

# THE ANALYSIS OF THE CONSTRUCTION COSTS OF TRANSPORT INFRASTRUCTURE PROJECTS

*Algirdas Griskevicius<sup>1</sup>, Ausrine Griskeviciute-Geciene<sup>2</sup>*

*Vilnius Gediminas Technical University*

*<sup>1</sup> Transport Management Department*

*Plytines str. 27, Vilnius, LT-10105, Lithuania*

*Ph: +370 52745099. E-mail: algirdas.griskevicius@gmail.com*

*<sup>2</sup> Urban Engineering Department*

*Saulėtekio al. 11, Vilnius, LT-10223, Lithuania*

*Ph: +370 52744719. E-mail: aushgri@yahoo.com*

The significant rise of the construction costs of transport investment projects at present days is considered in the paper. The analysis of reasons of cost rise is accomplished on the purpose to use the EU financial support and other financing resources for transport sector more effectively and to plan the further usage of investments for transport infrastructure. Costs, acting factors, financing resources influence on the priority projects of transport infrastructure are analysed and changes of construction costs are defined and the problems of the implementation of infrastructure project are clarified. The recommendations are offered concerning preventive measures for up the costs of transport infrastructure works and their application possibilities, and to substantiate the development of infrastructure projects.

**Keywords:** *transport infrastructure projects, financing resources, the evaluation of investment projects, construction costs, influence of external factors*

## 1. Introduction

People and companies of the State are users of transport infrastructure; operating influence of this infrastructure correlates directly or indirectly with all branches of the state economy. The government is responsible for the maintenance and the development of transport infrastructure; governmental programmes are prepared for its development. The substantiation of the state investment depends on the resources necessary for economic and social development and investments of the state [1].

The importance of infrastructure, including transport infrastructure, is real big on the level/scale of the macroeconomics. The development of transport infrastructure raises the prestige/status of the state and has direct influence on the implementation of the transport policy [2]. Furthermore, the construction of infrastructure objects requires scientific and industrial capabilities of the State, increases the employment and the productive level of different sectors of the Economy.

The process of the evaluation of infrastructure projects is very difficult and has separate methodologies and complexities for different sectors of the economy. There are many valuation methods of investment, but not all of them can be applied to the infrastructure [3].

The investment projects of transport infrastructure are characterized by as follows:

- duration of subject operating and also duration of whole project is quite enough;
- all projects are opened for capital and require large financial recourses; it is rarely possible to dispose the borrowing of means;
- usually project benefit overbalances cumulative costs after long period, therefore the payback period of investment mostly is very long [4].

The aim of this research is to analyse increased construction costs of transport infrastructure projects and to investigate the reasons of growth of construction costs as well as possible influence on the provided plans of the implementation of the EU support for transport sector and on perspective plans of investment usage for modernization of transport infrastructure in Lithuania [5, 6].

## 2. The Dynamic and the Tendency of Changes of Construction Expenditures of Transport Infrastructure Projects

The research is performed according to the formal annual adequate priced catalogues:

1. Comparable economic indexes of construction calculating prices [7].
2. Approximate calculation of construction work costs [8].

Comparable economic indexes of construction calculating prices evaluated on the basis of analogical building structures according to the calculated costs of adequate annual construction resources. All expenditures experienced during construction process of building: direct, supplementary, social insurance and other expenditures, including value-added, are determined and reckoned in these estimates. Extra share of constructor expenditures for the formation of contractor benefit is also included in these price indexes.

Comparable economic indexes of construction calculating prices are used in the process of investment needs planning on the pre-project stage or preparing construction substantiation and other cases. The costs of separate constructional units, including direct and supplementary expenditures of contractor, are determined in the approximate calculation of construction work costs.

**Table 1.** The changes of construction costs and expenditures of resources of transport infrastructure

Types of construction	Dimension	Price	2003	2004	2005	2006	2007	2008
<b>I. According to the comparable indexes of calculating prices [7]</b>								
1. State highways I category	1 km	Thous. LTL	6450	6689 (103,7)	7331 (109,6)	8444 (115,1)	10057 (119,1)	10560 (105,0)
2. Local roads (asphalt)	1 km	Thous. LTL	520	539 (103,7)	591 (109,6)	680 (115,1)	822 (120,9)	863 (105,0)
3. Urban roads (main streets)	1 km	Thous. LTL	4780	4957 (103,7)	5439 (109,7)	6258 (115,2)	7852 (125,5)	8269 (105,3)
<b>II. According to the approximate calculation of construction work costs [8]</b>								
<b>1. Cover of urban main streets</b>	100 m <sup>2</sup>	LTL	14651	14940/100 (102,0)	15909/100 (106,5)	19535/100 (122,8)	21801/100 (111,6)	23262/100 (106,7)
a) labour payment		LTL	189	221 / 1,5 (116,9)	262 / 1,6 (118,6)	323 / 1,7 (123,0)	408 / 1,9 (126,3)	434 / 1,9 (106,4)
b) materials		LTL	12117	12279/82,2 (101,3)	12740/80,1 (103,8)	14569/74,6 (114,4)	16155/74,1 (110,9)	17257/74,2 (106,8)
c) mechanicals		LTL	699	739 / 4,9 (105,7)	1072/6,7 (145,1)	1317/ 6,7 (122,9)	1496/ 6,9 (113,6)	1578 / 6,8 (105,5)
d) total price of resources (direct expenditures)		LTL	13005	13239/88,6 (101,8)	14074/88,5 (106,3)	16209/83,0 (115,2)	18059/82,8 (111,4)	19269/82,8 (106,7)
<b>2. Concrete borders (total price, without VAT)</b>	100 m	LTL	4833	5119/100 (105,9)	5713/ 100 (111,6)	6807 /100 (119,1)	8168/100 (120,0)	8452/ 100 (103,5)
a) labour payment		LTL					1719/21,0	1822/21,6
b) materials		LTL					3873/48,4	3932/46,4
c) mechanicals		LTL					48 /0,6	52 /0,6
d) total price of resources (direct expenditures)		LTL					5639/69,0	5806/68,7

*Note.* Increase of prices, comparing with last year is shown in brackets; in denominator – percentage share of expenditure and recourse input according to their types.

The data of Table 1 defines these trends and consistent patterns of changes of transport infrastructure costs:

1. In the period of 2003-2007 construction costs have been increasing constantly. Their change have expanded annually [5]. The reducing of these changes has been noticed only in 2008. Early future will show if this is the long-term tendency, which is circumstanced by the reducing of the demand in construction market and by other reasons.

2. According to separate expenditure types and separate resources costs there are considered the following consistent patterns:

- the share of labour expenditures in the total construction cost increases constantly. This is determined by unsatisfactory situation in the labour market;
- the expenditure of mechanical exploitation increases more rapidly. Probably it is stipulated by both the increase of labour payment and the increase of costs of energy resources, especially fuel.
- the share of building materials input reduces comparing with the increase of labour payment and mechanical exploitation share. However the tendencies of these changes can be determined by more detailed analysis.

3. The share of direct expenditures in the total construction contractor costs part is decreasing. Consequently, indirect expenditures, consisting of the extra chargers and estimated profit, are increasing respectively. Presumption can be done: the calculation of the supplementary expenditures of the increasing labour payment can stipulate the increase of these expenditures.

### 3. Projects with Extra Subsidies

During the period of analysis problems influenced by the procedures of preparation, evaluation, coordination and financing of projects and changes in construction market were formed in the evaluation and

planning sphere of transport infrastructure projects in Lithuania. Positive and negative experience has been already collected in 2006.

The financing of road sector construction was supreme in 2006 – 1278 millions LTL. Performing the development of the international transport corridors (roads), the projects financed by the EU funds and the means of Road Maintenance and Development Programme were successfully implemented. More than 219 millions LTL were realized from the EU funds.

Both the construction and the modernization, also periodical repair and the maintenance of roads give benefit for community. About 107 km gravelled roads were asphalted in 2006. Annual road transport operating costs reduced about 6.2 millions LTL per year due to asphaltting work. Due to the reduced dusty were saved about 2.4 million LTL per year. In total during the 20 years of project existence road users operating costs decreased about 155 millions LTL due to the asphalt works of the gravelled roads.

Summarized received benefit shows, that the State capital increased about 326 millions LTL, as this sum consisted of the investments of Road Maintenance and Development Programme used for the state importance roads. Moreover, the State capital enlarged by 219 millions LTL of the EU support funds used for the state importance roads. The capital of local authorities was enlarged by 172.8 millions LTL due to the investments of this programme used for local importance roads and streets in 2006.

The level of necessary resources for the development of road transport sector is changing together with the changes in the construction market. The net present value for the 20 year period (project existence duration) of transport infrastructure projects accomplished in 2006 consists of 1408.1 millions LTL or 40.4 millions LTL per year. The economical calculations of the most projects accomplished in 2006 were performed in 2004-2005. During this short period the prices of fuel and material were changing. The net present value could be larger, if the economical calculation were done in 2006. The internal rate of return of implemented projects was more than 24 percent.

During 2006 the Lithuanian Road Administration has announced 268 competitions and signed 1266 contracts. Though the financing was increased till 2006, but the prices for fuel, materials and labour increased largely. Only the prices of bitumen jumped to 40 percent per year. The estimate of the Road Maintenance and Development Programme was upgraded up to 874.1 millions LTL by the Government of Lithuania: in July 2006 to 1039.8 millions LTL (extra 165.4 mill LTL) and in October to 1068.5 mill LTL (extra 28.7 mill LTL). Seeking to implement projects of 219 millions LTL of the EU support, Ministry of Transport and Communications additionally had budgeted 2.073 millions LTL of the total financing means for sector.

In 2006 performing the Programme of the development of gravelled roads the procedure of the evaluation of applications and other administrative procedures were protracted, the financing contract of the 6th package (only 19-12-2006) was signed up behind time. These are the main reasons for the lost time of seasonal works to begin. Considering a great part of the Programme, financial means are not spent. Moreover, many contractors – competitors didn't perform their work plans for 2006, as the preparation, the coordination and the signing of the financing contract were protracted.

The contractors proposed distinctly larger prices in several competitions as it was calculated. This was the main reason repeatedly to declare new competitions for same subjects. Since the duration of these procedures was long, consequently the unused means were kept.

Since 2007 projects planned for 2007-2013 programming period and financed together with the EU are being started to perform. In 2007 projects of financial support of the Cohesion fund for 2004-2006 programming period were accomplished. During present period of the implementation of infrastructure projects is very important to keep the rate of planned works, to perform administrative procedures on time and to preserve the level of initiate construction prices.

Concerning above mentioned reasons performed new evaluation of projects shows, that many projects have already demanded the additional support (see Table 2 and Table 3). The extra support for local projects is 19.4 percent of total support of 94061.2 thousand LTL. The demand of extra support for state importance transport projects is 27.5 percent of total suitable sum of support contract: 99424.3 thousand LTL. The extra support dedicated only for two projects (see Table 3).

**Table 2.** Results of the evaluation of the applications for the extra support for the transport infrastructure projects

No.	Project subordination	Suitable expenditures for project financing determined in the support contract, LTL	Allocated sum for project support, LTL	Extra support sum requested by project contractor, LTL	Allocated extra support, LTL
1	Local projects	94061198.19	77836415.19	15120207.61	15120207.61
2	State projects	99424260.28	99424260.28	27304931.48	1060868.39

#### 4. The Comparison of the Prices of Vilnius Southern Bypass Project

The research analysis is based by transport infrastructure construction project „Vilnius Southern Bypass Project“. In this aim construction costs of new automobile road are estimated and compared with indexes of 2003 (Table 3).

**Table 3.** Comparison of road construction costs

State importance roads	Price of 1 km road construction, thousand LTL					
	2003	2004	2005	2006	2007	Average
AH category	7230	7498	8218	10034	10656	8727
I category (4 traffic lanes)	6450	6689	7331	8951	9508	7785

**Notes:**

1. When AH category road has 6 traffic lanes, the price of 1 km road is being increased by 1.25 coefficient;
2. When street for speed traffic has 6 traffic lanes, the price of 1 km road is being increased by 1.45 coefficient.

Obviously during the period of 2004-2006 the construction costs have been increasing up to 34 percent, evaluating both types of state importance roads from the level of the Project Feasibility study to the contract signing with contractors (see Table 3).

**Table 4.** Comparison of the construction costs of 2 layered asphalt cover

Asphalt cover (2 layers)	Price of 1000 m <sup>2</sup> asphalt cover (2 layers), thousand LTL					
	2003	2004	2005	2006	2007	Average
Driveways	140	145	159	191	203	168
Parking places	170	176	193	230	244	203

During the period of 2003–2007 the construction costs of 2 layered asphalt cover had increased up to 45 percent (Table 4). Meanwhile during the period of 2004–2006 the price had increased about 32 percent evaluating from the level of Feasibility study to the contract signing. Thus since 2004 up to 2006 calculated prices of new road construction and asphalt cover construction have been increasing 10 percent per year.

With reference to these conclusions the price of analysed bypass project can increase from 51.2 millions € to approximately 68.6 millions €. Furthermore, since one section (total of 1.1 km length) of fast traffic street is projected of 6 lanes, the costs of this section have to be increased in 1.45 times.

In conclusion larger prices can be logic reasoned by the changes of work amounts and the increase of work costs. Prices indexes estimated by the Statistic Department are presented in the Table 5 [5].

**Table 5.** The price indexes of construction expenditures, 2000 year - 100 percent

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Average
2000	97.5	97.4	97.5	99.4	99.9	101.0	101.4	101.1	101.4	101.6	100.9	100.8	100.0
2001	98.8	99.0	98.8	100.2	98.9	99.6	100.2	100.3	101.1	99.2	98.7	98.6	99.5
2002	97.3	97.7	98.4	98.9	99.4	100.1	99.8	100.6	100.6	100.2	100.6	99.8	99.5
2003	98.1	98.6	98.7	99.6	100.7	101.1	101.1	102.0	101.4	100.5	102.1	102.0	100.5
2004	101.3	101.8	102.0	104.2	106.4	106.7	108.4	108.8	109.2	110.4	110.3	110.2	106.7
2005	110.5	110.7	110.5	112.0	112.8	114.3	115.8	116.0	117.4	118.6	119.1	119.8	114.8
2006	120.5	120.8	121.3	123.4	124.1	125.5	127.1	127.7	129.4	129.8	130.5	132.4	126.1
2007	132.3	133.9	135.3	140.1	141.2	143.5	145.0	146.4	148.9	149.5	151.5	152.9	142.5
2008	153.0	153.9	156.3	156.8	158.5	160.0							

Obviously, not all the costs evaluated in the Feasibility Study are increased (Table 6). Some costs of contractor decreased – railway reconstruction, some costs were not foreseen at all (ransom of land and buildings) or these costs were included into other type of works. The costs of majority works increased signally.

The costs necessary for the implementation of construction project are presented in the Feasibility Study (according the price level of 2004). It is unclear what approximate calculated construction costs indexes were used as only final prices of construction and works are presented.

Only when the Feasibility Study was prepared new details which could not be predicted were clarified in the Technical Project. Since the new fast traffic street is being projected and the reconstruction of other crossing and joining streets are being planned in Vilnius City, the reconstruction of engineering communications (electricity lines, external electricity communications, cabling lines, gas and heating support lines, sewerage

lines, and water-supply) are planned. These extra works of reconstruction requires expenses – about 53.7 millions LIT (25 percents of total price) of unsuitable for financing expenses. The works planned in the technical Project are compared with works determined in the Feasibility Study and the purchase document. All the works foreseen in the Technical Project are included into the purchase documents.

**Table 6.** Comparison of works and costs foreseen in the Feasibility Study and in the Contract

Works	Costs, millions LTL in Feasibility study	Costs, millions LTL in Contract
Preparation of the site	----	0.42
Ransom of land and building	6.17	----
Road construction and street reconstruction	22.95	38.40
Buildings	69.5	101.31
Engineering works	34.6	53.70
Railway reconstruction	18,4	12.08
Total	145.45	196.70
Projecting and construction supervision	7.58	----
Other expenses	1.8	----
Incidental expenses	15,8	17.82
Total	176.77 millions LTL (51.2 millions €)	224.47 (65.01 millions €)

The duration from the beginning of Feasibility Study to the Contract signing takes 4 years. The most part of time is spent for – the preparation of Feasibility Study requires about 18 months. Purchasing documents are being prepared during 12 months. The period from the preparation of the tender application (being prepared during 8 months) to the decision of the EC extended about 9 months. Total period of all procedures extended up to 1.5 years (17 months).

**Table 7.** The main reasons of the changes of investment demand and approximate sums

The financing sum of project in the application	176.8 millions LTL
Works foreseen in the Feasibility Study but not included in the tender price: ransom of land and building	- 6.2 millions LTL
Works foreseen in the Technical Project, which amounts are increased comparing with the data of the Feasibility study	+ 24.4 millions LTL
Decreased works amounts comparing with the data of the Feasibility study: railway reconstruction	- 6.3 millions LTL
Influence of the changes of construction costs according common construction price indexes of October 2006	+ 43.2 millions LTL
Projecting and construction supervision costs and other expenses not included into the Contract	- 9.4 millions LTL
Increased incidental expenses	+ 2.0 millions LTL
The value of implementation Project at the time of analysis	224.5 millions LTL

In the period from the preparation of Feasibility Study to the Contract signing the biggest share of increased expenditures consisting of the increment of construction prices of skyways and other structures makes about 31.81 millions LTL; engineering works – 19.1 millions LTL; street construction – 15.45 millions LTL; and incidental expenses – 2.02 millions LTL.

## Conclusions

1. During several later years the increase of construction prices of transport infrastructure has become a heavy interruption in the process of new investment planning and also required the additional financial means for the finishing the early started constructions.
2. In the period of 2003-2007 the prices of construction prices has been increasing constantly and their change has been expanding annually. The reducing of these changes is noticed only in 2008. Early future will show if this is the long-term tendency, which is circumstanced by the reducing of the demand in construction market and by other reasons.
3. According to separate expenditure types and separate resources costs there are considered the following consistent patterns:

- the share of labour expenditures in the total construction cost increases constantly. This is determined by unsatisfactory situation in the labour market;
  - the expenditure of mechanical exploitation increases more rapidly. Probably it is stipulated by both the increase of labour payment and the increase of costs of energy resources, especially fuel.
  - the share of building materials input reduces comparing with the increase of labour payment and mechanical exploitation share. However the tendencies of these changes can be determined by more detailed analysis.
4. Feasibility studies of transport infrastructure don't present the specific works and their precise volumes. The prices of works determined in feasibility study can only be used for the approximately planning of means, preparing the application for the financing support of the EU; any more latterly covering of increased costs is going to LR financed share. Indicators of works and subject prices calculated according approximated indexes are presented in feasibility studies. The works indicators obligated in the purchase documents and contracts are different by their specification: each major indicator is elaborated in the technical project.
  5. The share of direct expenditures is decreasing signally in the total price of construction contractor (without VAT). Consequently, indirect expenditures are increasing respectively, including the extra charges and estimate profit. It confirms the precondition, that calculation of extra expenditures of the increase labour payment determined the increase of these expenditures;
  6. The amount of the EU financing share of Vilnius bypass project has not been changed after the decision on the project availability for financing of the Cohesion fund, consequently increased project implementation costs (18,7 millions €) had to be covered by the Republic of Lithuania; extra expenditures were divided into two equal parts: one for the administration of Vilnius city municipality and other for the Lithuanian road maintenance and development fund;
  7. The main reason of increased costs can be consider changed main indicators of the project and enlarged work amounts after the preparation of technical projects and also the changes of work prices during long period. According the formal price catalogue the prices were increasing about 10 % per year;
  8. The feasibility study of Vilnius southern bypass was prepared in 2003. This study was based on the prices increasing tendency, which even decreased during 2 years since 2000. According to the retrospective data the consultant could admit (in 2003) the index of construction price increasing about 2 % per year (this would be 6 percents growth to the end of 2006). In the period of 2003-2006 it had increased over 30 percents.
  9. In planning the new projects with the EU co-financing, the mechanism of the evaluation of price change should be described in the work implementation contract – it is necessary to index prices (during fixed and concerned period of time), as the implementation of transport project isn't possible during short time – it takes several years till contract signing, and construction works can be executed during several years.

## References

1. The state investment programmes (2007-2009 and 2008-2010). Vilnius: LR EM and FM, 2006.
2. The Lithuanian state long-time development strategic plan. Vilnius: LR EM, 2002.
3. Eurostat Yearbook 2007. Eurostat, 2007.
4. Griškevičius, A. *Transport business projects and programmes*. Vilnius: Technika, 2006. 108 p.
5. Statistics Yearbook. 2007. Vilnius: The Statistics Department at the Government of the Republic of Lithuania, 2007.
6. National Lithuanian strategy of EU structural support implementation for year 2007-2013 – [www.esparama.lt](http://www.esparama.lt)
7. TINA – transport infrastructure needs assessment programme. EK TINA secretariat, LR TCM, 1999.
8. *Comparable economic indexes for the calculation of building construction price (according to 2003-2008 estimated prices)*. Vilnius: JS „Sistela“, 2002-2008. 19 p.
9. *Calculation of approximately construction work prices. 2003-2008*. Vilnius: JS Sistela“, 2008.
10. Griškevičius, A. *Methodology of transport investment project' complex evaluation*. Vilnius: Technika, 2002. 96 p.
11. 2006-2008 programme of the Government of the Republic of Lithuania. Vilnius: LR Government, 2006.