# NEW REGULAR INTERVAL TIMETABLES IN OPERATION ON THE SUBURBAN LINES OF THE HUNGARIAN STATE RAILWAYS

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**Summary: This paper presents the introduction of the new regular-interval timetable structure on the suburban railway lines of Budapest, including the steps of planning and implementation. It also explains the experiences of the new system and the effects on the costs and benefits. Then - based on the results - it makes a proposal on the extension of the system to the whole Hungarian railway network.**

## 1. Introduction

In the past 15 years, the population of Budapest has decreased by about 300.000. More and more people move to the rapidly growing cities within a distance of 50-60 km-s around the capital. This mass migration out of the city and into the suburbs resulted in a formidable increase of commuters. In each day about 600.000 people commute between the city and the outskirts.

However, in the past 5 years the number of passengers travelling by train in the suburban area stagnates, which clearly shows that the time has come for the railways to respond.

In 2004 according to the current strategy of the Hungarian State Railways (MÁV Rt.) a project called „Suburban Railway Development Project" was started. The aim of this project is to determine the passenger demands, provide better services with a basically new timetable structure, new vehicles and infrastructure developments.

The new timetable structure has strategic importance, since it plays significant role in the planning process of optimal infrastructure and rolling stock development. On the other hand, the development of the timetable has the greatest flexibility in spite of the limited available resources. Thus, it is the cheapest way to provide better services.

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The building of the new timetable structure for the suburban area of Budapest has begun in 2004. As a pilot project, a new ITF-style [2] [5] timetable was introduced on two suburban lines carrying heavy commuter traffic. After six months of operation, it can be stated that this new timetable is a great success which is proven by the increasing number of passengers and a comprehensive demand survey.

## 2. The lines of the pilot project – no. 70 and 71

For the pilot project, lines no. 70 and 71 (Fig.1.) were chosen, since these lines had

- no long-distance traffic, just a few international trains (suburban traffic dominates)
- good infrastructural conditions
- multimodal interchange nodes (bus, ferry, narrow gauge train)


Fig. 1. Lines no. 70 and 71

Mainline no. 70 running along the river Danube is not just a suburban line but an important international link to Slovakia as well. It is double track, electrified, equipped with double direction automatic block control and the allowed speed is 100-120 km/h. Line no. 71 is single track, electrified and equipped with centralized traffic control (3 stations are remote controlled). The allowed speed is 60-80 km/h.

In 1991 giving up the old practice (commuter trains running only in the morning and the afternoon), a new periodic-like timetable was introduced on line no. 70 with stopping trains running most of the day. This resulted in a significant increase of passengers in the first years, which settled down around 2000, and later the tendency reversed.

## 3. The first steps – determining the demands of the commuters

In 2004 a non-representative survey was made on the homepage of the Hungarian State Railways (Fig.2.) to determine passengers' priorities for improvements to the quality of suburban railways. The major finding of the study was that most of the passengers require short journey times and frequent services, while the comfort and the price seem to have much less importance. This means that replacing the rolling stock with new, comfortable vehicles would not solve the problems in the suburban area. The vast majority of the commuters just

need fast, frequent and predictable services, which can be achieved by the development of the timetable.

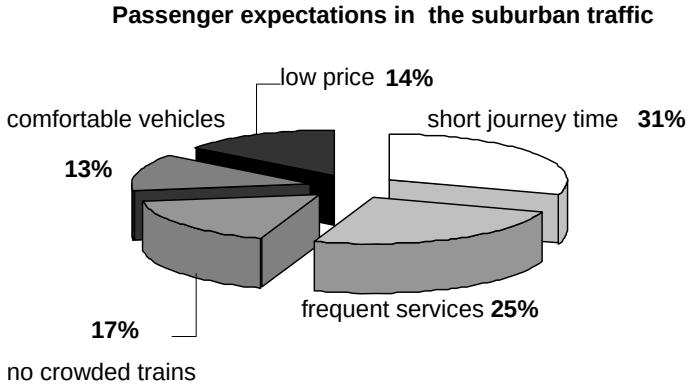



Fig. 2. Results of the demand survey carried out in 2004

In the meantime, another survey was made of the commuters travelling by car to/from the city. 84% of the responders said that the most important reason for using the car is the short journey time. 36% of car commuters answered that they would switch to train if there were regular train services with competitive journey time at least in every hour.

It is important to note that most of the commuters found the existing train service frequency adequate in the peak hours (15-20 minutes), while the journey time of the stopping trains was stated unacceptable.

It must be taken into consideration that commute habits are changing. The beginning of the work in the city is slowly shifting to 9:00 AM, while the work often ends after 6 PM. The number of employees working in flexitime, university students etc. is steadily increasing. All these lead to the conclusion that adequate service frequency must be provided not just in the rush hours, but at all other times of the day.

To get clear picture of the existing passengers' habits a comprehensive survey was carried out by the means of a questionnaire. The results of this survey helped to decide which timetable structure should be used.

## 4. The structure of the new suburban timetable

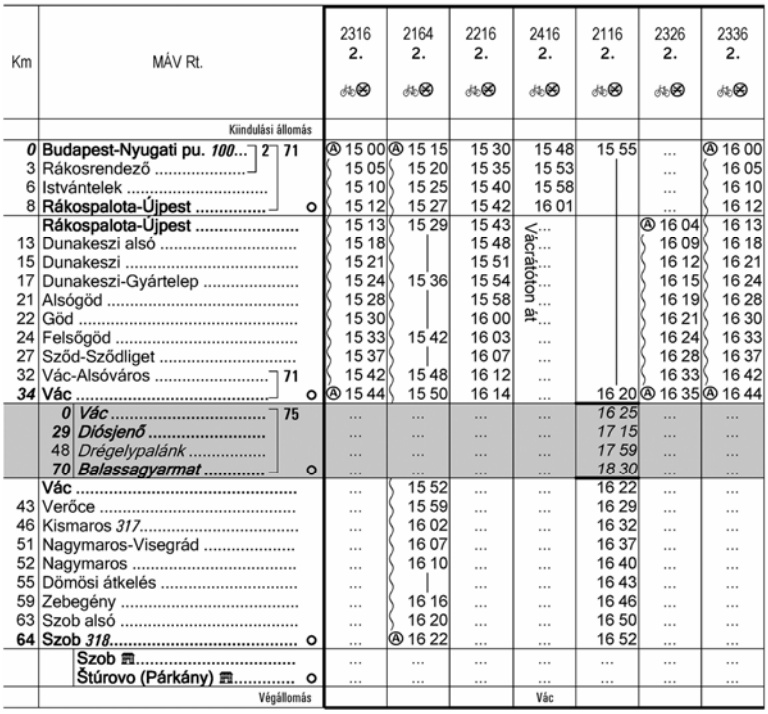
Before the introduction of the new timetable structure, there were only stopping trains, some semi-fast trains in the peak hours and a few international fast trains.

To meet the passengers' demands, an ITF-type timetable was built up, which relies on four main factors:

- the periodicity, which has to be a multiple or submultiple of 60 minutes,
- the symmetry,
- the connection system at the network nodes ("Spinne" or "spiders")
- the zoning system.

The basic structure („Grundtakt") is quite simple: mainline no. 70 is divided into two zones. The zone boundary is station Vác city (population: 34.000), which is at about the halfway of the line. In the first zone („the inner circle") stopping trains run in every 30 minutes in workdays and 60 minutes at weekends. The second zone („the outer circle" ending at Szob) is served with a periodicity of 60 minutes by the new zoning trains, which do not stop until the zone boundary, then stop at all stations between the zone boundary and the end

of the line. Without disturbing the basic structure of the stopping trains there are regular extra trains („Zusatzzüge”) in the peak hours.



| Km | MÁV Rt. | 2316 2. | 2164 2. | 2216 2. | 2416 2. | 2116 2. | 2326 2. | 2336 2. |
|---|---|---|---|---|---|---|---|---|
| | Kiindulási állomás | | | | | | | |
| 0 | **Budapest-Nyugati pu.** *100...* 2 71 | Ⓐ 15 00 | Ⓐ 15 15 | 15 30 | 15 48 | 15 55 | ... | Ⓐ 16 00 |
| 3 | Rákosrendező | 15 05 | 15 20 | 15 35 | 15 53 | | ... | 16 05 |
| 6 | Istvántelek | 15 10 | 15 25 | 15 40 | 15 58 | | ... | 16 10 |
| 8 | **Rákospalota-Újpest** o | 15 12 | 15 27 | 15 42 | 16 01 | | ... | 16 12 |
| | **Rákospalota-Újpest** | 15 13 | 15 29 | 15 43 | Vácrátóton át | | Ⓐ 16 04 | 16 13 |
| 13 | Dunakeszi alsó | 15 18 | \| | 15 48 | ... | | 16 09 | 16 18 |
| 15 | Dunakeszi | 15 21 | \| | 15 51 | ... | | 16 12 | 16 21 |
| 17 | Dunakeszi-Gyártelep | 15 24 | 15 36 | 15 54 | ... | | 16 15 | 16 24 |
| 21 | Alsógöd | 15 28 | \| | 15 58 | ... | | 16 19 | 16 28 |
| 22 | Göd | 15 30 | \| | 16 00 | ... | | 16 21 | 16 30 |
| 24 | Felsőgöd | 15 33 | 15 42 | 16 03 | ... | | 16 24 | 16 33 |
| 27 | Sződ-Sződliget | 15 37 | \| | 16 07 | ... | | 16 28 | 16 37 |
| 32 | Vác-Alsóváros 71 | 15 42 | 15 48 | 16 12 | ... | | 16 33 | 16 42 |
| *34* | **Vác** o | Ⓐ 15 44 | 15 50 | 16 14 | ... | 16 20 | Ⓐ 16 35 | Ⓐ 16 44 |
| *0* | *Vác* 75 | ... | ... | ... | ... | *16 25* | ... | ... |
| *29* | *Diósjenő* | ... | ... | ... | ... | *17 15* | ... | ... |
| 48 | *Drégelypalánk* | ... | ... | ... | ... | *17 59* | ... | ... |
| *70* | *Balassagyarmat* o | ... | ... | ... | ... | *18 30* | ... | ... |
| | **Vác** | ... | 15 52 | ... | ... | 16 22 | ... | ... |
| 43 | Verőce | ... | 15 59 | ... | ... | 16 29 | ... | ... |
| 46 | Kismaros *317* | ... | 16 02 | ... | ... | 16 32 | ... | ... |
| 51 | Nagymaros-Visegrád | ... | 16 07 | ... | ... | 16 37 | ... | ... |
| 52 | Nagymaros | ... | 16 10 | ... | ... | 16 40 | ... | ... |
| 55 | Dömösi átkelés | ... | \| | ... | ... | 16 43 | ... | ... |
| 59 | Zebegény | ... | 16 16 | ... | ... | 16 46 | ... | ... |
| 63 | Szob alsó | ... | 16 20 | ... | ... | 16 50 | ... | ... |
| 64 | **Szob** *318* o | ... | Ⓐ 16 22 | ... | ... | 16 52 | ... | ... |
| | **Szob** | ... | ... | ... | ... | ... | ... | ... |
| | **Štúrovo (Párkány)** o | ... | ... | ... | ... | ... | ... | ... |
| | Végállomás | | | | Vác | | | |

Fig. 3. Cutout from the timetable of mainline no. 70 in the afternoon peak hours. Trains no. 2164, 2416-2326 are the additional trains. Train no. 2416 runs on line no. 71. from Rákospalota-Újpest.

On line no. 71 it was not possible to create a zoning structure because of the infrastructural conditions (single track), so a simple, symmetric and periodic timetable was introduced with additional fast trains running in the peak hours.

| **Old timetable** | | | | | | | **New timetable** | |
|---|---|---|---|---|---|---|---|---|
| hour | minute | | | | | | minute | |
| **5** | | | | | 40 | | | 48 |
| **6** | | | | 35 | | | | 48 |
| **7** | | | | | | 50 | | 48 |
| **8** | | | | | | | | 48 |
| **9** | | 10 | | | | | | 48 |
| **10** | | 10 | | | | | | 48 |
| **11** | | | | | | | | 48 |
| **12** | | 10 | | | | | | 48 |
| **13** | | | | 35 | | | | 48 |
| **14** | | | 20 | | | | 23 | 48 |
| **15** | 5 | | | | 40 | | 23 | 48 |
| **16** | 5 | | | | 40 | | 23 | 48 |
| **17** | 5 | | | | 40 | | 23 | 48 |
| **18** | | | | 35 | | | 23 | 48 |
| **19** | | | | | 40 | | | 48 |

Fig. 4. Comparison of departure times from Budapest-Nyugati pu. on the line no. 71 in the previous and the new timetable (trains running after 8 PM are not included)

The significant structural change on the two lines required to modify the timetable of the connecting branch lines and bus routes as well, so the periodic timetable simply “spread” through the region. However, in the timetable of branch lines there are still some “holes” outside the peak hours.

The suburban lines together with the connecting railway lines, the regional buses and the ferry on the Danube construct a complete transport system based on changing relations.

The application of the zoning system resulted in a significant journey time decrease approximately to about 30% of the passengers. It is important to note that the new system did not cause unfavourable change in service frequency or journey time to any of the passengers.

Despite the fact that there is a new highway between Budapest and Vác, the 25 minutes journey time of the zoning trains running at a top speed of 120 km/h is absolutely competitive, especially in the morning. Because of the traffic jams and slowness of the car traffic in the inner city travelling by train and public transportation became the fastest way.

## 5. Introduction of the new timetable

The periodic timetable enabled to create simple, clearly structured „follow-up" brochures and small "reminder" timetable cards (Fig. 5.). 50,000 pieces of these cards were handed out to the passengers.

A separate webpage - www.mav.hu/utemesmenetrend - has also been designed, dedicated entirely to the introduction of the new timetable and the up-to-date timetable-brochures.

MÁV VONALI ÜTEMES MENETREND

PERIODIC TIMETABLE • TAKTFAHRPLAN

**71 Budapest-Nyugati pu.–Veresegyház–Vác**

Érvényes • Valid • Gültig: 2004.XII.12. - 2005.XII.10.

| ALAPÜTEM (NAPONTA KÖZLEKEDIK) BASIC STRUCTURE (RUNS DAILY) • GRUNDTAKT (FÄHRT TÄGLICH) | | | | | | | ALAPÜTEMEN FELÜLI VONATOK ADDITIONAL TRAINS • ZUSATZZÜGE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ◆ | ◆ | ◆ | ◆ | ◆ | ◆ | Hétfő (Mo., Mo.) | ◆ | | ◆ | ◆ | ◆ | ◆ | ◆ | |
| ◆ | ◆ | ◆ | ◆ | ◆ | ◆ | Kedd (Tu., Di.) | ◆ | | ◆ | ◆ | ◆ | ◆ | ◆ | |
| ◆ | ◆ | ◆ | ◆ | ◆ | ◆ | Szerda (We., Mi.) | ◆ | | ◆ | ◆ | ◆ | ◆ | ◆ | |
| ◆ | ◆ | ◆ | ◆ | ◆ | ◆ | Csütörtök (Th., Do.) | ◆ | | ◆ | ◆ | ◆ | ◆ | ◆ | |
| ◆ | ◆ | ◆ | ◆ | ◆ | ◆ | Péntek (Fr., Fr.) | ◆ | ◆ | ◆ | ◆ | ◆ | ◆ | | |
| ◆ | ◆ | ◆ | ◆ | ◆ | ◆ | Szombat (Sa., Sa.) | ◆ | | | | | | | |
| ◆ | ◆ | ◆ | ◆ | ◆ | ◆ | Vasárnap (Su., So.) | | | | | | | | |
| 2. ⊗ 🚲 | | | | | | | | | | 2. ⊗ 🚲 | | | | |
| … | 5:48 | :48 | 21:48 | 22:48 | 23:48 | Budapest-Nyugati pu. | … | 5 | 13:23 | Ⓐ | 14:23 | Ⓐ | 15:23 | Ⓐ | 16:23 | Ⓐ | 17:23 | 4 | 18:23 |
| … | 5:53 | :53 | 21:53 | 22:53 | 23:53 | Rákosrendező | … | \| | \| | | \| | | \| | | \| | | \| | | \| | | \| |
| … | 5:58 | :58 | 21:58 | 22:58 | 23:58 | Istvántelek | … | \| | \| | | \| | | \| | | \| | | \| | | \| | | \| |
| … | 6:01 | :01 | 22:01 | 23:01 | 0:01 | Rákospalota-Újpest | … | \| | 13:33 | | 14:33 | | 15:33 | | 16:33 | | 17:33 | | 18:33 |
| … | 6:03 | :03 | 22:03 | 23:02 | 0:02 | | … | \| | 13:34 | | 14:34 | | 15:34 | | 16:34 | | 17:34 | | 18:34 |
| … | 6:06 | :06 | 22:06 | 23:05 | 0:05 | Rákospalota-Kertváros | … | \| | \| | | \| | | \| | | \| | | \| | | \| | | \| |
| … | 6:11 | :11 | 22:11 | 23:10 | 0:10 | Alagi major | … | \| | \| | | \| | | \| | | \| | | \| | | \| | | \| |
| … | 6:15 | :15 | 22:15 | 23:14 | 0:14 | Fót | … | \| | 13:42 | | 14:42 | | 15:42 | | 16:42 | | 17:42 | | 18:42 |
| … | 6:18 | :18 | 22:18 | 23:15 | 0:15 | | … | \| | 13:43 | | 14:43 | | 15:43 | | 16:43 | | 17:43 | | 18:43 |
| … | 6:21 | :21 | 22:21 | 23:18 | 0:18 | Fótújfalu | … | \| | 13:46 | | 14:46 | | 15:46 | | 16:46 | | 17:46 | | 18:46 |
| … | 6:24 | :24 | 22:24 | 23:21 | 0:21 | Fótfürdő | … | \| | \| | | \| | | \| | | \| | | \| | | \| | | \| |
| … | 6:29 | :29 | 22:29 | 23:26 | 0:26 | Csomád | … | \| | \| | | \| | | \| | | \| | | \| | | \| | | \| |
| … | 6:35 | :35 | 22:35 | 23:32 | 0:32 | Ivacs | … | \| | 13:56 | | 14:56 | | 15:56 | | 16:56 | | 17:56 | | 18:56 |
| … | 6:37 | :37 | 22:37 | 23:34 | 0:34 | Veresegyház | … | \| | 13:59 | | 14:59 | | 15:59 | | 16:59 | | 17:59 | | 18:59 |
| 4:38 | 6:38 | :38 | 22:38 | 23:35 | 0:35 | | ⚒ | 5:38 | 13:00 | | 14:00 | | 15:00 | | 16:00 | | 17:00 | | 18:00 |
| 4:41 | 6:41 | :41 | 22:41 | 23:38 | 0:38 | Erdőkertes | | 5:41 | 14:03 | | 15:03 | | 16:03 | | 17:03 | | 18:03 | | 19:03 |
| 4:44 | 6:44 | :44 | 22:44 | 23:41 | 0:41 | Viczliántelep | | 5:44 | 14:06 | | 15:06 | | 16:06 | | 17:06 | | 18:06 | | 19:06 |
| 4:46 | 6:46 | :46 | 22:46 | 23:43 | 0:43 | Őrbottyán | | 5:46 | 14:08 | | 15:08 | | 16:08 | | 17:08 | | 18:08 | | 19:08 |
| 4:49 | 6:49 | :49 | 22:49 | 23:44 | 0:44 | | | 5:49 | 14:09 | | 15:09 | | 16:09 | | 17:09 | | 18:09 | | 19:09 |
| 4:55 | 6:55 | :55 | 22:55 | 23:50 | 0:50 | Rudnaykert | | 5:55 | 14:15 | | 15:15 | | 16:15 | | 17:15 | | 18:15 | | 19:15 |
| 4:58 | 6:58 | :58 | 22:58 | 23:53 | 0:53 | Váchartyán | | 5:58 | 14:18 | | 15:18 | | 16:18 | | 17:18 | | 18:18 | | 19:18 |
| 5:01 | 7:01 | :01 | 23:01 | 23:56 | 0:56 | Vácrátót | | 6:01 | 5 | 14:21 | Ⓐ | 15:21 | Ⓐ | 16:21 | Ⓐ | 17:21 | Ⓐ | 18:21 | 4 | 19:21 |
| 5:02 | 7:02 | :02 | 23:02 | 23:57 | 0:57 | | | 6:02 | … | … | … | … | … | … | … | … | … | … | … | … |
| 5:04 | 7:04 | :04 | 23:04 | 23:59 | 0:59 | Csörög | | 6:04 | … | … | … | … | … | … | … | … | … | … | … | … |
| 5:08 | 7:08 | :08 | 23:08 | 0:03 | 1:03 | Márlaudvar | | 6:08 | … | … | … | … | … | … | … | … | … | … | … | … |
| 5:12 | 7:12 | :12 | 23:12 | 0:07 | 1:07 | Vác-Alsóváros | | 6:12 | … | … | … | … | … | … | … | … | … | … | … | … |
| 5:15 | 7:15 | :15 | 23:15 | 0:10 | 1:10 | Vác | ⚒ | 6:15 | … | … | … | … | … | … | … | … | … | … | … | … |

NAPKÖZBEN MINDEN ÓRÁBAN / EVERY HOUR • JEDE STUNDE

2. Csak másodosztályú kocsikkal közlekedik • 2nd class cars only • Nur 2. klasse Wagen

⊗ Nemdohányzó vonat • Non-smoker train • Nichtraucherzug

🚲 Kerékpár az arra alkalmas kocsiban elhelyezhető • Coaches with bicycle compartments • Wagen mit Fahrradabteil

Fig. 5.Example of the new style timetable brochure. The periodic structure made possible to fit the timetable on one page. The left side shows the basic system ("Grundtakt"), while the right the additonal trains ("Zusatzzüge").

## 6. The system in motion – every beginning is hard

Since the ITF-style timetable was a brand new initiative in Hungary, it brought changes not just for the passengers but for the railway workers as well. In the previous timetable trains usually consisted of two coupled electric multiple units, while now single units run. The number of trains increased by 53%. In the first weeks, sometimes the punctuality had fallen to an unacceptable level. This required immediate intervention. By analyzing the reports it turned out that the delays were generally caused by the

- lack of experienced traffic control staff and low technical level of traffic control,
- spreading of delays because of short turnrounds (usually 13 minutes) and the „spiders”,
- capacity problems with some trains,
- problems with synchronization of staff and trainset turnrounds,
- passenger protection problems in stations without subway or footbridge (Vác, Rákospalota-Újpest).

To overcome the problems, the previous concept of keeping one trainset in reserve, which can just „jump in” in case of long delays, had to be given up. The turnrounds were optimized to fit the changed passenger flows, and the typical turnround time on Budapest-Nyugati was increased. New staff assignment was made and the timetable of some train types was slightly changed. After the modifications were carried out, the punctuality improved and the whole system became stable.

It also turned out that it took too long for the staff to get used to the new system. In the future projects more attention must be paid to the education of signalmen and dispatcher staff in order to avoid the mentioned problems.

## 7. More traffic, more passengers

The new timetable quickly brought new passengers. The increase of the number of passengers in the first month was about 10%, and still rising. In Vác station, which plays a key role in the life of the region, the increase was even higher: 12-15% (Fig.6.).

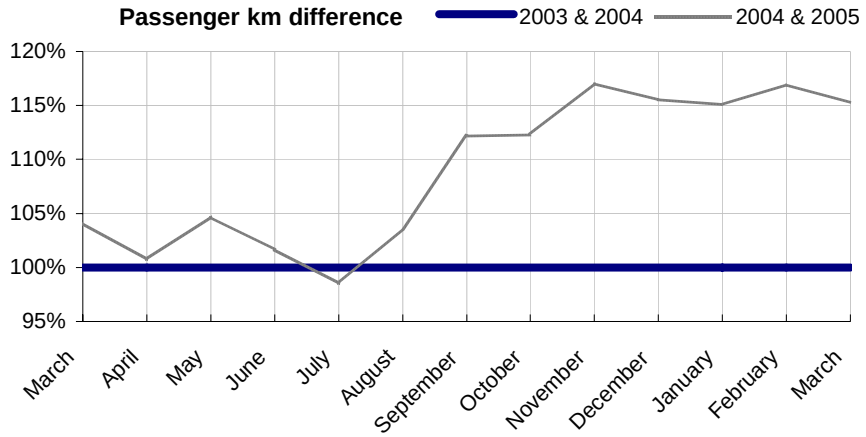



Fig. 6: Comparison of the passenger-km data from Vác station in 2004 and 2005. The new timetable was introduced on 29 August, 2004 Source: MÁV Rt.

According to the expectations [3] the most significant increase took place in the number of commuters from the „outer circle" (between Vác and Szob).

In order to analyze the impacts of the new timetable among the passengers a comprehensive survey was made by asking 1200 random passengers between 22 November and 9 December, 2004. The results showed that the pilot project is a real success. Not just the passengers from the "outer circle" are satisfied but the rest as well. Due to the new timetable, 3% of the current passengers changed from car and 4% from bus to train.

## 8. The new timetable – the financial side

The pilot project also became an economic success for the Hungarian State Railways, since it could be realized from the existing rolling stock and staff. This outstanding achievement was enabled by

- an ITF compliant timetable structure on both lines which fits the passengers' demands,
- optimized turnrounds with lower turnround times,
- eliminating bottlenecks (by reassigning less utilized resources),
- efficient staff assignment based on train allocation.

Income from tickets and season tickets increased by about 12% in the first months. On the other hand, total costs very slightly increased by about 0.4%, mainly caused by the higher traction energy consumption. This is due to the fact that the percentage of variable costs in the cost structure of the suburban railway traffic is quite low.

On the whole, the cost increase of the new timetable is only 10% of the income increase.

## 9. Conclusions

Summing up, the introduction of the system was followed by great success. It can be stated that the robustness of the new timetable has stabilized, and it was well received by the passengers.

Right after the introduction, the income from tickets and season tickets had increased suddenly. The number of journeys increased by about 10%. As we expected, the majority of the new passengers travel from distant stations (≥40 km). This has great importance, since these passengers pay more. After three months, a passenger questionnaire was carried out which showed that 3% of the passengers travelled by car, and 4% by bus before the new timetable. This is far better than the expectations.

Throughout the presented suburban pilot project many experiences were gained which will be employed in the further timetable development plans. In the framework of Suburban Railway Development Project new periodic and zoning timetable structure will be put into service on most suburban railway lines. However, this will require the harmonisation of the suburban traffic with the long-distance traffic, thus the introduction of the national ITF system. [1] [2] [4]

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