

Utilisation of the TRANSRAPID in Europe

Dr.-Ing. Bernd Neumann

Union of European Railway Engineer Associations, Frankfurt/Main, Germany

ABSTRACT: Globalisation of the economy is in full swing and is radically changing competitive conditions throughout the world. Ecological conditions are a further increasingly important influential factor. The economic area of Europe has to stand its ground under these circumstances. The technological know-how needed to cope with the traffic of the 21st century is available, but has to be applied efficiently in order to make full use of the potential for development. TRANSRAPID is the chance for a useful supplement to a modern, intermodal European transport system. A basic trans-European TRANSRAPID network which would fulfil all the economic requirements could be implemented within the next 30 years. To achieve that target, the European Commission would first have to initiate research, as well as coordinate, concentrate and support such research financially and take potential track routes into account in its transport plans for the coming decades.

1 EUROPE AND ITS TRANSPORT PROBLEMS

The need to move around has always been one of the constant factors of human life, and the quality of life has changed in line with the changes in our mobility radius. Both individuals and society demand mobility as a basic right. The amount of time that each individual can allocate for mobility has not changed significantly over the ages (literature estimates that figure at approx. one hour). Increasing mobility facilitates the convergence of different environments. If our living circumstances change to such an extent that the time we are prepared to spend on mobility is no longer adequate, it is up to mankind to create new conditions which enable sufficient mobility. This is the situation facing us in the world today.

1.1 Traffic Development (Expansion to the East)

Anyone concerned with the development of the transport sector in Europe cannot fail to notice that the amount of traffic on land, water and in the air is steadily increasing. This development can be attributed to the increasing international interdependence of industry, science and administration, as well as tourism. This trend has been accompanied by a corresponding modal shift in the overall transport market. While the railway held a share of 8.2 % of passenger transport in the 15 EU countries in 1980 (in terms of passenger-kilometres), this share had been reduced to 6.3 % by 2000. Over the same period, air

traffic was able to double its share (from 2.5 % to 5.8 %) and is now on nearly the same level as the railway. As a result of the political and economic changes in the member states of the Warsaw Pact since 1990, especially the accession of the eight Eastern European states¹ to the European Union in May 2004, passenger and freight transport has increased dramatically. The railways on the other hand, traditionally the most important means of transportation in the acceding states, have suffered a significant decrease in terms of traffic performance. Not only have the important trade relations with the Soviet Union collapsed, but, as a consequence of this new freedom, the number of automobile owners has also increased rapidly. In the passenger transport sector, the proportion of car ownership in the Czech Republic and Poland had already reached approx. 80 % – the same level as Greece, Spain and Denmark – by 2002.

Congestion on the roads and motorways of Europe – especially at border crossings, on transit routes over the Alps and in densely populated areas – is meanwhile the norm. The only solution that has been attempted until now has been to enlarge existing roads and build new ones. All the railways' efforts to modernise their networks and make them more efficient, and consequently more competitive, have on the whole remained unsuccessful. Amongst

¹ Poland, Hungary, Czech Republic, Slovakia, Slovenia, Estonia, Latvia and Lithuania

other things, this failure can be attributed to the lack of political action to create uniform framework conditions, such as equal taxation of the energy sources required for transport services, unified regulations governing tolls and charges for the use of infrastructure, and cost transparency which would lead to fair competition on the transport market.

The airspace over Europe is becoming more and more congested, primarily because of short-haul air traffic. In Germany this sector starts at approx. 400 km. Deutsche Bahn obviously regards that distance as a limit value when competing with the no-frills carriers (Hunold 2006). As we have almost reached the capacity limits of air transport in terms of traffic control and safety technology, the quality of this sector is already impaired, with delays as the noticeable consequence. The airspace over Europe is still relatively safe, but the potential for dangerous incidents will naturally increase as traffic density rises.

1.2 Energy Resources

Mobility for passengers and goods worldwide is provided primarily by fossil fuel and atomic energy. Neither wind, solar, water power nor biomass have as yet assumed an important role. Even if there are long-term alternatives on the horizon for land-bound vehicles (e.g. fuel cell, bio-diesel), air traffic will still remain entirely dependent on oil.

Over the short term, oil will become too valuable for use as a vehicle fuel, not to mention the significant CO₂ emission and consequent global-warming effect. In Germany, road-bound traffic is responsible for more than half of the CO₂ emissions (worldwide 42 %). It has to be assumed that oil production will reach its peak in 15 years. At that point, demand will surpass supply, leading to a cost explosion which will have a significant influence on the transport market (acatech 2006).

1.3 Land Consumption

Mobility and energy production place a great strain on the environment and the land consumption alone is tremendous. Motorways with up to 8 lanes and gigantic intersections, road and railway bridges which cut valleys in half, unsightly high-voltage lines and overhead power lines for railways as well as wind farms which will soon be installed on every hill and coastline are ruining whole landscapes. The people who live in the surroundings areas consider them indispensable and are consequently prepared to tolerate them. Wherever railways and high-speed lines are built, land consumption increases. This effect could be reduced to a minimum if the railway lines were routed parallel to the infrastructure for other modes of transport. However, the track layout pa-

rameters prevent that option, or permit it only to a certain extent in flat terrain. The additional land consumption is therefore enormous and that, too, is generally tolerated by the public.

1.4 Infrastructure Status and Interoperability

The European Union has initiated a vast programme for the improvement of railway infrastructure in order to boost its competitiveness with other modes of transport. This will involve high costs over an extended period of time. One of the focal points of the programme will be the implementation of a cross-border high-speed network.

This programme is bound to attract the attention of the newly acceded countries of Eastern Europe, whose railway networks are generally in poor condition and is likely to generate hope in these countries that substantial portions of their networks can be upgraded for high-speed traffic. There are two ways in which this can be achieved:

- a) Upgrading existing tracks for high-speed traffic but continuing to use them also for freight and regional passenger services (mixed-operation lines). However, this would not achieve the objective of enabling a high-speed long-distance passenger network, as is clear from the example of many lines in Germany.
- b) Constructing new tracks or lines for use exclusively by high-speed traffic. However, this would not solve the problem of the poor condition of the track infrastructure which would still be used for freight and regional passenger services, so that substantial funds would have to be provided to improve these installations.

For this European effort to be successful, the countries involved would first have to reduce their railway networks, which are too big and therefore inefficient, or alternatively would have to provide the substantial funds required to improve these networks themselves. The governments of these countries, however, tend to give priority to investments in the road sector and are therefore endangering the success of these European efforts.

The implementation of an effective cross-border high-speed network is further impeded by the lack of interoperability, e.g. as regards energy supply and signal systems. These differences are relatively easy to overcome. The different gauges in Central Europe and the railways of the former Soviet Union on the one hand and the Iberian Peninsula on the other hand is a different matter altogether.

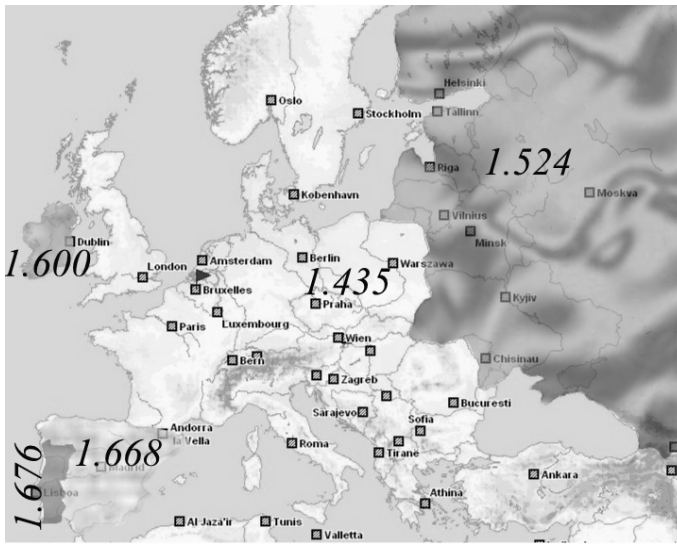


Figure 1: Problems of interoperability with different gauges

It will not be possible to find a solution which is compatible with the railway networks of all the countries involved. This would mean creating a separate network which would then involve additional transfers on one side – a situation which is already reality in Spain.

2 THE TRANSRAPID – A SOLUTION COMPONENT

“It is not the frightening scenario of the traffic forecasts that is our destiny, but the way we deal with the chances that we have.” (Mietsch 2005). Europe already has the technical know-how and competence to cope with the traffic of the 21st century. All we have to do is apply that know-how sensibly so as to make the most efficient use of its potential. If the right conclusions are drawn from what has been said so far, then the TRANSRAPID, which has been operating in Shanghai for more than two years and which is certain to be built in Munich, is one such chance. The TRANSRAPID is not an alternative to the wheel-rail system and is therefore not in competition with it, but an ecologically sensible complement to a future European intermodal transport system. This is especially true in regions which do not have a high-speed network right now and which can exploit the advantages of the TRANSRAPID even better. This is also true of point-to-point connections in densely populated areas and for connecting such areas to airports.

When will we see a worldwide ban on the combustion of oil and gas in order to prevent the collapse of the chemical industry? Will this happen within the lifetime of our grandchildren or the following generation? The short-haul flight will be the first mode of transport to feel the consequences and this is where the TRANSRAPID can provide a sensible substitute. Moreover, as a link between railway

and aircraft, it will generate more competition in the transport segment for distances between 50 and 400 km. Planning and building the TRANSRAPID from central Europe to Spain, south-eastern Europe, Russia, Latvia etc. is therefore worth considering as a medium-term option.

The TRANSRAPID is frequently perceived by the public, especially outside Germany, as an invention that has been marketed too late. ICE and TGV, the flagships of the wheel-rail system, already set the standards in the dense and highly-developed railway network in central and western Europe. It is argued that the TRANSRAPID would be too expensive and ecologically untenable. It is also claimed that it would be incompatible with the railway and would entail additional transfers.

2.1 Comparison with Wheel-Rail

A recent survey (Schach, Jehle & Naumann 2006) analysed the technical and economic aspects of the two systems. The results prove that from a technical point of view, the TRANSRAPID is superior to the railway in substantial aspects. The following are just some examples:

- Shorter travel time (better acceleration, higher speed)
- Less spatial requirements and shorter tracks (better limit values for track layout enable better adjustment to the terrain; positive options for track design)
- Lower maintenance cost (non-contact levitation, guidance and propulsion systems)
- Lower energy consumption at the same speed (consumption approx. equal at 300 km/h by ICE3 and 400 km/h by TRANSRAPID)
- Substantially lower noise emissions and vibrations
- Higher level of safety and security (system-inherent, technical design, organisational)

Whether or not the TRANSRAPID is the better economic solution can only be determined by analysing the concrete project concerned. The overall higher investment costs for infrastructure and rolling stock, which are offset against lower maintenance costs, do not inevitably make it the more profitable option, but that should not be a no-go implementation criterion at an early stage of the development. Whether or not such a transport project can make a profit depends to a great extent on its attractiveness. The shorter travel times and the experience of travelling at high speeds undoubtedly contribute to the special image of the TRANSRAPID. To date, the cost-benefit analyses do not include the ecological benefits, but these should definitely be taken into

account during the decision-making process for such projects.

In view of the great development potential for the tracks, vehicles and motorisation, it is reasonable to assume that investment costs will decrease in line with advances in science and research. The railway is a prime example: although it is 180 years old, it still has potential for further development.

2.2 City Connections and Track Layout

It is also claimed that the TRANSRAPID cannot reach the centres of large cities. This is disproved by the projects planned in Germany so far, such as Berlin – Hamburg, and the connection between Munich central railway station and Munich airport. From the technical point of view there were no substantial problems for TRANSRAPID connections to the major inner-city railway stations in Berlin and Hamburg, nor are there any such problems in Munich.

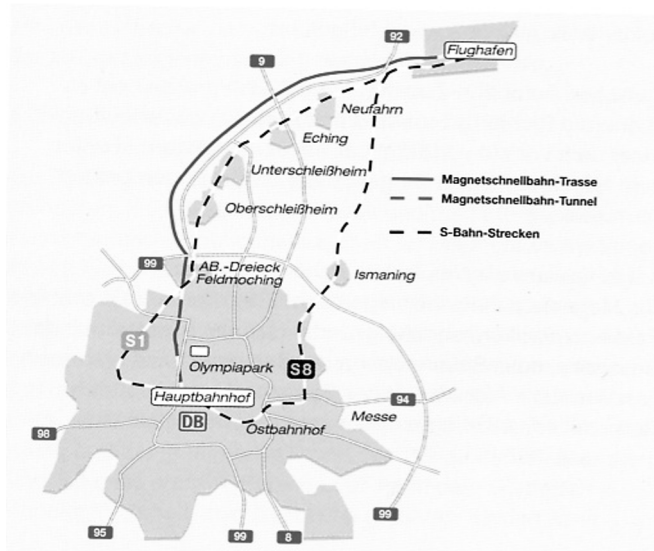


Figure 2: Project Munich, 60 % of the tracks are routed parallel to the motorway (DB AG 2004)

Linking the TRANSRAPID directly with the transport system means that passengers need not change the transport mode more often than usual.

2.3 Shanghai

Any account of the advantages of the TRANSRAPID for the transport system in Europe cannot fail to mention the first commercially used line in Shanghai. What is there to say about the Shanghai project that has not been said before? It has been the subject of frequent and detailed reports since the 1st meeting of TRANSRAPID experts in Dresden in 2001. The statement made by Wackers at the 5th meeting a year ago is still true today: “The Transrapid in Shanghai is still proceeding along the road to success: The volume of passengers has risen in the meantime, according to data from the operator

SMTDC.” (Wackers 2005). Availability is still above 99.5 %. During one of my journeys in March this year I was able to gain first-hand experience of the comfortable connection between Longyang Road and Pudong airport.

Because of this success, the Chinese government has decided to build the 180-km extension from Longyang Road Station to Hangzhou. I sincerely hope that this line will actually be built by 2010, even though some buildings are still in the way (Fig. 3).



Figure 3: Shanghai, view from Longyang Road Station (Author 2006)

3 WHAT HAS TO BE DONE IN EUROPE

Globalisation of the economy is in full swing and radically changing competitive conditions throughout the world. China has recently experienced a tremendous boom and is utilising more and more natural and technical resources on a long-term basis. Europe has to assert its position in this environment as a coherent economic area, as individual countries or companies will largely be unable to compete by dint of their own strength. Ecological conditions are a further increasingly important influential factor for the economic potential of Europe. A forward-looking strategy for transport planning is essential.

The European Union has set itself the objective of making the region “the most competitive and dynamic, knowledge-based economic area in the world, which is able to achieve sustainable and ongoing economic growth with more and better jobs and greater social cohesion.” This objective was voiced for the first time by the EU heads of state and governments at the 2000 summit in Lisbon.

In 2001, in her foreword to the White Paper “European transport policy for 2010: time to decide”, the former Commissioner for Energy and Transport de Palacio stated that Europe finally had to initiate a change in its joint transport policy, saying that it was time “to set new policy initiatives

geared principally at changing the modal split in the long term, eliminating bottlenecks, tackling congestion, and placing safety and quality at the heart of transport policy. ...“ (Palacio 2001). These demands were set forth in further detail in the following “Policy Guidelines of the White Paper”: “A modern transport system must be sustainable from an economic and social as well as an environmental viewpoint. Rail transport is literally the strategic sector ... Step by step, a network of railway lines must be dedicated exclusively to goods services... ”. A naïve reader might interpret this as referring to the TRANSRAPID. Unfortunately that is not the case, as neither the White Paper nor any of the documents regarding the Trans-European Transport Networks (TEN-T) make any mention of the TRANSRAPID, despite the fact that it could make an excellent contribution to achieving all the above objectives.

The European Commission should reconsider the advisability of developing the TRANSRAPID as a third, independent railway network dedicated exclusively to freight transportation. Extension of the existing railway network exclusively for freight and regional passenger transport would presumably be a simpler and more effective option. A TRANSRAPID network for long-distance passenger transport has to be established over the long term, making many of the lines currently used for mixed services available for freight and short-distance passenger transport.

3.1 European Perspective for Science, Research and Construction

The TRANSRAPID is already powerful, dependable and safe, and moreover still has huge potential for further development. Intensified research could enable it to fulfil the expected high standards of economic efficiency. It could link the densely populated areas of Europe in less time than is currently possible by air or land transport.

The USA and other countries are looking towards Germany and awaiting introduction of the reference maglev line in Munich. China, Japan and Korea, on the other hand, are no longer waiting, but have already tackled this transport mode. The German economy is not able to cope with this task on its own. Europe needs innovations in order to trigger the necessary economic upswing. European cooperation in the research, planning and construction of European TRANSRAPID lines is therefore urgently needed. The AIRBUS and GALILEO projects have proved that the European economy is capable of such feats. Establishing an international consortium along these lines for the TRANSRAPID could lead to similar success.

We are convinced that a basic trans-European TRANSRAPID network could be implemented within 20 to 30 years. To achieve that target, the European Commission would first have to initiate research, as well as coordinate, concentrate and support such research financially. The responsible institutions of the Directorate-General for Energy and Transport (DG TREN) as well as the UIC should already consider potential track layout alternatives in their transport plans for the coming decades. The planning, approval and construction process is extremely time-consuming and the relevant tracks should be kept free as a precautionary measure.

3.2 From Isolated Solutions to Network

In some European countries, TRANSRAPID projects have already been considered seriously for several years. Germany had made most progress with the Berlin – Hamburg project, until it was aborted at the beginning of 2000. The 5 other projects covered by the “Preliminary study for the selection of magnetic levitation system routes” were never really tackled in earnest. The proof of a negative operational balance has always been the knockout criterion. The important benefits that these projects could provide for infrastructure and industry were never evaluated or sufficiently taken into account. Preliminary projects are also under discussion in the Netherlands, Great Britain and the Scandinavian countries.

Germany has declared TRANSRAPID technology one of five flagship projects of its economic policy and, according to the coalition treaty signed by the currently ruling parties, has committed itself to building at least one line. Europe, as stated above, intends to become the leading innovative power in the world. If these claims are taken seriously, all TRANSRAPID projects should be put to the test.

Fast ‘point-to-point connections’ between densely populated areas like Brussels and Paris, or as connections to the airports of large cities such as Munich, could be the first step towards an European network and are therefore particularly important for the trans-European transport network. Long-distance routes such as Amsterdam – Groningen and on to Hamburg via Bremen, as well as Berlin – Dresden – Prague – Vienna – Bratislava – Budapest could be another possible approach to creating such a network.

3.3 Extension of TEN

The special situation regarding the cross-border connection of railway networks with different gauges was dealt with at the beginning of this report. The European Commission has initiated the TEN-

Project 19 in order to improve the connection between Spain and Portugal with the rest of Europe; the costs are as yet unknown. “The different gauges of the railway networks on the Iberian Peninsula and in the rest of the European Union are one of the biggest hindrances for the efficient operation of the European railway network system. The project includes the construction of new lines and the installation of polyvalent sleepers, additional tracks or gauge-changing installations for the high-speed net in Spain and Portugal in order to provide full interoperability with the remainder of the trans-European railway network.” (European Commission 2003) The same situation, but on a vastly bigger scale, exists in the east of Europe with all the countries of the former Soviet Union.

Since 2004, a European Commission high-level group has researched the extension of the main trans-European transport axes to the neighbouring regions and states. In its final report (European Commission 2005) the group defines five main axes which will provide a connection to the networks of the neighbouring states. The so-called central axis will connect the centre of the EU with the Ukraine and the Black Sea in the direction of Central Asia and the Caucasus. This also includes a direct connection to the Trans-Siberian Railway (Fig. 4). The group stresses the need for further study and analysis before the projects are ready for implementation. The economic feasibility, technical specifications as well as the consequences for the environment and financial mechanisms are focal points.

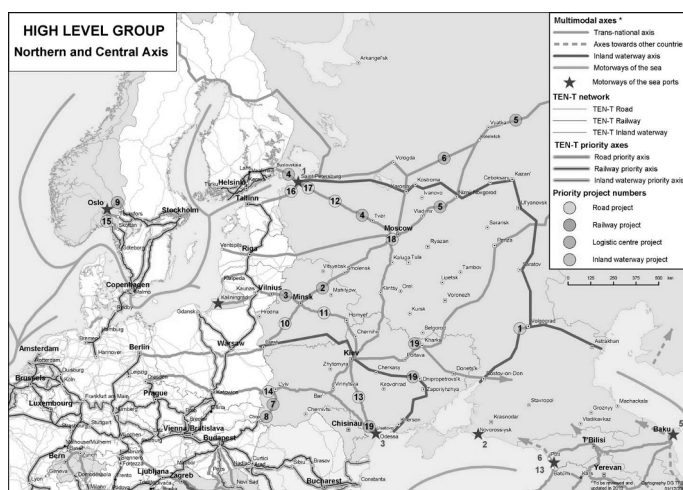


Figure 4: Northern and central axis projects for the connection of Eastern Europe

All the above points are valid grounds for DG TREN to conduct a thorough investigation of whether the solutions planned for the Iberian Peninsula and also required for Eastern Europe could and should be replaced by the establishment of a TRANSPRAPH system. The Spain – Italy – Ukraine line could serve as the southern nucleus of a future network in accordance with the following sugges-

tion. This would be a combination of TEN Projects 3, 6 and 19 with the central axis. This could be followed by connections from Verona across the Alps to Innsbruck and Munich, as well as a route from Budapest to Berlin. Starting from Lyon, the network could lead to Paris and Western Europe.

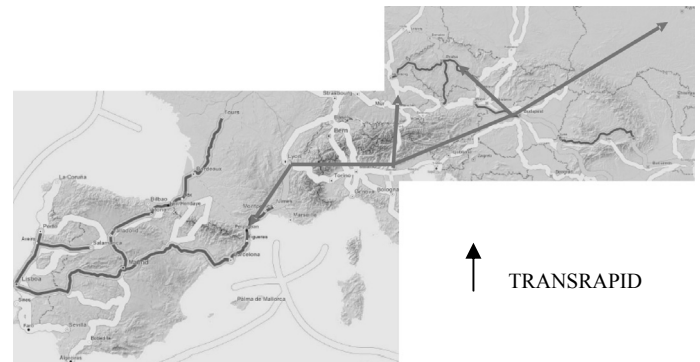


Figure 5: Connection between Spain (TEN 3 and 19) – Italy (TEN 6) – Ukraine (Central Axis)

3.4 European Standardisation

All ongoing planning processes in Europe as well as all future projects will inevitably have to attempt to keep costs to a minimum. This may lead to the optimisation of technical parameters such as track dimensions, clearance, installations for power on the track and in the vehicle in the course of the individual projects. This means that each project will develop according to different criteria. If all these lines are actually built and later joined up to form one network, which would be desirable under infrastructural and economic aspects, Europe would however again be faced with a high number of interoperability problems. It is vital to take preventive action by implementing European standards right from this stage. These standards could be derived from the “Basis for the implementation of magnetic levitation systems” compiled this year by the German Federal Railway Office [EBA], which could serve as “generally accepted engineering standards” as defined in the “Magnetic Levitation Train Construction and Operating Regulations” [MbBO] which apply to the project approval process for the Munich airport connection project.

“Those who act foresightedly on their own initiative will be able to reap substantial prosperity increases. Those who wait until they are forced to act because of the lack of public funds and the increase in traffic volumes will have to import at least part of the necessary solution components.” (Mietsch 2005) Whether Europe will be able to cope with the forecast increase in traffic and whether it will actually succeed in making the region the most competitive, dynamic, knowledge-based economic area in the world will be determined by various key decisions that have to be taken now. Let us hope that they will be the right ones!

REFERENCES

- acatech 2006. Abschlussbericht Mobilität 2020 – Perspektiven für den Verkehr von morgen. In *Verkehrsentwicklung macht Umdenken beim Ausbau nötig*, München/Berlin, 03.04.2006, kompetenznetze.de
- DB AG (ed.) 2004. Zur Sache – Die Magnetschnellbahn zwischen Hbf. München und Flughafen München
- European Commission (Publ.) 2003. *Trans-European Transport Network: TEN-T Priority Project*: 46-47, Luxembourg: Office for Official Publications of the European Communities, 2003
- European Commission (Publ.) 2005. Extension of the trans-European major transport axes to the neighbouring countries and regions, report of the high-level group of the EU Commission, Annex 9.4.2
- Hunold, J. 2006, Wir übertreffen derzeit unsere Ziele. *DER TAGESSPIEGEL online*, 02.05.2006
- Mietsch, F. 2005. Mobilität und Kommunikation 2020. In U. Stopka & W. Pällmann (Hrsg.), *Für eine neue deutsche Verkehrspolitik – Mobilität braucht Kommunikation*: 8-47, Hamburg: Edition Internationales Verkehrswesen, Deutscher Verkehrsverlag.
- Palacio, L.d. 2001. Foreword. In European Commission (Publ.), *White paper – European transport policy until 2010: time to decide*: 3, Luxembourg: Office for Official Publications of the European Communities
- Schach, R. & Jehle, P. & Naumann, R. 2006. Transrapid und Rad-Schiene-Hochgeschwindigkeitsbahn – Ein gesamtheitlicher Systemvergleich. Berlin Heidelberg: Springer-Verlag.
- Wackers, M. 2005. Transrapid – Verkehrsentwicklungen, Anwendungsbereiche und internationale Projekte. In R. Schach (Hrsg.), 5. *Dresdner Fachtagung Transrapid – Tagungsband*: 47-61, Dresden