Examination of a Railway Corridor Using a European Transport Model

Zs. Berki, F. Cselle

FŐMTERV Ltd. 1024 Budapest, Lövőház str. 37.
Phone: +36-1-3459746, fax: +36-1-3459550
email: berki@fomterv.hu, ferenc.cselle@fomterv.hu

Abstract: This paper describes some aspects of building of a European macro level freight transport model, which was part of a three step model system, designed to investigate the feasibility of a freight priority railway corridor bypassing Budapest.

Keywords: bypass, rail freight transport, feasibility study, European, strategic macro model

1. Background

The recent global transport policy efforts put considerable focus on enabling commercialisation of rail freight services and promote its competitiveness against road freight. This efforts lead to serious corridor investments based on underlying studies having large scale European Economic and Transport Models in background. However these investigations miss to catch a number of local issues and suffer from data gaps. Therefore in this paper, the authors focussed on showing, through a case study investigation, what local crosschecks and amendments needed before drawing conclusions from a global model. The most important words have to be capitalized in the title, according to the English conventions.

The Association of Hungarian Logistic Service Centers trusted the „V0 Magyarország" consortium (consisting of Főmterv Co. Ltd., Ákmi co. Ltd, COWI Magyarország Ltd. and Mott McDonald Hungary Ltd.) to carry out a feasibility study for „V0, the Budapest southern bypassing railway line", a freight oriented railway line, which bypasses Budapest. The bypass frees Budapest from the currently heavy freight traffic, and allows the southern main railway bridge (which currently is one of the major bottlenecks on the Hungarian railway infrastructure) to be used mainly, by passenger traffic. [1]

As Figure 1 shows, the international rail freight connections of the Hungarian economy comprise most of Europe, and are especially strong with the Central European economic region, the Balkan Peninsula and Eastern Europe.

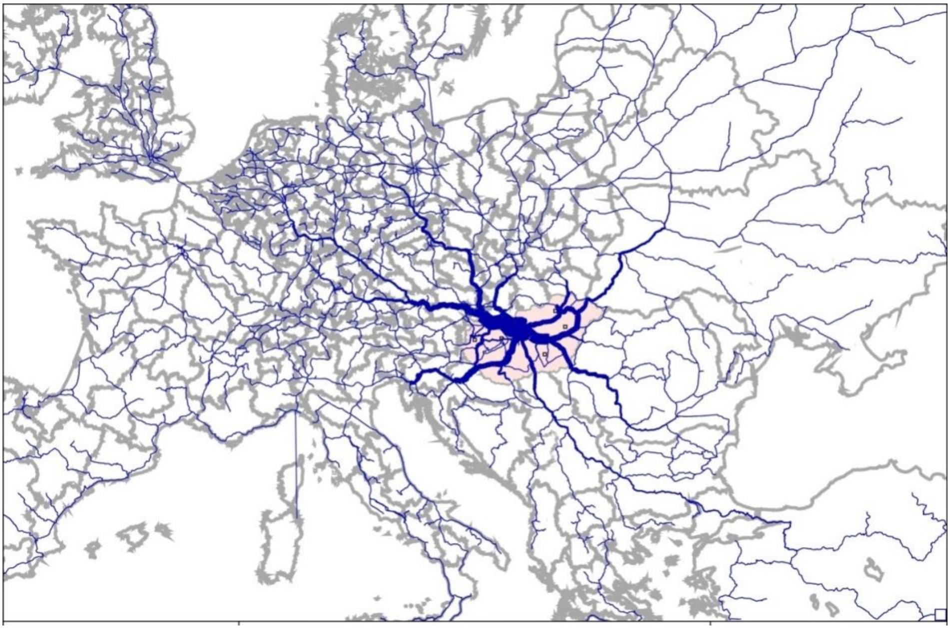

Figure 1. Rail freight connections of Hungary

With such a wide area of transport connections, the level of detail and complexity varies in the modelling of different aspects of the railway lines. Therefore a three step model approach has been adopted to support the analysis layers of the study to be able to examine all required aspects of the proposed railway development, with the appropriate detail. [2]

Figure 2. shows the model system used in the feasibility study.

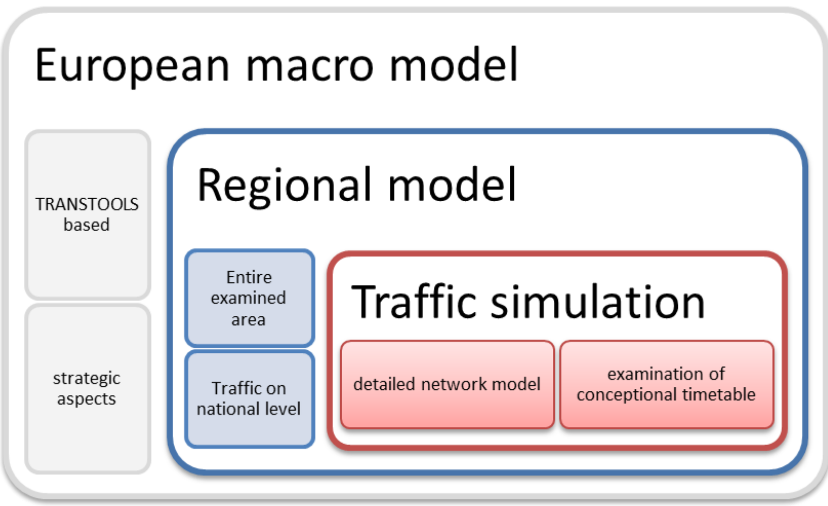

Figure 2. The model system used in the study

TRANSTOOLS was chosen as the base of the European macro level freight transport model. The macro level model had to:

- cover both the network and demand on NUTS3 level for entire Europe, based on TRANSTOOLS and ETIS+ data.
- be able to model the impacts of the planned transport development on the strategic level.

As TRANSTOOLS is a European level strategic model, it was necessary to adopt it to Hungarian country level, a level lower than it was originally designed, therefore its complexity had to be increased for the focus on country level impact assessment. This paper describes the changes made to the original model through the model building steps.

2. Some aspects of the macro level freight transport model

2.1. Aspects of the supply model

2.1.1. Network

Since TRANSTOOLS is a European level model, the network contains basically the TEN-T network, with some extensions. [3] For impact assessment purposes, the network model has been extended by some parts of the Hungarian network important in freight transportation or accessibility reasons. Figure 3. shows the network model used in the improved model.

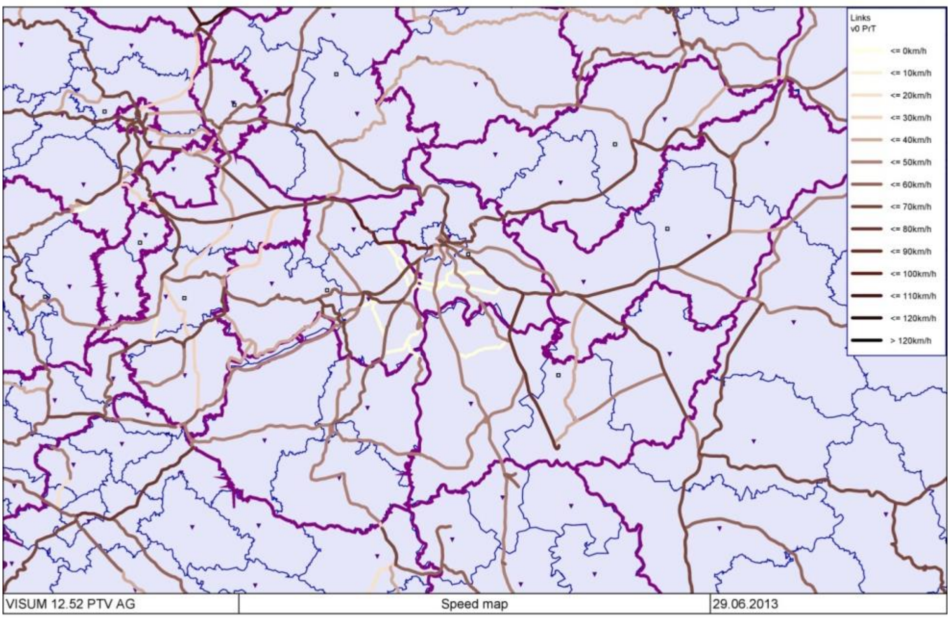

Figure 3. Railroad network used in the macro model

The network impedance was taken over from the original model, but speed set on the Hungarian network is based on the MAV PASS2 database of recorded runs of theHungarian Railways (MAV PASS2).

2.1.1. Zones

The original TRANSTOOLS model contains the freight data on NUTS2, regional level, which is completely sufficient on continental level, but is too aggregated to examine the impacts of a transport corridor within a single country, therefore a NUTS3 level zone system was adopted based on the ETIS+ data.

2.2. Aspects of the demand model

2.2.1. Connector system

With the new zone system, the original connectors had to be adapted to NUTS 3 level. To extend this, in the Hungarian zones 1-5 connectors are used for the transport system Rail. The sharing of traffic between the connectors is based on data from MAV PASS2 database, from which the loaded and unloaded amount of cargo was taken for each cargo stations per zone. The stations with less traffic than 5000 tons/year were left out, its traffic was added to the nearest main freight stations. The share of each connector gives its share of the overall traffic of the zone it is connecting to the network.

2.2.2. Demand matrices

The macro level model uses commodity flows, which are converted to vehicle flows for the assignment. This approach allows for more complex modelling of freight movements if needed (eg. transport chains), however this way to obtain the actual traffic flow on the network a conversion factor (commodity to vehicle) and a correction factor (the model does not contain empty runs) has to be used. The model uses the original 11 commodity group according to the NST/R 1 nomenclature, which are the following:

Table 1. Commodity groups in the macro model

NST/R 1	Commodity group
0	Agricultural products and live stock
1	Foodstuff
2	Solid mineral fuel
3	Crude oil
4	Ores, metal waste
5	Metal products
6	Minerals and building materials
7	Fertilisers
8	Other chemicals
9	Machinery, vehicles
10	Petroleum products

The 11 commodity group demand matrices, aggregated on NUTS2 level, had to be converted to the aforementioned NUTS 3 level zone system. For this task, available NUTS3 data from ETIS+ was used to create a weight matrix, which contained the share of each NUTS3 zone compared to the whole of the NUTS2 zone that contains it. Figure 4. shows the methods of OD matrix conversion.

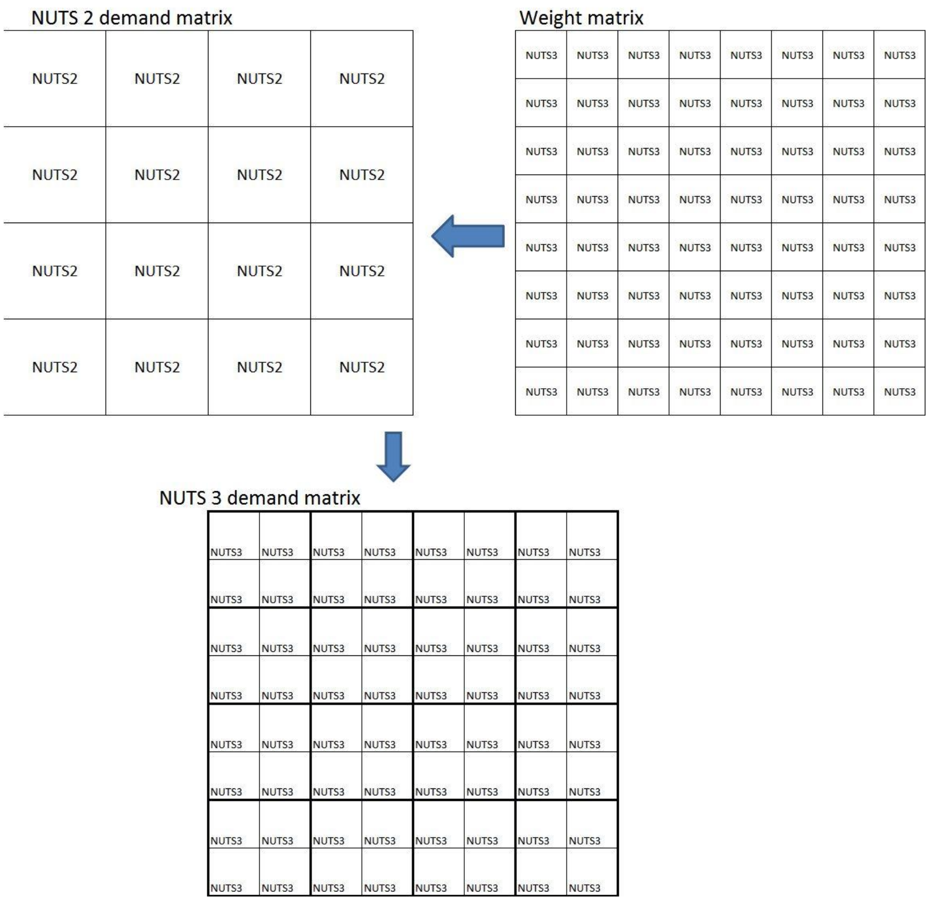

Figure 4. Methods of OD matrix conversion

The converted commodity group matrices were added together to form a single demand matrix for both rail and road freight demand. To assign the traffic, the commodity matrices had to be converted to vehicle matrices. For this, a 1200 t/ train conversion factor was used for rail traffic, which complies to the Iron Rhine study of TNO [4] and the MAV PASS2database. For road traffic, the original 14,3 t/vehicle factor was kept.

The economy of Hungary also has connections to overseas regions, with which the freight flows through the Adriatic and North sea ports, mainly in containers. Data on commodities lifted in containers is scarce, however there’s quite detailed data on vehicle movements between the European seaports and the Hungarian combi freight terminals. Using this data, an additional matrix was created on NUTS 3 level containing the container train movements. The entire demand therefore is comprised of the vehicle movement matrices created from commodity flows and a vehicle matrix of container flows created from data European port and railway companies.

3. Results of the macro model

By assigning the vehicle matrix to the network, the results were in line with the available statistical data.

On commodity flow level:

Table 2. Results of the macro model compared to the National Statistics Office's data

	Model [ton/year]	NSO [ton/year]	Model/NSO
Import	15859200	15470899	103%
Export	12289200	11859336	104%
Transit	7215260* (9495600)	9768501	97%

*the NSO data was incomplete in the Russian-Ukrainian relation, data for 2010 in brackets

On vehicle flow, the crossings of the river Danube were used as validation sections. Table 3 shows the results of the model compared to available statistical data.

Table 3. Rail freight data of the macro model on validation sections

	South Budapest bridge		Baja Danube bridge		Total	Total	Goodness of fit
	train/y	train/d	train/y	train/d	train/y	train/d	Model/MAV [%]
EU macro model	17 337	58	365	1	**17 702**	**59**	
EU macro model*	31 522	105	664	2	**32 185**	**107**	
MAV PASS2adat	30 234	101	228	1	**30 462**	**102**	**106%**

*with correction factor

Since the demand matrix doesn't contain empty runs, a correction factor is needed. According to interviews carried out in the projects with transportation companies, an average proportion of loaded/empty runs can be set at 55%/45%, which means, that an average of 1.8 multiplication factor is applied to obtain the actual traffic load on the network.

4. Summary

With the improvements in detail to the original TRANSTOOLS model, a tool has been developed for the national level strategic examinations on rail freight traffic. It is important, that this tool is not sufficient as a standalone model for feasibility studies, the results of the strategic modeling have to be further analyzed by more detailed models with focus on a much narrower section of the infrastructure, thus allowing more complex parametering.

Using these amendments and more complex approach at the analysis layers in the study, it justified the benefits of the V0, even in economic scenarios of moderate growth unlike the study carried out by Panteia-PWC [5], where it was stated that "the Budapest bypass should be postponed until 2020".

References

[1] FOMTERV-AKMI: *Feasibility study of V0, the Budapest bypassing southbound rail line*, 2011-2012

[2] Berki, Zs.: *The three step approach used in regional transport modelling*, Acta Technica Jaurinensis, vol. 5, no. 3, pp. 287-297, 2012

[3] TRANSTOOLS: *Transport modelling for policy impact assessments*, DG MOVE, 2011-2013

[4] Transport and Mobility Leuven-TNO: *Final Report Social cost-benefit analysis*, Iron Rhine, 2009

[5] Panteia-PwC: *Carrying out a study on the completion of the Priority Project Nr 22*, Final report, 2012