Bulletin of the Transilvania University of Braşov • Vol. 9 (58) - 2016
Series I: Railways, Roads and Bridges Section

MOBILITY PATTERNS OF TWO OCCUPATIONAL CATEGORIES IN THE CITY OF CLUJ-NAPOCA

C. TOŞA[1]

Abstract: *This paper investigates how socio-demographic variables of two occupational categories characterize their commuting patterns. The study is using a web-based questionnaire that was administered for private and government employees, and included questions regarding travel behaviour, as well as socio-demographic information. The results suggest that there is a clear difference between the occupational categories and we emphasize further implications on future urban transportation planning issues, considering the current urban development trends.*

Key words: *mobility patterns, morning commuters, transport planning.*

1. Introduction

For 26 years, Romanian urban areas have been experiencing continuous economic growth, exhibited through motorization growth [12] and urban sprawl [9-10]. Our current approach is focused on the Cluj-Napoca city and surrounding communes. According to the General Population Census in 2011 [6], the city of Cluj-Napoca has 324,576 inhabitants, ranking the second among the top cities in Romania. As mentioned previously, like most of the major urban areas in Romania, the metropolitan area of Cluj-Napoca experienced population growth over the last decade, as well as an increase in the level of motorization. Urban mobility [3-5], and transportation impacts [1;13] as well as social impacts [2] have been previously discussed for the study area (Figure 1) in recent years.

Fig. 1. *Study area*

As the first comprehensive Sustainable Urban Mobility Plan for Cluj-Napoca – SUMP-CN [7] was recently released (November 2015), it is among other eight such other plans for major Romanian urban areas. The purpose of current research is based on the strategic priorities mentioned in the SUMP-CN, which aim for accessibility and social equity while assuring an environmentally sustained economic

[1] *Group for Research on Transport Systems*, Faculty of Civil Engineering, Technical University of Cluj-Napoca.

environment within the Cluj-Napoca Metropolitan Area.

Therefore, this paper investigates how socio-demographic and attitudinal variables of two occupational categories characterize the commuting patterns of two occupational categories, such as administrative and government employees, and private company employees.

2. Data Collection and Methodology

The study is using a web-based questionnaire that was administered for private and government employees, and included questions regarding travel behaviour, socio-demographic characteristics, and attitudes towards travel and the environment. We formulated requests to most of the administrative and government agencies located in the city of Cluj-Napoca, and to many big private companies.

The questionnaire was administered via SurveyGizmo platform, while the data filtering and analysis was performed via R programming environment [11] and MsExcel. In order to report spatial information, several tools have been used: QuantumGIS [8] for location data visualization, while for geocoding an online tool was used, such as GPS visualizer with a MapQuest API developer key.

3. Data Analysis

After cleaning and filtering of raw data, we have obtained a final sample of 200 state employees and 126 private company employees. The reason for such a small number is due to inconsistencies of home or work address reporting, or the absence of other variables which were needed in current analysis. Socio economics of sample for state and private employees can be seen in Table 1.

Socio-demographic characteristics are split on occupational status, and differences are observed amongst most of the chosen indicators. State employees seem to have a higher age average and lower income, while the private company employees are exhibiting exactly opposite patterns. This is revealed also in average car ownership per household, as well as gender and driver's licence distribution.

3.1. Location Characteristics

In order to obtain a more detailed commuting pattern over these two occupational groups, in the following we

Socio-demographic characteristics of the sample Table 1

Characteristic	Details	% state	% private
Gender	Female	74.00	59.52
Age intervals	<25	3.00	15.87
	26…45	47.50	78.57
	45…65	43.50	4.76
	>65	6.00	0.79
Marital Status	Married	67.50	50.00
Drivers licence	Car	67.00	83.33
Cars per household	Average	1.09	1.15
Income intervals (in RON)	900-1500	29.00	10.32
	1501-2500	48.50	14.29
	2501-3000	0.00	8.73
	>3000	22.50	66.67

have plotted the distance to downtown from workers' home and workplace location. Geocoding was performed over all addresses and QGIS was used in order to perform the spatial analysis. Figure 2 reveals the boxplots for home location distances to downtown, while Figure 3 reveals the boxplots for distance measures of workplace location to downtown.

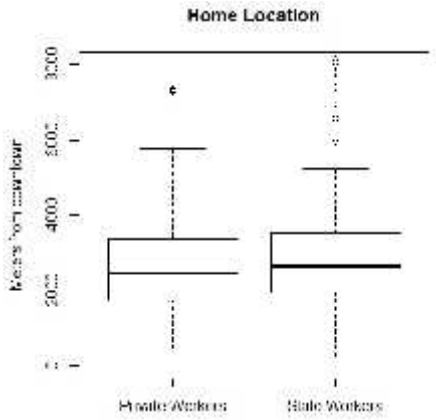

Fig. 2. *Workers home location*

Taking into account the spatial distribution of home location, we do not notice big differences among occupational groups. Due to the centralized locational pattern of state institutions and government agencies, work location for state workers are slightly smaller than the ones of private company workers.

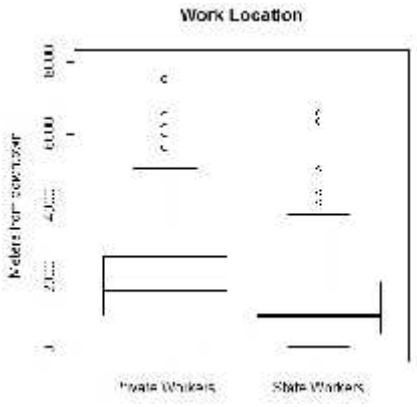

Fig. 3. *Workers work location*

3.2. Modal Characteristics

Modal distribution for state employees is revealed in Figure 4. It can be noted the high share of commuters using public transport, followed by commuters by private means of transport, while the share of non-motorized modes is reduced.

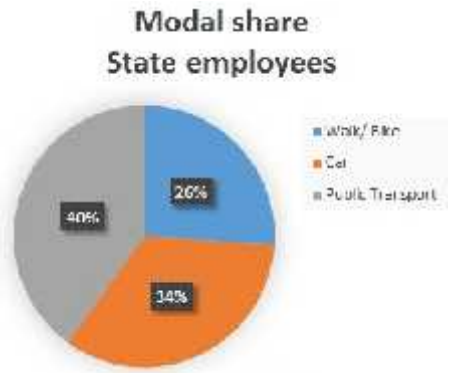

Fig. 4. *Modal distribution for state employees*

On the opposite, private employees highly prefer private means of transport, while commuting by public transport or by non-motorized means is less than their counterparts.

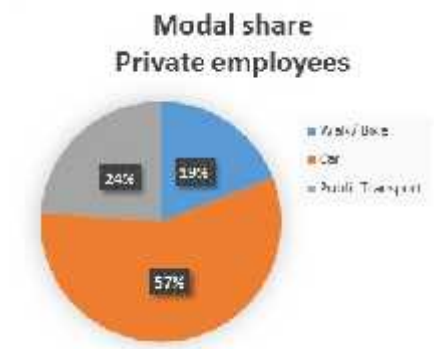

Fig. 5. *Modal distribution for private company employees*

Using Google Maps capability of providing routes between a given origin and a destination, we analysed the travel distance between home location and work

location for all O-D pairs, for all commuters, by considering the used commuting mode, for each employee. In this way, table 2 reveals the shares of state and private employees, split by the commuting mode, and by travelled distance intervals. This information allows us to obtain some insights of the travel behaviour, by pairwise comparison, between the percentage of commuting mode and travel distance interval between for state and private employees, respectively. For instance, for public transport, while there is some notable difference between classes for distances covering more than 3 kilometres, private employees are less likely to use the bus for distances smaller than the mentioned value. Behaviour by private means of commuting seems to have similar tendencies for the two occupational categories, slightly higher for distances over 3 km in the case of private company employees. Surprisingly, non-motorized modes shares reveal opposite tendencies. While state employees outweigh the private ones for distances less than 1 km, probably due to the relative location of home and work, but also distance between origin and destination, private employee's exhibit a larger share of non-motorized commuting for distances between 1 and 3 km. We assume that happens because of lower age average, but also the popularity of using bicycle as a non-motorized mode among the young people. As the non-motorized mode has not distinguished between walking and using other means of non-motorized modes of transport, we mention that the above covered issues are limited to assumptions.

3.3. Spatial Patterns

Figure 6 represents a view of the downtown area of Cluj-Napoca, revealing the O-D pairs for state and private employees. Also, we represented a buffer zone of 500 meters' radius around the historical city centre. We then connected with a straight line (Euclidian distance) the origin and destination for each employee.
The reason we performed this operation is to analyse in an exploratory way the O-D lines that intersect the city's central core. In this way, among the state employees, 47.21% of commuters cross the downtown buffer, while in the case of private company employees 31.53% cross the downtown buffer. Nevertheless, some of the employees, both state and private have their origins within the city core, and therefore, we assume that these are not transiting the downtown area. Also, we assume that the parking supply is less generous and the commuters adopt public transport or non-motorized modes.

Travel distance distribution by mode and by occupation Table 2

Characteristic	Details	% state	% private
Travel distance bus	< 1km	1.25	0
	1…3	30	20
	> 3	68.75	80
Travel distance car	< 1km	4.41	4.17
	1…3	25.00	13.89
	> 3	70.59	81.94
Travel distance non-motorized	< 1km	44.23	16.67
	1…3	36.54	54.17
	> 3	19.23	29.17

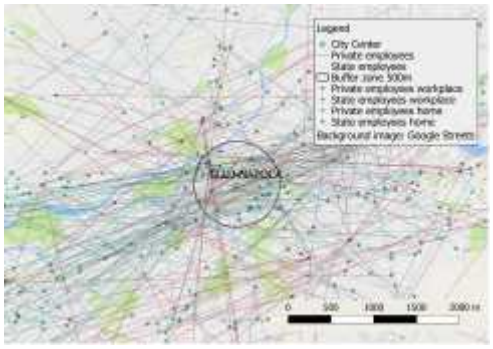

Fig. 6. *Euclidian distance from workers' home to workplace*

In this way, by eliminating the commuters with workplace in downtown area, we obtain the corrected percentage, 20.60% for state employees and 23.85% private company employees, respectively. In this direction, we wanted to analyse the impact of commuting on the city's central core, which is an area with limited transport supply and transited at rush hours by a significant share of commuters.

In the following we will analyse the split between occupational categories by considering the Euclidian distance between home location and workplace. Figure 7 exhibits the Euclidian distance distribution for state and private company employees. Interestingly, state employees exhibit a peak commuting distance interval between 1 and 2 km, and deceasing linearly towards the maximum commuting distance.

On the other hand, private company employees commuting distance interval pattern exhibits almost a multi-modal distribution, for Euclidian distances between 2 and 6 km.

4. Conclusions

The conclusion reminds of the implications that socio-economic, demographic and occupational characteristics of urban dwellers exhibited on travel demand and the impact on the quality of life. The modal share represents an important marker of the quality of commuting and the externalities regarding travel time, congestion index and air quality. Travel distance is an important determinant in choosing the travel mode, but through appropriate policies from the local authority, including hard, but also soft measures, can rebalance the modal share towards a more sustainable urban environment.

Moreover, higher income for private company employees, the dynamics of workplace location and the life-course situation of the individuals, is a powerful driver for urban sprawl, causing higher commuting distances and growing impact on the urban quality of life.

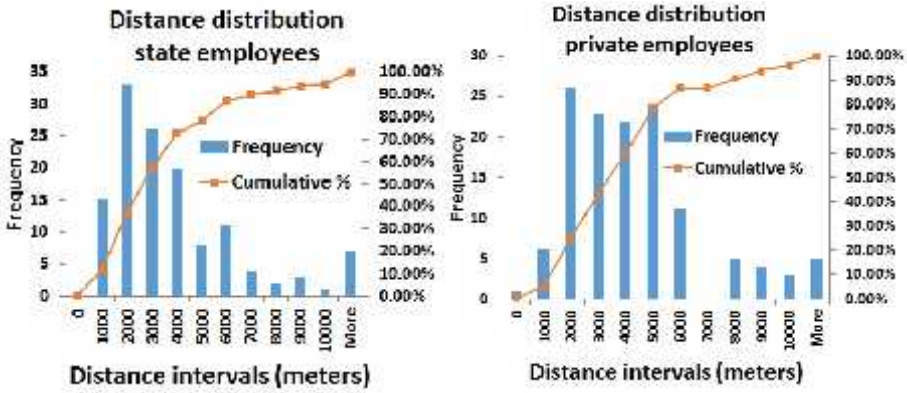

Fig. 7. *Euclidian distance distribution for employees*

Acknowledgements

The author acknowledges financial support from Kakenhi Grant-in-Aid number 26-04707 for Scientific Research from Japan Society for the Promotion of Science – JSPS.

References

1. Beca, M., Cadar R.: *An Assessment Model of Urban Noise Performed Through SIMITR Subsystem.* Romanian Journal of Acoustics and Vibration **10** (2), 2013.
2. Benedek, J., Ciobanu S.M., Man T.C.: *Hotspots and social background of urban traffic crashes: a case study in Cluj-Napoca (Romania).* Accident Analysis & Prevention **87,** 2016 p 117-126.
3. Boitor, M. R., Antov, D. *et al.: Sustainable urban transport planning*. Romanian Journal of Transport Infrastructure, ***2***(1), 2013. p. 39-50.
4. Cadar, R., Iliescu M., *et al.*:*Travel Behavior in Cluj-Napoca Suburban Area*. In: *6th International Conference USCUDAR*, Rome, Italy. vol. 15. 2015. pp. 7-9.
5. Ciont, N., Iliescu M., Cadar R.D.: *Comparative studies regarding traffic flow improvement scenarios using software modelling and real measured data* In: *Proceedings of the International Conference on Road and Rail Infrastructure CETRA*. Split, Croatia. 2014.
6. National Institute of Statistics, Romania – INS 2012 Online database, Available at: www.insse.ro. Accessed 01.09.2016.
7. Ove Arup & Partners. European Bank for Reconstruction and Development. 2016. *Cluj-Napoca Sustainable Urban Mobility Plan 2016 – 2030*. Available at: http://www.primariaclujnapoca.ro/userfiles/files/Plan%20mobilitate%20Cluj%20Napoca.pdf. Accessed 01.02.2016.
8. Quantum, G.I.S. Development Team. *Quantum GIS geographic information system. Open source geospatial foundation project* Free Software Foundation, India. 2012.
9. Soaita, A.M.: *Romanian suburban housing: Home improvement through owner-building* Urban Studies **50** (10) 2013. p. 2084-2101.
10. Soaita, A.M.: *Overcrowding and 'underoccupancy' in Romania: a case study of housing inequality* Environment and Planning **46**(1). 2014. p. 203-221.
11. Team, R.C. *R.: A language and environment for statistical computing* 2013.
12. Toşa, C., Miwa T., et al.: *Modelling and Forecasting Car Ownership in Romania's Counties Using Bass Diffusion Model* In: *European Transport Conference 2015*. 2015a.
13. Toşa, C., Antov D., et al.: *A methodology for modelling traffic related emissions in suburban areas Transport* **30**(1) 2015b. p. 80-87.