TECHNOLOGICAL AND ECONOMIC DEVELOPMENT OF ECONOMY
Baltic Journal on Sustainability
2009
15(1): 60–77

COMBINING THE GRID-BASED SPATIAL PLANNING AND NETWORK-BASED TRANSPORT PLANNING

Beno Mesarec, Marjan Lep

University of Maribor, Faculty of Civil Engineering, Centre for Mobility Management, Smetanova 17, 2000 Maribor, Slovenia
E-mail: beno.mesarec@uni-mb.si; lep@uni-mb.si

Received 7 October 2008; accepted 23 January 2009

Abstract. Border regions of EU countries are confronted with changes of spatial and economical development. The lack of border crossing strategic information system for regional planning purposes reflects in non-intense cooperation in the field of regional development strategies harmonization. The article presents the methodology developed during Interreg III B project REDECON. Grid-based database with GIS interface, merging socio-economic, environmental and spatial data with vector-based network accessibility data, what enable the public planning departments to analyze and simulate different policy measures concerning transport. The article is focused on the modifications of (during project REDECON) developed methodology, which enable besides cross-border spatial analysis also analysis of current status of public transport demand and supply for finding the areas, where the supply of public transport services does not reach the demand for public transport services. It describes the methodology for selecting the main indicator thematic groups for different public transport demand types, the characterization (evaluation) of suitability of locations in respect to the balance between public transport supply and demand. At the end of the article the results of methodology application are presented on the regional pilot project concerning accessibility of pilot area, regional public transport demands and regional optimization of the public transport supply.

Keywords: public passenger transport, spatial planning.

Reference to this paper should be made as follows: Mesarec, B.; Lep, M. 2009. Combining the grid-based spatial planning and network-based transport planning, *Technological and Economic Development of Economy* 15(1): 60–77.

ISSN 1392-8619 print/ISSN 1822-3613 online
doi: 10.3846/1392-8619.2009.15.60-77
http://www.tede.vgtu.lt

1. Introduction

Public passenger transport in the Republic of Slovenia has been characterized by the fact that both supply and demand have been more or less steeply declining for the past 15 years. A vicious circle was created: the reduction in supply resulted in a reduction in demand, which, in turn, caused a reduction in supply.

The authors of the article participate in the REDECON project (INTERREG IIIB Program), where one of the main tasks was to define an effective methodology to develop and implement an innovative tool for supporting Public Authorities in developing efficient regional passenger transport system. Such a system has to survive and successfully operate on the market, and it is necessary for public transport companies to look for and implement new management models in their system (Susnienė and Jurkauskas 2008).

Besides quality requirements, efficiency is related to performance indicators, such as low operational cost to users, minimum number of vehicles and personnel but without a decrease in the quality of the service provided. And efficacy is related to the number of users of transport in relation to population, kilometres of routes provided in relation to area, as well as satisfaction level, all represent in a high quality service for the lowest fare as possible (Sampaio *et al.* 2008).

Similar performance and efficacy indicators were subject of the pilot project – increasing the number of public passenger users by reducing fares, increasing the frequency of services and intensive media campaign. In this way we showed that response to changes in quality or fares reduction of public transport supply is not non-elastic, as it is often believed.

The pilot project of public passenger transport, which focuses on a specific spatial problem – transportation, is one of the systems aimed to provide services to the inhabitants of a particular territory, which should be developed in accordance with the priorities stated for social and economic development of this territory and its main functions (Griškevičienė and Griškevičius 2004) – from the public interest point of view comprehended several activities presented in Fig. 1.

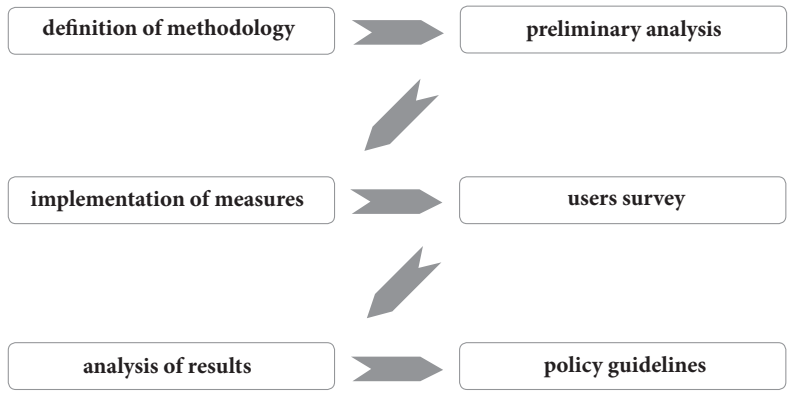

Fig. 1. Pilot project application activities

2. Definition of the methodology

Methodology of pilot project level application is based on (Lep *et al.* 2008):

a) definition of pilot project area (Prekmurje region – north-east of Slovenia);
b) territorial cell subdivision;
c) characterization of each cell according to a set of qualitative and quantitative territorial attributes;
d) directory of public passenger transport inbound and outbound attractors;
e) characterization of public passenger transport according to a set of qualitative and quantitative attributes.

And it will provide location oriented analyses which should render comparison of different locations in terms of variation of:

a) indicators (indicator homogeneity);
b) demand types (demand types homogeneity);
c) suitability (balance of demand and supply).

The methodology will comprise two different steps: a supply side (public passenger transport services offer) and a demand side (potential demand for public passenger transport services) analyses.

Public passenger transport is characterized by passenger transport potential related to the population to be transferred to or from defined area, by attractors which attract population into the area or out of it, by criteria of passenger behaviour and by actual public passenger transport supply.

Characterization of public passenger transport is done in a grid-based model including only those indicators that are different cell-wise (e.g. price of transport per kilometre is the same for all cells and therefore omitted).

For the needs of a pilot project the following set of indicators was considered (divided into 4 thematic groups):

A population and outbound attractors,
B inbound attractors,
C transport characterization,
D public transport characterization.

The demand is divided into 6 demand types which can be used for demand type homogeneity investigation.

Demand is differentiated according to the population category:

- population attending school (primary, secondary school, university),
- employees,
- others

and according to the preferred public passenger transport means:

- bus,
- train.

To assess suitability of demand and supply the comparable demand and supply categories should be compared. Since a breakdown demand is more detailed in respect to the supply, the one should be suitably aggregated (combination of detailed demand type into aggregated demand type) to obtain the same level.

The demand is combined of several indicators which are expressed in a variety of units. Therefore the level of demand needs to be properly normalized and translated into the number of passengers in order to have a valid comparison means with the supply (passenger seats).

Each demand type is calculated as a maximum of:

- outbound traffic (departures),
- inbound traffic (arrivals).

For each cell a demand of departing passengers as well as a demand of arriving passengers are calculated. The maximum of the 2 represents the actual demand type level of the cell – irrespective of the occupancy at the station of observation.

The level of supply is expressed straightforwardly in a number of seats. For each cell or area all buses and trains that arrive/depart to/from the area of investigation in the period of one day are considered, irrespectively of a bus or train.

Assessment of demand and supply balance should be not bound to the amount of traffic in a cell. A small extent of public passenger transport (small traffic) in a cell should equally be assessed in terms of demand and supply balance as well as the one of bigger extent (big traffic). Suitability is expressed as a difference between supply and demand and normalized to the number of migrating people in a cell.

Demand is calculated as the bigger value of demand of outbound traffic (1) and inbound traffic (2), respectively. Different thematic groups of indicators are used to build demand types of:

- outbound traffic:

$$D_{out} = F_{11} \cdot A + F_{12} \cdot C + F_{13} \cdot D\,, \tag{1}$$

- inbound traffic:

$$D_{in} = F_{21} \cdot B + F_{22} \cdot C + F_{23} \cdot D\,, \tag{2}$$

where:

A, B, C, D – thematic groups of indicators,

F_{11}, ..., F_{23} – weights of indicators.

The values of weights of thematic groups of indicators for both outbound and inbound traffic are the same, since similar impact can be expected on the passenger migrations of the potential, on the one hand, and of the attractors, on the other. The sum of all weights values within each thematic group equals 100. The same applies to the weights of the thematic groups for each demand type ($F_{11} + F_{12} + F_{13} = 100$; $F_{21} + F_{22} + F_{23} = 100$).

Demand type weights – thematic groups

No.	Demand type	Outbound			Inbound		
		F_{11}	F_{12}	F_{13}	F_{21}	F_{22}	F_{23}
1	PSB: school attendees – bus	80	8	12	80	8	12
2	PSB: school attendees – train	80	8	12	80	8	12
3	PSB: employees – bus	50	25	25	50	25	25
4	PSB: employees – train	50	25	25	50	25	25
5	POB: others – bus	35	20	45	35	20	45
6	POT: others – train	35	20	45	35	20	45

3. Preliminary analysis

In order to get state of the art of the public passenger transport in Prekmurje region, two types of analysis (Lep *et al.* 2008) were done:

a) analysis of REDECON public passenger transport indicators,

b) qualitative analysis of the public passenger transport status.

3.1. Analysis of REDECON public passenger transport indicators

The database for Public passenger transport pilot project has been designed to include 49 different indicators. However, the presented ones are only a few most typical (A10, A21, B12, D11), having a big influence on the overall public passenger transport quality profile.

Fig. 2 gives a clear overview of the disposal of working (active) persons in the region (indicator A10). It is clearly noticeable that the south-western part of the region represents the biggest potential for public passenger transport of active persons.

The Fig. 3 shows the disposal of enterprises in the region (indicator A21). The majority of them are located in the south of the region – the city of Murska Sobota with surroundings. Again, it is clearly noticeable that the biggest potential for public passenger transport lies in the south-western part.

In Fig. 4, it is possible to see clearly the areas to which the most of daily travels of school attendees are directed (indicator B12). The need for data to be acquired on a lower as the municipality level is visible too. It is obvious that for the purpose of achieving better and more detailed results, data should be acquired on the level of settlements.

Fig. 5 shows that the southern part of the region, on the average, has lower bus connection frequency per populated cell compared to the northern part of the region (indicator D11). It is also noticeable that in the northern part of the region there are bus stops in almost all populated areas, while in the southern part there is a considerable number of cells without bus stops in the cell or in the neighbouring cells.

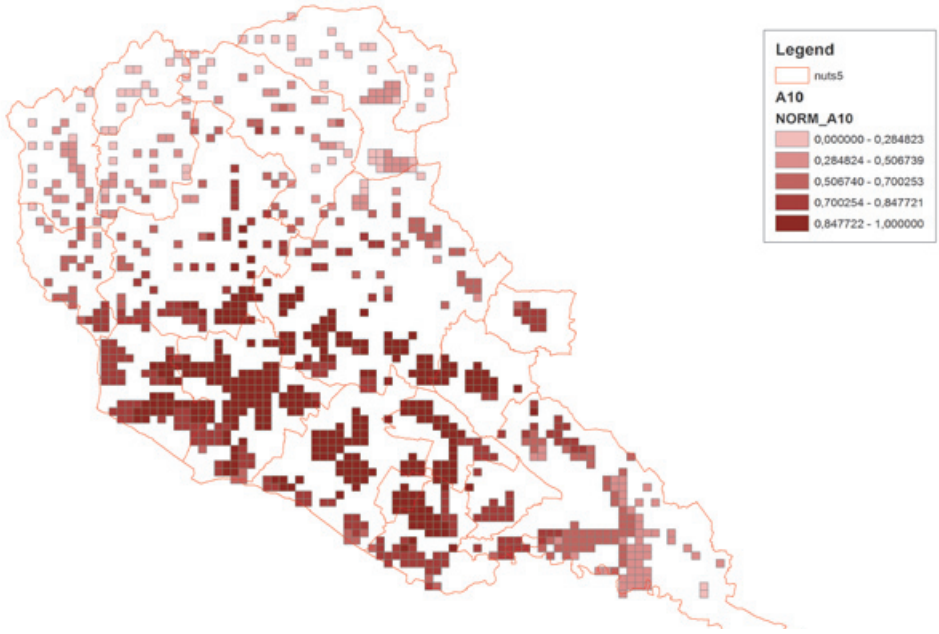

Fig. 2. Indicator A10 – number of (working) active persons within 30 min by road

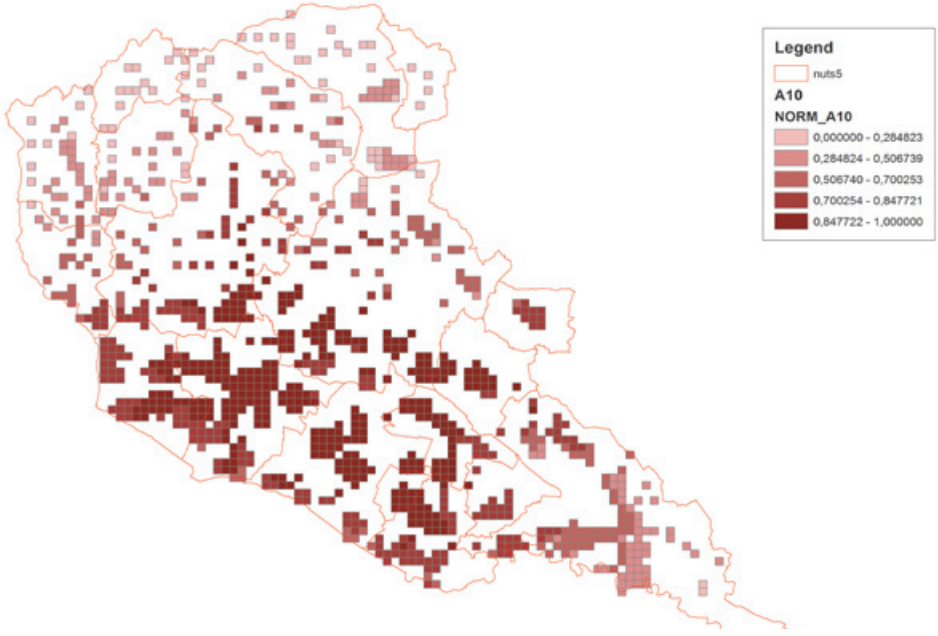

Fig. 3. Indicator A21 – number of enterprises within 30 min by road

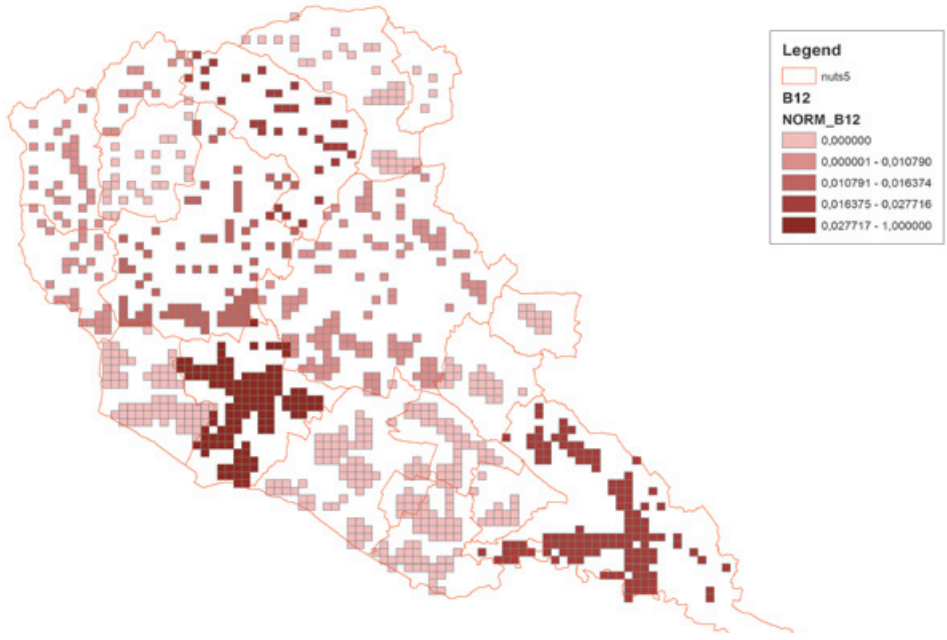

Fig. 4. Indicator B12 – number of school attendees migrating to a cell

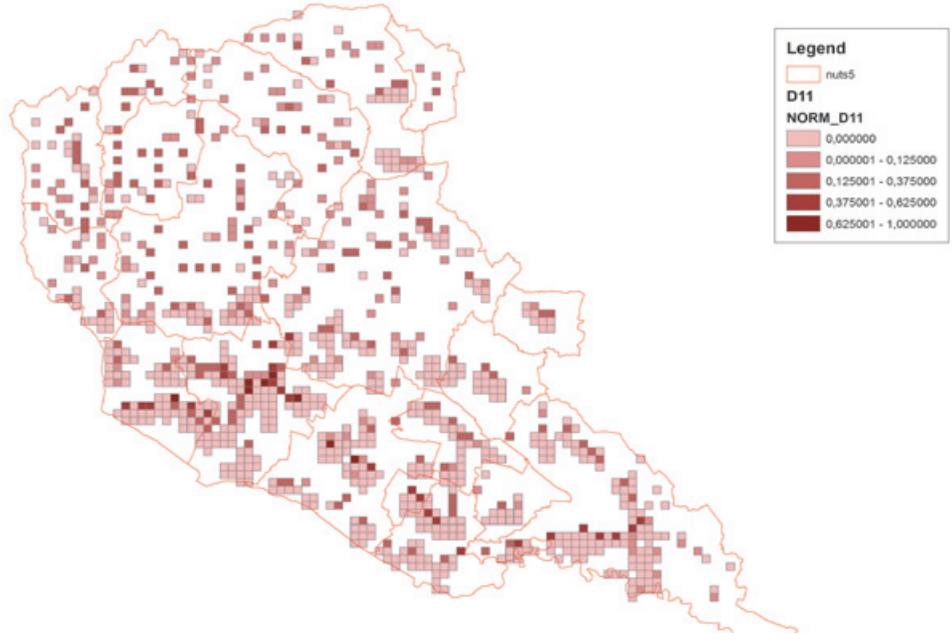

Fig. 5. Indicator D11 – frequency of bus connections

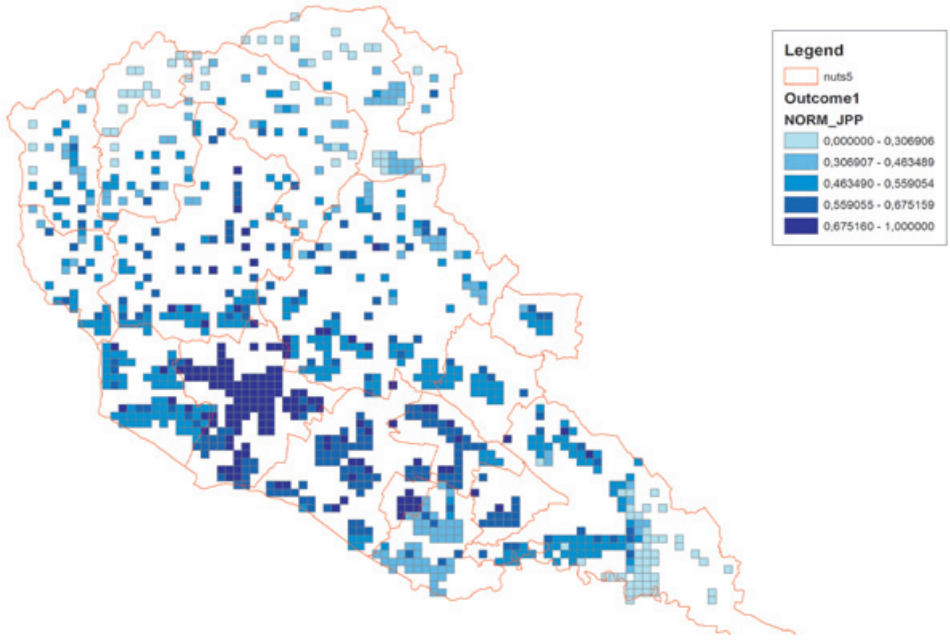

Fig. 6. Public passenger transport quality profile

Fig. 6 shows the general public passenger transport quality profile (combination of 11 indicators). It is clearly shown that the majority of locations with the worst public passenger transport quality profile lies in the north and east of the Prekmurje region, while the city of Murska Sobota has the best quality profile. The quality of locations from the public passenger transport point of view is falling rapidly with the distance from Murska Sobota.

3.2. Qualitative analysis of the public passenger transport status

According to theoretical considerations, major factors could be divided into the following groups (Griškevičienė and Griškevičius 2003):

- the factors related to spatial planning and residential areas,
- macro-economic and social factors,
- factors related to purposes of travel and means of transportation,
- factors associated with purchasing power of passengers.

Current public passenger transport offer (Plevnik and Lep 2004). Concerning cross-border public passenger transport connections, it was established that the only public passenger transport concessionaire in the region does not offer any cross-border public passenger transport bus lines, while Slovenian railroads are offering only 3 international connections in direction of Hungary per day. Consequently, it can be concluded that the Prekmurje region does not have an adequate cross-border public passenger transport offer (Lep *et al.* 2008).

Interregional public passenger transport offer consists of 5 daily round-trip train connections provided by Slovenian Railways. On Sunday afternoon (but not during the summer break), there is also a bus connection with Ljubljana.

Beside 5 connections along the railway line (Hodoš–Murska Sobota and Murska Sobota–Ljutomer); the regional PT supply is done by regional busses.

Lines that connect different settlements with a regional centre Murska Sobota or with other commuter centres were divided into 9 groups. A group of lines is defined as a closed link of a range of municipalities with a commuter centre.

Public transport accessibility situation. Walking is the most usual method for accessing public transportation. The access distance is usually considered about 500 m for local buses (the passengers, normally and safely, covers this route in 5 minutes and the disabled people in wheel chairs and the old need two times more than the above-mentioned time) (Ziari *et al.* 2007). For assessing the public transport accessibility situation in Prekmurje region it was taken a bigger access distance – 1 km (Gabrovec and Bole 2006). Below there is space and time coverage using public passenger transport in the Prekmurje region:

- 90% of inhabitants have less than 1 km in radius to a public passenger transport stop,
- 70% of all inhabitants in settlements with more than 500 inhabitants have stops in the radius of 1 km and runs of a satisfactory frequency. A satisfactory offer frequency is 1 hour in the peak and 3 hours outside the peak (Fig. 7).

Public transport demand and utilization rate. In the region of Pomurje, suburban and inter-urban bus runs represent 8.5% of the total Slovene offer; 7.7% of the complete Slovene income is realized with the sale of tickets. Only 0.9% of the income in the studied region is covered from the so-called third sources (mainly contributions from local communities and industry), while the Slovene average is 6.4%. The portion of income realized with the sale of tickets is 83.4% in Pomurje (72.2% in Slovenia) (Gabrovec 2007).

Fig. 7. Schematic view of regional bus lines

Costs calculations and payment flows in public transport. Slovenian railways represent a state company which realizes losses in passenger transport. The studied region has no influence on this situation (either with respect to costs or incomes).

Urban transport is in the phase of introduction (for one year) and real financial streams are not yet available.

The state has a limited maximum sum of compensation in contracts on financing concessionary lines if the income from the sale of tickets and from other financing sources does not cover standard costs. The maximum compensation varies and amount approximately to 0.30 ct per vehicle-kilometre. Fig. 8 shows detailed cost division in regional public transport system

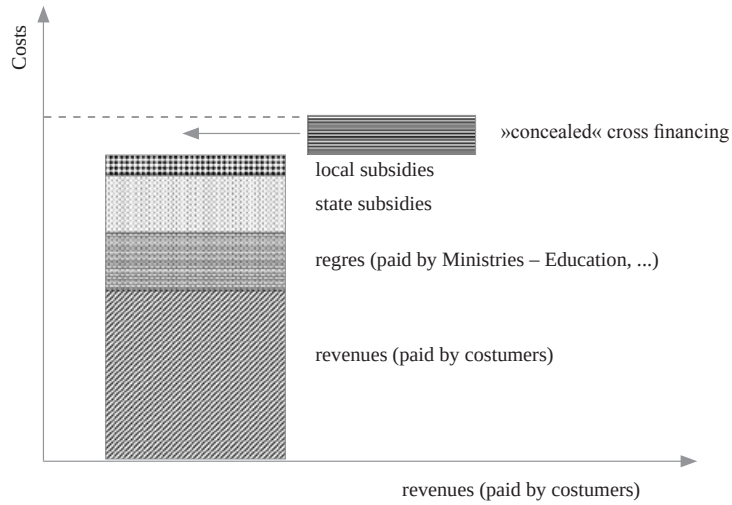

Fig. 8. The scheme of cost division

4. Implementation of measures to enhance the attractiveness of public transport

During the pilot project (12 11 2007 – 31 1 2008) in 3 public passenger lines in smaller testing area were introduced additional round-trips during the working days and Saturdays on a contractual basis between the Ministry of Transport of Republic of Slovenia and the licensed local public passenger transport provider. The aim was testing 3 different approaches combined with improvement of frequency (Lep *et al.* 2008):

- Prolongation of line – avoiding changing of bus.
- Rerouting of line – originally the majority of buses in testing area went on the main road, which is to far away from settlements to be useful for local inhabitants. During the pilot project some buses were rerouted to the road which is going through the settlements.
- Introduction of a new line. The existing bus line which connects settlement of Bakovci with Murska Sobota was extended to the settlement Dokležovje which was before unconnected with the city of Murska Sobota with a direct line.

During the pilot project period approximately 3500 bus trips were done together.

Besides the improvement of frequency on the bus lines, there were taken other measures in order to encourage the use of public passenger transport system.

The municipality of Murska Sobota covered 50% of the ticket price for the users on the dealt lines.

The pilot project was accompanied by media campaign in order to inform users about the improvement. In the framework of media campaign there were:

- paid commercials on local radio stations,
- notices and articles in local newspapers,
- notices on the internet pages,
- each household in the area got the leaflet with the new exact public passenger transport timetable including information about all new connections and reduced prices.

5. Analysis of results

Analysis of results was done in 2 steps (Lep *et al.* 2008):

a) quantitative analysis and

b) qualitative analysis (users survey).

5.1a. Quantitative analysis

Good user responses were anticipated after implementing measures. The number of trips made by passengers by bus lines can be seen from the Fig. 9. The studied period falls within Christmas holidays, which is reflected in a number of transported passengers in December.

5.1b. Qualitative analysis (users survey)

In order to understand true effects of the improved public passenger transport, not only the number of passengers but also their structure and motives for using the public passenger transport should be considered. To get an insight into this information, a survey was conducted among passengers on the studied lines (450 questionnaires).

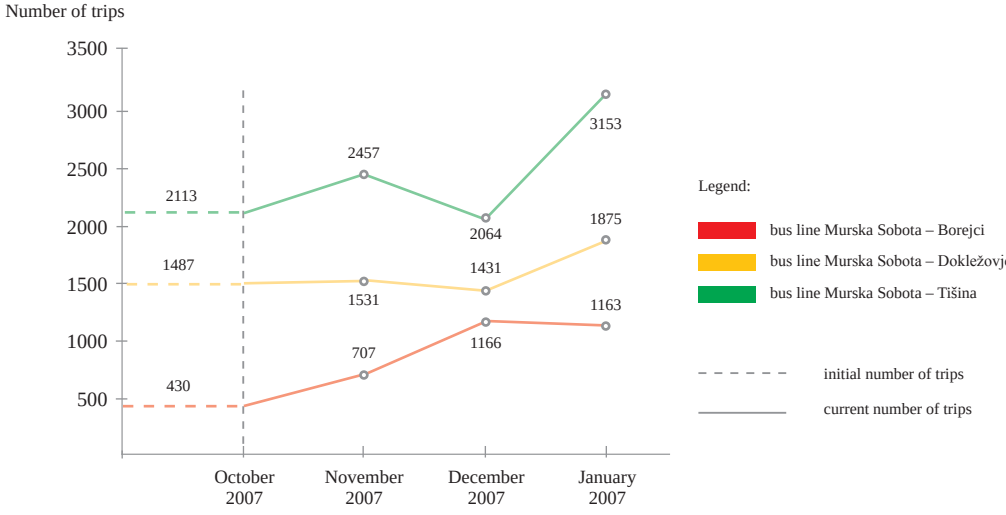

Fig. 9. User responses to improved supply

The results of the survey show that more than a half of questioned users use public transport on the regular basis (Fig. 10).

Fig. 11 shows that more than a half of public transport users undertake trips with the purpose of going to school. Surprisingly, only 6% of them use public transport for going to work. This indicates that further activities should be focused more on active population.

Passengers of new lines were asked how they would undertake these journeys before as there were no bus at this hour before the start of the pilot project. The answers show that almost two thirds of passengers would have chosen a bus at some other time (Fig. 12). These are passengers who do not have much possibility to select some other type of transport. The extremely high percentage confirms the need for improving the existing passenger transport system.

Three quarters of informants answered negatively to the question whether the reduced ticket price influenced their decision to take the bus (Fig. 13).

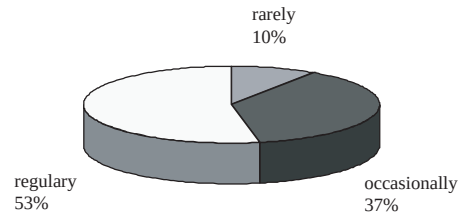

Fig. 10. Frequency of usage of public passenger transport system

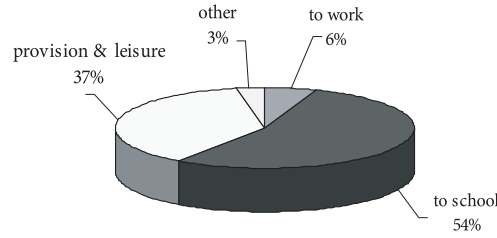

Fig. 11. Purpose of journeys

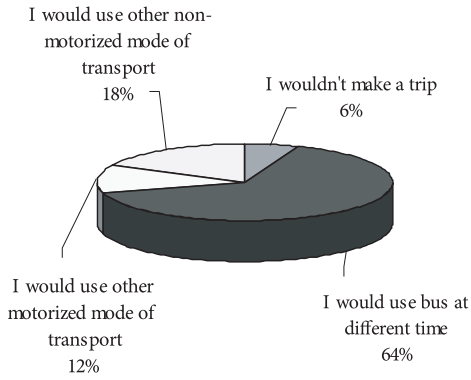

Fig. 12. Currently used alternatives of transport

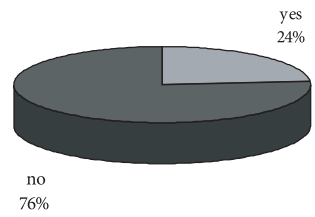

Fig. 13. The influence of trip price on the selection of transportation means

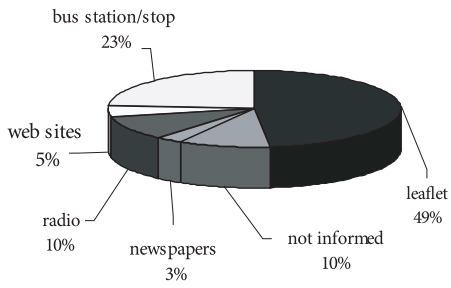

Fig. 14. Percentage of informed and uninformed users

It can be again concluded that these are passengers who cannot choose another transport means, so the price is a less important item for them, when deciding which type of transport to use.

With respect to the question on whether they were informed about the improved offer and about the reduction of ticket prices, half of the users answered that they got the information from the leaflet brought to their homes, and a quarter – at the bus station or stops (Fig. 14). One tenth of users only was uninformed, which shows that the media campaign was successful.

The analysis of the questionnaire showed that for students the price is a decisive factor for selecting transport means; students are followed by the retired persons. This shows that lower prices would attract these 2 population groups, while the employed would need additional measures to decide for public passenger transport.

6. Development of measures to enhance the attractiveness of public transport

An indispensable condition of improving the attractiveness of public transport is introduction of changes in the organization and structure of transport, as well as improving financing rules (Niewczas *et al.* 2008).

Based on the results of pilot project, it is possible to suggest some improvements to enhance the attractiveness of public transport (Lep *et al.* 2008):

a) regional optimization of the public transport supply;
b) definition of a regional minimum standard in public transport and calculation of costs for achieving the minimum standard in the whole studied area;
c) definition of measures for organizing public transport;
d) information technologies in public transport – the aim of information technologies is reducing the travel times, monitoring and managing traffic flows, ensuring safety and security as well as speeding up journeys, improving quality of public transport services, planning a multimodal journey, saving time and costs, reducing congestion, providing passengers with real-time traffic information, alternative routes etc. (Jakubauskas 2006);
e) costs calculations for developing an optimized public transport offer;
f) measures for efficient use of subsidies in public transport;
g) unified transport ticket systems.

Below are stated the proposals for some of the listed measures.

6.1. Regional optimization of the public transport supply

Public transport supply in the region does not satisfy the intended social goals. These are especially the assurance of a certain scope of mobility and of access to functions by persons who cannot reach destinations as drivers in their personal cars. Another social goal is to make public passenger transport, partly at least, competitive to personal transport. This would increase the portion of journeys made by more acceptable means, such as public passenger transport. In the past, the optimization was achieved – considering buses at least – by using the entrepreneurial principle of transportation. The optimum between production costs and income, including subsidies, was searched for, which is legitimate and logical from the operator's perspective. Such a situation, however, cannot represent a social optimum. Considering external costs of personal transport and indirect social affects, public funds could be invested in a more efficient way.

It is known that the scope of public transport supply in the Republic of Slovenia is relatively low (Griškevičienė, Griškevičius 2003). It is also known that the response of passengers to the increased transport supply is relatively inelastic. The increased supply does not attract new passengers; only season ticket holders make a few additional journeys (this fact is shown with Line 1 in Fig. 15). State subsidies depend on a bus-kilometre travelled, yet the amount of subsidies is limited and covers approximately 15% of costs (this fact is shown with Line 2 in Fig. 15). Operators optimize their supply by avoiding engagements of new drivers when working legislation and the road traffic law allow it. This practically means that they suppress night runs as well as Saturday and Sunday runs. They also transfer buses to make special and contractual runs, which is more profitable (the fact that operators optimize their costs by avoiding purchase of new buses or employing new drivers is shown with line 3 in Fig. 15). In the Slovene system, operators tend to offer the supply which is shown as point "4" in Fig. 15. Owing to lower amounts of public subsidies awarded to public passenger transport, the state, too, is not worried by the suppression of lines by transporting companies.

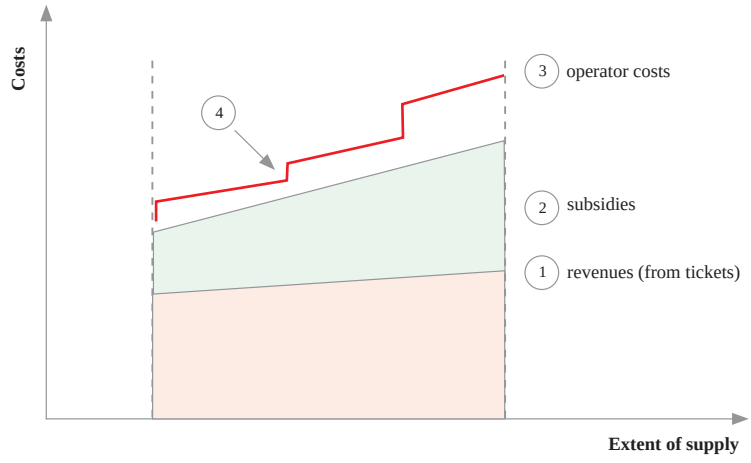

Fig. 15. Operator's cost optimization and social optimum

In preparing short-term optimization methods we shall proceed from the limitation that no changes can be expected in railway transport supply. This refers both to the speed of railway transport as well as to the amount of supply on the existing network. On the other hand, no changes in the valid legislation can be expected in road (that is bus) public passenger transport, as well as no important increase of public funds to subsidy transport services or tickets. This means that in the short term we can practically only change itineraries and departure times of regional bus lines and adjust local public passenger transport (urban public passenger transport in the municipality of Murska Sobota) with the suburban one.

The short-term development concept of the public passenger transport network system: Owing to low and uncompetitive supply of rail transport, no "feeder" system is encouraged on the regional level (shown as Concept "1" in Fig. 16), but direct, radial transport from regional centres is offered (shown as Concept "2" in Fig. 16). Joining radial transport into transit transport is supported because there is demand for it and because schedules (technique) allow it (shown as Concept "3" in Fig. 16).

Public passenger transport must function as a municipality system, which means that it must be available – in a certain amount – throughout the day and not only in peak hours when demand exits. Certain mobility must be also assured on Saturdays and Sundays.

Inter-regional and long-distance transport has been introduced on long-distance (direct) bus lines to Maribor and Ljubljana, using the principle of public passenger transport and not the principle of special line transport.

Medium- and long-term optimization is oriented towards such a supply system which would integrate fares, physical possibilities and logic. The second development pillar (after 10 years) should greatly increase the quality of rail transport because the first results of investments into railway infrastructure are then expected. The third (medium-term) pillar concentrates on the increase of road (bus) public passenger transport which should present a serious competition to personal transport, at least to transport for special purposes, as well as to tourist and free-time journeys.

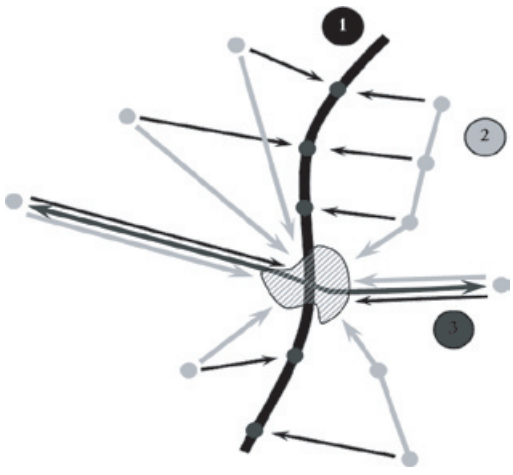

Fig. 16. System concepts

6.2. Definition of measures for the organization of public transport

The above analysis of the existing public passenger transport supply does not (!) show another phenomenon present in Slovenia in the studied regions. Public passenger transport is mostly performed as the so-called "special" transport. It especially comprises journeys of primary school children to school, and it should be covered by municipalities according to the law. Municipalities pay considerably high tariffs for this transport which may represent up to 10% of a municipality budget. Special line transports are contracted on

the basis of placing orders, and the job is often (but not always) contracted with a concessionaire providing regular public passenger line transport. We thus have a situation where 2 order placers and financial supporters run 2 parallel systems. But most of the runs are performed by the same operator and often along the same itineraries. Therefore, an organizational measure is necessary, namely "the integration of special and public line transport". This measure can be applied immediately, so it is a short-term measure.

Within medium-term and long-term measures, regional organizations are meant to organize public passenger transport or, even broadly, to "manage mobility". Although such a measure is entered into Slovene program documents, a pre-requisite for its successful implementation is (probably) the establishment of countries; this, however, depends on vast changes in legislation and public administration systems. This measure was therefore classified as a medium-term measure.

6.3. Costs calculations for development of an optimized public transport offer

In the region, calculations for short-term and medium-term measures in bus public passenger transport have been prepared. The calculations consider three basic elements:

a) fare system,

b) supply,

c) rolling stock quality.

It is known that in the bus fare system the majority of elements are twice as expensive as in the railway one. A short-term measure, according to which bus transport fares would be equalized with railway fares, would theoretically mean a revenue loss of 50%, but in reality this loss would be somewhat lower. The revenue loss should be covered by public expenses. On the level of state, such a correction of fares would mean additional 20 million EUR per year. In the studied area, which represents approximately 8% of the Slovene market, additional funds needed to implement fare correction measures would amount to approximately 1.5 million EUR. Negotiations about this fare reform are under way. The main aim of this project is to show the response to changed fares and the possibility of transferring acquired experience to a vaster area.

The increase of the supply would mean the increase of costs, but not a linear increase (!). On the one hand, the increased supply lowers (theoretically at least) costs per a unit product. On the other hand, production has already been optimized with a definite number of drivers and a fixed number of buses. Both affects should be "equalized". The increased supply standard, as planned, would mean additional 2.0 million kilometres per year, which will result in an additional sum of 3.0 million EUR per year.

The third element is rolling stock. The fleet has aged steadily in the last years in the Republic of Slovenia. To increase safety and comfort of passengers and to satisfy environmental demands, the rolling stock would need to be renewed faster in future to obtain an average age of vehicles between 8 and 10 years at least and to put vehicles with engines EURO 0, 1 and 2 out of stock. To implement the planned public passenger transport supply in the studied area, approximately 100 buses will be needed; as far as renewal of renewal of the fleet is considered, 20 new vehicles will have to be purchased at least in the next 3 years.

According to new legislation, concessions will be awarded on the basis of order placements. From these the response of operators could be observed. As to their calculations and the price of supply, they are not known at present.

7. Conclusions

New developed REDECON methodology and its pilot application enables the analysis of a current situation of regional public transport systems what was shown on the case of pilot project in Prekmurje region.

The use of REDECON methodology also showed that it represents adequate tool for:

a) identification of locations, where public passenger transport supply is not in balance with (theoretical) demand potentials,

b) testing of taken measures for improvement of public passenger transport system in regional point of view.

The public passenger transport supply in dealt area, which was chosen on the basis of results of the REDECON methodology, significantly arises. In this way we proved that response to changes in quality or fares reduction of public transport supply is elastic.

References

Gabrovec, M.; Bole, D. 2006. Dostopnost do avtobusnih postajališč [Accessibility to bus stops], *Geografski vestnik* 78(2): 39–51.

Gabrovec, M. 2007. *Migracije na delo in šolanje* [Migrations to the work and to the school]. Vmesno poročilo, Ljubljana.

Griškevičienė, D.; Griškevičius, A. 2003. Social and economic analysis of the demand for public transport in Vilnius, *Transport* 18(4): 182–188.

Griškevičienė, D.; Griškevičius, A. 2004. The influence of territory planning and social development on strategic decisions in passenger transport development, *Transport* 19(5): 224–229.

Jakubauskas, G. 2006. Improvement of urban passenger transport ticketing systems by deploying intelligent transport systems, *Transport* 21(4): 252–259.

Lep, M.; Mesarec, B.; Kranjec, P. 2008. *REDECON – Deliverable 11*. Results of pilot project on public passenger transport.

Niewczas, A.; Koszalka, G.; Wrona, J.; Pieniak, D. 2008. Chosen aspects of municipal transport operation on the example of the city of Lublin, *Transport* 23(1): 88–90.

Plevnik, A.; Lep, M. 2004. Organisation of public transport in Slovenia, in *Proceeding of the 9th International Scientific Conference MOBILITA '04*, Bratislava: Slovak University of Technology, 141–145.

Sampaio, B. R.; Neto, O. L.; Sampaio, Y. 2008. Efficiency analysis of public transport systems: lessons for institutional planning, *Transportation Research*, Part A 42, 445–454.

Susnienė, D.; Jurkauskas, A. 2008. Stakeholder approach in the management of public transport companies, *Transport* 23(3): 214–220.

Ziari, H.; Keymanesh, M. R.; Khabiri, M. M. 2007. Locating stations of public transportation vehicles for improving transit accessibility, *Transport* 22(2): 99–104.

INTEGRUOTAS ERDVINIS TERITORIJŲ IR VIEŠOJO TRANSPORTO PLANAVIMAS – REDECON METODIKA

B. Mesarec, M. Lep

Santrauka

Aprašoma Redecon metodika, sukurta vykdant tarptautinio projekto Interreg III B metu. Tinklelinė duomenų bazė, paremta geografinėmis informacinėmis sistemomis, suvienijo socialinius ir ekonominius, aplinkosaugos, erdvinius ir vektorinius pasiekiamumo duomenis. Visa tai leido viešojo transporto planuotojams lengviau analizuoti ir modeliuoti transportą skirtingomis priemonėmis. Straipsnyje aprašomoji sukurtos metodikos modifikacija, padedanti nagrinėti transporto sistemos paklausą, parodo, kuriose teritorijose viešojo transporto aprūpinimas nepakankamas ir pan. Pabaigoje svarstoma, kokiam regionui galima pritaikyti šią metodiką, to regiono viešojo transporto paklausą ir optimizavimą.

Reikšminiai žodžiai: viešasis transportas, teritorijų planavimas, geografinės informacinės sistemos.

Beno MESAREC. BSc. Assistant in Transportation Planning and Transportation Informatics at the University of Maribor, Faculty of Civil Engineering. His major research interests: mobility management and sustainable transportation planning, transport modelling.

Marjan LEP. PhD. Assistant Professor in Transportation Planning and Transportation Informatics at the University of Maribor, Faculty of Civil Engineering. Currently the Head of graduated Study Programme in Transportation Engineering at the same Faculty and the Head of the Chair for Transportation Techniques and Traffic Safety. His major research interests: mobility management and sustainable transportation planning.