Theoretical and Empirical Researches in Urban Management
Volume 13 Issue 2 / May 2018

COMPARATIVE ANALYSIS ON PUBLIC TRANSPORT SYSTEMS IN EUROPEAN CAPITALS: BUCHAREST & BERLIN

Alexandru-Mihai BUGHEANU
Bucharest University of Economic Studies, Piata Romana 6, Bucharest, Romania
mihai.bugheanu@man.ase.ro

Abstract
The present study examines the public transport networks in two European capitals, specifically Bucharest and Berlin. The public transport systems of interest in this research displays similar characteristics regarding the number of users, transport vehicles, geographic area served or provided services.
The main objective of the paper is to perform a comparative evaluation on the two transport systems, including here specific features, transportation performances and costs, travellers perceptions towards the public transport operators and so on.
The purpose of the research was to identify two European capitals, which presents similarities in terms of their public transport systems. For this reason, Berlin and Bucharest metropolis were selected.
The results of the analysis can be used to perform a more thorough comparative research on public transport systems across the European Union, or in direct comparison with other metropolitan areas.
Keywords: public transport, comparative analysis, Bucharest, Berlin.

1. INTRODUCTION

The present research will analyze the topic of public urban transport in the European Union, the study focusing on the comparative assessment of the metropolitan areas of Berlin and Bucharest.

Public passenger transport systems are an area of significant importance in any capital, considering allowing fast and continuous movement for a major part of the population, providing at the same time low-fees services to an extended geographical area. Secondly, a large part of the urban areas are served by the public transport, and sometimes it is not necessary to use other means of transport.

As an illustration, this article will examine the characteristics of the public transport networks in two European capitals. For this purpose, it was necessary to identify two metropolis with similar particularities.

2. CONTEXT

First of all, Bucharest, Romania's capital, represents the most important economic, cultural, and political center of the country. With a population of 2.264.865 people in 2012, the public transport system is facing a multitude of new challenges regarding the increasing number of users, outdated infrastructure, more stringent pollution prevention law or traffic movement and congestion.

Secondly, the city of Berlin has been selected due to the following arguments:

- It is a European Capital;
- It is the largest city in the country in terms of population: 3,292,365 individuals according to the last official census of 05/09/2011 (Population, 2016);
- Has the widest area of 892 km2;
- Presents the highest population density in the country: about 3,809 persons / km2;
- It provides both surface public transport networks and underground systems;
- The city has a rate of 342 cars / 1,000 inhabitants;
- It is the most important political center in Germany, being the headquarters of the government Government.

Additionally, the Berlin metropolis needs to face significant challenges, similar to those in Bucharest. First of all, the city benefits from a very complex passenger transport management system, but the characteristics of the environment are constantly changing. The city limits are shifting simultaneously with the increase in the number of residents, attracted by the rapidly economic growth.

Secondly, the officiall population remained relatively stable in the 1991-2012 period: approximately 3.4 million official inhabitants, while the number of individual residences increased significantly, recording a 34% expansion over a 15 year period. Specifically, those aspects have direct influence on urban congestion, due to more intensive use of personal modes of transportation.

3. PURPOSE AND RESEARCH METHOD

For this research were used the official reports published by the Ministry of Urban Development of the State of Berlin, the official statistics from the National Institute of Statistics in Romania, activity reports from the public transport authorities, as well as other scientific research.

Theoretical and Empirical Researches in Urban Management
Volume 13 Issue 2 / May 2018

The next section of the study will present a comparison between the official residents registered in both the European capitals, in order to observe the evolution of the population, an evolution that has influence on the use of public transport networks. The statistical data are presented in Table 1.

TABLE1 - COMPARISON OF THE OFFICIAL POPULATION IN THE PERIOD 2003-2012

City/ Perioad	2003	2005	2007	2009	2011	2012
Berlin	3,388,477	3,395,189	3,416,255	3,442,675	3,326,002	3,375,222
Bucharest	1,926,334	1,926,917	1,939,748	1,944,419	1,936,375	1,883,425

Source: Author adaptation after (National Institute of Statistics), (National Institute of Statistics, 2012), (Ministry of Urban Development of the State of Berlin, 2013).

In conclusion, as can be analyzed in the table above, the number of residents officially registered in both cities did not change significantly over the years.

On the other hand, the unofficial number of people working, studying or transiting the two cities is significantly higher. However, in the absence of official statistics this issue cannot be part of the present research. Furthermore, Table 2 will present a profile analysis of the individual using the public transport systems in both of the cities.

TABLE 2 - PROFILE ANALYSIS ON THE USERS OF THE PUBLIC TRANSPORT SYSTEMS

Criterion	Berlin	Bucharest
Active population - individuals leaving their home daily	88.4 %	-
Average number of daily trips per person	3.4 trips/day	2.7 trips/day
Average time spent in urban traffic	70.1 minutes/person/day	64.6 minutes/person/day
Average travel distance	6.9 km/person/day	5.3 km/person/day
Average travel time	24 minutes/person/day	39 minutes/person/day
Average trips distance - total	20.2 km/person/day	14.9 km/person/day
Number of personal cars/1.000 individuals	358 cars/1.000 individuals	455 cars/1.000 individuals
Occupancy rate of personal vehicles	1.3 individuals/trip	1.6 individuals /trip
Average bicycles/1.000 individuals	721 bicycles/1.000 individuals	-

Source: Author adaptation after (Ministry of Urban Development of the State of Berlin, 2013), (National Institute of Statistics, 2016).

Under these circumstances, an analysis can be started on the user profile for the public transport systems in both two cities.

Therefore, statistical data are similar, with differences being found primarily in terms of average passenger car ownership, which is higher in Bucharest: 455 cars/1.000 people, compared to only 358 cars /1.000 people in Berlin.

One of the potential arguments is related to the high rate of car registrations in the Romanian capital, even if they are not used especially in the urban area. Specifically, these are vehicles registered under operational or financial leasing contracts, most companies offering such financial services having their headquarters in Bucharest.

On the other hand, it is necessary to provide comparative analysis on the transport modalities used in the two European capitals. The data are presented in Table 3.

TABLE 3 - COMPARATIVE ANALYSIS ON THE TRANSPORT MODALITIES

Transport mode used	Berlin	Bucharest
Private transportation	31 %	32.8 %
Public network transport	26 %	50.20 %
Pedestrian travel	30 %	- no statistical data
Non-motorized vehicles	13 %	17 %
Total	100 %	100 % [1]

Source: Author adaptation after (Ministry of Urban Development of the State of Berlin, 2013), (National Institute of Statistics, 2016)

Regarding the use of transport modes, it should be noted that no official statistical data on pedestrian travel were recorded for Bucharest, which is the reason there are significant differences between the use of public transport systems between the two cities. Therefore, there is a noticeable difference between the use of non-motorized transport means. Secondly, Berliners people record a higher percentage of using of bicycles and pedestrian travel. On the contrary, only 5.2% of Bucharest individuals use the bicycle regularly as a means of transportation. An as illustration, Figure 1 presents the graphical representation of the statistical data.

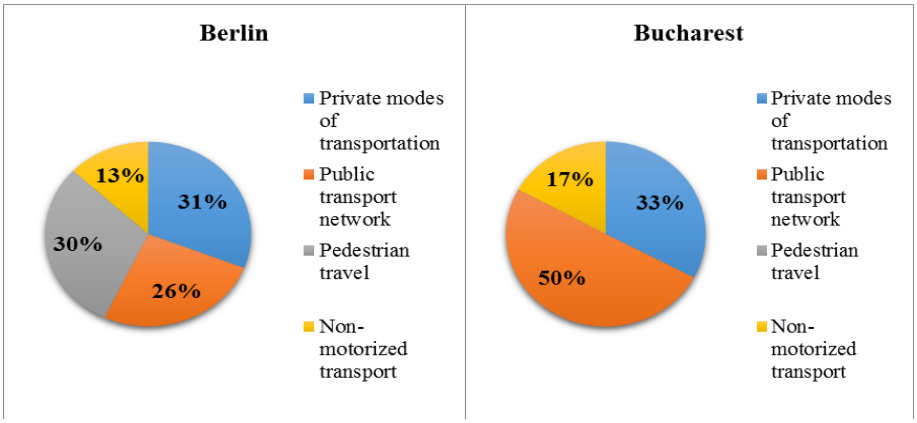

FIGURE 1 - COMPARATIVE ANALYSIS ON THE USE OF TRANSPORT MODES

Source: Author adaptation after (Ministry of Urban Development of the State of Berlin, 2013), (National Institute of Statistics, 2016)

[1] Calculul a fost efectuat pe baza informațiilor privind numărul de călătorii efectuate pe raza Municipiul București la nivelul anului 2014, fără a fi luate în considerare călătoriile pietonale, deoarece nu fost identificate date exacte.

Theoretical and Empirical Researches in Urban Management
Volume 13 Issue 2 / May 2018

Regarding the data presented above it should be noted that in the case of public transport in Bucharest there are no official statistical data concerning pedestrian travel, which directly influences the high percentages of using public transport networks.

Therefore, Table 4 presents the non-motorized modes of transport for both cities.

TABLE 4 - NON-MOTORIZED TRANSPORT MODES COMPARATIVE ANALYSIS

Transport mode	Berlin	Bucharest
Bicycle lane - overall length	630 km	194 km
% of total urban travel	26 %	5.2 %
	Germany	**Romania**
Number of bicycles produced in each country	2,288,000 units	422,000 units
Number of bicycles purchased in each country	3,975,000 units	375,000 units

Source: Author adaptation after (European Commission, 2011).

This analysis is particularly relevant because depending on usage of non-motorized vehicles that have their own runway, urban decongestion can be directly influenced. In addition, another factor of great significance is pedestrian travel. In detail, the facilities provided to individuals are extremely important, due to their major role in improving the quality of urban life.

With this in mind, it should be noted that the Berliners use on average bicycles or pedestrian travel in 4 out of 10 trips. In order to highlight the significant differences in the purchase and production of bicycles was realized a graphic representation at country level. The data are presented in Figure 2.

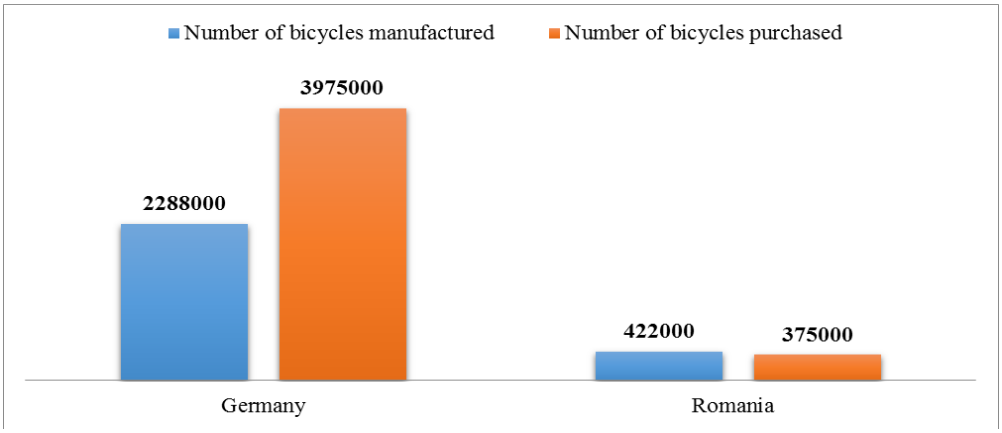

FIGURE 0 - COMPARATIVE ANALYS ON USING NON-MOTORIZED TRANSPORT VEHICLES
Source: Author adaptation after (European Commission, 2011).

Furthermore, Table 5 presents a comparative study between the types of vehicles registered in the two European capitals.

TABLE 5 - COMPARATIVE ANALYSIS ON THE VEHICLES TYPE

Vehicles type	Berlin	Bucharest
Passenger Cars	1,150,191	957,068
Motorcycles	99,099	20,468
Buses	2,126	8,655
Lorries/Trucks	83,415	130,697
Agricultural machines/Tractors	5,186	21,467
Other vehicles	14,864	10,199

Source: Author adaptation after (Ministry of Urban Development of the State of Berlin, 2013), , (National Institute of Statistics, 2016).

To summarize, based on the previous information, we can develop furthermore the analysis of public transport in both the European Capitals.

Another key point is the fact that Berlin city has one of the most complex public transport networks in all the European Union, consisting of:

- Regional trains;
- Trains with urban coverage area: S-Bahn;
- Underground trains: U-Bahn;
- Trams and buses, with an average total length of the transport network of approximately 1,900 km.

As an illustration, taking into account all these means of public transport, passengers have access to about 3,100 transport stations, most of them equipped with facilities for people with disabilities: access ramps, lifts, automatic ladders or equipment for the blind people.

On the other hand, the research on the Bucharest public system shows that it provides 51 underground public transport stations and 2,330 surface transport stations.

Equally important, the annual average individuals using U-Bahn - the underground transport in Berlin, along with the private cars and tram network, amounts to more than 937 million people. In addition, the S-Bahn network, which uses urban trains, records about 395 million passengers each year.

Comparatively, as far as Bucharest Capital is concerned, the statistical analysis indicates the following aspects:

- Approximately 1,050,830 thousand passengers were transported during 2016, including here underground and surface transportation networks;

Theoretical and Empirical Researches in Urban Management
Volume 13 Issue 2 / May 2018

- The underground system carries around 20% of the total number of passengers using a network length of only 4% of the entire public transport system.

TABLE 6 - COMPARATIVE ANALYSIS ON THE PUBLIC TRANSPORT STATIONS

Transport stations	Berlin	Bucharest
Regional trains network length	204,6 km	-
Regional trains stations	21	-
S-Bahn trains network length	256,2 km	-
S-Bahn stations	132	-
Underground metro network length	146,3 km	69,2 km
Underground transport stations	173 stations	51 stations
Trams network length	191.2 km	137 km
Buses network length	202,2 km	418 km
Trolleybuses network length	-	66 km

Source: Author adaptation after (Ministry of Urban Development of the State of Berlin, 2013), (Regia Autonomă de Transport București, 2015), (Societatea Comerciala de Transport cu Metroul Bucuresti Metrorex - S.A., 2016)

As can be seen, a major difference is the lack of urban trains in Bucharest. On the other hand, we must mention the absence of a trolleybus network in Berlin.

In essence, the capital of Romania benefits from an average length for the bus network of 418 km, double compared to only 202.2 km in Berlin. On the contrary, the underground transport system is much more developed in Berlin. First of all, the number of passenger stations exceeds 170 units, while in Bucharest only 51 stations are available at the present time. Secondly, the length of the Bucharest underground network is only 69.2 km, compared to the 146.3 km in Berlin. The statistical data are presented in Table 7.

TABLE 7 - COMPARATIVE ANALYSIS ON THE VOLUME OF TRANSPORTED PASSENGERS

Criterion	Berlin (thounsand)	Bucharest (thounsand)
Total number of passengers transported by the public systems	1,386,000 passengers	1,050,830 passengers
Total number of passengers transported by urban trains S-Bahn	395,000 passengers	-
Total number of passengers transported by the underground and the surface networks (buses and trams)	937,000 passengers	174,830 passengers - underground network 876,000 passengers - surface network
Regional transport	54,000 passengers	-

Source: Author adaptation after (Ministry of Urban Development of the State of Berlin, 2013), (Regia Autonomă de Transport București, 2015), (Societatea Comerciala de Transport cu Metroul Bucuresti Metrorex - S.A., 2016)

Obviously, there is a first difference regarding the regional public transport, due primarily to the fact that the official statistics on the Ilfov region around Bucharest are not as detailed as those available for the

outside the German metropolis. Moreover, Bucharest does not benefit from the availability of a regional train system, such as the S-Bahn network.

Furthermore, Table 8 presents a comparison on the number of transport lines in the two cities as well as on the circulating fleet of modes of transportation.

TABLE 8 - COMPARATIVE ANALYSIS ON THE TRANSPORTATION MODES

Criterion	Berlin	Bucharest
Bus lines *Including* -express lines	149 -13 express lines	110 -2 express lines
Tram lines	22	24
Underground transport lines	10	4
Transport modes circulating fleet		
Trams fleet	378 units	485 units
Buses fleet	1,316 units	1,147 units
Trolleybuses fleet	-	297 units
Underground trains fleet	1,242 metro units	546 metro units

Source: Author adaptation after (Ministry of Urban Development of the State of Berlin, 2013), (Regia Autonomă de Transport București, 2015), (Societatea Comerciala de Transport cu Metroul Bucuresti Metrorex - S.A., 2016)

In the previous table, we can observe similarities in terms of surface transportation: 149 bus lines in Berlin, while Bucharest has 110. On the other hand, Bucharest public transport operator provides only two express express transfer lines to Henri Coanda International Airport.

Moreover, the number of tram lines is almost equal: 22 for the Capital of Germany and 24 for Bucharest. At the same time, regarding the number of transport units, Bucharest reaches a tram fleet of 485 units, compared to only 378 in the case of Berlin.

On the other hand, a trolleybus network is not implemented in Berlin, because urban trains or other surface modes of transportation are being used for this type of travel.

Likewise, a considerable difference is noted in the case of underground transport, substantially more developed in Berlin, with a number of 10 metro lines, compared to only 4 in the case of Bucharest. Additionally, the number of metro wagons exceeds 1,200 units in Berlin, while in Bucharest the public operator uses 546 underground wagon trains.

This comparison between the two Capital cannot be completed without considering the travel costs of the two transport systems. The data are presented in Tables 9 and 10.

Theoretical and Empirical Researches in Urban Management
Volume 13 Issue 2 / May 2018

TABLE 9 - COMPARATIVE ANALYSIS OF THE PUBLIC TRANSPORT COST IN BERLIN - 2017

Costs analysis	Berlin 2017
1-trip ticket *Transport de suprafață*	AB zone normal fare: 2.80 €; Reduced fare: 1.70 € ABC zone normal fare: 3.40 €; Reduced fare: 2.50 €
Short distance pass *Surface and underground transport which allows a route of up to 3 stations with changing the surface and underground lines*	Normal fare: 1.70 €; Reduced fare: 1.30 €
Children prices	Age < 5 years old: 0 €; Age 6-14 years old: 1.7 €
1 day pass *Surface and underground public transport*	AB zone normal fare: 7.0 €; Reduced fare: 4.70 €
7 days pass *Surface and underground public transport*	AB zone normal fare: 30 €
Group ticket *Maximum 5 people*	AB zone normal fare: 19.90 €
Additional bicycle cost	Normal fare: 1.90 €
Additional companion pets cost	Normal fare: 1.70 €
Fine for ticketless circulation	60 €

Source: Author working after (Berlin.de, 2017).

With this in mind, it should be noted that the fares charged by the Berlin operator are divided into three price categories, depending on the urban areas: AB, BC and ABC. The different categories provide access to regions farther from the central areas: the surroundings of the city and the Potsdam Hauptbahnhof.

Furthermore, an advantage of the tickets used by the Berlin operator is that they have a validity of two hours regardless of whether the transport mode is changed.

For comparison, Table 10 present the public transport tariff plan charged in Bucharest.

TABLE 10 - COMPARATIVE ANALYSIS OF THE PUBLIC TRANSPORT COST IN BUCHAREST - 2017

Costs analysis	Bucharest 2017
2-trips ticket / *Underground transport*	Normal fare: 1.10 €
10-trips ticket / *Underground transport*	Normal fare: 4.45 €
1 day pass / *Underground transport*	Normal fare: 1.80 €
1 week pass / *Underground transport*	Normal fare: 5.55 €
1 month pass / *Underground transport*	Normal fare: 15.55 € / Reduced fare: 7.77 €
1 day pass / *Surface transport*	Normal fare: 2.13 €;
1 week pass / *Surface transport*	Normal fare: 3.8 €
2 weeks pass / *Surface transport*	Normal fare: 5.6 €
Monthly pass on 1 transport line / *Surface transport*	Normal fare: 6.70 € / Reduced fare: 3.35 €
Monthly pass on all transport lines / *Surface transport*	Normal fare: 11 € / Reduced fare: 5.50 €
Fine for ticketless circulation	Surface transportation: 11.10 €

Source: Author working after (Societatea Comerciala de Transport cu Metroul Bucuresti Metrorex - S.A., 2016), (Regia Autonomă de Transport București, 2015).

All things considered, both public transport systems provide users with extensive service packages ranging from single travel tickets to weekly, monthly or other subscriptions. A first significant difference is found in the case of Berlin public transport, where passengers have access via certain tickets to any transport network: underground or surface, regardless of the transit mode used.

To put it differently, users can switch from subway to bus, train or tram using the same travel ticket. This is a remarkable advantage in terms of time management for the public transport system user, as well as a way to improve the comfort and overall quality of the services provided by the operator.

On the contrary, Bucharest public transport operators, R.A.T.B. and Metrorex, do not have a partnership relationship for the use of common travel tickets, which makes the transfer of transit networks substantially more difficult.

In essence, the transport systems in the two capitals have similar characteristics regarding the number of passengers transported, relative to the official populations and the extent of the networks.

4. CONCLUSIONS

In conclusion, the present research is relevant because it facilitates the evaluation of the Bucharest public transport network in relation to another international network from a highly developed West European city, both in terms of infrastructure and from a social and economic point of view.

To summarize, the role of public passenger transport systems must be assessed to its true significance, explicitly with a special emphasis on improving the urban life of individuals.

As a result, additional attention should be paid to the role of public transport on medium and long-term. Therefore, the demand and necessity of public transport is steadily increasing, and transport operators must be able to offer constantly improved services, focusing on increasing passenger safety and comfort while reducing travel times.

Equally important, improving environmental impact should be a mandatory target for any public transport administration, as the transport sector presents a major environmental risk.

Therefore, at European and international level there is a high-level of interest for the gradual introduction of new pollution regulations in order to reduce the use of highly polluting passenger cars in urbanized areas. For this reason, similar restrictions are necessary in domestic traffic, especially in Bucharest, but it is necessary to implement a long-term strategy, aiming both at creating a sustainable public transport network and meeting the users requirements.

Theoretical and Empirical Researches in Urban Management
Volume 13 Issue 2 / May 2018

REFERENCES

Brinkhoff T. (2016). *City population. Population Statistics for Countries, Administrative Areas, Cities and Agglomerations* – Interactive Maps and Charts. Retrieved September 07, 2016, from City Population, https://www.citypopulation.de/Deutschland-Berlin.html.

European Commission (2011). *Future of transport - Analytical report. Hungary*: Directorate General Mobility and Transport.

Ministry of Urban Development of the State of Berlin (2013). *Mobility in the City - Berlin Traffic*. Berlin : Senatsverwaltung für Stadtentwicklung und Umwelt.

National Institute of Statistics (2016). *Cercetarea statistica privind vehiculele inmatriculate in circulatie. Bucharest*: Institutul Național de Statistică.

National Institute of Statistics (2016a). *Recensământul populației și locuințelor*. Retrieved January 25, 2016, from Institutul Național de Statistică - România, http://www.insse.ro/cms/ro/content/recensamantul-populatiei-si-locuintelor-2002.

National Institute of Statistics (2016 b) *Recensământul populației și locuințelor*. Retrieved January 23, 2016, from Institutul Național de Statistică - România, http://www.recensamantromania.ro/rezultate-2/.

National Institute of Statistics. (2015). *Transport of passenger and goods by modes of transport - 2015. Dissemination of statistical information*, 22-25. ISSN: 2065 – 8559.

Regia Autonomă de Transport București (2015). *Activity report*. Bucharest, S.C. RATB R.A., 2015, 107-118.

Societatea Comercială de Transport cu Metroul București Metrorex - S.A. (2016*). Metrorex S.A. Activity Report.* Bucharest: S.C. METROREX S.A.

VisitBerlin (2017) *Tickets, Fares and Route Maps*. Retrieved May 01, 2017, from The Official Website of Berlin, https://www.berlin.de/en/public-transportation/1772016-2913840-tickets-fares-and-route-maps.en.html.