Refinery shuttle

An innovative and efficient logistics solution for supporting the refinery operation optimized on MOL group level

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Abstract

Refinery Shuttle – an innovative and efficient logistics solution supporting the refinery operation optimized on group level

For optimizing its downstream business, the oil industry uses a linear programming supporter tool worldwide, namely PIMS. MOL Group uses this tool on group level, involving the operation of both the Bratislava and the Százhalombatta refineries. This multimodal optimization can reveal synergies, which result in just more than the sum of the optimized parts. Utilizing those synergies often depends on the possibilities of the whole operation, including logistics solutions. PIMS raised the need of refinery transfers, but the sufficient logistics solution was lacking. Group Logistics worked out an innovative theoretical solution, which was realized with the cooperation of two railway companies and a forwarding agent finally. The rail bridge connection between Bratislava and Százhalombatta, the so called refinery shuttle, which started its operation in April 2007, fulfilled all the expectations and provides a sufficient logistics support of integrated refinery operation. The refinery shuttle is a novelty, at the same time creating the best industry practice, thus MOL Group Logistics set the pace for the industry.

Összefoglalás

Refinery Shuttle – egy innovatív és hatékony logisztikai megoldás a csoportszinten optimalizált finomítói működés támogatására

Az olajtársaságok világszerte alkalmazzák downstream üzletük optimalizálására a PIMS lineáris programozási eszközt. A MOL csoportszinten használja ezt az eszközt, bevonva a pozsonyi és százhalombattai finomítók működését. Ez a multimodális optimalizáció olyan szinergiákat tárhat fel, melynek eredménye több mint az optimalizált részek összessége. A szinergiák kihasználása gyakran függ a működés egészétől, így a logisztikai lehetőségektől is. A PIMS felvetette a finomítói transzferek szükségességét, de hiányzott a hatékony logisztikai megoldás. A Logisztika szervezet kidolgozott egy újszerű elméleti megoldást, melyet végül két vasúti társaság és egy szállítmányozó bevonásával valósított meg. A

Pozsony és Százhalombatta közötti vasúti híd, a finomítói "shuttle", mely 2007. áprilisában kezdte működését, teljesítette a vele szemben támasztott valamennyi elvárást, és hatékony támogatást nyújt az integrált finomítói működéshez. A finomítói "shuttle" egyidejűleg egy olyan újdonság, mely a legjobb ipari gyakorlatot teremtette meg, és mutatott utat a saját területén.

Looking for the common optimum of the elements of entire value chain. The role of optimization in a multi-site environment

In the article of "PIMS a Tool for Optimizing Dowstream" by Csaba Mészöly (MOL Szakmai Tudományos Közlemények – 2008/1), MOL Group Downstream business optimization planning process and its linear programming supporter tool: PIMS was introduced. The PIMS model of MOL Group is a multi period, multi plant abstraction; it can handle more refineries, markets in one integrated model for several time periods. This means that the optimum feedstock purchases, transfers between production units, refineries, processing details, distributed and marketed quantities are calculated in one single model. The optimum represents the highest cash generating solution with all other limiting conditions met. The optimal solution is proposed as a downstream plan for different time horizons (e.g. monthly, annual, etc).

Mergers or acquisitions (abbreviated M&A) are tools used by companies for the purpose of expanding their operations aiming at an increase of their long term profitability. Synergy between 2 companies is the simple equation of M&A where the whole is greater than the sum of the individuals. In case of SN and MOL downstream cooperation, PIMS is the tool which has revealed the synergies in the refineries' harmonized operation and the value creating points: possible market synergies, transfers between refineries.

Planning refinery transfers

Refinery transfer means that semi-finished products produced at specific production units are transported to another refinery where it can be processed economically. This may be continuous under operating conditions when the transfer is economical normally and ad hoc when the excess can be processed or stored in a co-refinery during turnarounds or unplanned S/D.

Transferring semi-finished products between the Bratislava Refinery (BR), and the Danube Refinery (DR) is a good example of a continuous, mutually advantageous conjunction. Let us think over a BR to DR and a DR to BR transfer!

RHC residue

The Residue Hydrocrack unit (abbreviated RHC) in BR, besides naphtha and middle distillates, produces 38% less attractive RHC residue in a quantity of 400-500 kt a year. This quantity has to be placed.

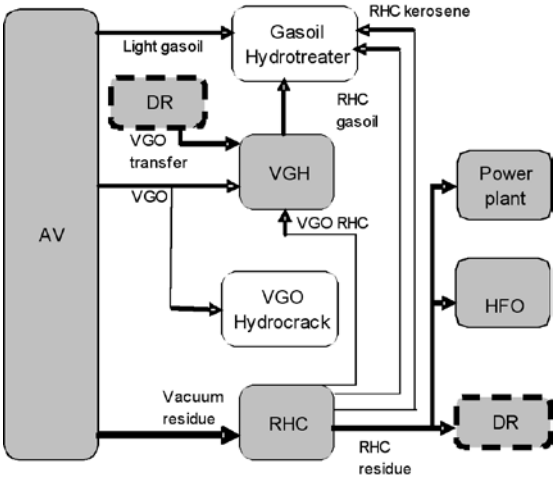


Figure 1. RHC residue placing possibilities from BR (only the referred units)

The demand of Heavy Fuel Oil (abbreviated HFO) blended from RHC residue is continuously decreasing, the prices are shrinking, the SO_2 emission limit for power plant significantly decreases. These constrains have a strong influence on the possible use of RHC residue. In a stand alone optimum for BR (no transfers between refineries), the RHC residue would limit the operation of other units, or even crude oil processing.

On the other hand, the demands and prices in the bitumen market are quite attractive. In a stand alone optimum, the DR Delayed Coker unit (abbreviated DC) could have free capacity as the vacuum residue of the Atmospheric and Vacuum Distillation units (abbreviated AV units) are pushed to bitumen production. In a multi plant optimal solution the RHC residue

can be processed by the Delayed Coker unit (abbreviated DC) and gas oil production can be increased on Group level.

Vacuum gas oil (VGO)

In DR the capacity of VGO Hydrotreater Unit (abbreviated HDS-MIC) is one of the bottlenecks, which means that utilizing the AV and DC units the produced VGO (yields: 23% in AV, 41% in DC) cannot be processed totally in HDS-MIC time-to time. In a stand alone optimum for DR VGO sales is the solution.

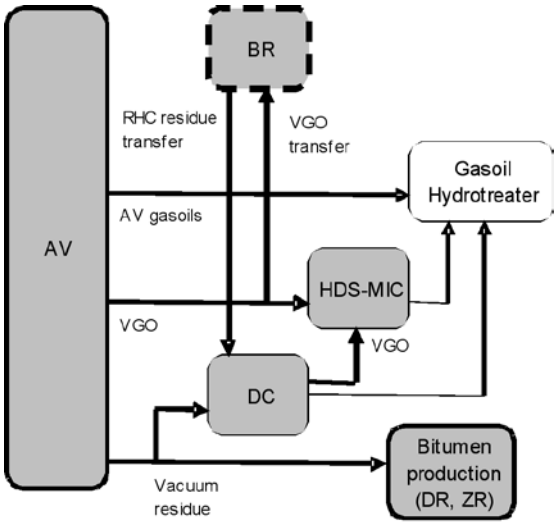


Figure 2. Semi-finished transfers possibility from DR (only the referred units)

On the other hand, VGO Hydrotreater Unit (VGH) in BR time to time can have free capacity in a standalone optimum for BR. In a multi plant optimal solution VGO can be transferred to BR and gas oil production can be increased on Group level.

Based on the group level optimization, the RHC residue and VGO transfers between refineries have created value in 12 months out of the last 1,5 years. In the given price environment of HFO, bitumen, white products, evaluating the capacity utilization in the consumer units creates value, the transfers are more economical than any other solution.

The limits of logistics manageability of the transfers

The multi-refinery optimization model formulates goods movements similar to RHC residue and VGO as a common optimum of the DR and BR that can become operational in practice only when Logistics can offer economically efficient support which is capable of handling large volumes in addition to other conditions.
The goods transportation methods can be in principle the following: by river, pipeline or rail.
River: the Százhalombatta port can load and discharge a relatively wide range of goods if the necessary development is realized.
The Bratislava port can load only gas oil via a direct refinery pipeline connection, and there is no opportunity to discharge at all.
Any development of the port would require an enormous CAPEX expenditure with a long payback.
Pipeline: there is no direct pipeline connection between the two refineries, the investment would also require enormous financial sources, and pipeline transport would be deemed almost impossible because of the physical properties of some required products, the potential volumes and the alternating transport directions.
Rail: Transportation by rail proved appropriate although it has remained an opportunity in principle only because of a number of factors (high charges, often unpredictably long delivery times, complete uncertainty of turn back times of empty wagons, and high specific wagon rental fee because of the above fact, etc.).
Railway, operating with low reliability and high costs, did not offer a real alternative in practice.
At the same time, Logistics set forth the thoughts, needs and expectations in the 2007 integrated rail forwarding tender (See below).
In case these conditions are fulfilled, PIMS requirements could be realized.

Conflict of interests between the logistics requirements and the limits of the service providers: outlines for a solution

Supply Chain Management (SCM) has formed the potential options resulting from optimization, and Logistics had to convert it to a set of specific requirements for the external logistics provider market. This was indicated in the frame of the 2007 rail forwarding tendering process in the following ways:

- consignments should always be delivered between the two refineries in block-train for an adequately fast transportation. The requirement was maximum 24 hours on a fix schedule, instead of the earlier 3-7 day long trip.

- the system should be sufficiently flexible. Subject to refinery needs, MOL should have the possibility to change the weekly number of trains, reduce or increase it with almost any limit and consequence.
- any goods should be inserted to block-train, in any repartition including the private railcars to be transported as goods by rail. This requirement has been in deviation from the earlier practice and charge setting rules of the railways.
- the freight costs need to be 15-20% lower than the earlier ton based fee, and there should be a rate for a complete train without regard to goods classification, which is used by the railways normally.

The terms of the railway transportation are changing. The customers want to have a shorter delivery time, the parties fighting for better financial results. But to operate a block train system with products of different custom codes (NHM) is an unusual method. The custom code classification of the goods is used as a general rule ensuring for the railway companies the optimum income and the simplest organization of trains at the same time. Therefore, accepting this requirement should be considered as revolutionary step.

Through setting the above, some needs have been expressed which are in conflict with the earlier practice. But the solution -- considered as an unusual one -- has been supported by certain changes over the past years. These can be seen by the example of MÁV Cargo Zrt. indicating that the liberalization and privatization processes have been put in place or are still in progress in a number of European countries.

MÁV Zrt. and its cargo branch were operating in a relatively stable environment before 1990. Accession to the European Union, however, required a new organizational structure defined on a commercial basis and compatible with community legislation. The business, service and control functions were first separated in 2002.

Following the accession to the EU in 2004, rail liberalization was started through the opening of the transportation market, thereby opening access to the railway network for private railway companies (commonly known as Eisenbahn Verkehrsunternehmen [EVU]). Thus, MÁV Zrt had to offer a competitive alternative not only to other means of transportation, but also to new railway companies. To this end, it outsourced its Cargo Branch in a separate company in 2006, and MÁV Cargo Zrt. (hereinafter: MC) has been active as an independent market player since then. The new company is the legal successor of the Cargo Branch of MÁV Zrt only in terms of labor law, but regarding all other aspects, it is a new, autonomous and independent legal entity as it could take on the goods transportation business in an efficient way and maintain its position on the international markets.

Hungarian Railways were given a derogation from applying the provisions of the European Community on access to railway network capacity until 31st December 2006. During the interim period, the Hungarian party provided access to the Hungarian part of Trans-European Transport Network only by 20% of the network capacity for the railway companies of the Community.

The effect of derogation ceased on 1st of January 2007, so the railway network can be used by all the companies as of 2007 that have a license of a rail company and operate a pool of assets for railway transportation. In order to create the competition neutrality of the commercial railway companies and regulated conditions, the Hungarian Rail Office was established in 2006, and its tasks were taken over by the National Transport Authority (Department of Railway Regulation) by the 1st of July 2008 according to Govt. Decree 156/2008 (VI.6.).

At present time 21 companies have a railway transportation license in Hungary. Private railway companies achieve a larger share in the railway transportation market every year, meanwhile MC kept its market leader position. In the year of terminating the derogation, private railway represented for only about 5% of the total turnover, which will increase by an additional 2-4% in 2008, according to analysts. In order to facilitate the use of open-access railway infrastructure, the countries of the European Economic Area (EEA) publishes the data of railway infrastructure, determines the conditions for access to the railway infrastructure, the services offered by the infrastructure providers and the charges for the access. The application of the provisions of the Network Regulations (hereinafter NR) is binding for the rail infrastructure providers, for the organizations authorized to use the network services, as well as for the railway capacity allocation department alike. MC can

carry out transport by purchasing the services determined in the NR. This contains the costs of used (railway) lines, operating activities, train sorting, use of electricity, use of locomotive, etc. MC develops a technology for the specific transport for each and every case and optimize the costs on this way.

The decade-long conditions of railway transportation have fundamentally changed in Hungary, as well as in numerous European countries. Open access to the railway network and the appearance of private service providers (EVU's) have increased the competition and promoted the implementation of new constructions such as the set of requirements put forward by MOL LOG.

The coordination between several collaborating railway companies – in the present case a Hungarian and a Slovak rail service provider – is not the core business of an international oil company. We have therefore communicated our needs to rail forwarding agents, of which Mávtranssped was the one capable of consistently enforcing them with the MC and the cargo branch of the Slovak Railway (ZSSK Cargo).

A new system is born. Operation of the "Refinery Shuttle" between the Danube and the Bratislava refineries.

For the traffic between DR and BR, a variety of tariffs were in use depending on the type and volume of the products before 2007. Daily deliveries of one type of goods often did not reach the quantity (netto cca. 1.000tons) required for a block-train; therefore, they were transported as individual consignments. Such deliveries entailed higher transportation tariffs and a longer turnaround time, which caused an additional problem in terms of the empty private wagons and because they did not arrive in time for the next loading, the planning was uncertain. From spring of 2007, in the organization of the forwarding agent Mávtranssped the complete traffic has been organized into roundtrip block-trains, under transportation conditions jointly agreed by MC and ZSSK Cargo. The mixed trains transport various products under different custom code (NHM) numbers and under strict schedule. The timetable of the BR and DR trains is organized so that the two trains coming from opposite directions have the very same arrival time at Komarno border crossing stopping just for a simple locomotive change and they can continue their trip to the destination without any further time loss. Placing this kind of logistics arrangements into place between the refineries was quite pioneering as both cooperating railways have had to radically change their "good old" rigid system and praxis. The traditional "rail" mindset had to be abandoned. At the initiative of MOL Logistics and with the intercession of Mávtranssped a cost-based construction has been elaborated resulting in an unprecedented cost reduction.

Following the schedule of traffic between the two refineries into this system, previously decreasing rail traffic started to indicate a dynamic increase. The volume of turnover showed a slight (5%) decrease in 2006 compared to 2005 but increased by 51% in 2007. Based on the data of the first six months in 2008, additional turnover increase is forecasted.

Organizing all deliveries into this system entails benefits for MOL Group – beyond transportation cost reduction – because of the faster turn back of private railcars, as well as for Cargos due to cost savings by better organization possibilities. There are some examples in excuse of above:
The turnaround time of wagons has decreased: in 2005-2006 the running time on the Százhalombatta – Komárom border crossing relation was 33 hours, while in reverse it was 48 hours on average, of which, according to statistics, an average stoppage of 23 hours arose at the Budapest-Ferencváros shunting yard. The same time in a mixed block-train diminished to 3 hours in export and 6 hours in import, while the stoppage time at the shunting yard Budapest-Ferencváros practically disappeared.

The total transportation time in a mixed block-train from DR to BR is 8 hours forth and 9 hours back. This way the transportation time decreased to one fourth in export and one fifth in import on MÁV network. Based on the above, the congestion at shunting yard Budapest-Ferencváros was also alleviated.
As a result of this new system, the provider MC was able to reduce its own costs, too. The following NR charges have been saved due to block-train organization:

- 12.600,- HUF/train for rail line cost (Transportation of single wagons with shunting and train reorganization at Budapest-Ferencváros station needs

two permits and train-number. According to the new system, just one permit and train-number is needed, based on a yearly timetable.)

- 2.260,- HUF/wagon shunting charges because of train reorganization
- Savings of traction and network charges between Budapest-Kelenföld and Budapest-Ferencváros stations:
  - 6.600,- HUF/train on running charges,
  - 4.900,- HUF/train on traction charges, and
  - 4.300,- HUF/train on "mixture" transportation fee

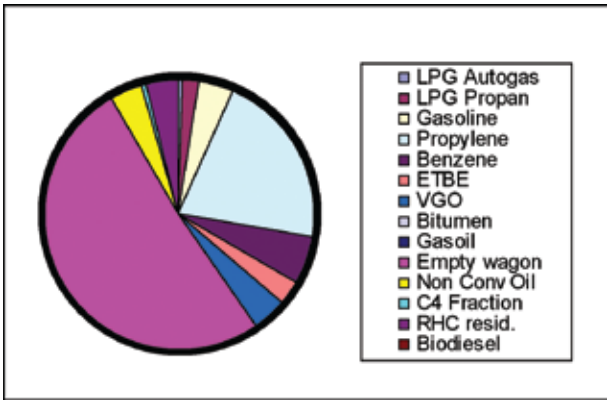
Experiences, analysis, just in time, financial benefits on provider and client side

The Mávtranssped Kft., commissioned to organize the deliveries, was fully able to enforce MOL Logistics' requirements, the service started in April 2007. Analyzing the experiences of the six block-trains in the first month and executing some modifications, there were already 14 block-trains a week in August. The border crossing Komárom – playing the role of a turntable – carried out the fastest locomotive change and transportation time. As a result, the trains dispatched at the loading point the previous night were arrived at the destination the following early morning. The sophisticated operation of the system brought additional benefits, too. There is a live rail "bridge" between the two refineries, which can perform tasks that have not been envisaged and considered in the original concept but support the most optimal refinery operations. A practical example: if for any reason and all of a sudden, the storage capacity of liquid sulfur at DR should become insufficient, then some wagons from BR can be reallocated to DR in even less than 12 hours. Earlier such an action required up to 4-8 days, and as a consequence, the liquid sulfur had to be dumped into a temporary storage place, causing significant additional work and waste of energy. This type of connection can, of course, be used in the reverse direction and for any consideration.

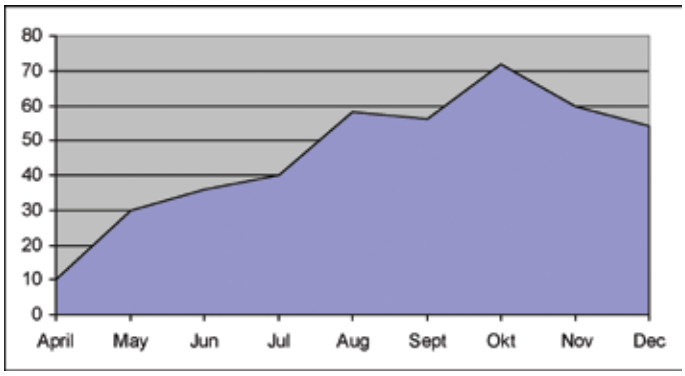
The project has delivered the basic expectations: speed, flexibility, correct planning of rolling stock, complex usability, decreasing logistics costs. The cooperating partners (ZSSK Cargo, MÁV Cargo, Mávtranssped, SN, and MOL Logistics) evaluated the experience of the first 200 trains in Komárom in September 2007. The representatives of the railway companies declared they had no knowledge of the operation of a similar system either in the region or throughout Europe. It means that in this case not the best industry practice of others has been observed and implemented, but through this project we are setting the pace for the other market players. The tables below show the real need for this service and the efficient operation:

The proportion of the products compared to the total turnover in the refinery shuttle:

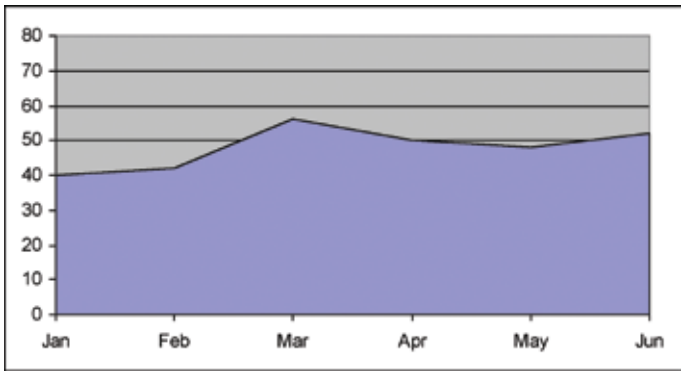
Product	NHM	%
LPG Autogas	271112	0,65%
LPG Propan	271113	1,97%
gasoline	272400	4,15%
propylene	290122	20,90%
benzene	290220	5,57%
ETBE	290919	2,88%
VGO	274900	4,12%
bitumen	271320	0,00%
gasoil	274200	0,00%
empty wag.	992200	51,31%
non conv. oil	274900	3,94%
C4 fraction	271111	0,62%
RHC resid. (DC feed)	274900	3,89%
biodiesel	382499	0,00%

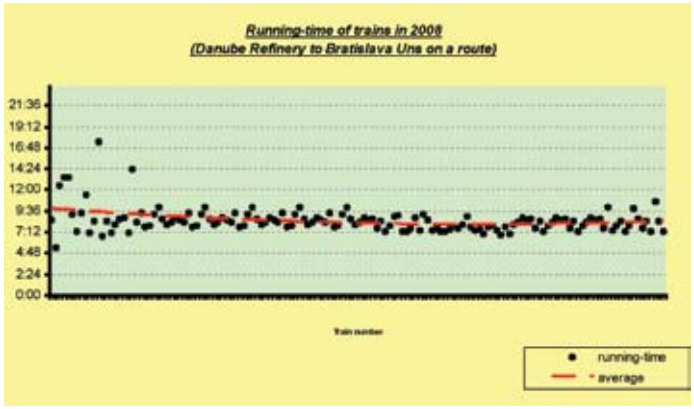


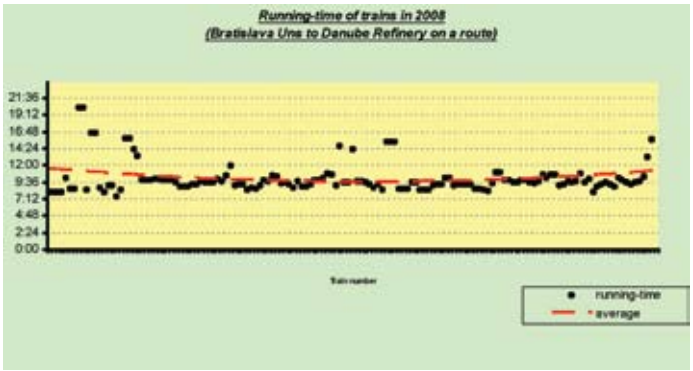
Number of trains between the two refineries in 2007



Number of trains between the two refineries in 2008







List of abbreviations:

NHM:	Nomenclature Harmonisée Marchandises – harmonized product specification number
NR:	Network Ragulations of the limited liability company for rail capacity distribution enounced on its homepage
MC:	MÁVCARGO joint stock company

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