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Aušrinė GRIŠKEVIČIŪTĖ-GEČIENĖ

MODEL FOR THE JUSTIFICATION OF LITHUANIAN URBAN TRANSPORT SYSTEMS INFRASTRUCTURE DEVELOPMENT

SUMMARY OF DOCTORAL DISSERTATION

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Introduction

The Investigated Problem. Urban development is a complex and multi-functional process influenced by various external factors: social – economic, demographic, environmental, planning, technical, management and others. The impact of the above factors is methodologically defined by the three main aspects: social, economic and environmental. The relationship between these aspects provides the background for a sustainable urban development. Being the main participants of the planning process, urban self-government institutions should define the requirements for the territorial planning process so as to ensure the application of these principles both in planning and implementing the urban transport infrastructure.

Development of transport infrastructure increases the prestige of a city and of the whole country, and has direct impact on the implementation of urban development and transport policy. According to the experience gained during the recent decades, the increasing automobilization level in Lithuania changed the nature of use of urban territories and urban structure, determined the development of an agglomeration process and revealed new problems. At the same time the rates of automobilization determined changes in the transport system which resulted in the gap between the static parts of the infrastructure and changing transport connections/increasing transport flows. Insufficient funding of technical transport infrastructure development has also affected the above situation.

Topicality of the Problem. The main reason why it was decided to address this topic was that so far the territorial planning process and funding of urban economy systems lack prepared theoretic principles and methods how to justify the development of separate urban transport infrastructure objects, how to select priority objects, what assessment methods use. Justification of transport infrastructure development is a complex and multi-stage process, therefore not all of assessment methods could be applied for the urban transport systems infrastructure. The assessment of urban transport systems infrastructure development should be based on the comparison and assessment of factors affecting the sustainable development.

Object of the Research. The object of the Research is defined as a framework for justification and assessment of urban transport systems infrastructure development, including: establishment of justification principles and assessment system; analysis of preparation and adaptation of the theoretical justification methodology (following the example of Lithuanian cities). In Object of Research is detailed with these issues: identification of urban and rural

transport systems infrastructure objects; analysis of urban transport infrastructure development project cycle; analysis of justification process of urban and rural transport systems infrastructure development by defining the assessment framework and operating principles.

Aim and Tasks of the Work. The main aim is to develop a theoretical model for the justification of urban transport systems infrastructure development by adapting the model for identification of priorities and practical execution of construction and reconstruction projects. The following tasks have been set for implementation of the objective of the Research:

1. To analyse the objects of the role of current urban transport infrastructure in the sustainable urban development, and to define the trends for the development of transport systems infrastructure in Lithuania and foreign countries.
2. To analyse the principles for the justification of transport infrastructure development projects. To carry out the analysis of the assessment methods applied during the process of the justification of transport systems infrastructure development by defining the key aspects and criteria.
3. To develop a theoretical justification model by defining social – economic and other characteristic assessment aspects and criteria.
4. To test practical performance of the developed model through the assessment of the selected and implemented urban transport systems infrastructure development projects in Lithuania.

Methodology of the Research. A theoretical model for justification of Lithuanian urban transport systems infrastructure development projects was prepared according to the analysis of the latest scientific literature from scientific databases. In this way analysis of justification principles of the development projects and the assessment methodologies applied was carried out. Proposed justification model was developed applying the method of the expert assessment, statistical data processing/analysis and the method of multi-criteria analysis.

Scientific Novelty. This work can be distinguished from other works of the above field by the following elements of novelty:

1. Assessment methods of investment projects of urbanised and non-urbanised territories transport systems infrastructure development are analysed. Assessment aspects are systemized and criteria applied for the assessment of urban transport systems infrastructure development are identified.
2. Developed theoretical model is applied for the justification of urban transport systems infrastructure development and for formation of priority sequence of development projects. Integrated assessment indicators of develop-

ment projects are compared with each other in order to form the priority sequence. Specific weight multipliers of criteria identified for the development of urban transport systems infrastructure are used in calculation of integrated assessment indicators.

Practical Value of the Research. The activities included: the research on the development of urban transport systems infrastructure and surveys of project executors working in public institutions and in the private sector and implementing transport infrastructure development projects (including project promoters, assessors and experts). The Research has revealed that during the process of justification decision-makers follow methodological recommendations for the development of automobile roads in non-urbanised territories investment projects. In view of this and due to the lack of relevant methodology, urban transport systems infrastructure development projects are not detailed and do not reflect the principles of the sustainable urban development.

Developed model helps to form priority sequence of project implementation and define the relevance of the investment to urban transport infrastructure. The model can be adapted for all types of Lithuanian urban territories.

Defended Statements

Three defended statements were developed by the author:

1. Methodology comprising traffic safety, economic, social, strategic, technical, environmental and land use aspects is created, referring to which urban transport systems infrastructure development is justified and assessed.
2. Due to differences in technical infrastructure the justification of transport systems infrastructure development of urbanised territories has to be separated from assessment methods of development projects of non-urbanised territories.
3. Implementation of multi-criteria analysis methods enables to develop a theoretical model of the justification of urban transport systems infrastructure development which allows performing appropriate selection of alternative projects.

Structure of the Dissertation. The Research consists of the general characteristics of the dissertation, 4 chapters, conclusions, references, the list of the publications and the addenda. The total scope of the dissertation is 154 pages, including 21 figures, 34 tables and 6 appendixes.

1. Development trends for modern urban and rural transport infrastructure

The scientific literature provides various factors qualifying urban and rural transport systems. Their analysis revealed that similarities and differences of the above systems determining the need for infrastructure development are: technical infrastructure, transportation needs and opportunities, transport means and operations; communication territory and space, transport administration and management. This determines the division of infrastructure objects of the Lithuanian urban transport system into separate but correlating groups, and facilitates problem identification in urban transport sub-systems.

Pursuant to the scientific literature, relevance of urban development problems has increased due to the global integration process. According to the current practice of implementation of transport infrastructure development projects, despite obvious differences in urban and rural transport infrastructure objects, methodologies justifying and assessing development of rural transport infrastructure are applied (since there is no other way out) for justification of the development of Lithuanian urban transport infrastructure. The obtained data is not precise: the objectives of the sustainable urban development are usually not achieved due to the lack of information and under-assessment of relevant documentation. In order to improve the assessment of the effectiveness of project implementation process, first of all it is necessary to define the concept of urban and rural transport systems and their infrastructure, and define the key characteristics affecting final project results and implementation of the sustainable development objectives.

2. Justification systems for the implementation of urban transport infrastructure development projects and assessment methodology

Lack of funds and multiple problems in all the sub-systems of the urban transport system determined the principle for the establishment of priority development objects. Selection of the alternative investment projects highlighting the need to develop separate objects, and efficient implementation of the procedures are one of the main issues addressed by the national decision-makers.

Both, the EU Member States and other countries seek to develop strategic urban planning methods and methodologies promoting sustainable development of urban transport. The analysis of best practice examples and scientific literature on justification of transport development revealed the following general features:

- the process of justification of separate projects is the same for all level projects and consists of main stages of project cycle;
- the process of territorial planning is not distinguished;
- variety of methods for selecting the alternative projects for further implementation process;
- assessment methods applied for the investment projects are mainly enhanced in the sphere of road and railway transport; meanwhile the scope of the methods for the assessment of other transport modes projects is limited. Taking into account the main presumptions and author's practical experience in preparing the investment projects, the author will further refer only to the methodologies assessing land road transport sector projects.

In all the cases social – economic assessment is used for justification of transport investment. There are also some uncertainties in the social – economic assessment. Frequently, during project implementation, the numeric value of relevant impacts is simply unknown. EU Member States try to apply common assessment methodologies for the investment projects submitted for the EU financial support. For implementation of transport infrastructure development projects it is necessary to implement the Planning phase and prepare project justifications. Following the results of theoretical research, the main problems of the planning process could be defined: not all the urban transport systems infrastructure objects are related to the decisions embedded in the territorial planning documents; specific impacts affecting the development of urbanised transport systems (cities, settlements and villages) are not identified; there is no common system for justification of transport systems infrastructure development in urbanised territories, and for project assessment; organization of common transport infrastructure development in the urbanised territories is not regulated by common legal acts.

3. Development of the model for the justification of Lithuanian urban transport infrastructure development

Taking into account the current system of implementation of transport systems infrastructure development projects, the most challenging implementation phase under the current economic conditions is Project Funding. Due to the lack of own funds and in pursuit of support of the financial institutions, one of the main issues to be addressed by the decision-makers is the selection of most appropriate development projects. In order to ensure effective selection of the priority projects, it is necessary to develop a justification model providing for a detailed description of the need for project implementation. In view of this the following analytical research was pursued during the period 2008–2012.

The analytical research executed during the period of 2008–2012 was related to the Lithuanian urban and rural road transport systems infrastructure investment projects financed from the EU funds of 2000–2006 and 2007–2013 programming periods. The main objective of the above research was to define the applied methodology in preparing the investment projects, including: the structure of projects, initial information, detailed justification procedure, assessment methodology, methods for calculation of the assessment criteria and indicators. The research sample included 26 projects implemented in the cities, settlements and rural areas and (for comparison) 2 rural automobile road investment projects; 10 projects were prepared by the author.

The following statements have been made after analysing the selected projects:

- Development of urban transport systems infrastructure is analysed both in the feasibility studies and in the investment projects.
- Justification based on Economic, Social and Strategic aspects prevails in justifying the need for selected projects (less based on the Environmental aspect).
- CBA method is used for the Economic justification of implementation of all (without any exemptions) urban and rural road transport systems infrastructure development projects.

According to the integrated data of the analysis on social impact indicators in the selected projects, the most challenging was identification of social and environmental impacts. Due to the absence of a relevant assessment system, identification of these impacts is incomplete and lacks the assessment of all possible factors. Moreover, there is no specific qualitative and quantitative expression; this impedes comparison of projects and gives preference to economic priorities.

In order to define which direct and indirect social and environmental impacts should be assessed in the projects related to the development of urban transport systems infrastructure objects, and the procedure and principles of project justification, the author carried out the expert survey. In order to find out the opinion of experts the author carried out a questionnaire survey based on the principles of the Delphi Method. Expert selection was based on their qualifications and practical work fields: territorial planning, design and construction of transport systems, project preparation and evaluation etc. The experts were employed both in public institutions and private undertakings.

In order to ensure adequate assessment of expert survey results, the results were processed by applying the statistical analysis method which includes the analysis of number sequence and identification of key statistical features. According to the results, general questions were interrelated; the key question was question No 6 analysing the importance of separate assessment aspects (atti-

tudes). In order to define compatibility of experts' attitudes toward specific issues, the author has identified expert reliability through the coefficient of concordance (W). Pursuant to estimations, the opinion of experts could be relied upon in developing the model for justification of urban transport systems infrastructure development.

Pursuant to the assessment of general questions, development should be justified for all types of urban transport systems infrastructure objects. Respondents mainly supported justification of the development of a Common network, Main hubs and Public transport infrastructure. According to the integrated assessment results, all justification aspects (they were assessed by more than half of respondents) are relevant for the development of a Common network, Main hubs and Public transport infrastructure. Development of Traffic regulation / control and Traffic safety measures should be justified by taking into account Traffic safety, Economic and Technical aspects. It is important to justify the development of Environmental measures by taking into account Environmental, Social, Technical and Economic aspects; whereas Strategic, Financial and Traffic safety aspects are not relevant.

Taking into account the number of respondents and frequency of repeated answers to the same question with respect to all the above urban transport systems infrastructure groups, the obtained results were integrated by applying the Cluster Analysis Method. In order to decide which assessment criteria should be included in the clusters (i.e. in order to define the number of clusters), the author carried out the Hierarchical Cluster Analysis. For cluster grouping and priority setting the author applied the K-means non-hierarchical clustering technique inside the cluster. After identification of the statistical features of separate variables, statistically relevant variables have been distinguished in all clusters (Table 1).

Clustering of qualitative data in expert survey revealed that the number of criteria specified in all the three clusters is very high taking in mind that the model suggested by the authors is directed toward the decision-makers of wide auditorium. The author has defined only the most general criteria suitable for justification of the development of suggested transport systems infrastructure objects groups. In case of less significant assessment qualitative criteria should also have a numerical equivalent. In order to define importance of indicators the author applied a simple indicators rating method. The final result of the criteria assessment is the establishment of the integrated assessment indicator. Taking into account that the assessed indicators define justification aspects (referred to as interrelated) by applying the cluster analysis method, it is necessary to define additional weighting multipliers to separate clusters.

Table 1. Grouping of criteria in clusters

Clusters	Criterion			Mean	Importance of criteria
	Justification aspect	Code	Title		
<i>Cluster 1: low impact criteria</i>	Technical	TE4	Compliance of technical solutions with the requirements of technical documents	2,990	<i>Least important</i>
	Environmental	AP1	Effect of the change in noise exposure	2,762	
		AP6	Impact on the ecological landscape balance	2,729	
	Technical	TE1	Impact of object environment and connection with other objects on object development	2,720	
	Environmental	AP2	Impact on air quality of the territory	2,695	
	Land use	ZN4	Impact on the sustainable use of the land	2,630	
	Environmental	AP8	Impact on natural recreational environment	2,617	
		AP3	Impact on quality of natural resources	2,593	
	Land use	ZN2	Impact on land borders	2,558	
		ZN1	Compliance with the regulation on the use of the land	2,536	
		ZN3	Taking of land for public needs	2,511	
<i>Cluster 2: high impact criteria</i>	Traffic safety	EIS1	Effect of the change in traffic intensity	3,040	<i>The most important</i>
	Technical	TE3	Effect of the change in traffic intensity and composition	3,020	
	Traffic safety	EIS2	Effect of the changes in the number of traffic accidents	3,015	
		EIS6	Effect of the traffic accident site	2,999	
		EIS7	Effect of the speed limit change	2,965	
		EIS8	Effect of the change in time delays	2,899	
		EIS3	Effect of different types of traffic accidents	2,882	
		EIS4	Effect of the change in the number of fatalities	22,855	

Table 1 (continued)

Clusters	Criterion			Mean	Importance of criteria
	Justification aspect	Code	Title		
Cluster 3: medium impact criteria	Economic	EK1	Economic benefit	2,997	Average importance
	Social	SC6	Impact on the mobility of population	2,818	
	Strategic	ST2	Compliance with the decisions of the territorial planning documents of the Republic of Lithuania	2,780	
	Economic	EK12	Economy of object maintenance costs	2,762	
	Strategic	ST6	Object development need at local level	2,700	
	Social	SC2	Impact on the development of the settlement (area) community	2,559	
		SC1	Impact on social state of local citizens	2,531	
	Strategic	ST1	Compliance with the strategic development objectives at international/national/regional level	2,523	
	Social	SC3	Impact on population employment	2,518	
	Strategic	ST5	The need for object development at international/national/regional level	2,397	

Below there are model development steps (Fig. 1).

The first step includes initial stages of the Planning phase. In this phase the author suggests to include specific criteria which could compare the expediency of the development of transport systems infrastructure objects of different urban territories. Besides, the author suggests to supplement the eligibility criteria by the selected Strategic aspect criteria, and supplement the efficiency criteria by the criteria related to main characteristics of the alternative projects indicating the compliance of the object with the concepts of urban transport systems infrastructure development object groups; and the compliance of the object development types with concepts of types requiring justification.

Second step includes the establishment of the level of minuteness: project development recommendations and main guidelines for planning specialists, project promoters and assessment consultants. The author has established the content of project justification documentation by including the standard points of the currently prepared projects. *Third step* includes the Assessment Phase which encompasses the comparison of alternative projects and assessment. The assessment consists of the establishment of separate main effectiveness indicators, their comparison with the suggested assessment criteria and their possible expressions, the establishment of an integrated indicator and comparison of the obtained results.

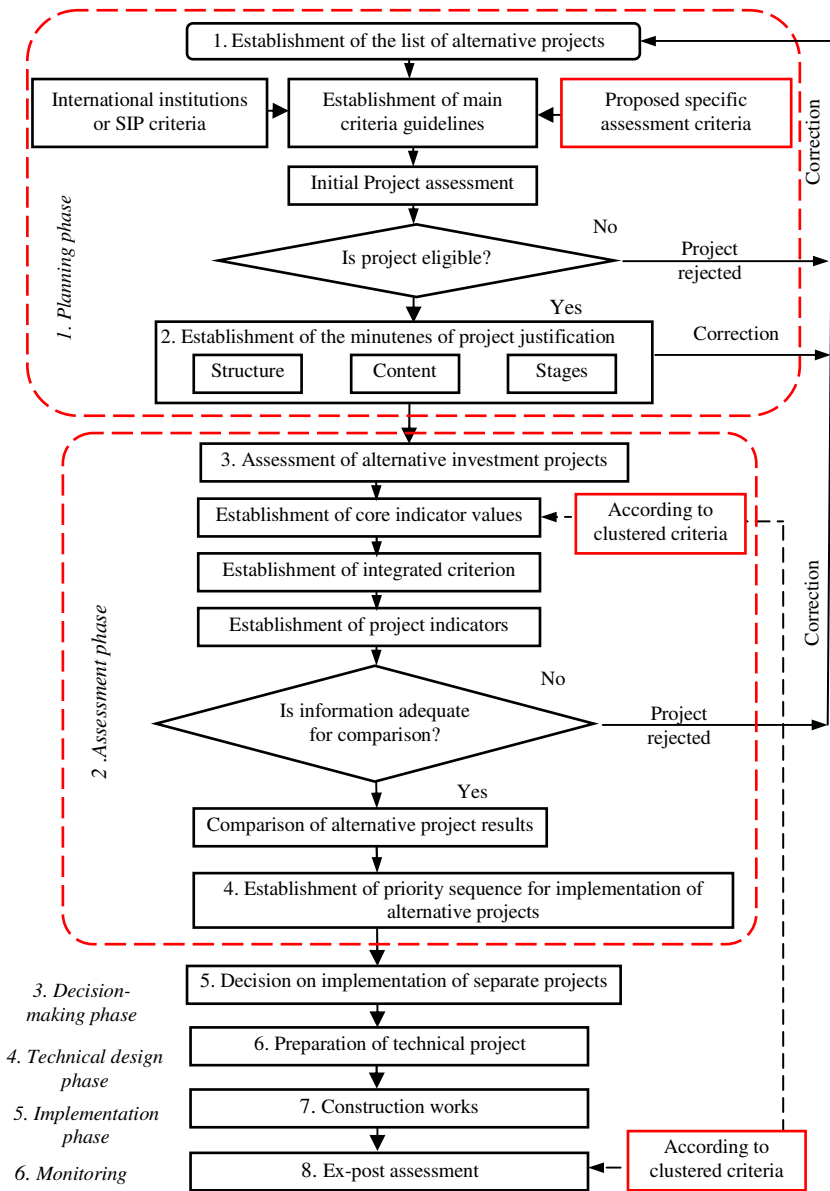


Fig. 1. Proposed model for justification of urban transport infrastructure development

Fourth-Fifth-Sixth-Seventh step includes the phase of Decision-Making and Funding, namely: establishment of the sequence of priority projects when non-eligible projects are rejected and eligible projects are adequately grouped in priority order according to final assessment results. *Eighth step* includes the Monitoring Phase. This phase encompasses the ex-post study comparing the actual indicators obtained after technical design and construction works with the forecasted indicators (pursuant to the same criteria).

4. Adaptation of the developed model for the justification of actual urban transport infrastructure development projects

Taking into account the current assessment principles of project proposals, the author suggested to correct selection of regional projects by supplementing the initial assessment of project eligibility carried out during the Planning phase. During this phase it is necessary to define project eligibility criteria and the criteria of project relevance to regions/municipalities, including the establishment of specific project assessment criteria.

For verification of the effectiveness of the proposed justification model the author carried out a multi-criteria analysis of actually implemented projects submitted for the EU financial support for the period of 2004–2011. To this end the author has selected five alternative investment projects for the development of road transport systems infrastructure. Projects were selected by taking into account different types of transport infrastructure objects and project activities in order to define on whether the suggested model is effective by comparing the projects of different scope.

Project No 1. Construction of the missing link of transport corridor IXB: Vilnius western by-pass (Feasibility Study, 2008);

Project No 2. Construction of the bridge over the Šešupė River in Aušros street (Marijampolė) and its access roads (Feasibility Study, 2006);

Project No 3. Reconstruction of Birutė and Mindaugas streets in Trakai city (Investment project, 2006);

Project No 4. Reconstruction of Treniota, Gargždė and Vytautas streets and Vytautas by-street in Gargždai (Klaipėda district) (Feasibility Study, 2009);

Project No 5. Investment project for the construction of the pedestrian lane between Visaginas and Veteranų streets (Feasibility Study, 2006).

After the assessment of eligibility of the selected projects and cost-benefit analysis according to the principles described in Chapter 3, an integrated assessment indicator was defined with a view to comparing the alternative projects and establishing the priority sequence for project implementation (Table 2).

Table 2. Determined integrated evaluation criteria of the selected projects

Projects	No 1	No 2	No 3	No 4	No 5
IR _v	5,448	4,220	4,327	4,872	4,950
Priority sequence	1	5	4	3	2

Justification of *Project 1* was best of all the projects under analysis. It analyses the opportunities for construction of the city by-pass and evaluates the interface between transport infrastructure object groups of different cities. *Project 5* was in the 2nd place. It specifies the development of the pedestrian zone. *Project 2* analysing the possibilities of construction of a new bridge received the lowest marks. Pursuant to benchmarking (comparison) results, despite the differences in the project scope and peculiarities of objects under analysis, it is possible to do a technical comparison of the projects.

General Conclusions

Following elaboration of the theoretical model for justification of urban transport infrastructure development and verification of its functional capacities, the following scientific and practical conclusions have been made:

1. In order to achieve sustainable development in urban territories it is necessary to ensure a clear performance of development process of separate urban systems. Theoretical researches have revealed that there is no formal methodology for justification and assessment of urban transport systems infrastructure development projects in Lithuania. In view of this, and despite the identified differences of objects, methods used for justification of rural road transport infrastructure development are applied for urbanised territories road transport infrastructure development. The result is not accurate, due to methodological inconsistencies; the principles of sustainable development are not pursued.

2. Transport infrastructure development is highly influenced by financial support of national and international institutions mechanisms specifying the trends and ways of developing transport infrastructure in urbanised territories. Project assessment is closely related to the entire system of strategic planning: the planning of state budget, formation of development priorities and trends depends on assessment results. Theoretical research has revealed that appropriate definition of priority implementation of project is one of the main issues ensuring sustainable urban development.

3. It was defined that social – economic assessment is applied in the process of justification of transport systems infrastructure development. Its results are followed in the process of decision-making seeking to determine the expediency of implementation of separate development projects and create opportunities

for the use of priority investment. In order to avoid inconsistencies, it is necessary to apply modified multi-criteria analysis methods combining specific factors influencing on urban development and concretizing coherence with the processes of territorial planning and strategic planning into common system of assessment impacts. The author proposed an addition to the initial project assessment carried out during the Planning phase: to definite Relevance (correspondence to solutions of territorial planning and strategic planning) and Efficiency (after systemized groups of objects and types of development) criteria.

4. The proposed model for justification is recommended to be applied for all types of urbanised territories. Since urbanised territories differ in size of urban areas, level of transportation development; alternative projects could be influenced by different impact criteria, the author proposed modifications of a model which have to be carried out in Planning phase by defining minuteness of justification, and in Assessment phase by defining main indicators of project effectiveness.

5. The results of expert assessment have revealed that justification is necessary for all types of urban transport systems infrastructure objects groups systemized by the author, and especially for the development of Main hubs (88,9 proc. of respondents), Common network (72,2 proc. of respondents) and Public transport (72,2 proc. of respondents) infrastructure. The results of experimental and theoretical research have revealed that urban transport systems infrastructure development is mostly influenced by main criteria related to Traffic safety and Technical aspects, average – by criteria related to Economic, Social and Strategic aspects and least – by criteria related to Environmental and Land use aspects.

6. The operational principle of the proposed model for justification of urban transport systems infrastructure development projects is the selection of alternative projects by comparing an integrated assessment indicator. The author proposed the method of priority effectiveness criteria and their indicators which must be applied in decision – making process for selection of projects. The author proposed to improve the calculation of integrated assessment indicator by adding separate weight multipliers for effectiveness criteria. The Weights multipliers are recommended as follows: 2,5 for Traffic Safety criteria; 1,5 for Social and Economic criteria; 1,0 for Environmental and Land use criteria. Values of multipliers are defined assessing compliance to recommended development trends introduced in the White Paper. This modified definition of an integrated assessment indicator reflects singularities of urban transport systems infrastructure and improves the process of justification of development.

List of Published Works on the Topic of the Dissertation

In reviewed scientific periodical publications

Griškevičius, A.; Griškevičiūtė-Gečienė, A. 2008. The Analysis of the Construction Costs of Transport Infrastructure Projects. *The Journal of Transport and Telecommunication* 9(4): 15–21. Transport and Telecommunication Institute, Riga, Latvia. ISSN 1407-6160. (VINITI; Scopus; Elsevier).

Griškevičiūtė-Gečienė, A. 2010. Evaluation of Investment Projects within the Territory of Development. *Transport* 25(2): 203–214. ISSN 1648-4142 print, ISSN 1648-3480 online. (Thomson ISI Web of Science).

Griskeviciene, D.; Griškevičius, A.; Griskeviciute-Geciene, A. 2011. A New Approach to Assessment of Infrastructure Projects on Urban Transport Systems. *Journal Transport and Telecommunication* 12(13-2): 108–12. (2012). Transport and Telecommunication Institute, Riga, Latvia. ISSN 1407-6160 print, ISSN 1407-6179 online (VINITI; Scopus; Elsevier).

In other editions

Griškevičius, A.; Griškevičiūtė-Gečienė, A. 2008. External and Internal Factors Predetermined the Fluctuation of the Constructions Costs of Transport Projects. “*Transport Means 2008*”: *proceedings of the 12th International Conference*, October 23–24, 2008, Kaunas University of Technology, Lithuania. p. 235–238. ISSN 1822-296 X. (Thomson ISI proceedings)

Griškevičius, A.; Griškevičiūtė-Gečienė, A. 2008. The Analysis of the Construction Costs of Transport Infrastructure Projects. *The 8th International Conference “Reliability and Statistics in Transportation and Communication (RelStat’08)”*, 15–18 October 2008, Riga, Latvia: *proceedings/ Transport and Telecommunication Institute*, p. 81–86. ISBN 978-9984-818-11-5.

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LIETUVOS MIESTŲ SUSISIEKIMO SISTEMŲ INFRASTRUKTŪROS PLĖTROS PAGRINDIMO MODELIS

Problemos formulavimas. Miestų plėtra yra sudėtingas ir daugiavfunkcinis procesas, kuriam įtakos turi įvairūs išorinės veiksniai: socialiniai – ekonominiai, demografiniai, aplinkosauginiai, planavimo, techniniai, valdymo ir kiti. Šių veiksmų poveikis metodiškai nusakomas trimis pagrindiniais aspektais: socialiniu, ekonominiu ir aplinkosauginiu. Būtent šių aspektų sanglauda yra pagrindas darniai miestams vystytis. Darnios miestų plėtros prielaidos turi būti įteisintos planavimo dokumentuose. Miestų savivaldos, kaip pagrindiniai planavimo proceso dalyviai, turi nustatyti reikalavimus teritorijų planavimo procesui taip, kad šie principai būtų pritaikomi tiek miestų susisiekimo sistemų infrastruktūros planavimo, tiek įgyvendinimo stadijose.

Susisiekimo infrastruktūros plėtra didina atskirų miestų ir visos šalies prestižą, turi tiesioginės įtakos miestų plėtros, susisiekimo politikos įgyvendinimui. Tinkamam susisiekimo sistemos funkcionavimui reikalinga tiek kiekybinė, tiek kokybinė techninės infrastruktūros plėtra. Paskutiniųjų dešimtmečių patirtis rodo, kad augantis automobilizacijos lygis Lietuvoje pakeitė miestų teritorijų naudojimo pobūdį, miestų struktūrą, stimuliuojo aglomeracijų susidarymo procesą ir suformavo naujas problemas. Tuo pačiu automobilizacija darė įtaką transporto sistemos pokyčiams, dėl to didėjo ir vis didėja infrastruktūros statinės dalies atsilikimas nuo besikeičiančių transporto ryšių bei augančių transporto srautų. Šiam atsilikimui taip pat įtakos turi nepakankamas susisiekimo techninės infrastruktūros plėtros finansavimas.

Temos aktualumas. Pasirinkti šią temą paskatino tai, kad Lietuvoje teritorijų planavimo procese bei miesto ūkio sistemų finansavimo kontekste nėra parengtų teorinių principų ir metodų, kaip pagrįsti atskirų miestų susisiekimo sistemų infrastruktūros objektų plėtrą: kaip parinkti prioritetinius objektus, kokius veiksmus įvertinti, kokius vertinimo metodus naudoti. Susisiekimo sistemų infrastruktūros plėtros pagrindimas yra sudėtingas ir daugiapakopis procesas, todėl ne visi egzistuojantys plėtros projektų vertinimo metodai pritaikomi miestų susisiekimo sistemų infrastruktūrai. Vertinant miestų susisiekimo sistemų infrastruktūros plėtrą, būtinas miestų darnaus vystymo veiksmų lyginimas ir įvertinimas.

Tyrimo objektas. Tyrimo objektas apibrėžiamas kaip miestų susisiekimo sistemų infrastruktūros plėtros pagrindimo ir vertinimo sistema: pagrindimo principų, vertinimo sistemos nustatymas, analizė ir naudojimas teorinės pagrindimo metodikos parengimui ir pritaikymui (Lietuvos miestų pavyzdžiu). Tyrimo objektą detalizuoja tokie etapai: urbanizuotų ir neurbanizuotų teritorijų (miestų ir užmiesčio) susisiekimo sistemų infrastruktūros objektų nustatymas; miestų susisiekimo sistemų infrastruktūros plėtros projektų ciklo analizė; miestų susisiekimo sistemų infrastruktūros plėtros pagrindimo proceso analizė, apibrėžiant vertinimo sistemą ir jos veikimo principus.

Darbo tikslas ir uždaviniai. Pagrindinis darbo tikslas – sukurti teorinį miestų susisiekimo sistemų infrastruktūros plėtros projektų pagrindimo modelį, pritaikant jį prioritetų nustatymui ir praktiniam susisiekimo sistemų infrastruktūros statybos ir rekonstravimo projektų vykdymui. Darbo tikslui įgyvendinti buvo suformuluoti šie uždaviniai:

1. Išanalizuoti šiuolaikinių miestų susisiekimo sistemų infrastruktūros objektų vaidmenį darniame miestų vystyme, nustatyti susisiekimo sistemų infrastruktūros plėtros tendencijas Lietuvoje ir užsienio šalyse.
2. Atlikti susisiekimo sistemų infrastruktūros plėtros projektų pagrindimo principų analizę. Atlikti susisiekimo sistemų infrastruktūros pagrindimo procesuose naudojamų vertinimo metodų analizę, išskiriant pagrindinius aspektus ir kriterijus.
3. Sudaryti teorinį plėtros pagrindimo modelį, nustatant socialinius-ekonominius bei kitus būdingus vertinimo kriterijus ir aspektus.
4. Patikrinti sudaryto modelio praktinį veiksmingumą, atliekant pasirinktų įgyvendintų ar įgyvendinamų Lietuvos miestų susisiekimo sistemų infrastruktūros plėtros projektų vertinimą.

Tyrimo metodika. Teorinis Lietuvos miestų susisiekimo sistemų infrastruktūros plėtros projektų pagrindimo modelis buvo parengtas, išanalizavus naujausią mokslinę literatūrą iš mokslinių duomenų bazių. Tokiu būdu išnagrinėti praktikoje taikomi susisiekimo sistemų infrastruktūros plėtros projektų pagrindimo principai ir vertinimo metodikos. Pasiūlytas pagrindimo modelis sudarytas, taikant ekspertinio vertinimo, statistinių duomenų apdorojimo ir analizės, daugiakriterinio vertinimo metodus.

Darbo mokslinis naujumas. Šis darbas iš kitų šios srities mokslinių tyrimų išsiskiria šiais mokslinio naujumo elementais:

1. Darbe ištirti naudojamų investicijų projektų vertinimo metodai urbanizuotų ir neurbanizuotų teritorijų susisiekimo sistemų infrastruktūros plėtrai. Susisteminti vertinimo požįūriai ir nustatyti kriterijai, kurie turi būti naudojami urbanizuotų teritorijų susisiekimo sistemų infrastruktūros plėtros vertinime.

2. Sukurtas teorinis projektų pagrindimo modelis pritaikytas urbanizuotų teritorijų susisiekimo sistemų infrastruktūros plėtrai pagrįsti ir projektų prioritetinei sekai sudaryti. Prioritetinei sekai sudaryti tarpusavyje lyginami plėtros projektų integruoto vertinimo rodikliai, kurių apskaičiavime naudojami specifiniai miestų susisiekimo sistemų infrastruktūros plėtrai nustatytų kriterijų svorio daugikliai.

Darbo rezultatų praktinė reikšmė. Atlikti miestų susisiekimo sistemų infrastruktūros plėtros tyrimai bei Lietuvos Respublikos viešose institucijose ir privačiame sektoriuje dirbančių susisiekimo sistemų infrastruktūros plėtros projektų rengėjų, vertintojų, ekspertų, konsultantų apklauskos. Tyrimų metu nustatyta, kad sprendimų priėmėjai miestų teritorijų susisiekimo sistemų infrastruktūros objektų plėtros projektų pagrindimo procese daugiausiai vadovaujasi rekomendacinio pobūdžio automobilių transporto užmiesčio kelių plėtros vadovu. To pasekoje ir neturint oficialios metodikos, miestų susisiekimo sistemų infrastruktūros plėtros projektai nerengiami detaliai ir neatspindi darnaus vystymosi principų. Pasiūlytas miestų susisiekimo sistemų infrastruktūros plėtros pagrindimo modelis taikytinas kaip projektų rengimo ir vertinimo rekomendacijos prioritetinių projektų atrankai. Modelis pritaikomas visų tipų Lietuvos urbanizuotoms teritorijoms.

Ginamieji teiginiai

1. Sudaryta metodika, apimanti eismo saugumo ekonominius, socialinius, strateginius, techninius, aplinkosauginius ir žemės naudojimo aspektus, kuria remiantis grindžiamas miestų susisiekimo sistemų infrastruktūros plėtros pagrįstumas ir vertinimas.

2. Urbanizuotų teritorijų (miestų) susisiekimo sistemų infrastruktūros plėtros projektų pagrindimas turi būti atskirtas nuo neurbanizuotų teritorijų (užmiesčio) plėtros projektų vertinimo metodų dėl techninės infrastruktūros skirtumų.

3. Daugiakriterinės analizės metodų įdiegimas įgalina sukurti miestų susisiekimo sistemų infrastruktūros plėtros pagrindimo teorinį modelį, kuris leidžia atlikti tinkamą alternatyvių projektų atranką.

Darbo apimtis ir struktūra. Darbą sudaro įvadas, 4 skyriai, išvados, literatūros sąrašas, publikacijų sąrašas ir priedai. Bendra disertacijos apimtis – 154 puslapiai, 21 iliustracijos, 34 lentelės ir 6 priedai.

Pirmasis skyrius skirtas literatūros analizei: nagrinėjama urbanizuotų ir neurbanizuotų teritorijų susisiekimo sistemų infrastruktūros samprata, analizuojamos jų plėtros tendencijos Lietuvoje ir užsienyje. Antrajame skyriuje pristatoma tyrimo metodika, atlikta miestų susisiekimo sistemų infrastruktūros plėtros projektų pagrindimo proceso analizė. Trečias skyrius skirtas teoriniam ty-

rimui: Lietuvos miestų susisiekimo sistemų infrastruktūros plėtros pagrindimui, prielaidų ir principų nustatymui, teorinio modelio sukūrimui. Ketvirtajame skyriuje pateikti principai ir praktinės rekomendacijos Lietuvos miestų susisiekimo sistemų infrastruktūros plėtros projektų pagrindimui bei pasiūlyto modelio veiksmingumo patikrinimo rezultatai.

Bendrosios išvados

Sudarius teorinį miestų susisiekimo sistemų infrastruktūros plėtros pagrindimo modelį ir patikrinus jo veikimą, suformuotos tokios mokslinės ir praktinės išvados:

1. Miestų teritorijų darnios plėtros tikslams pasiekti būtinas aiškus atskirų miesto sistemų plėtros procesų veikimas. Teoriniais tyrimais nustatyta, kad Lietuvoje nėra oficialios metodikos urbanizuotų ir neurbanizuotų teritorijų (miesto ir užmiesčio) susisiekimo sistemų infrastruktūros plėtros projektų pagrindimui ir projektų vertinimui. Urbanizuotų teritorijų kelių transporto infrastruktūros plėtros pagrindimui vis dar naudojami užmiesčio kelių plėtros projektų vertinimo metodai, nors išskiriami akivaizdūs infrastruktūros objektų skirtumai. Dėl metodikos netikslumų nukenčia rezultatai, nėra įgyvendinami darnios plėtros principai.

2. Susisiekimo infrastruktūros plėtrai didelę įtaką daro valstybinių ir tarptautinių institucijų finansinės paramos instrumentai, apibrėžiantys urbanizuotų teritorijų susisiekimo infrastruktūros plėtojimo kryptis ir būdus. Projektų vertinimas yra glaudžiai susijęs su visa strateginio planavimo sistema: nuo vertinimo rezultatų priklauso valstybės biudžeto asignavimų planavimai, atitinkamos srities plėtros prioritetų ir kryptių formavimas. Teoriniais tyrimais nustatyta, kad miesto susisiekimo sistemos darniai plėtrai užtikrinti ypatingai svarbus yra tinkamas plėtros objektų įgyvendinimo prioritetiškumo nustatymas.

3. Tyrimais nustatyta, kad susisiekimo infrastruktūros plėtros pagrindimo procese taikomas socialinis – ekonominis vertinimas yra ypač svarbus. Jo rezultatais vadovaujamasi sprendimų priėmimo procese siekiant nustatyti, ar tikslinga įgyvendinti atskirus plėtros projektus ir sudaryti prioritetines investicijų panaudojimo galimybes. Siekiant išvengti pasitaikančių neapibrėžtumų, būtina taikyti modifikuotus daugiakriterinės analizės metodus, kurie į bendrą poveikių vertinimo sistemą įtraukia specifinius miestų susisiekimo plėtrą įtakančius veiksnius, sukonkretinančius ryšį su teritorijų planavimo ir strateginio planavimo procesais. Autorė pasiūlė papildyti projekto ciklo planavimo stadijoje atliekamą pirminį plėtros projektų vertinimą tinkamumo (atitikimo teritorijų planavimo ir strateginio planavimo sprendiniams) ir veiksmingumo (pagal objektų grupes ir plėtros tipus) kriterijais.

4. Pasiūlytas miestų susisiekimo sistemų infrastruktūros plėtros pagrindimo modelis rekomenduojamas taikyti visų tipų urbanizuotoms teritorijoms. Kadangi urbanizuotos teritorijos skiriasi savo dydžiu, susisiekimo infrastruktūros išvystymo lygiu, alternatyvius plėtros projektus veikia skirtingi vertinimo kriterijai, autorė pasiūlė modelio modifikacijas atlikti projekto ciklo planavimo stadijoje, nustatant projekto pagrindimo detalumą, ir vertinimo stadijoje, nustatant svarbiausius projekto efektyvumo rodiklius.

5. Atlikto ekspertinio vertinimo rezultatai parodė, kad plėtros pagrindimas būtinas visoms autorės susistemintoms miestų susisiekimo sistemų infrastruktūros objektų grupėms, ypačiai – pagrindinių mazgų (88,9 proc. respondentų atsakymų) bendrojo naudojimo tinko (72,2 proc.) ir viešojo transporto infrastruktūros (72,2 proc.) plėtrai. Eksperimentinių ir teorinių tyrimų rezultatai parodė, kad iš projektų pagrindimo aspektų kriterijų miestų susisiekimo sistemų infrastruktūros plėtrą labiausiai įtakoja – eismo saugumo bei techninio aspektų, vidutiniškai įtakoja – ekonominio, socialinio bei strateginio aspektų ir mažai įtakoja – aplinkosauginiai bei žemės panaudojimo aspektų kriterijai.

6. Pasiūlyto miestų susisiekimo sistemų infrastruktūros plėtros projektų pagrindimo modelio veikimo principas – alternatyvių projektų atranka pagal integruoto vertinimo rodiklio palyginimą. Autorė pasiūlė bendrą prioritetinių efektyvumo kriterijų ir juos apibūdinančių rodiklių metodą, kuris būtų privalomai taikomas priimant sprendimus projektų atrankoje. Integruoto vertinimo rodiklio apskaičiavimui rekomenduojama taikyti autorės nustatytus atskirų efektyvumo kriterijų svorio daugiklius: eismo saugumo kriterijams – 2,5; socialiniams ir ekonominiams – 1,5; aplinkosauginiams ir žemės naudojimo kriterijams – 1,0, kurių reikšmės nustatytos, įvertinus kriterijų atitikimą Baltosios knygos rekomenduojamoms plėtros kryptims. Toks modifikuoto integruoto vertinimo rodiklio nustatymas atspindi miestų susisiekimo sistemų infrastruktūros ypatumus ir patobulina plėtros projektų pagrindimo procesą.

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MODEL FOR THE JUSTIFICATION OF LITHUANIAN URBAN TRANSPORT
SYSTEMS INFRASTRUCTURE DEVELOPMENT

Summary of Doctoral Dissertation
Technological Sciences, Civil Engineering (02T)

Aušrinė Griškevičiūtė-Gečienė

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