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ScienceDirect

Procedia - Social and Behavioral Sciences 162 (2014) 449 – 458

Procedia
Social and Behavioral Sciences

XVIII Congreso Panamericano de Ingeniería de Tránsito, Transporte y Logística (PANAM 2014)

Analysis of explanatory variables of rail ridership: the situation of Rio de Janeiro

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Abstract

This paper aims to establish, from the variables incorporated in the bibliography, the ones potentially indicated to explain and rate the rail ridership, considering the characteristics and specificities of the suburban trains and stations of Rio de Janeiro Metropolitan Area (RJMA) as well as its environment. It will be considered the data of railway branch lines of RJMA and their links, along with the econometric models that will be determined, taking into account the explanatory variables of boarding and landing rates of train stations. Contrary to what is observed in international literature, the HDI (Human Development Index), average income and population variables present low interrelation with the following dependent variables: boarding rate, landing rate and total amount of journeys. The HDI calls our attention because it presents a negative interrelation, which strengths the idea that in Brazil the train offer does not contribute to a human development. The low correlation with the average income and population may explain the low quality of the service and the unattractive image of the train. The variables that present greater explanatory capacity of railway rates were the number of jobs in the area of influence and the numbers of extensions of the train itself. This suggests that in Rio the train plays the role of the transport that will take the employees to their workplaces, highlighting the importance of connectivity to obtain passengers.

Peer-review under responsibility of PANAM 2014.

Keywords: Railway Stations, Trip Generation Hubs, Travel Management

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Peer-review under responsibility of PANAM 2014.
doi:10.1016/j.sbspro.2014.12.226

1. Introduction

The train is a transportation mode historically recognized its ability to structure the territory and organize the transport system. It is clear the international interest in research the variables that influence the rail ridership, for many reasons, such as planning the best outlines, designing an integrated network and encourage the development of the area near the train station (Cervero, 2009; Bertolini and Spit, 2007). Some researches confirm that large cities that are built in rail systems are more likely to provide less costs regarding traffic congestions, accidents and environmental impacts (Litman, 2004; TTI, 2003). For a lot of cities it is common that the train, besides providing a service of excellent quality, execute the essential role of providing a well articulated environment, connecting the different locations and means of transportation along with a sustainable development (Cervero, 2009). Some theories, like TOD (Transit Oriented Development), enhance the potential of the train and its stations, stimulating the use of the others social modalities, like public transportation and non-motorized vehicles (Gonçalves et al, 2014).

So that the railway system can achieve its purpose and its fully form, some conditions are required. The complexity of the performance of the railway system requires a multidisciplinary and fundamentally integrated perspective. This approach is identified in the Bertolini's study (1999), in which he analysis the railway system based on some variables, such as: urban environment, land use, socioeconomics and transportation. The main objective of the study is classifying the stations according to the balance between offers of transportation and activities developed in its area. This guideline is identified in other several studies (Gutierrez et al., 2011; Maghelal, 2011; Sohn and Shim, 2010; Kim et al., 2007; Kuby et al., 2004), all of them aiming to detect the variables that can influence ridership. These studies have been carried out in different historical, cultural, social and political contexts. Therefore, the results naturally vary according to the local specificities (Maghelal, 2011).

In Brazil's scenario, giving its serious problems concerning urban mobility, it is a big challenge to be provided with good public transportation, especially considering that there are twenty two metropolitan regions across the country, resulting in more than one million of inhabitants (IBGE, 2010). A land of such large extent justifies an integrated system, based on the means of transportat with greater capacity, like railway. However, typically, more than 90% of the motorized commutes are done by road vehicles that compete with each other for a scarce road space (Gonçalves et al, 2012). The most incoherent fact, as in the case of RJMA, is the number of under-used railroads: there are more than 200 miles of railroads that serve to less than 600 thousand daily passengers (SETRANS-RJ, 2011), which corresponds to 3% of the total amount of motorized journeys. It should be stressed that nearly fifty years ago the trains carried more than a million passengers on a daily basis, taking responsibility for more than 15% of the travels. The poor utilization of the railway system becomes clearer when it is taken into account the data of 56 cities in Europe, USA and Asia, categorized by Ely (2012). This research indicates that, in similar condition, the railroads of RJMA should attend more or less 4 million daily commutes.

After decades of abandonment, there are several current investments that point to an upgrade of the urban mobility. According to Marchesi (2013), there are over 60 projects of railway transport being planned across the country. Is it expected that 22 of this projects will be ready until 2016 and the rest of them until 2020, when R$ 100 billion will have been invested in this area. In addition, there is an effort to revitalize the branch lines that already have been build in many Brazilian metropolis.

What concerns RJMA, the State Secretariat of Transport, with the end of turning this situation around, created in 2011 the State Program of Transport II (PET II), that aims to increase the railroad offer capacity to 1,2 million passenger per workday. In spite of the fact that the raise is still below the expected, this program will benefit the estimated population of 10,2 million inhabitants and 19 municipalities (SETRANS-RJ, 2011). For the appropriate enforcement of these decisions, it is required the knowledge of the variables and measures that can add to a decisive polish up of the trains, so they can seize the demand as long as it is compatible with the new offer.

The historical occupation of the suburbs and the outskirts of town, places where the trains attend, were made by population with low buying power, being regular the existence of poor communities along the railways branch lines. These communities tend to present low rate of mobility, characterizing a picture of social exclusion. In such conditions, it is a challenge to revitalize the trains and actually recover the role of this form of transport in the socioeconomic development and the social inclusion.

This paper aims to establish, from the variables incorporated in the bibliography, the ones potentially indicated to explain the rail ridership, considering the characteristics and specificities of the suburban trains and the stations as well as its environment.

2. Characterization of Railroads Stations and Their Roles

As an element of the urban environment, the railroads stations have the following characteristics: they link two areas divided by the train line, they share the same physical space with other types of transportations and they are a pole of modal integration. Moreover, many activities are executed in their inner space and in their neighborhood, usually involving several types of land use. As a geographical entity, the station is a "dot", meaning that is the access point to the train and, increasingly, to others means of transportation. At the same time, the station itself is a place of the city. It is a part of the city with an infrastructure concentration with great numbers of different constructions and different styles, along with and public spaces (Bertolini and Spit, 2007). In all of these situations the railroad station acts like a Trip Generation Hubs (TGH).

Being that so, the station plays several roles in the urban environment. In accordance with Zemp (2011), five of these roles may be highlighted, as it shows Table 1. These roles interact with each other and their developments must be understood as directions or general tendencies.

Table 1. Roles played by stations in the urban environment (Zemp, 2011)

Title	Role	Main Features
F_1	To connect the catchment area (CA) with the transportation system	To delimited size and nature of the demand resulted of the activities developed at the AI and it their attractiveness
F_2	To give support to the modal integration	To capture users of other lines and means of transportation
F_3	To capture commercial activities to its intern area	To concentrate activities in its intern area aiming to increase the income of the companies and its own attractiveness
F_4	To promote social and cultural activities in public spaces	To provide recreation and emphasize journeys alternatives, besides attract users from other modalities of transportation
F_5	To contribute to the identification of its neighborhood in time and space	To make the train a part of people's lives

The acknowledgment of the roles played by the station and the tagging of the facts that may interfere in the demand of railways travels can point out different channels so that the train achieves its full potential, in benefit of the community. Historically, some aspects are deeply connected to the railway demands, such as: the number of population, the number of job offers, the familiar income and the distance between the homes and the station. The implementation of the train had the major goal of transport a large number of workers from their houses until the factories. Later, the issue of the connection between railroads lines, and the link between those and the socioeconomic space, became more important, bearing in mind the complexity of urban journeys in nowadays world's metropolis. Nonetheless, others facts and variables must be taken into account, with more punctual connotations, that also interfere in rail ridership – which must be further investigated.

3. Factors, Variables and Protagonists of Rail Travel Ridership

In order to identify and analyze the factors the influence the boarding and landing rates of the railways stations, a bibliographic review was carried out, from Gonçalves et al (2012), contemplating the following studies: Brown et

al. 2013; Frei and Mahmassani, 2013; Basu and Hunt, 2012; Gutiérrez et al., 2011; Lucas, 2011; Sohn and Shim, 2010; Debrezion et al., 2009; Brons et al., 2008; Anspacher, 2005; Chu, 2004; Kuby et al., 2004; Walters and Cervero, 2003 and Quade and Douglas, 1996. It is worth mentioning that Basu and Hunt (2012), trough the performance of the study in the case of Mumbai, India, along with Gonçalves et al. (2012) are the only ones focused on developing countries.

The variables indicated on the bibliographic research are typically grouped according to some factors, which seek to represent the major dimensions that contribute to ridership. These variables are: Urban Environment, Land Use, Socioeconomic, Transport and Railroad Network Structure (Table 2). Among these, stand out the factors of "Land Use" and "Transport" due to the constant mentions of their variables, by different authors, and/or their importance for the models.

The factor "Land Use" presents four variables mentioned by six authors at least (population, jobs in the catchment area, city center and TOD). The attribute "Trip Generation Hubs", although less envisaged, presented similar importance.

Table 2. Factors and indicators with influence power over rail stations

Factors	Variables	Description
Urban Environment	Security	Repulsion/Attaction of passengers.
	Extreme Climate	May discourage travels.
	Touristic Area	Attraction of passengers.
	Accidents	Number of deaths per trampling.
	TOD (Transit Oriented Development)	Urban Project oriented to public and non-motorizes transportation.
Land Use	Jobs in the catchment area (CA)	Number of jobs.
	Population in the CA	Number of residents.
	Trip Generation Hubs (TGH)	Educational Institution; Airports; Bus Station; Commercial, Financial, Hospitalogical and Recreational Centers.
	Human Development Index (HDI)	Railway tends to promote socioeconomic development.
Socioeconomic	Income	Medium familiar income in the CA, which influences the mobility rate
	Unemployment Rate	Immobility.
	Level of Schooling	Schooling of the population in the CA.
	Percentage of tenant/rented houses in the AI	They use to have low income; Young people sharing houses, not requiring parking.
	Age Group	Capacity of displaciment.
	Gender	Men tend to have higher mobility.
	Ethnicity	Different patterns of travels.
	Motorization Rate	Number of cars per homes or residents.
Transport	Intermodal Integration	Feeder Buses; Parking space; Bicycle stand; Bicycle tracks.
	Congestion of Bus Station	Encouragement of the use of railway transport.
	Price and Service Quality	Fare; Punctuality; Waiting and travel time; Easiness in the purchase of the ticket; Occupation rate; Information; Air conditioning; Service (Sympathy) and Cleanness.
	walkability	Distance, connectivity and quality of the walk;
	Competition	Buses Lines Competitors.
	Gasoline Value	Encourage the use of public transportation.
Railways Network Structure	Terminal Station	Comprehensiveness of the CA.
	Distance between stations	Comprehensiveness of the CA.
	Centrality	Attractiveness
	Connectivity	Number of lines in each station and of necessaries transferences in each travel and access (relation to transport integration).
	Brake between trains	Waiting time and seats offer capacity.
	Network Congestion Level	Speed and Quality of the service.
	Technology	Type of vehicle that interferes in the capacity, comfort and world access.

In the “Transport” factor, same variables are in evidence: Intermodal Integration/vehicle accessibility, quality of service and walkability. These variables are referenced by at least seven authors. Quality of service is a variable that presents great relevance because it is possible of be interfered by the service operator company and because it has been considered important in the four newest publishing. Others variables that presented high relevance in the bibliographic research where Income and Connectivity, being the first in the factor Socioeconomic and the second in Railroad Network Structure.

As long as influence of the income in the boarding and landing rates of railroads stations is concern, according to Rosenbloom and Clifton (1996) apud Kuby (2004), the percentage of people that use train and subway increase according to the income. Workers with higher income tend to make longer travels and are more likely to use the train (Wachs and Taylor, 1998 and Wachs et al., 1993 apud Kuby, 2004).

Still talking about the “Socioenomic” factor, the variable “Unemployment Rate” was mentioned only in the studies of Brown et al (2013) and Frei and Mahmassani (2013), both north-Americans. Its appearance in the year of 2013 may be mirrored in the financial crisis that begun in 2006 in the United States – which nowadays is responsible for unemployment not only in the US but also in Europe.

The “Gender” indicator appears as a explanation of the ridership just until the year of 2005 (Anspacher, 2005 and Walters and Cervero, 2003), which can be explained by the large insertion of the woman in the labor market and a smaller difference between the genders in the societies of which the papers originated from.

The “Railroad Network Structure” calls our attention because of the continuity of the variable “Connectivity”, present in eight out of the thirteen papers analyzed. The less approach factor by the authors was “Urban Environment”, although it cannot be said that it presents less importance. The "Security" indicator, although little mentioned, it is present in two out of the four most recent studies (Gonçalves et al., 2012; Frei and Mahmassani, 2013).

Due to socioeconomic, cultural and political specificities of Brazil, the factors raised in the bibliography can present different interferences in the ridership of the country. It is important to analyze them so that we can understand the Brazilian reality and ran interference, aiming to increase population mobility, spreading the activities throughout the city, decreasing the need of transportation, encouraging the use of the train e, finally, decreasing the number of cars on the streets.

4. Relevant Factors in the Brazilian Issue

According to the study of PlanMob (2007), the maximum concentration of the Brazilian population does not occur only in the metropolitan regions. It shows, still, that this concentration will become greater. The larger the city, the more your residents depend on the traffic routes infrastructure to have full access to work opportunities and to the markets offers. This accessibility it is not homogeneous yet and the urban pattern of low density along with the horizontal ongoing expansion, operated by the real estate speculation, segregate the low-income population. They live in increasingly distant areas, totally or partially lacking of infrastructure and services, damaging their access to those opportunities, preventing an equal appropriation of the city and worsen the difference of wealth distribution.

According the same study, throughout the decades, ours cities were built, reformed and adapted to a circulation model today understand as impossible, totally based on the motorized transportation: the automobiles. The challenge that presents itself to the object of the Directors Plans and Mobility Plans lies in the alteration of the conditions that generated this scenario.

As it established Nigriello (1999, apud Santos, 2007), the breakthrough of urban obstacles must find its way in railway transports solutions, along with the improvement of cities that embrace increasing population density – which also means the installation of urban equipments design to attend their needs and activities that generates jobs in the area around station. In an environment with such features, there is a tendency of higher demands for the railroad transportation, both in the home-work-home commute and in other types of travels.

In a nutshell, in the case of Brazil and of RJMA, the five factors observed in the review must be analyzed in an integrated and well articulated form, so that it is possible to identify and improve accessibility and urban mobility. These improvements must take into account certain features present in our cities, as the case of the slums, the housing deficit and the transportation system inefficiency, which stress the inequalities, the exclusion and subsequent immobility of the poorest segments of society.

The Social Development Index (SDI), administered by IPP (2008), and the Human Development Index (HDI), calculated by ONU (United Nations Organization) can serve as reference when verifying the contribution of the train to the socioeconomic development of the areas around stations.

Based on the results of the review and on the specificities observed in our towns, among the potentially indicated variables, the most indicated ones to explain the boarding and landing rates, in the "Socioeconomics" factors, are HDI and Income. In the "Land Use" factor, it is important the variable related to urban projects (like TOD); jobs in the catchment area; population density and the presence of Trip Generation Hubs; all of them seek to express the level of attraction of the travels. In "Transport", variables like quality of service, image and integration easiness are important. Regarding "Railways Network Structure", it is emphasized the importance of connectivity and distance between stations.

Still, it is worth mentioning that, in the study of Gonçalves et al. (2012), considering research carried out in our country, there was found no relation between the HDI and the trains stations ridership. That could indicate that the train, in Rio de Janeiro, does not deliver its mission of promote development, differently from what happens in others countries. There was neither a relation with the population or income, although there was with jobs.

To confirm these hypotheses and to comprehend the variables that influence the boarding and landing rates, as well as the form and intensity in which it occurs – differently from what it is understand in international scenarios –, had been utilize correlation and regression tools. In order to create a relational model, a case of study was carried out in two railways branch lines of Rio de Janeiro.

5. Relational Models Applied to The Branch Lines of "Deodoro" and "Santa Cruz" - Rio de Janeiro

The branch lines of Deodoro and Santa Cruz presented 35 actives railway stations, at the time of the study, spread through 32 neighborhoods, mainly in the North and East Zones of the Rio de Janeiro city. This area has 54 km and its catchment area is occupied by populations with different socioeconomics characteristics. The average familiar income, including the people without it, vary between R$5,000 (Maracanã) and R$1,020 (Santa Cruz) (IPP, 2010), meanwhile the HDI vary between 0.944 and 0.742, in the same neighborhoods (IPP, 2000). The Santa Cruz district, that has presented the worst indexes, is located at the end of the branch line and at the outskirts of town. The data from different years are justified because they have been the most recent ones that are available in the district scale.

A great part of these stations present a negative image among the town population, given that they are old, with low maintenance and present few roles. Their main role is to connect different areas, otherwise cutoff by the railway lines, and serve as a boarding and landing of passengers.

The dependent variables established were "boarding rates, landing rates and total(boarding plus landing)" among the train stations in the hours of 05 a.m. and 07 p.m., which would be the space time with great flow of passengers and also because this was of the available data given by PDTU (SETRANS-RJ, 2011). The Central station was not considered in the models so as not to distort the comparative analysis, as far as it concentrates approximately 39% of the total of the branch lines travels. It is worth mentioning that, for all selected variables, the delimitation of the catchment area of the stations perfectly matched the district limits where the last ones were located. In relation to the land use developed in the area of influence of the station, were utilized, in the analysis, the variables "population" and "numbers of jobs" (IPP, 2010), which reveal part of the activities performed and the mobility of the population in the CA. Beyond these, it was analyzed the presence of the slums, that have the potential to be a TGH because they present high population density – variable which is considered by the bibliography as a positive one concerning generation of travels.

To analyze the presence of the slum, it was considered the limit of 1,200 meters from the train station, so the population was willing to take the train. Until 800 meters it is classified as a favorable shape, in accordance to the recommended patterns (Meziani, 2012).

In the “Socioeconomic” factor, the variable “HDI” was analyzed to test the relation between the development and the presence of the train, defined by its travel demand.

So as to analyze the “Income” factors, two attributes were created: percentage of population with income less than the minimum wage and nominal and house average income. It is believed that the percentage of low income population will disclose if there is the tendency of immobility among this social group, and nominal average income will reveal if there is a positive relation between the increase of income and the travel rates.

Concerning the "Network Structure" factor, it was analyzed the "distance previous station" variable, since it is believed that the longer is the distance between stations the higher power of attraction upon passengers, because the railway will cover a larger CA. The “station connectivity” factor, identified as essential to travel generation analysis, was also observed. It was expressed through the number of branch lines that stop in each station. The hypothesis is that the larger is the connection, the higher will be the travel rate, since the number of branch lines is directly link to the location offer and options of destiny.

This paper provide a simplified model of rail ridership that is easy to apply, especially in places where there are limited availability data. Among the variables considered important by the literature, though weren't included in the analysis is possible highlight: Quality of service, which has similar aspects in all stations since just one branch line is analyzed; intermodal integration, in Brazil, in the particular case of Rio de Janeiro , there are a lack of bus lines feeders stations that, most time, operate as competitor of railway and also the data deficiency blocked the possibility of measuring; and walkability, since it is a large territory generating the need for a large staff to identify attributes as dead ends, quantity of impedance paths, and pedestrian-friendly nodes.

As of the analyze of the matrix correlation, it is plausible to affirm that the explanatory variables that present higher capacity of explain are Number of Jobs, Connectivity and Total Area of Slums Until 800m (Table 3).

Table 3. Correlation between the dependents and explanatory variables

			Dependent Variables		
			Boarding	Landing	Total Amount of Travels
Explanatory Variables	Land Use	Population	0.1643	0.0240	0.0735
		Number of jobs	0.5226	0.5619	0.5574
		Total area of slums until 800m	-0.2078	-0.1996	-0.2057
		Total area of slums until 1200m	-0.1202	-0.1128	-0.1172
	Socioeconomics	Income (% population with income below 1 minimum wage)	-0.0970	-0.1177	-0.1124
		Income (familiar midium)	0.0507	0.0757	0.0682
		HDI	-0.0730	-0.0506	-0.0593
	Network Structure	Distance of previous station	-0.1137	-0.2222	-0.1879
		Connectivity (number of branch lines)	0.5627	0.6598	0.6367

Whitin the variables with most explanatory capacity, the variable “total area of slums until 800m” presented a different coefficient than expected, taking into account what the international bibliography considers in relation to populational density. The variable "total area of slums until 1200m" also presented a negative correlation, confirming that despite having the necessaries attributes, it does not constitute a TGH. It shows that the low mobility by train may be related to the low income of the population, as well as it may be because of the difficult access to the station, marking a social exclusion scenario in these communities.

Analyzing the rest of the variables with great explanatory power, the ones “Jobs” and “Connectivity” present a relation with consistent coefficients, giving the hypothesis generated. This means that the higher the number of jobs in the area of influence and the higher the number of branch lines, the higher will be the boarding and landing rates.

The “Percentage of population with income below 1 minimum wage” variable presented a negative coefficient. That is to say that the higher the presence of this type of population, the lower will be the boarding and landing rates, which brings out the restrict railroad mobility for low income population.

The “Income” variable (residence average) presented positive coefficient even though it also showed low correlation with travel rates, which confirms that in Brazil the situation differs from the international situations. In our country, high income it is not an indicative of longer travels, it is just the opposite. In the outskirts of town, where live the segments of people with lower income, lives the part of the population most attended by the train. The wealth part of the population that live in the area of influence of the station, even with more easiness to use the railroad system, tend not to use it – because of the poor quality of service or because of its image. As expected, the variables HDI, SDI and Population also presented low correlation with the total amount of travels, though they still have great explanatory power over the boarding and landing rates in other countries, especially in the USA and the ones located in Asia and Europe. In the same way, “Population” did not presented satisfactory results to be an explanatory variable of the boarding and landing rates.

The best correlation between the explanatory variables “HDI”, “SDI” and “Population” with the dependents variables were: -0.073; 0.098 and 0.073 with the boarding, landing and total amount of travels variables, respectively. Reviewing the “HDI” and “SDI” variables it is possible to say that the trains does not contribute for the socioeconomic and human development of the area of influence of the stations in Brazil – especially in the Rio de Janeiro city, as it confirms the study of Gonçalves et al. (2012), realized in other branch line of the city. The “HDI” variable, aside from presenting low correlation, also presented negative coefficient.

In table 3 it is possible to find the explanatory variables that presented different correlations with the boarding and landing rates, when compared to the results of the international bibliography.

The "distance of previous station" presented negative coefficients, differently from what was suggested. The previous theory believed the longer the distance between stations, the higher the power of attraction upon passengers. A possible explanation to this result may be the loss to other modalities, best walkability, like buses and alternative transportation (vans and kombis). Or even the high cost of the ticket for the little distance could explain this result – which could be analyzed by a Tariff Policy, considering the number of travels out of the rush hour and new charge technologies and electronic ticketing possibilities.

Examining the previously quoted variables with high explanatory powers – “number of jobs in the CA” and “connectivity” – both presented a higher correlation with landing rates.

Simple and multiple regressions were realized, utilizing these two variables and with other ones that presented intermediate correlation with the dependents variables, respecting the correlation that some of them presented with each other. The simple regressions presented heteroscedasticity.

From the available variables and according to correlation between this variables and respective validation tests, was reached the model with best performance, which presents the following variables: “number of jobs” in the CA (X1) and “number of branch lines” (X2) that stop in the station, indicating the connectivity of the station with the network (equation 1). The independent variable with the most correlation with these dependents variables was the landing rate (Y).

$$Y = -5443.15 + 0.19\,X1 + 5{,}714.48\,X2 \quad (1)$$

The model presented a 0.557 R^2 and the same model was applied to a P Test and to all variables of this model with 93% level of trust. The null hypothesis was not rejected, as it shows Table 4.

The dependents variables do not presented high correlation with each other. The Significant F presented a value close to zero and higher than the error margin utilized (7%), which validates the model.

Table 4. Coefficient of parameters of model: values and statistics validation

	Coefficients	*Value-P*
Intersection	-5443.1498	0.03496
Numbers of Jobs	0.1952	0.00638
Numbers of Branch Lines (connectivity)	5714.4769	0.00026
R^2	0.557	
Significant F	3.24E-06	

6. Conclusion

The railways of Brazilians town have different needs when compared to integrated networks. Furthermore, the studies about the stations are inefficient and most of them do not point out the most important and possible way to its insertion as the main transportation option in urban displacement.

In the bibliographic review, some factors stand out because of their frequency, current importance and ease intervention. Even so, not always these factors present the same behavior when analyzed in Brazilian railways, due to its specificities. In Brazil, the train and its stations, on the whole, do not use all of their potential, regarding passengers' transportation in urban areas. Plus, a lot of the time they actually have a negative image, reflect of a historical processes of city occupation and bad service.

The HDI, Income and Population factors presented different correlation with both the boarding and landing rates when compared to the international bibliography. They confirm previous Brazilian studies and had the expected results.

The negative correlation of the variables, concerning the percentage of low population income with the travel rate, emphasizes the low mobility of the poor part of the population. The weak correlation of the average income variable with the same rates reveals that the train it is not an option of transportation to a lot of people, even when they have access to the tariff of the tickets and are covered by the branch lines of the train.

As well as in the study accomplished by Lara et al. (2007) apud Gonçalves et al. (2012), it was checked the importance of jobs numbers in the CA to the preview of the travelling rates, confirming that in Rio the train plays the vital role of taking the workers to their workplaces. The results also stress the relevance of the relation of station network connectivity with the generation of travels.

In relation to the presence of the slums, which could be a TGH because of its population density, it is possible to see that the high negative correlation with the variable that measures the area within the estimated distance, that would mark a favorable access (800m), suggests that deeper studies must be carry out in order to understand this relation. It is also necessary an analysis of the accessibility of these communities to the train stations as a way to become social integrate.

Nowadays, some of the branch lines presented in this study are going through a renovation, so that that can attend the 2014 World Cup demands as well of the 2016 Olympic Games, that will be held in Rio de Janeiro. After the renovation, a comparative study could be performed, analyzing the "Transport" factor in the travels generation, since changes of image and trains service are expected.

The elaboration of a network integration, that boosts the population to make the train the main way of displacement, is vital to reduce traffic jams in the Brazilian cities and to provide a higher quality of life.

Acknowledgements

To CNPq and the Rede Íbero-Americana de Estudos em Pólos Geradores de Viagens - Network of Studies of Trip Generation Hubs- (http://redpgv.coppe.ufrj.br).

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