POLYTECH
Peter the Great
St.Petersburg Polytechnic
University

SPbWOSCE-2017
20-22 of December 2017
Saint-Petersburg, Russia

PREFACE

The International scientific conference SPbWOSCE-2017 «Business Technologies for Sustainable Urban Development» was held by Peter the Great Saint-Petersburg Polytechnic University, Institute of industrial management, economics and trade, on 20-22 of December 2017.

The conference was aimed at sharing the most recent scientific achievements, consolidating academic relations and creating favorable conditions for cooperative researches in the field of Business Technologies for Sustainable Urban Development.

The following issues became the core topics to discuss for the participants: Innovative Projects in Municipal Facilities and Urban Development, Municipal Facilities Management, Modeling and Planning in Sustainable Urban Development, Human Resource Management, Financial Issues of Sustainable Development of Socio-Economic Systems, Municipal Healthcare System Management, Energy Efficiency, Process Reengineering and Information Systems, Business activity management in construction under the conditions of new types of economic relations promotion, Transport System Management, Transport Modeling and Transport Planning.

The support of the Government of St. Petersburg was realized by Housing Committee, Construction Committee, Committee on Energy and Engineering Support.

Scientific Editors:

- Dr. Olga Kalinina
- Dr. Igor Ilin

Among the participants of the conference, there were representatives of the academic community, experts in business, representatives of Russian and foreign companies, specialists in energetics, urban planning and modern technologies of the city infrastructure, transport, etc.

Nearly 300 research papers written by authors from several countries were submitted to BTSUD 2017. This enabled an actual multinational and multicultural exchange of ideas and experiences.

Urban Development is an extremely urgent problem for today. The top priority objective of urban development is creating modern urban environment, which is comfortable for people and efficient in terms of economics, healthcare, energy saving, etc.

The members of our organizing committee express their gratitude to the crew of journal MATEC Web of Conferences.

We sincerely hope for and look forward to your attention to the next SPbWOSCE in 2018

Olga Kalinina & Igor Ilin

Statement of Peer review

In submitting conference proceedings to *Web of Conferences*, the editors of the proceedings certify to the Publisher that

1. They adhere to its **Policy on Publishing Integrity** in order to safeguard good scientific practice in publishing.
2. All articles have been subjected to peer review administered by the proceedings editors.
3. Reviews have been conducted by expert referees, who have been requested to provide unbiased and constructive comments aimed, whenever possible, at improving the work.
4. Proceedings editors have taken all reasonable steps to ensure the quality of the materials they publish and their decision to accept or reject a paper for publication has been based only on the merits of the work and the relevance to the journal.

Title, date and place of the conference:

SPbWOSCE-2017 "Business Technologies for Sustainable Urban Development"
20-th – 22th of December 2017

Peter the Great St. Petersburg Polytechnic University, Russia

Proceedings editor(s):

Dr. Igor Ilin
Dr. Olga Kalinina

Date and editor's signature

I. Ilin **O. Kalinina**

03.05.2018

Analysis of the offer and demand for the transportation of people from a settlement in the city of Skopje

Zlatko Zafirovski[1,*], *Vasko* Gacevski[1] , *Zoran* Krakutovski[1] and *Slobodan* Ognjenovic[1]

[1]Faculty of Civil Engineering, University „Ss. Cyril and Methodius“, Skopje, Republic of Macedonia

Abstract. Transportation planning is a complex task and a major challenge that plays primary role in the development of the economic processes in the exchange of people and goods. There are several approaches from which transport can be analysed. As an economic activity transport is analysed in terms of offer and demand. The offer of transport is an offer of given capacity which can transported from one place to another. The offer analysis is made in relation to the demand for transport which is made by the individuals that travel or the firms and industrial facilities that want to transport goods. An initial representation of the theoretical approach in the analysis of the transport of people through the description of a specific case is shown in this paper.

1 Introduction

In order to enable the progress of transport, large financial funds are needed which should be invested for its functioning, that is for the construction of the infrastructure, for the production and procurement of vehicles and for the organization and exploitation of the transport. These investments are based on the analysis of the functioning of the transport service markets, by studying: the characteristics of the demand, the characteristics of the offer and the transport service market (equilibrium, etc.)

1.1 Target group

In the analysis the target group whose mobility was studied was a group of students studying at several faculties in the city of Skopje. Common for all the students is the place of residence, i.e. the settlement Dame Gruev located in the municipality of Gjorce Petrov. From this group all the relevant information about their mobility was obtained through a survey process.

* Corresponding author: zafirovski@gf.ukim.edu.mk

1.2 Environment characteristics

The settlement Dame Gruev is located in the west part of the city of Skopje approximately 7 km from the central area. It extends at 2,5 square kilometres with a modern urban plan and has around 15000 inhabitants. Nearby there is a military barrack and part of the railway that goes towards the cities of Kicevo and Prishtina.

Currently the only way to travel to other city areas is via the road network (city streets), because the existing railway is not used for urban transport and there are no other transportation alternatives. However the approach ("entrance" and "exit") of the settlement Dame Gruev is limited to one street that is through an overpass at the very beginning. The other way that does not represent a suitable approach to the settlement is through the city ring road.

Fig. 1. Air distance between the settlement Dame Gruev and the city centre

2 Methods

This article contains analyses and descriptions of the transportation offer and demand which affect the target group and the city in general.

2.1 Analysis of the transportation systems

Considering the transport vehicles, the alternative to the individual transport (cars) is the public city transport that is represented by the buses of the public city enterprise Skopje. On the territory of the settlement pass 3 different lines of the public city transport, the buses 22, 22A and 64A. Two of them (22 and 22A) represent city lines, and the other one is a suburban line.

The line 22 has a length of 14,5 km with 30 stations from which 3 of them are in the settlement Dame Gruev. This line passes throughout the most vital city areas. The travel time in one direction from the beginning to the end of the line is 1 hour, i.e. the duration of one rotation is 2 hours. The time of departure of two consecutive buses varies from 7 (in the

morning) to 20 (in the evening) minutes. The line 22 is one of the most busy and most frequent lines in the city of Skopje. There are average of 110 rotations per day.

The other two lines (22A and 64A) have similar characteristics (length, stations, travel time) as the line 22, but different ending points and drastically less rotations per day.

Generally on the lines throughout the city the transporting is done by two-deck buses. This buses by the brand "Yutong" have length of 11,8 m, height of 3,9 m and capacity of 80 passengers (60 seating and 20 standing). In addition to these, there are also single-deck buses from different brands with a capacity of 50 passengers with various seating and standing combinations. In average, the commercial speed of the buses on the city lines is around 14 km/h, but it should be taken in consideration that the legal speed limit in the cities in Macedonia is 50 km/h. The accuracy of the timetable of the busses is 5 to 10 minutes give or take, and it depends on several factors. Also it should be emphasized that the frequency of the buses varies throughout the week, i.e. there is difference in the timetable on weekdays and weekends and holidays.

Fig. 2. Two-deck city bus from the brand "Yutong"

2.2 Analysis of the demand for transport

Through the analysis of the target group, valuable information about their mobility has been obtained. Such information's are:

- Generation of trips
- Destination of trips
- Main and secondary motives for traveling
- Distribution of trips by the means of transport
- Time distribution of trips throughout the year, week and day.

These information's are used for determination of the transportation demand. From spatial aspect the people who travel to destinations near the route of the line 22, don't have a problem with the public city transport. For the other users of public transport who travel to different city areas, where there is no direct line from the settlement or the rotation intensity is very low (line 22A and 64A), problems occur which lead to loss of time and money.

In terms of transport capacity there are major problems in the public city transport. The line 22 is one of the busiest and most packed lines in the city of Skopje, because it passes through the most frequent areas and settlements where it is the main transport offer. Due to this and the fact that the other lines (22A and 64A) have low frequency, the buses very often reach their maximum capacity. This mostly occurs in the morning hours (from 7 to 8

o'clock) and the afternoon hours (from 15 to 17 o'clock) when most residents have the need to travel.

Besides the capacity of the transport vehicles there are problems with the capacity of the streets. Because the infrastructure in the settlement Dame Gruev is reduced to one main street with two traffic lanes, the maximum traffic density is often reached. This condition affects all users of the road and leads to breakdowns in vehicular flows, traffic accidents and overall low level of service.

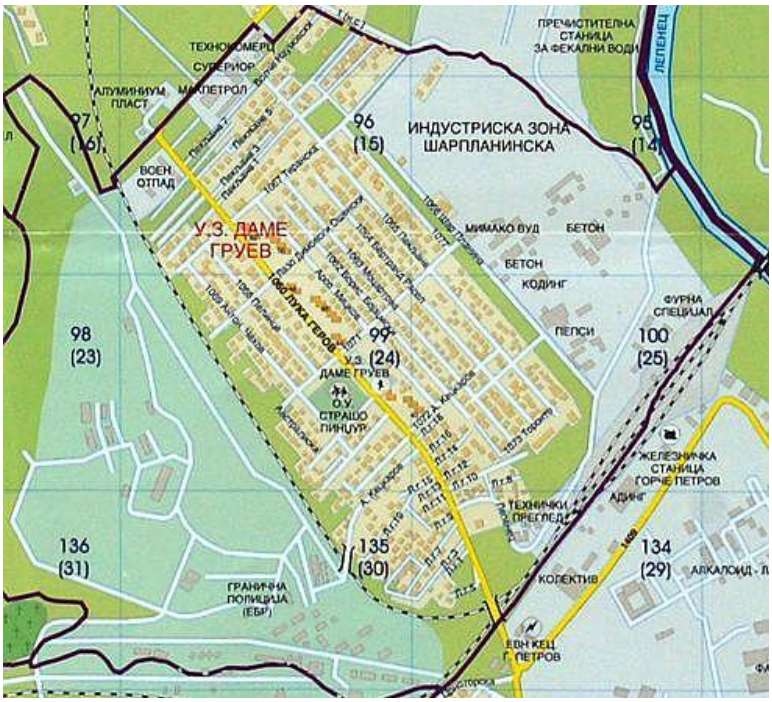

Fig. 3. Map of the settlement Dame Gruev

3 Results

The current state based on the data from the analysis of the offer and demand indicates major transport problems in the settlement Dame Gruev and the city of Skopje in general. At the moment besides the individual and the public bus transport there is no alternative solution. Besides the improvement of the current transport offer, possible alternatives for the transport problems in the settlement Dame Gruev and the city of Skopje are:

- Construction of new infrastructure i.e. streets that will improve the access to the settlement and reduce the traffic volume on the existing streets. Positive sides to this solution are: traffic distribution, improvement of the level of service, increased traffic safety, faster time of travel and more. Negative when building a new infrastructure in city areas are the major costs and the problems that arise when constructing in densely populated places.

- Implementation of a tram in the public city transport would generate great benefits for the users of the public and individual transport. With a tram solution there would be faster, more accurate and cheaper transportation for the users. This solution should be considered

at the level of the whole city, and requires detailed analysis, planning and large investments for the infrastructure, vehicles and expropriation.

- Utilization of the existing railway in the public city transport can be done with an adequate reconstruction and integrating new lines. The existing lines pass through a few settlements in the city and most of them have little frequency of trains, which makes them suitable for this kind of transformation.

Fig. 4. Urban transportation planning process

4 Conclusions

The analysis of the offer and demand for transport represent compulsory process when there is a requirement for solutions to a certain transportation problem. This could be oriented to the improvement of the existing state of the transport, as well as finding and implementing a new transport system. The analysis its self is a complex and long term process that involves several areas of expertise. For the particular case stated above the results of the analysis indicate a major transport problem from several aspects. The solutions for this problem are proposed through three alternatives. The future research based on this analysis should be pointed towards the design of a model, which will serve for the prediction and planning of the mobility in the future. With detailed analysis, careful planning and proper design the urban transport can function properly. Skipping or leaving out some of the phases usually lead to problems which are manifested as a loss of time and money.

References

1. S. Ponnuswamy, D. J. Victor, *Urban Transportation: Planning, Operation and Management* (2012)
2. M. D. Meyer, *Transportation Planning Handbook, 4th Edition* (2017)
3. M. D. Meyer, E. J. Miller, *Urban Transportation Planning, Second Edition* (2000)
4. S. Hanson, G. Giuliano, *The Geography of Urban Transportation* (2004)

5. S. de Luca, Publ. E. In Strat. Transp. Plan.: An A. H. Proc. Hier. Proc. Bas. A., **33**, 110, (2014)
6. J. W. Dickey, *Metropolitan Transportation Planning*, (1974)
7. N. Lichfield, P. Kettle, M. Whitbread, *Evaluation in the planning process: The Urban and Regional Planning Series*, (1975)
8. G. F. Chadwick, *A Systems View of Planning: Towards a Theory of the Urban and Regional Planning Process, Second Edition* (1978)
9. T. Litman, *Introduction to Multi-Modal Transportation Planning, Principles and Practices* (2017)
10. CA O'Flaherty, *Transport Planning and Traffic Engineering* (1997)
11. E. Cascetta, A. Carteni, A Qual.-Bas. Ap. to Pub. Transp. Plan.: T. and a C. Stud., **8**, 84 (2011)
12. P. Nijkamp, E. Blaas, *Impact Assessment and Evaluation in Transportation Planning* (1994)
13. S. Owens, R. Cowell, *Land and Limits: Interpreting Sustainability in the Planning Process, Second Edition* (2011)
14. A. Amekudzi, M. Mayer, C. Ross, *Transportation Planning* and *Sustainability Guidebook* (2011)
15. F. Stainer, K. Butler, *Planning and Urban Design Standards* (2006)
16. T. F. Golob, R. Kitamura, L. Long, *Panels for Transportation Planning: Methods and Applications* (1997)