysis was performed.

Principal Component Analysis (PCA)

PCA is a statistical approach that can be used to analyze interrelationships among a large number of variables and to explain these variables in terms of their common underlying dimensions (Hair et al., 2010).

PCA was used as an exploratory method in order to empirically reduce the number of underlying dimensions by grouping different attributes of the service according to the

respondents' service quality perceptions. These were recorded by the 12 attributes selected from the survey questionnaire (all attributes, except "Timetable of the service"). PCA has been previously used in the development of customer satisfaction scales in the transportation field (Brons et al., 2009; Carreira et al., 2014; Chou et al., 2014) since it allows the researcher to better understand customer's ratings of service quality and empirically analyze the dimensions that are conceptualized. Therefore, in this paper PCA is used to reveal which are the latent constructs underlying the service quality attributes. The sample collected with the three surveys (2008, 2011 and 2014) was used as a whole for the PCA in order to ascertain the latent constructs that are common to the three years under study.

Structural Equation Modeling (SEM)

SEM is a powerful multivariate analysis technique allowing the modeling of a phenomenon in which a set of relationships between observed and unobserved variables are established. SEM examines more than one relationship at a time; therefore, it is a technique that tests a set of hypotheses and considers all possible information (Hair et al., 2010).

SEM consist of two components, a measurement model assessing unobserved latent variables as linear functions of observed variables, and a structural model showing the direction and strengths of the relationships of the latent variables.

The basic equation of the structural model is defined as (Bollen, 1989):

$$\eta = B\eta + \Gamma\xi + \zeta \qquad (1)$$

in which η is a $m \times 1$ vector of the latent endogenous variables, ξ is a $n \times 1$ vector of the latent exogenous variables, B is an $m \times m$ matrix of the coefficients associated with the latent endogenous variables, Γ is an $m \times n$ matrix of the coefficients associated with the latent exogenous variables and ζ is an $m \times 1$ vector of error terms associated with the endogenous variables.

The basic equations of the measurement model are the following:

$$x = \Lambda_x \xi + \delta \qquad (2)$$

$$y = \Lambda_y \eta + \varepsilon \qquad (3)$$

in which x and δ are column q-vectors related to the observed exogenous variables and errors, respectively; Λ_x is a $q \times n$ structural coefficient matrix for the effects of the latent exogenous variables on the observed variables, y and ε are column p-vectors related to the observed endogenous variables and errors, respectively, and Λ_y is a $p \times m$ structural coefficient matrix for the effects of the latent endogenous variables on the observed ones.

The Maximum likelihood method was used to estimate the model´s parameters, which are estimated in a way that minimize the differences between the predicted variance-covariance matrix and the observed one, while respecting the constraints of the model (Carreira et al., 2014). For analyzing how well the structural model fits the data we use several goodness-of-fit indices such as the goodness-of-fit index (GFI), the adjust goodness-of-fit index (AGFI), the root mean square error of approximation (RMSEA) and the root mean square residual (RMR). Furthermore, the normalized fit index (NFI) and the comparative fit index (CFI) can be classified as Incremental fit indices, which compare the chi-square value to a baseline model for rejecting the null hypothesis that all variables are uncorrelated. Last the parsimony goodness-of-fit index (PGFI) and the parsimonious normed fit index (PNFI) were also used, which are respectively based upon the GFI and NFI by adjusting for loss of degree freedom. The recommended values

for these goodness-of-fit parameters are: GFI and AGFI higher than 0.9, RMSEA lower than 0.08 for a very good fit, RMR closer to 0 indicates a perfect fit and NFI and CFI values closer to 1 indicated a perfect fit. Multigroup analysis in SEM tests for the invariance of several model parameters (measurement weights, structural weights, covariances and residuals) between different populations or market segments. See Bollen (1989) for a detailed description.

Moreover, SEM is confirmatory rather than exploratory since the researcher constructs the model by defining unidirectional effects between variables (Golob, 2003). Therefore, in this paper, SEM is used to investigate how service quality dimensions relate with users' satisfaction and whether these relationships are the same across the three years under study.

RESULTS AND DISCUSSION

SEM methodology is applied to investigate the evolution of quality on the metropolitan public bus service of Granada on a context of economic downturn. In addition, PCA ascertains the service quality dimensions underpinning the attributes describing the service. Then, two different purposes are pursued. The first target is to reveal how service quality dimensions are related to users' overall satisfaction; that is to discover if the main drivers and secondary drivers are related themselves and if they affect users' overall satisfaction directly, indirectly or both. In order to achieve this purpose, different models were specified, and the best one is found. The second target tries to identify which are the main changes at these relationships along the years. The previous selected model is calibrated for the three years under study (2008, 2011 and 2014) and a multigroup analysis examines invariances between the measurement and structural weights.

TABLE 4 Principal Component Analysis (PCA) of Service Quality Attributes

	PCA Factor Loadings				
	All years (12 attributes)	**All years** (11 attributes)	**2008** (11 attributes)	**2011** (11 attributes)	**2014** (11 attributes)
Transport Service Factors					
Punctuality			0.532	0.346	0.327
Frequency	0.806	0.825	0.791	0.826	0.828
Speed of the trip	0.691	0.695	0.791	0.709	0.612
Proximity of the stops	0.701	0.711	0.703	0.635	0.747
Fare of the ticket	0.584	0.574	0.562	0.659	0.616
Comfort & Convenience Factors					
Punctuality	0.570	0.604	0.456	0.667	0.699
Cleanliness of the vehicle	0.750	0.756	0.721	0.753	0.746
Space in the vehicle	0.735	0.734	0.733	0.758	0.694
Temperature in the vehicle	0.723	0.718	0.752	0.709	0.686
Safety on board	0.766	0.780	0.739	0.781	0.824
Courtesy of personnel	0.748	0.757	0.677	0.795	0.789
Easiness to get on/off the bus or Accessibility	0.587	0.577	0.610	0.599	0.519
Information					
Available information	0.939	-			

Principal Component Analysis

The PCA was applied on the three years sample as a whole and also to each year. Varimax procedure was used to rotate the factor to an orthogonal simple structure. Our data met the recommendations underpinning PCA in regards to sample size and number of variables (recommended ratio of over 5 observations per variable) (Hair et al., 2010). Then, the service quality attributes were reduced into a small number of dimensions. Initially 3 dimensions were obtained (Table 4): Transport Service Factors Comfort & Convenience Factors and Information. Transport Service Factors consisted of those attributes more related with the trip availability (Transportation Research Board, 2013): "Frequency", "Speed of the trip", "Proximity of the stops" and "Fare of the ticket". We consider these attributes as the main drivers of the service. This agrees with Eboli and Mazzulla (2008), who also defined Frequency and Proximity of the service (named walking distance in their research) as basic attributes, exerting the highest impact on users' overall satisfaction. Comfort & Convenience Factors grouped the attributes more related to the passengers' interaction with the service when they make a trip: "Punctuality", "Cleanliness of the vehicle", "Space in the vehicle", "Temperature inside the vehicles", "Safety on board", "Courtesy of personnel" and "Easiness of get on/off the bus or Accessibility". The same as the Transit Capacity and Quality of Service Manual (Transportation Research Board, 2013), we consider these attributes as secondary attributes of the service. Finally, the dimension Information consisted of only one attribute. As seen from Table 4, this structure is globally stable for the 3 years used in this study. Only in 2008 punctuality is related to the factor Transport Service, but only for a small margin.

As initial SEM models presented problems for a correct specification when "Available information" was defined as an independent dimension, "Available information" was joined to Transport Service Factors. Then, the 12 attributes were grouped into two dimensions. However, PCA results were not satisfying: "Available information" showed a very low communality (0.242), its factor loading was relatively low (0.45), the rest of variables presented high factor loadings on both factors; and the proportion of explained variance was not very high (55.9%). Therefore, 2 dimensions were extracted by considering 11 attributes ("Available information" was excluded from the analysis) and results were improved. In addition, previous studies on the Granada metropolitan transit service identified "Available information" as a very low importance attribute for passengers (de Oña et al., 2012). Given both reasons, the following two factors were retained as valid: Transport Service Factors and Company Factors. Table 4 shows the dimensions, attributes per dimension, and factor loadings. Attributes with factor loadings higher than 0.5 were included in the same factor. Moreover, the following parameters provided support for this PCA (Hair et al., 2010): the proportion of explained variance was 59.5%; the Bartlett test had a value of 21,798 and was significant ($p<0.001$), which assesses the overall significance of the correlation matrix; the factorability of the overall set of variables and individual variables was assessed with the measure of sampling adequacy (MSA), which showed an acceptable value of 0.932 (above 0.5).

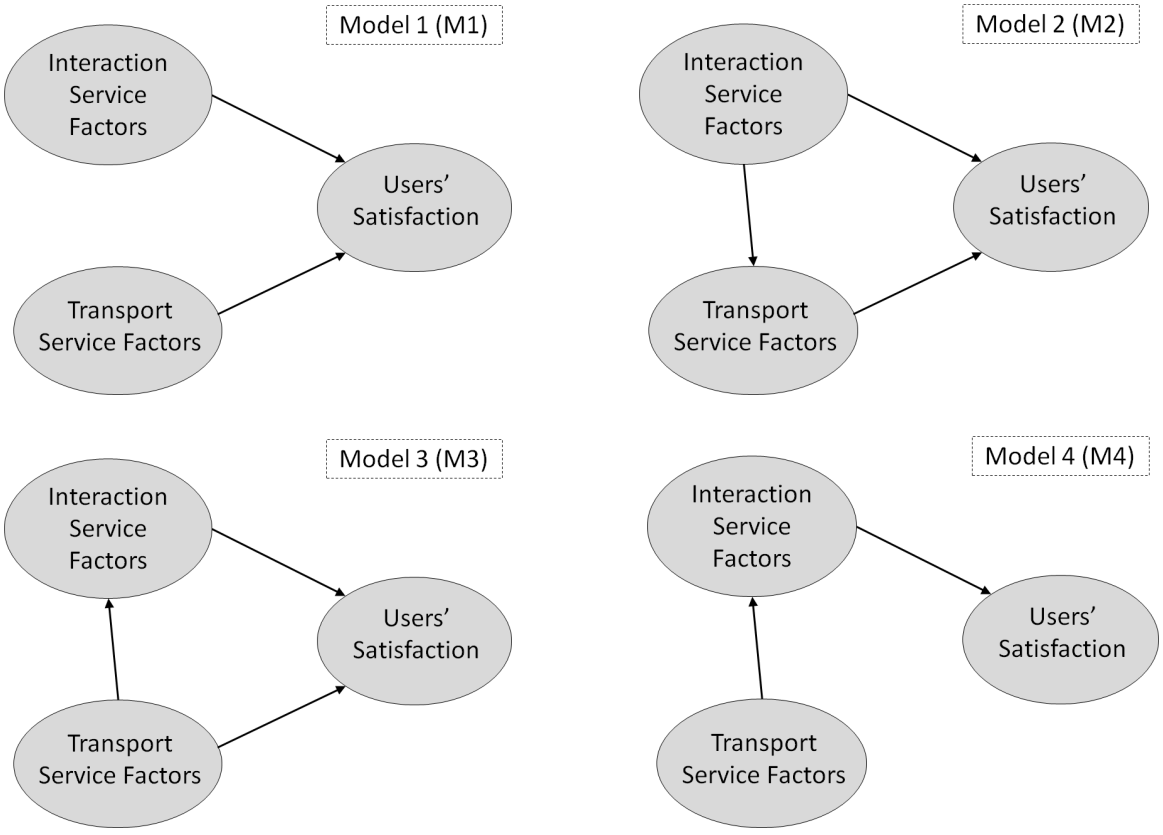
Selecting the best SEM model

Following, SEM models were calibrated using a competing model strategy. The constructs that composed the measurement model were Transport Service Factors, Comfort & Convenience

Factors and Users' Satisfaction. These latent variables were respectively related to several observed items. Transport Service Factors construct and Comfort & Convenience Factors construct were related to the service quality attributes, while Users' Satisfaction was related to both questions about satisfaction: "Satisfaction with overall service quality" and "Satisfaction with service management". Additionally, Cronbach's Alpha assessed construct reliability at each year under study (2008, 2011 and 2014). All constructs showed satisfying values every year (0.75 or higher), in spite of Users' satisfaction construct that was rather lower (0.64, 0.68 and 0.63 respectively).

Therefore, different models were specified (Figure 1) to ascertain how service quality dimensions were related to Users' Satisfaction. Selecting the optimal one is based on the goodness-of-fit parameters and the significance and congruence of item-construct and construct-construct relationships. Five different models were proposed. Each of them explains Users' Satisfaction in regards to service quality attributes in a different manner. Therefore, each model is described together with the theoretical basis behind it.

The first model (M1) is based on de Oña et al. (2013) research work. It is well recognized that there are different service quality dimensions and these dimensions directly affect users' satisfaction. This model was rejected from the analysis because the goodness-of-fit parameters were not satisfactory in any year under study (GFI and AGFI < 0.9; RMSEA >0.08; NFI and CFI < 0.9).



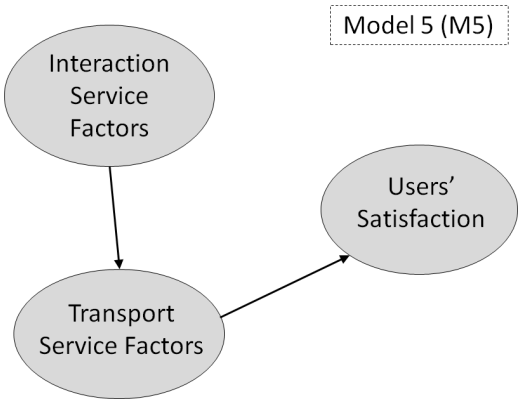


FIGURE 1 Calibrated structural equation models

The *Transit Capacity and Quality of Service Manual* (Transportation Research Board, 2013) indicated that if availability factors are not present, other aspects of transit service quality will not matter for passengers. Following this affirmation, we try to provide support for the hypothesis that some service quality attributes are indispensable for users' satisfaction, while other service quality attributes acquire a less important role for users' perceptions, affecting indirectly users' satisfaction.

From second to fifth models (M2, M3, M4 and M5) it is considered that one service quality dimension can indirectly affect users' satisfaction. That is, there are two levels of dimensions, and the secondary one can affect the perception of the principal one or, on the contrary, the principal one can affect the perception of the secondary one (Figure 1). As it was mentioned above, Comfort & Convenience Factors is considered as a secondary dimension, more related with passengers' interaction with the service when they make a trip, and Transport Service Factors is considered a principal dimension, more related with trip availability.

Particularly, the second and third model (M2 and M3) proposes that in addition, both service quality dimensions directly affect Users' Satisfaction. M2 introduces Comfort & Convenience Factors as a dimension that exerts a positive effect on the perception that users have about the quality of Transport Service Factors. That is, Comfort & Convenience Factors affect users' satisfaction directly and indirectly. On the contrary, in M3, Transport Service Factors dimension directly influences the perception of Comfort & Convenience Factors and it exerts a direct and indirect effect on Users' Satisfaction. Both models were rejected because we could not find evidences that Transport Service Factors and Users' Satisfaction relationship existed in 2011 ($p>0.05$ in both models).

On the other hand, M4 proposes Comfort & Convenience Factors as the group of attributes exerting a directly influence on Users' Satisfaction, and Transport Service Factors affects indirectly across Comfort & Convenience Factors. At this model the relationships between construct were significant, but the goodness-of-fit parameters were not satisfying in 2008 and 2014 (AGFI < 0.9 and RMSEA >0.08).

Finally, M5 considers Transport Service Factors as the dimension with direct effect on Users' Satisfaction, and Comfort & Convenience Factors exerts a direct effect on Transit Service Factors and an indirect effect on Users' Satisfaction. M5 is the best model as all the relationships between constructs are significant and the goodness-of-fit-indices are satisfying for the three years under study (Table 4). Absolute fit indices GFI and AGFI had values higher than the

recommended at the three models (>0.9). RMSEA was equal or under 0.08, expressing a very good fit. Additionally, RMR had values of 0.192, 0.117 and 0.132 respectively. Furthermore, NFI and CFI values were higher than 0.9 at the three models.

Evolution of the main drivers of Users' Satisfaction – Effects of the downturn

Table 5 shows the best model's results (M5). Multigroup analysis considering the three periods rejects the null hypothesis that the models are invariant in both measurement and structural weights. By looking at individual model coefficients we cannot reject the hypothesis that several of them are equal between different models, and one structural coefficient (from Comfort & Convenience Factors to Transport Factors) could be considered as invariant in the three models. Table 5 shows that 2008 and 2014 share a higher proportion of invariant coefficients. As a result a multigroup analysis between these two years was performed. Its results show that, the structural coefficients are invariant.

TABLE 5 Factor loadings and fit indices for best model (M5).

			2008			2011			2014		
Factor Loadings			**ERW**	**SRW**	**S.E.**	**ERW**	**SRW**	**S.E.**	**ERW**	**SRW**	**S.E.**
Among constructs											
Transport	<---	Comfort & Convenience	0.882 d	0.826	0.058	0.937 d	0.884	0.039	1.013 d	0.820	0.048
Satisfaction	<---	Transport	0.327 b	0.800	0.021	0.209	0.626	0.013	0.302 b	0.759	0.016
Among items and constructs											
Accessibility	<---	Comfort & Convenience	1.000	0.584		1.000	0.716		1.000	0.634	
Temperature	<---	Comfort & Convenience	1.080 b	0.702	0.058	0.937	0.791	0.032	1.092 b	0.729	0.044
Space on board	<---	Comfort & Convenience	1.225 b	0.730	0.064	1.079 c	0.808	0.036	1.130 b,c	0.734	0.045
Cleanliness	<---	Comfort & Convenience	0.943 a	0.648	0.054	0.901 a	0.785	0.031	1.100 b	0.727	0.044
Courtesy	<---	Comfort & Convenience	1.086 b	0.716	0.058	0.877	0.705	0.033	1.067 b	0.731	0.043
Safety on board	<---	Comfort & Convenience	1.116 a,b	0.743	0.058	1.017 a	0.792	0.035	1.240 b	0.792	0.047
Punctuality	<---	Comfort & Convenience	1.115 b	0.645	0.064	0.941	0.710	0.036	1.184 b	0.738	0.047
Proximity stops	<---	Transport	1.000	0.593		1.000	0.703		1.000	0.691	
Frequency	<---	Transport	1.242	0.630	0.073	1.019 c	0.671	0.043	1.024 c	0.673	0.043
Speed of the trip	<---	Transport	1.136 a	0.784	0.058	1.225 a	0.823	0.043	0.938	0.734	0.036
Fare of the ticket	<---	Transport	1.071 a	0.629	0.063	0.999 a,c	0.593	0.047	0.907 c	0.553	0.045
Service Quality	<---	Satisfaction	1.000	0.694		1.000	0.733		1.000	0.696	
PT management	<---	Satisfaction	0.922 a,b	0.680	0.055	1.004 a	0.708	0.061	0.794 b	0.668	0.043
Goodness-of-fit statistics											
Sample Size			1288			1625			1731		
Chi-squared			525.82			668.26			707.89		
Degrees of freedom			63			63			63		
GFI			0.935			0.931			0.937		
AGFI			0.906			0.901			0.909		
RMR			0.192			0.117			0.132		
RMSEA			0.079			0.08			0.078		
NFI			0.913			0.934			0.926		
CFI			0.922			0.939			0.932		
PGFI			0.647			0.645			0.649		
PNFI			0.737			0.754			0.748		
Multigroup analysis (comparison between 2008, 2011 and 2014)											
Assuming the unconstrained model to be correct											
Measurement weights (df; chi^2;p-value)			20; 106.49; 0.000								
Structural weights (df; chi^2;p-value)			24; 172.78; 0.000								
Assuming the measurement weights to be correct											
Structural weights (df; chi^2;p-value)			4; 66.29; 0.000								

Note: ERW: Estimate (non-standardized) Regression Weights (p< 0.001). SRW: Standardized Regression Weights (p< 0.001). S.E.: Standard Error of the respective not standardized regression weight. a denotes differences not statistically significant (p>0.05) between 2008 and 2011; b denotes differences not statistically significant (p>0.05) between 2008 and 2014; c denotes differences not statistically significant (p>0.05) between 2011 and 2014; d denotes differences not statistically significant (p>0.05) between all 3 years.

Looking into the relationships between item-construct, some interesting results can be highlighted. The latent construct Transport Service Factors is better explained by "Speed of the trip" at the three years under study (SRW=0.784, SRW=0.823 and SRW=0.734 respectively). It is known that travel times variations are widely appreciated by users. Travel times mainly depend on traffic congestion, and in our case, on the LRT construction works that caused disturbances. The traffic counts placed at the Granada accesses reveal that the annual average daily traffic (AADT) has been diminishing since 2008 until 2013 and started to rise in 2014 (although AADT is still lower than in 2011). Moreover, Granada accesses represent the main congestion areas for the interurban services. This traffic reduction occurs in parallel with the economic crisis. On the other hand, the disturbances caused by the LRT construction works were higher in 2011, while in 2014 they were almost finished. Both reasons could explain how "Speed of the trip" influence has changed along the three years under study. The highest change is identified between 2011 and 2014, and the best conditions (lowest AADT and no traffic disturbances) were in 2014.

"Proximity of the stops" effect also changed along the years. From 2008 to 2011, in spite of the economic crisis, some new lines were added to the metropolitan transit service, giving access to some new development areas previously not served by public transportation. The influence of "Proximity of the stops" on the latent construct Transport Service Factors was relatively higher in 2011 than in 2008 (SRW=0.703 versus SRW=0.593). In fact, in 2008 Transport Service Factor is better explained by the other three factors, while in 2011 "Proximity of the stops" becomes the second most important factor for explaining this construct.

In regards to the "Fare of the ticket", the perceived level of quality has strongly decreased between 2011 and 2014 (6.37 and 4.76 respectively, Table 2). This fits with the various ticket price increases in the study period. However, Transport Service Factors is less explained by this attribute each year in spite of the economic crisis; in 2011 and 2014 "Fare of the ticket" represents the less important factor for explaining this construct. We should highlight that, although the perception about "Fare of the ticket" has fallen during the last years (from 6.37 in 2011 to 4.76 in 2014) due to a sustained fare increase, joint to a users' purchasing power reduction due to the economic crisis (mainly from 2011 to 2014), this very low perception has not been transferred directly to Users' Satisfaction because there are other service attributes (i.e., "Speed of the trip", "Proximity of the stops", and "Frequency") that have compensated it. This has resulted in a sustained weight loss of the "Fare of the ticket" attribute in the overall Users' Satisfaction.

According to the Comfort & Convenience Factors, the same attributes were important along the years. "Easiness of get on/off the bus or Accessibility" is the sole attribute that reached a more important role in 2011 (SRW=0.716). This year, the users also evaluated this attribute better than in 2008 or 2014.

Additionally, the results show that the effect of Comfort & Convenience Factors on Transport Service Factors could be considered as constant. Table 5 shows that their differences are not statistically significant between the three years. This indicates that secondary factors have a positive and potentially constant impact on the main factors more related with transport

availability. In addition, Transport Service Factors influenced more Users' Satisfaction at the beginning and at the end of the crisis than in 2011.

CONCLUSIONS

In this study, a SEM approach was used to investigate service quality evolution at the Granada metropolitan transit service in a context of economic downturn. First, PCA identified latent dimensions hidden under the service attributes describing the system, and subsequently, the relationship between service dimensions and Users' Satisfaction was determined. Finally, service quality evolution was analyzed by calibrating three different SEM models, one for each year under study (2008, 2011 and 2014).

Two underlying dimensions were revealed from PCA: Transport Service Factors, as primary attributes of the service more related to trip availability, and Comfort & Convenience Factors, as secondary attributes more related to passengers' interaction with the service when they make a trip. Transport Service Factors, as main drivers of the service quality, grouped "Frequency", "Speed of the trip", "Proximity of the stops" and "Fare of the ticket". All the other attributes, except "Available information", were grouped under the dimension Comfort & Convenience Factors.

Taking into account these two dimensions, a competing model strategy was applied for revealing construct relationships. Five different models were analyzed, and the best structure was identified. That is, Transport Service Factors, as main drivers of service quality, exerts a positive direct effect on Users' Satisfaction, while Comfort & Convenience Factors, as secondary attributes, does not exert a direct effect on Users' Satisfaction but an indirect one through primary attributes. These results agree with Transportation Research Board (Transportation Research Board, 2013) as it indicated that when primary factors are not available, secondary factors have no sense for explaining service quality.

Another important point of this work was to evaluate the effects of downturn in item-construct and construct-construct relationships. "Speed of the trip" was revealed as the key factor of Transport Service Factors, and in 2011, as a consequence of the existing downturn, traffic diminished and "Speed of the trip" was better valued and achieved a higher SRW respect to Transport Service Factors. In this line, it is worth noting that "Fare of the ticket" has lost importance as the financial crisis has become more noticeable, in spite of the price of the ticket has been risen several times and the perceived value has dramatically diminished. Then, the fall on "Fare of the ticket" does not generate a great fall on users overall opinion, as the effect of "Fare of the ticket" on Users' Satisfaction construct has diminished along the years. In addition, Transport Service Factors have diminished their impact on Users' Satisfaction in 2011, when downturn was more intense.

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