EX-POST EVALUATION OF RAILWAY INVESTMENTS IN HUNGARY

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ABSTRACT

The aim of this paper is to investigate the possible **methods for determining input data** necessary for the further development of the CBA methodology. These state of the art methods are currently missing from the Hungarian analysis practices. We will first summarize the main technical and cost data related to actually implemented **railway developments**, rehabilitations and track constructions of the last 10 years. Sample projects are selected for three main investment types, and then presented as **case studies**. After carefully reviewing the preliminary Cost-Benefit Analyses of the selected projects, their planned traffic, investment, maintenance and operational properties are collected and compared to actual data.

The comparison of Cost-Benefit Analyses is hindered by the fact that they were created on the basis of different guides used over the past ten years. Another problem is that the method of determining specific costs is also varied, a fact that cannot be justified by different price levels.

When evaluating the effect of individual investments it can be stated that **benefits are primarily due to reduction of passenger time and accident cost**. By the modernization of railway lines, stations and structures the capacity of the network will increase, the safety of the railway traffic will improve. However due to those actions the Maintenance Costs and due to higher velocity the Vehicle Operating Costs will also be increasing.

With the realization of the most missing network elements the number of the investments of the highest cost efficiency will be decreasing. **Cost-Benefit Analyses can help professionals in selecting the most cost effective projects as priorities.**

The planned investments, together with the renewal and completion of the existing infrastructure, will create a modern high capacity railway network and can also contribute to the economic development of less developed regions in Hungary.

Keywords: ex-post evaluation, traffic study, railway investments, CBA, Hungary

INTRODUCTION

The **objective of our paper** is: the review and the results' summary of railway cost-benefit analysis made between 1998 and 2007; developing the efficiency analysis' methodology of railway investments, as well as composing proposals for the innovative using up of EU sources. At first it summarizes the results of cost-benefit analysis made previously for railway investments, which were realized in the last years, after that it sets an aim to composing recommendations and general statements by the 3 chosen sample projects.
The analysis contains the following subsections:

1. the **selection and the description** of three projects as **case studies** (for three investment types: building and reconstruction of sections, stations and structures);

2. the **review of CBAs of selected projects** in details;

3. the collection and comparison of the main planned and actual data of the projects (traffic volumes, investment costs, maintenance and operating costs)';

4. setting up proposals.

The project list contains attributes, evaluation figures which can be used up for further examinations as a database. The 3 selected sample projects suitably represent the whole spectrum of railway developments.
Previously made methodology guides had not been available for cost-benefit analysis, therefore economic evaluation models were determined one by one in many cases.

COST-BENEFIT ANALYSIS OF RAILWAY INVESTMENTS

We have grouped the rail investments to the following categories:

1. line modernizations,
2. bridge and other construction projects,
3. station reconstructions,
4. other rail investments.

Comparing the economical characteristics of the line modernization projects

Analysing the NPV (Net Present Value) values, we can state that in most of the proposed projects the benefits are higher than the costs. The projects are remunerative investments for the nation in the evaluation period, which is 25 years. Financially the **most effective investments are around the capital** (Budapest-Ferencváros – Budapest-Kelenföld) or border-crossings.

Analysing the IRR (Internal Rate of Return) values, the rates are higher than the expected alternative return, so it is valuable to realize.

The IRR values – similarly to the NPV values – are better concerning the suburban lines and international main corridors.

Comparing the economical characteristics of the bridge construction projects

Economic parameters both of the rail structures (mainly bridges) reconstruction and construction of new structures are influenced by the **location, environment, and position in the rail network**.

Generally the bridge construction works have significantly higher benefits and IRR values than the line modernization projects. The exception is the Northern (Északi) railway bridge, in which project the traffic was lower than expected and so the benefits were lower than the investment costs.

Comparing the economical characteristics of the station reconstruction projects

All of the station reconstruction projects are affordable, but only in mid- or long term. The time of the economical remuneration is strongly influenced by the traffic volume.

Comparing the economical characteristics of other rail investment projects

The **Cegléd – Győr line electrification** is financially affordable, and the economical parameters are enlarged by the positive externalities of the environmentally beneficent traffic.

The **modernization of the vehicle fleet** is also considered as an affordable investment. Firstly because the new trains (Siemens-Desiro, Talent, Flirt) are ensuring shorter travel times than before, and are more environmental-friendly, while the passengers also enjoy it (the growth of the passenger traffic is verifiable). Secondly with the changes of freight trains the capacity is increasable, while the noise and other negative environmental effects are reducible.

SUMMARY OF THE REVIEWED COST-BENEFIT ANALYSES

The CBA results of the analyzed investments are in **Table 1.**

To sum it up, **most of the analyzed projects are cost-effective**, while the others are necessary to realise. The NPV values are positive and the BCR is more than one for the greatest part of the projects. These are remunerative investments for the national economy.

After the comparison of the efficiency indexes it is clear that from some parts of the results it is not easily decidable, which are the best possible investments seeing the situation from the economical point of view. The position in the rail network seems to be the most definitive factor. The most economical investments are either on the international main lines or on the suburban lines of Budapest.

Esteeming the effects of the investments it is clear that the advantages are mainly the **decreases in the travel times and accidental costs**. With the reconstruction of lines, stations and structures the capacity becomes higher, and the traffic safety improves, but the maintenance and vehicle operating costs (due to the higher speeds) increase.

The number of the most cost-effective investments will decrease after the most required links construction will be finished. The general purpose is to create a transport infrastructure, which uses the available resources with the best possible **cost-effectiveness** regarding the short-term investment and long-term operating factors. The cost-benefit analyses help the experts to choose these.

The proposed investments – reconstruction and expansion of the current infrastructure - are about to create a **modern rail network with high capacity**, which can satisfy the grown freight traffic, and regional passenger traffic demands. A modern rail network could support the improvement of the back warded region’s economy.

Table 1: Details of rail project investments

	A	B	C	D	E		F	G	H	I
	Project name	**Project details**					**Evaluation indicators**			
		Section length (km)	Investment cost (billion HUF)	Increase in passenger traffic (%)		Year of the CBA	Net Present Value (NPV, billion HUF)	Benefit-cost Ration (PVB/PVC)	Internal Rate of Return (IRR, %)	Length of remuneration (year)
				Short-term	Long-term					
	Line modernization									
1	Budapest – Cegléd - Szolnok	100	55,630	4,00%	1,50%	2000	56,305		12,69	11
2	Budapest – Dabas – Lajosmizse	73	11,000	1,00%	1,00%	2003	5,174	1,489	9,40	
3	Hatvan – Somoskőújfalu	65	10,780	2,00%	1,00%	1999	-5,181			
4	Martfű – Szentes line modernization, Hármas-Kőrös bridge reconstruction	42	2,407	1,50%	0,00%	1999	1,495		11,50	15
5	Budapest – Szob	64	14,970	2,00%	1,00%	1999	0,239		6,10	33
6	Bp. Ferencváros – Bp. Kelenföld left track reconstruction	6	2,250	2,00%	1,50%	1999	81,858		46,50	5
7	Rákos – Újszász	76	16,370	2,00%	1,50%	1999	-2,773		4,80	
8	Budaörs – Biatorbágy	4	2,400	2,00%	0,00%	1999	1,816		10,10	19
9	Nagytétény - Diósd - Érd	4	2,630	1,00%	1,00%	1999	12,210		31,00	5
10	Wide-gauge track network modernization around Záhony		0,800			1999	3,975		27,00	5
11	Zalalövő - Zalaegerszeg - Boba	83	2,980			1999	3,935		8,00	15
12	Budapest - Kelebia	163	36,100			1999	-23,109			7
13	Budapest - Miskolc - Nyíregyháza - Záhony	336	21,300			1999	2,765		9,20	10
14	Budapest - Dombóvár - Gyékényes	263	40,600			1999	7,072		8,00	14
15	Budapest - Nagykanizsa - Murakeresztúr	168	18,600			1999	-4,845		0,80	
16	Szolnok - Békéscsaba - Lőkösháza	125	18,300			1999	-3,921		2,80	
17	Szolnok - Debrecen - Nyíregyháza	170	44,700			1999	1,850		6,50	9
18	Dombóvár - Magyarbóly - Országhatár	107	2,403			1999	0,025		6,10	22
19	Balatonfűzfő - Tapolca	86	36,200	2,00%	1,00%	2005	-0,810	0,97	4,70	
20	Hatvan - Somoskőújfalu	65	55,000	2,00%	1,00%	2005	5,385	1,176	6,10	
21	Mezőzombor - Sátoraljaújhely	41	38,200	1,50%	1,00%	2005	8,663	1,389	7,30	
22	Püspökladány - Biharkeresztes	51	34,500	2,00%	1,00%	2005	-8,356	0,578	0,40	
23	Székesfehérvár - Nagykanizsa	154	117,400	1,30%	1,00%	2005	-34,371	0,554	0,00	
	Bridge reconstruction projects									
24	Déli railway bridge third structure reconstruction		5,280	1,50%		1999	86,866			1
25	Északi railway bridge modernization		4,880	2,00%		1999	-3,592			
26	Redumption of the Kisköre road and rail bridge		0,990	2,00%	1,00%	1999	0,395		10,70	15
27	Modernization of Sió-bridge at Simontornya		0,640	1,00%	1,00%	1999	15,276		93,00	1
	Station reconstructions									
28	Rákospalota – Újpest staion construction			2,00%		2003	4,036		5,91	13,3
29	Érd and Érd-embranchment station construction		4,013	6,00%		2003	31,830		20,70	16
30	Érdliget station reconstruction		0,466	4,00%		2004	0,389	1,87	11,00	
	Other rail investment projects									
31	Győr-Celldömölk line electrification		5,117			2003	6,970		10,50	
32	Nógrád Regional Rail: Vác - Balassagyarmat section	70	9,675	1,50%	1,00%	2005	16,250	3,309	22,30	
33	Nógrád Regional Rail: Aszód - Balassagyarmat section	49	7,465	1,50%	1,00%	2005	2,050	1,371	8,60	

EX-POST EVALUTIONS

Frame of the analysis, sample projects

In the comparison of the realised sample projects we analysed the differences between the original data and also the reasons of these differences.
The analysed sample projects are the followings (**see Figure 1**):

1. **Modernization of the Budapest – Vecsés and Szajol – Lőkösháza sections:** As the part of the Budapest - Cegléd - Szolnok – Lökösháza railway line the Budapest- Kőbánya-Kispest - Vecsés and Szajol - Lőkösháza sections were evaluated. The project consist of new track construction, speed limit increase, existing track rehabilitiation and high level passenger information system construction.

2. **Reconstruction of Érdliget station:** As the part of the track-bound suburban public transport improvement between Budapest and Érd project, the Érdliget station reconstruction were implemented. The investment cosnsist of several constructions like new roof over the platform, new passenger information systems, new lightning, new P+R parking over 110 space capacity and new connecting roads.

3. **Reconstruction of the Northern (Északi) railway bridge:** The Northern (Északi) railway bridge is part of the Budapest - Esztergom railway line. This line has an important role in the suburban transport of Budapest agglomeration. Before the investment there was a 10 km/hspeed limit over the bridge with the exception of the light Multiple Units using for passenger transport (20 km/h). The authorized speed on the bridge after investment is 80 km/h.

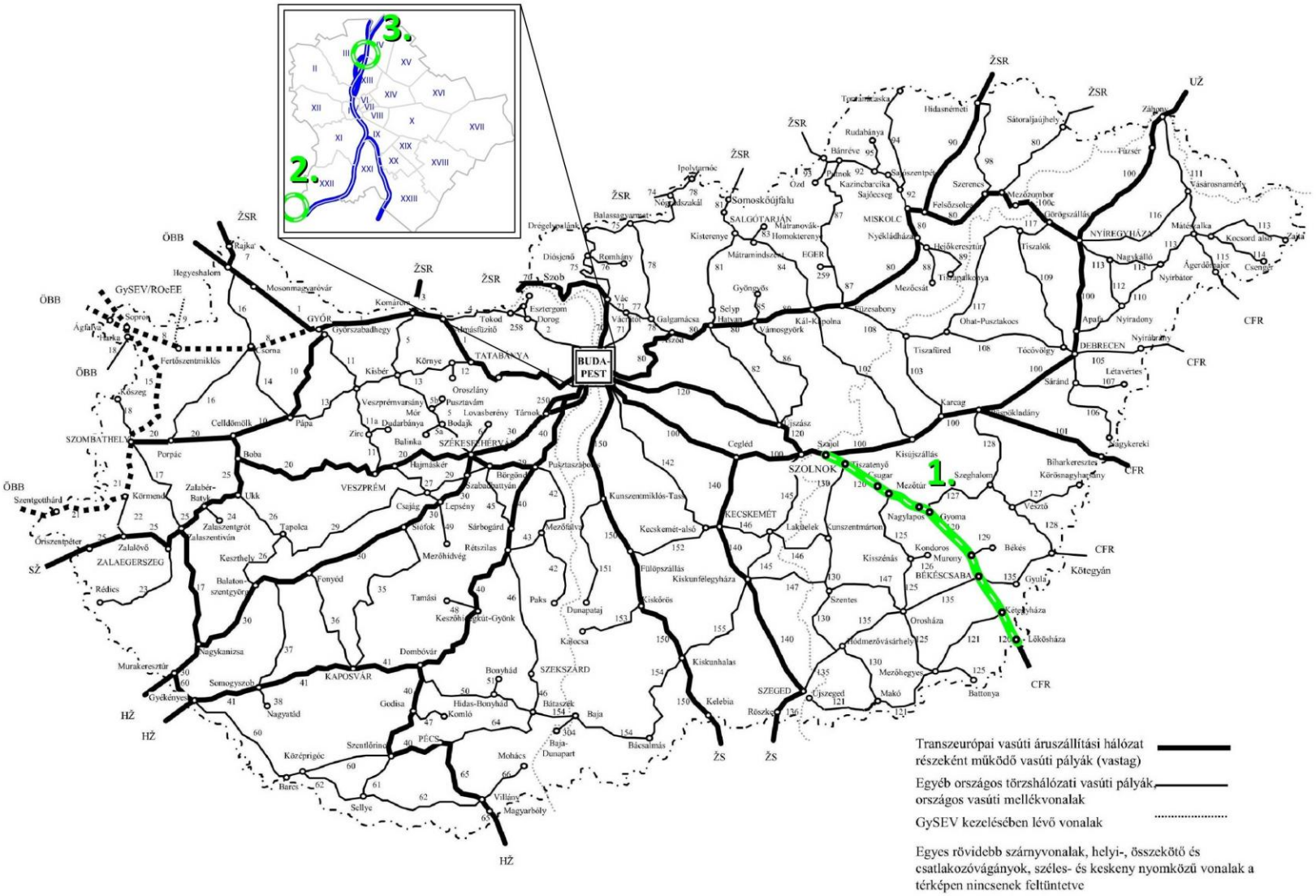

Figure 1.: Location of the sample projects in Hungary

Changes in the investment costs

The investment cost contains every expenditure regarding the realization, which can be summed up from the expenditure of the different sections. Differences in the specific costs separately and cumulatively influence the whole investment cost. During the analysis we compared the original and the actual costs.

Based on the Hungarian and international experiences the **investment costs are often underestimated**. In general slight increases in the investment costs are expectable. These increases are causing drops in the financial and social effectiveness of the projects.

Changes in the schedule of the investment

Time schedule changes generally have two important effects: the growth of the investment costs and diminish in the predicted traffic. So if the investment cannot be realized within the original timeframe, it is always a cost increasing factor.

The shortfalls from the original schedule are causing drops in the financial and social effectiveness of the projects.

Changes in the operating and maintenance costs

The **operating and maintenance costs** are playing an important role in the analysis, as these costs can be highly different than the predicted ones.

The collection of the facts for the comparison of these costs are usually very hard, and often there are **not so well detailed and does not contain detailed values**. The operational costs are planned by specific costs.

Similarly to the investment costs the operating and maintenance costs will probably also slightly increase.

Changes in the traffic volumes

The **tendencies of the passenger and freight traffic** are ones of the most important bases of the assessment. The economical analysis almost fully lean on the traffic volumes. The evaluation indicates the differences between the predicted and actual data, verify or deny those correctness.

Based on the Hungarian and international experiences the **traffic volumes are generally overestimated.** The actual traffic probably does not reach the planned level, and as a consequence the benefits become lower.

The decreased benefits are causing drops in the financial and social effectiveness of the projects.

Advantages and barriers of ex-post evaluations

The economic ex-post evaluation of the completed investments can be give a numerous information. From the analysis it appears how accurate the estimated parameters like forecasted traffic volume. The schedule of the project and the implementation costs can be exactly determined.
At the same time we can run into some **barriers due to the short time** pass since the investments. This makes more difficult to process the available facts and draw the conclusions. Making clear and exact statistics is difficult and the trends are not stable due to the short time period between the end of the investment and the ex-post analysis.
Impacts of parallel investments have to be underlined as an important indicative factor. Parallel investments may cause **significant traffic realignment**, mainly related to motorway constructions.
Advantages and barriers of the ex-post evaluations can be stated as follows.

Advantages:

1. The analysis can compare the planned and the actual values of the project
2. Can be determined the main differences, can be analyzed the changes of the main parameters
3. Can be formulated recommendations which are useful to create more accurate analysis by the means of the results of the ex-post evaluation

Barriers:

1. The **length of time periods** between the year of evaluation and the finalization of the investments (3 -5 years) **are not long enough**. These short time periods are not sufficient for analyzing long term data, however it can be shown the initial impact and result of the project:
    a. **trends are not stable**,
    b. analyzing the changes of the accidents by statistical instruments are not possible,
    c. travel behaviour is not changed yet,
    d. the immediate traffic changes are hardly identifiable.
2. The changes of the macro-economic environment (GDP, inflation) can be differ from the planned, so the impact of this are hardly eliminate or forecast.

EX-POST EVALUATION OF SAMPLE PROJECTS

Budapest – Vecsés, Szajol – Lőkösháza railway line reconstruction

Changes in traffic data

Figure 1 clearly shows that the traffic of the line section had been declining until the implementation of the cyclic suburban timetable in 2005, since then it has been increasing. Having evaluated the traffic data it can be concluded that the passenger freight forecast was accurate in the short-run. However, there were some significant factors, which slightly modified the medium and long-run scenarios (improvement of the Budapest suburban railway transport and Romania's accession to the EU).

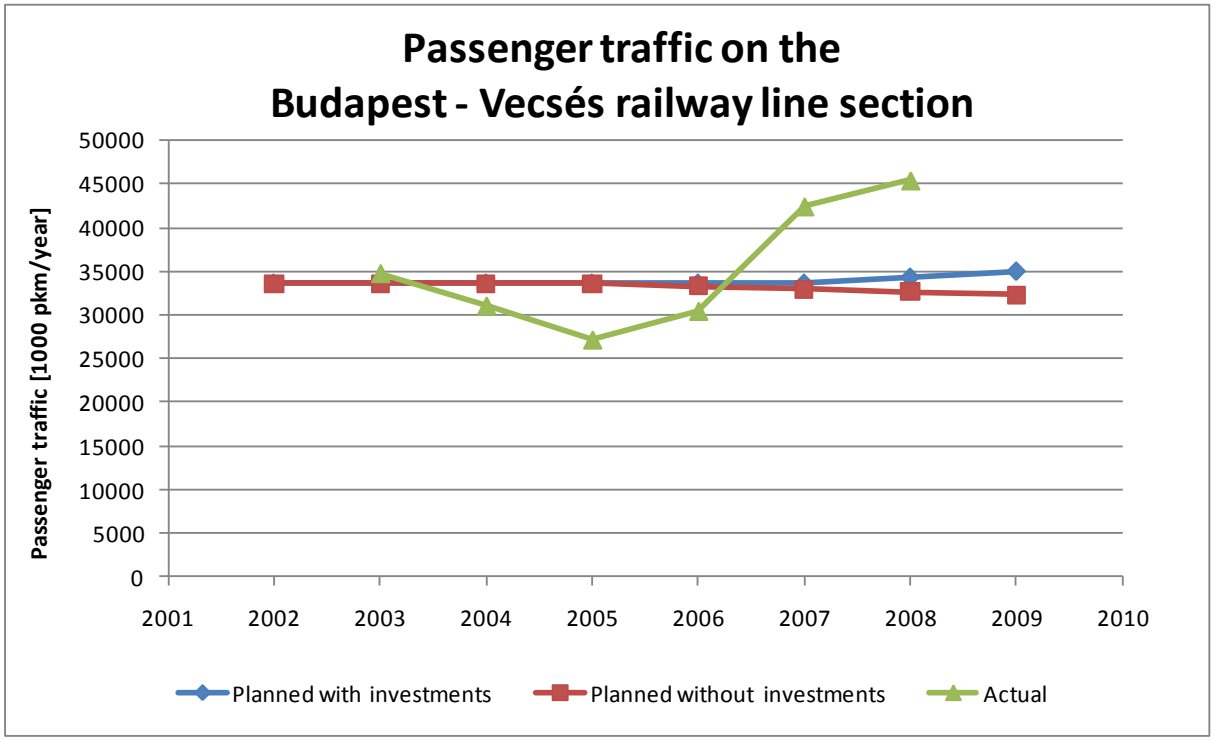

Figure 1: Tendencies of the passenger traffic in the Szajol-Lökösháza line section [Source: MAV.]

Based on **Figure 2**, we can state that the volume of the actual commodity freight has exceeded the estimated values, which is most probably a result of the accentuateing international role of the section. The economic efficiency of the project is further improved by the advantageous tendency of the transport performance.

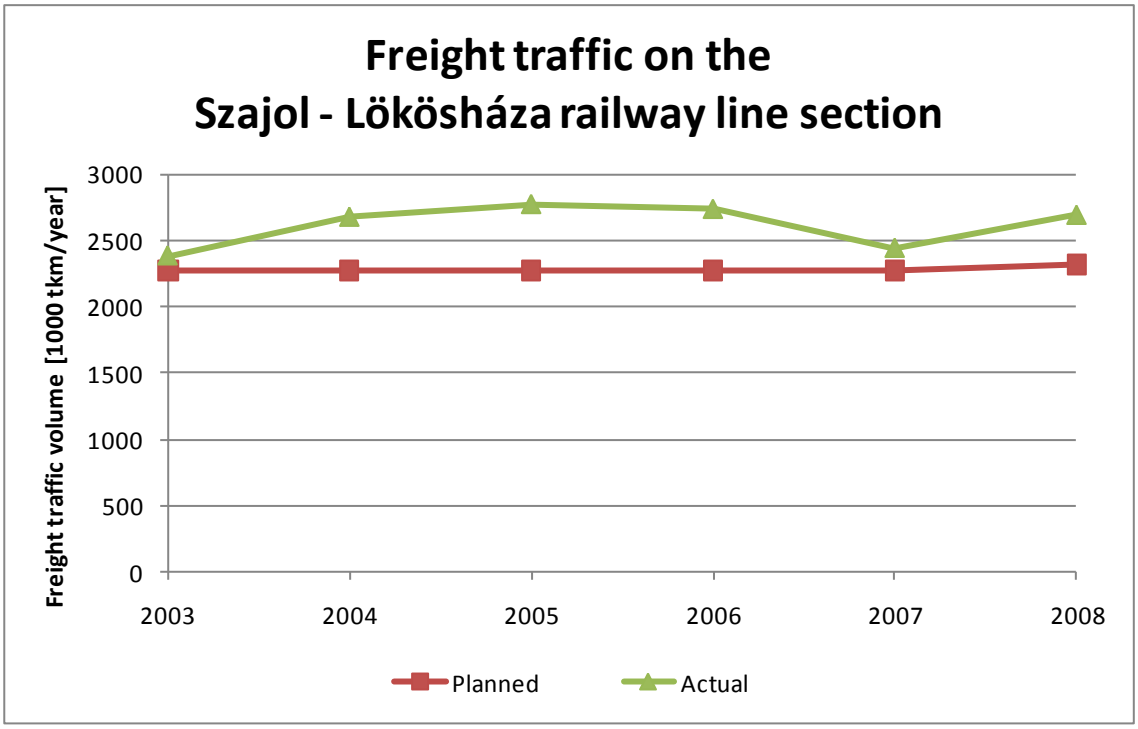

Figure 2: Tendencies of the freight traffic along the line section Szajol-Lökösháza [Source: MAV]

Changes in the investment costs

Table 2 shows that less than 50 % of the planned investments were actually carried out in the period of 2003-2007.

Table 2: Comparison of the incestment costs of the Budapest-Vecsés and Szajol-Lökösháza railway line [Source: MAV]

Investment costs		
million EUR (price level: 2007)	Planned	Actual
Bp.Ferencváros - Vecsés	23,94	26,01
Szolnok - Szajol	6,31	0,00
Szajol - Mezőtúr	83,00	87,96
Mezőtúr - Gyoma	36,14	2,07
Gyoma - Békéscsaba	21,05	4,53
Békéscsaba - Lőkösháza	53,48	9,59
Other locations	49,85	0,42
Total	**273,77**	**130,57**

In case of the implemented investments, extra costs arisen during the reconstruction of the section Szajol-Mezőtúr and Bp.Ferencváros-Vecsés were 5,98 % and 8,62 % of the planned price respectively. Hence, the **investment costs are underestimated**. The size of the deviation does not exceed the 8 % contingency rate in case of the Szajol-Mezőtúr section. However, in case of the Bp. Ferencváros-Vecsés section it exceeds the planned contingency rate by 0,62%. The increase in the investment costs obviously leads to the loss of project efficiency.

Changes in the schedule

In the project schedule there are significant timing miscalculations. The whole project has not been realized under the period of 2003-2007. Increases in the investment costs might occur due to the timing problems.

Reconstruction of the Érdliget stop

Changes in the traffic data

The traffic data clearly show that the traffic of the stop is overvalued. However, it is quite surprising that compared to the traffic in 2004 there has been a decline of 31,6 %. The reasons behind are mainly the modifications appeared in the timetable of the suburban railways.

Changes in the investment costs

The ratio of investment costs in the planned and actual costs are quite different, therefore we compare the values estimated for all the project costs. (**Table 3**)

Table 3: Comparison of the Érdliget stop's planned and actual investment costs [Source: MAV]

Investment cost of Érdliget stop reconstruction					
million HUF (price level:2008)	2005	2006	2007	2008	**Total**
Planned	1,32	532,39	0,00	0,00	**533,71**
Actual	0,00	316,33	205,64	15,37	**537,34**
Difference	-1,32	-216,06	205,64	15,37	**3,63**

The whole investment has been realized approximately according to the planned costs, with with only a 0,68 % excess. The estimation of the investment costs can be said punctual.

Changes in the scheduling

Scheduling has been carried out as planned, with the ony extension in the construction time. The deviation becomes tangible only in the period of the invoicing.

Northern (Északi) connecting railway bridge reconstruction

Changes in the traffic data

The planned and actual traffic of the Északi connecting railway bridge is depicted in **Table 4**.

Table 4: Comparison of the traffic data of the Északi connecting railway bridge [Source MÁV].

	Average Daily Traffic (passengers / day)		Difference	
	Planned	**Actual**	**pass. / day**	**%**
Északi connecting railway bridge	4449	8522	4073	91,5%

Actual data are almost two times higher than the planned figures because the traffic forecast did not take into account the implementation of the cyclic suburban timetable and the improvement of the density of the service.

Changes in the investment costs

Investment costs involve the costs of all project elements. In **Table 5** we compare the planned and actual investment costs for the project.

Table 5: Comparison of the Északi railway bridge investment costs [Source: NIF]

Investment cost (price level: 2008)			
	Planned	**Actual**	**Difference**
Billion HUF	12,73	15,74	23,69%
Million EUR	53,98	66,77	23,69%

The realization of the project cost 23,69% more than planned, therefore the costs were undervalued to a large extent.

Changes in the scheduling

Compared to the planned scheduling there were significant delays. These delays will probably increase the project expenditures.

SUGGESTIONS, RESULTS, COMMENTS REGARDING THE SAMPLE PROJECTS

We have chosen three main investment type sample projects: track, station and structure reconstruction and renovation to demonstrate it like case studies. Having evaluated the cost-benefit analyses of the chosen sample projects, we have gathered the main traffic, investment, maintenance and operating details featuring the projects and compared them with the actual numbers.

The general objective is to establish the **most cost-efficient transport infrastructure** possible whose construction is feasible with the available resources both from the point of view of the medium term and long-term scheduling.

Based on the comparison we can conclude the follows:

a) investment costs exceed the planned values in most cases,

b) there were serious delays compared to the planned scheduling,

c) operating and maintenance costs did not reach the planned numbers,

d) railway traffic data in the short run are satisfying, but the tendency is a bit exaggerated.

The comparison of the CBA-s is further complicated by the fact that in the last 10 years the studies have been made according to **different guides**. Other problems may arise because the **definition of the specific costs** is also not uniform so it cannot be only explained by the different price levels' influence. Specific time and accident costs are considered to be different in the various guides.

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