Mobility as a crucial factor of spatial development in Function urban areas - Case study of Kosice region

Ladislav Eliaš, Vladimír Ondrejička, Silvia Ondrejičková, Milan Nič
Spectra Centre of Excellence of the EU, Slovak University of Technology in Bratislava, Vazovova 5, 812 43 Bratislava, Slovakia
vladimir.ondrejicka@stuba.sk

Abstract. The majority of the population of Slovakia - 53.35% live in 141 cities, with a density of 398.27 inhabitants / km2 which, however, occupy an area of only 14.9% of the total territory of the republic. In 2749 villages occupying 85.1% of its territory, 46.65% of the population lives at a density of 60.98 inhabitants / km2. In the last century, there was a significant migration of the village population in Slovakia to work in the cities. In the Slovak Republic, there are 325.8 dwellings per 1000 inhabitants, this indicator in the original states of the European Union ranges from 390 to 500 dwellings per 1000 inhabitants. The current shortage of flats in Slovakia has also become a political agenda; the current government has to build 25,000 flats a year in the program. The biggest obstacle to the housing construction program is the lack of suitable building plots. It is not possible to find enough plots only in the territory of cities, it will be necessary to organically involve municipalities in the vicinity – I functional urban areas of economically prosperous cities/regional centres in the preparation of suitable building plots and related infrastructure. The development of municipalities so far, as well as the preparation of building plots for housing construction, which relies on the "market will solve it" model, has not proved successful. Developers in the pursuit of financial profit have focused on the production of as many apartments as possible in the vicinity of economically prosperous cities without building the necessary infrastructure. Thus, new "Satellite Cities" were created, with a deficient transport connection to the dominant city. Based on the research made, we concluded that living in a village for workers working in the city requires quick transport between home and work. So effective mobility is a priority but also a necessary condition for young families to decide where to live. Article summarizing research dealing with the challenge mentioned above and offers a case study from Slovakia especially from FUA of regional centre Košice. Case study including the proposal for the mobility model for specific villages in FUA of Košice.

1. Introduction

The Slovak Republic (hereinafter referred to as Slovakia) has a population of 5.45 million, living on 49034 km2, so the density is 111.23 inhabitants / km2. The majority of the population of Slovakia 2.91 million (53.35%) live in 141 cities, with a density of 398.27 inhabitants / km2. However, which cover an area of 7306 km2 (14.9%) of the total area. The majority of the area of 41728 km2 (85.1%) consists of cadastres of 2749 villages, where 2.54 million (46.65%) inhabitants live, with a density of 60.98 inhabitants / km2.

During the 2011 census, 1,776,698 dwellings were registered in the territory of the Slovak Republic (325.8 dwellings per 1,000 inhabitants) [1]. This indicator ranges from 390 to 500 dwellings
per 1000 inhabitants in the original states of the European Union [1]. The housing shortage is not only a social problem for young families, but has also become one of the main political agents, so the current government has to build 25,000 flats a year in the program [2].

As is clear from the above data, the planned construction of housing will not be possible only in the territory of cities, it will be necessary to involve municipalities in the construction of economically prosperous cities. The development of municipalities so far, which relies on the "market will solve it" model, has not proved successful not only at the national level, but mainly within individual regions. There was a migration of inhabitants for work to the hinterland of larger cities from the whole territory of the Slovak Republic.

The consequence of this migration was an increase in the population of smaller municipalities in the hinterland of larger cities. Thus, new "Satellite cities" were created, with a deficient transport connection to the dominant city. Every morning and in the evening there are huge columns and traffic collapses on the main roads to these places.

The available theories and the results of available research do not yet provide us with the answer to the question: what systems of regulation, support or regulations will best enable territorial units to achieve their full socio-economic and environmental goals at the same time.

Therefore, we must always and again look for the fulfilment of the goals of sustainable development with regard to the specific conditions of place and time.

By studying the specific conditions of several regions, we have come to the conclusion that living in a village for workers working in the city requires a quick transport between home and work. Such transport is not only a priority but also a necessary condition for young families to decide where to live. Rapid transport is important especially for employees: state and public administration, public services, high school students, all these institutions are usually located in cities.

Another supporting factor is leisure and sports activities for city dwellers.

The planning of this fast road connection must be coordinated with the plan for sustainable mobility of the higher territorial unit - the region as well as the dominant city. The route of connecting roads between the villages and the dominant city should lead mainly outside the residential and public parts of the individual transferred municipalities.

The municipalities surrounding the dominant city could plan the management of the city's transport circuits through their territory, of course in cooperation with it. This would not only speed up the transport between the residence and employment of the villagers, it would also benefit the inhabitants of the city, so both actors (city - village) would win - win model, which would also be reflected in finding common solutions for the development of the whole micro - region.

In this paper, we want to present a proposal for improving transport networks in the functional urban area Košice (hereinafter referred to as FUA Košice) via completion of existing transport connections between the typical rural areas (the village of Nižný Klátov and microregion Holisko) and the core city of the FUA (regional city of Košice). We propose to plan this transport connection in 2 stages: the transport connection of the municipality of Nižný Klátov itself to Košice, the transport connection of the entire micro-region "Holisko" to Košice.

2. The current situation in transport connection within FUA Košice
The village of Nižný Klátov has 711 inhabitants, its cadastre has an area of 5.94 km². It is located in the district of Košice - surroundings, about 7 km west of the regional city of Košice (Figure 1).
It was founded in the 13th century by German colonists. In the 17th - 19th century, the village had the character of an agricultural serf village, the landowners were the city of Košice. From ancient times, the inhabitants of Nižno-Klátov were employed in agriculture, mining, logging, charcoal production and the collection of forest crops, which could be sold on the Košice market.

Figure 1. The situation of the village Nižný Klátov on the territory of the Slovak Republic [3]

The transport connection of the village with Košice took place along the road through the Black Forest, which has long been owned by the city of Košice. After the construction of a new road connection between Nižný Klatov and Košice III / 3404 through the village of Myslava, bus transport was introduced to the village.

The original road from Nižný Klatov to Košice through the Black Forest (Figure 2) was used for horse-drawn carriages. Its technical parameters ceased to suit the emerging motorization in the 1960s and gradually ceased to be used en masse [4]. It is currently used for hiking and cycling.

At present, on this new road connection of the village of Nižný Klátov with Košice through the city part of Košice - Myslava, traffic jams occur every morning and in the evening, so this traffic connection is significantly congested in terms of capacity. The described unfavorable traffic situation is also evident from the cartogram of the load of the transport network in the vicinity of the village of Nižný Klátov from 2018 (Figure 3). In the city part of Košice - Myslava, after the turn to the KVP housing estate, there are 3 state roads converging, from Hyťov and Nižný Klátov III / 3404, which passes through the larger part of the village of Myslava and Bašky III / 3403. The capacity congestion of the road network is obviously documented from the submitted cartogram [5].

The municipality of Nižný Klátov has no possibility to influence the solution of this situation because the traffic-congested section of the state road III / 3404 is located on the territory of another district. The congested section is located in the Košice II district of the Košice - Myslava district.

We propose to build a new 6.5 km road from the state road III / 3404 connecting the villages of Nižný Klátov and Vyšný Klátov, to the petrol station at KVP street in Košice, using the route of the former Nižný Klátov - Košice transport link through Čierny les on Figure 4 marked route „number 3“. For the separate connection of the municipalities of Nižný Klátov and Vyšný Klátov, the route "number 3" alone would suffice, but it would be necessary to prevent the passage of citizens of foreign municipalities through the urban area of the municipality of Nižný Klátov.
Therefore, due to the exclusion of transit traffic through the village of Nižný Klátov, we recommend adding the continuation of route "number 3", with route "number 6" 0.9 km long up to the connection to the state road III / 3319, connecting the villages Nižný Klátov and Hýľov.

**Figure 2.** Transport connection of the village Nižný Klátov with Košice, through the Black Forest [3]

The implementation of the proposed routes "number 3 + number 6" will improve, in addition to the transport connection of Nižný and Vyšný Klátov to the city of Košice, also the transport connection of Hýľov and Zlatá Idka, as evidenced by the traffic network load map and Figure 5.

**Figure 3.** Cartogram of the load of the transport network in the vicinity of the village of Nižný Klátov in 2018 [5]
Figure 4. Scheme of proposed road connections [5].

Figure 5. Cartogram of the load of the transport network in the vicinity of Nižný Klátov after the construction of the proposed routes "number 3 + number 6" [5].
2.1 Transport connection of the whole micro-region "Holisko" with Košice
We propose to abandon the hitherto applied spatial planning of individual municipalities and extend it to the spatial planning of regions, resp. microregions consisting of geographically natural areas - valleys. We can clearly imagine this micro-region as an island in the sea where everything that can be equipped and secured at home will take place there by our own forces and resources, in everyday matters of life should go to the city only exceptionally. Thus, without travel, right at home, citizens are provided with all the necessary services, including state and public administration services. Detached "in situ" offices will be set up to which officials will visit and provide services, mainly to senior citizens.

An example of a functioning region is the town of High Tatras, which consists of 15 city districts, with a population of 4009 on an area of 35979 ha, where the distance between Podbanský on the western edge and Tatranská Kotlina on the eastern edge of the town is about 40 km. Furthermore, the only centre of the new region is not a condition. In the town of Vysoké Tatry, we know three important centers of national importance: Starý Smokovec, Štrbské Pleso and Tatranská Lomnica [6].

On the eastern edge of the Volovské vrchy, where the dominant hill is Predné Holisko with an altitude of 948 m above sea level, there are villages in the valleys. By the river Ida: Bukovec, Hýľov, and Zlatá Idka. In the valley of the Myslavský brook: Baška, Nižný Klátov and Vyšný Klátov. Villages in the valley of the river Belá: Košická Belá and Opátka.

There is a primary school in the village of Nižný Klátov, which is also a catchment school for other villages: Hýľov, Vyšný Klátov and Zlatá Idka. A school club and a branch of the Košice leisure centre have been established at the primary school. Kindergarten is attended by preschool children mostly from Nižný Klátov, but they are also visiting from children from the surrounding villages. The post office in the village is also catchment office for the villages of Hýľov and Vyšný Klátov. The registry office in the village also serves the villages: Baška, Hýľov, Vyšný Klátov and Zlatá Idka.

It is clear from the above that the village of Nižný Klátov provides services for the surrounding villages, ie for the valley of the river Ida and Myslavský stream. For this micro-region, we have chosen the working name "Holisko Microregion". Perspectives, in the case of the implementation of a new road connection of Nižný Klatov with the state road II / 547 led through Jahodná (route 5 in Figure 4), the extension of the "Holisko Microregion" could be considered to include the municipalities of Košická Belá and Opátka. An overview of the population and acreage of individual municipalities in the micro-region is given in Table 1.

Table 1. Overview of the population and population density of the Microregion“Holisko”

| Name           | Residents | km²  | inhabitants/km² |
|----------------|-----------|------|-----------------|
| Baška          | 424       | 4.50 | 94.2            |
| Bukovec        | 732       | 7.32 | 100.0           |
| Hýľov          | 467       | 23.86| 19.6            |
| Nižný Klátov   | 711       | 5.94 | 119.7           |
| Vyšný Klátov   | 443       | 17.84| 24.8            |
| Zlata Idka     | 380       | 16.25| 23.4            |
| Together       | 3157      | 75.71| 41.7            |
| Košická Belá   | 979       | 39.41| 24.8            |
| Opátka         | 88        | 13.90| 6.3             |
| Total          | 4224      | 129.02| 32.7           |
For the connection of the whole micro-region "Holisko", in addition to the above-mentioned routes "number 3 + number 6", we propose to add four more routes (Figure 6):

"Route 1." Luník IX – Baška (on the former road to Baška),
"Route 2." Baška – Hýľov (along the ridge in the route of existing field roads)
"Route 4." Bukovec – Hýľov (according to PUM KSK [7]),
"Route 5." connection of route III / 3404 - Košice KVP (Route3) to state road II / 547 in the Jahodná area.

![Figure 6 Cartogram of road network load after construction proposed routes numbers „1+2+3+4+5+6“ [5]](image)

3. Results and discussions

3.1 The potential of the proposed solution at the theoretical level

The positive impact of transport on the development of the area has been known for several millennia and is described in sufficient detail in the literature [8]. "Sustainable mobility, which is considered a structural factor in the development of cities and regions", is again at the forefront of urban and regional development [9-11].

The current road network of Slovakia was established mainly after the Second World War when it solved mainly the problems associated with the coming industrialization, as well as the transition from the transport of horse-drawn carriages to motor vehicles. New road routes were built, dimensioned for the then intensity of traffic when motor vehicles were owned only by the state sector. It was no exception that the children played football in the villages on paved and dust-free roads. The traditional horse-drawn carriage routes connecting the villages with the town have ceased to be used for public transport and to this day serve only as agricultural or forest roads.
The use of these centuries-old proven routes without the risk of floods or landslides will increase mobility between the village and the city. Furthermore, by tracing the outer circuits of cities through the cadastres of the surrounding villages, it can significantly increase the mobility of the cities themselves. By building these new transport routes, we will reduce the carbon footprint, which will have a significant positive impact on the environment.

The development of tourist routes also finds its potential here, especially cycle routes with the possibility of connection to existing cycle routes in the vicinity of Košice, but also to the European cycle route EUROVELO 11 passing through Košice.

3.2 Potential of the proposed solution in application practice.

The presented concept contains new ideas of mobility solutions in the northwestern part of the city of Košice, as well as in the northwestern part of the district of Košice - countryside. Until now, routes 1, 2, 3, 5 and 6 (Figure 4) have been described by Eliáš in 2019 [12]. The construction of route 4 (Figure 4) is shown in PUM KSK [7], from where it is presented.

The presented proposal can serve as a starting point for modelling reasonable villages in the form of Smart Village using the knowledge of Industri 4.0 technologies as well as 5G communication networks.

3.3 Limits of the proposed concept.

The biggest handicap of this proposal is that it requires the cooperation of state and public entities at various levels. First at the lowest level of public administration - cooperation of individual municipalities with the city of Košice, which, however, has a two-tier structure: the municipality and 22 city districts. Furthermore, cooperation with the Košice self-governing region will be necessary, especially in the area of planning and construction of state roads II. and III. classes. Finally, the cooperation of municipalities and cities with state authorities will be necessary, from the district authorities, in this case, five: Košice I, Košice II, Košice III, Košice IV and Košice - countryside, to individual ministries and central state administration bodies.

Another handicap will be the financial issue in the preparation of individual documents, where it will be necessary to create an association of future administrators and users of individual objects ensuring the development of the territory.

In Slovakia, the risks associated with the preparation and construction of infrastructure are often not taken into account when planning activities, resulting in insolvency. We are witnessing the forced administration of some municipalities as a result of investment preparations. One solution could be to ensure these activities.

4. Conclusions

By reviving the transport routes of horse-drawn carriages between the economically beneficial city and its hinterland formed by the surrounding villages, it will increase their mutual mobility and significantly start the development processes in this area.

This new approach to the use of centuries-proven transport routes, where there is no risk of floods or landslides, will make it possible to revitalize garden projects, ie living in a healthy ecological environment.

By re-using proven transport routes outside the built-up areas of towns and villages, it will significantly reduce the carbon footprint of road traffic in a particular region.
Through the analysis of the current state of knowledge and the analysis of existing knowledge, the concept of a new perspective on mobility solutions on the northwestern outskirts of the city of Košice and its surroundings was outlined. The presented proposal is only a starting point, which should serve as a basis for its discussion at various levels of self-government. After the subsequent completion of comments, this material could serve as a basis for the decision-making process in the field of development planning in the northwestern part of the city of Košice, as the northwestern part of the Košice district - the countryside on the slopes of Volovské vrchy. It can serve as a starting point for modelling reasonable villages in the form of Smart Village using the knowledge of Industri 4.0 technologies as well as 5G communication networks.

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References
[1] Statistical Office of the SR, Demography and social statistics (online database), [Online] 2021. Available at: http://statdat.statistics.sk/cognosext/.
[2] Government office of SR, „Program Statement of the Government of the Slovak Republic for the period 2020-2024,” 2020.
[3] Google maps service, [Online] Available at: https://www.google.com/maps/.
[4] Nižný Klátov, “History”, [Online] Available at: https://www.niznyklatov.sk/vyvoj-historia, 2020.
[5] NCCon, “Prognóza zaťaženia doplnenej cestnej siete Mikroregiónu Klatovy,” Praha, 2020.
[6] Vysoké Tatry, “City status of Vysoke Tatry,” [Online] Available at: https://www.vysoketatry.sk/, 2020 (in Slovak).
[7] J. Kasik, et al., “Plan of sustainable mobility of self-government region Kosice,” 2020.
[8] D. Banistera, Y. Berechmanb, “Transport investment and the promotion of economic growth,” Journal of Transport Geography, vol. 9, pp. 209-218, 2001.
[9] K. Maier, “Principy udržitelného rozvoje území,” Ústav územního rozvoja, Brno, 2010.
[10] P. Rietveld, and P. Nijkamp, „Transport and regional development.” Serie Research Memoranda; No.1992-50, Vrije Universiteit Amsterdam, 1992 (in Slovak).
[11] N. C. Berg, et al., “Transport policies and development,” Policy Research Working Papers, World bank group, 2015.
[12] L. Eliáš, “Analysis of the influence of selected factors on increasing the intensity of development of selected regions in the Slovak Republic,” PhD. thesis paper, Slovak University of technology in Bratislava, 2019.