TRANSPORT PROBLEMS 2010
PROBLEMY TRANSPORTU Volume 5 Issue 3

RETRACK, East-West corridor, transhipment techniques and systems

Tom ZUNDER, Dewan Md Zahurul ISLAM, Marin MARINOV*
Rail Freight and Logistics Group, NewRail - Newcastle Centre for Railway Research
Faculty of Science, Agriculture and Engineering, Newcastle University
Newcastle upon Tyne, NE1 7RU, United Kingdom
**Corresponding author*. E-mail: marin.marinov@ncl.ac.uk

KEY ISSUES FOR PAN-EUROPEAN RAIL FREIGHT SERVICES

Summary. The objective of the RETRACK[1] project, funded by the European Commission, is to conduct research to develop, demonstrate and implement a sustainable rail freight service along the East-West corridor (see fig. 1[2]) from Constantza to Rotterdam crossing over the five national railway networks and four border crossing points. The authors have conducted state-of-the-art literature review and field surveys for this project. The current research reports the state-of-the-art of rail freight services along the RETRACK corridor in the areas of transhipment technology and systems, information and communication systems, safety and security of cargo, rolling stock and locomotives, human resources, legislative and regulatory status, and command and control systems. The research finds that all of national networks vary in terms of capabilities, competence and capacities in these areas and that the demonstration of a commercial rail freight service on the corridor will be feasible, competitive, and environmental friendly and will help achieving the long-aspired European Commission's (EC) transport policy of modal shift.

КЛЮЧЕВЫЕ ВОПРОСЫ ДЛЯ ПАНЪЕВРОПЕЙСКИХ ЖЕЛЕЗНОДОРОЖНЫХ ГРУЗОВЫХ ПЕРЕВОЗОК

Аннотация. Цель проекта RETRACK, финансируемого Европейской комиссией, состоит в том, чтобы провести исследования, развить, продемонстрировать и осуществить жизнеспособное обслуживание железнодорожных грузоперевозок вдоль коридора Восток - Запад (см. рис. 1) от Констанцы до Роттердама, пересекающего пять национальных железнодорожных сетей и четыре пограничных переходных пункта. Авторы выполнили современный литературный обзор и обзоры отраслевой литературы для этого проекта. Данный отчет информирует о современном состоянии услуг железнодорожных грузоперевозок вдоль коридора RETRACK в области технологии перегрузки и систем, информации и систем связи, безопасности груза, подвижного состава и локомотивов, человеческих ресурсов, законодательного и регулирующего статуса, а также систем принятие решений и управления. Исследование находит, что все национальные сети изменяются с точки зрения способностей, компетентности и мощностей в этих областях и что модернизация коммерческого обслуживания железнодорожных грузоперевозок в коридоре будет выполнимой, конкурентоспособной и экологической и поможет

[1] REorganisation of Transport networks by advanced RAail freight Concepts (FP6-2005-TREN-4)
[2] http://maps.google.pl/

достижению перспективных модальных изменений транспортной политики Европейской комиссии (ЕС).

1. INTRODUCTION

An efficient transport system is at the heart of economic growth in a global competitive market. It is also a source of negative effects including congestion, noise, and air pollution (Maibach, et al, 2007). The European Commission aims at achieving a sustainable and competitive freight transport system (EC, 2001, 2006a, b and c, 2007a and b). The Brundtland Commission created the definition[3] of sustainable development in 1987 at the World Commission on Environment and Development as 'Development that meets the needs of the present without compromising the ability of the future generations to meet their own needs.' Sustainable development can also be defined[4] as a development of an economic system that will last indefinitely or for long periods. The preliminary findings of this research suggest that RETRCK project will meet the underpinning objectives of both definitions.

The freight growth rate has been greater than GDP growth rate in Europe since the 1980s in Europe in particular in the EU15 (ERC, 2004; EC, 2006b). The main reasons for this sharp increase are: global sourcing, reduction in manufacturing depth, removal of customs and non-tariff barriers to trade, internationalisation of economic relations. All these had led to a steady increase in average transport distances of growth products, and the relative decline in transport as a cost component in the end-price (ERC, 2004; EC, 2006b, 2008). Many estimates (e.g. Allianz pro Schiene et al, 2008; ERC, 2004) suggest that this freight growth is expected to continue due to, among others, the expansion of the European Union and single currency (Euro zone).

Many national and international roads in Europe are highly congested resulting in higher pollution and noise from idling traffic and in many areas (e.g. many urban areas) (ECMT, 2003; EC, 2007c) or networks (e.g. port approaches in Rotterdam, Antwerp and Hamburg, major North South routes in Germany) unable to take any more traffic. Over the last ten years the road freight market share has been increasing while that of rail freight has decreased. Rail transport is widely accepted as an environmentally sustainable transport option. The modal shift of freight from road to rail, sea and canal has been at the heart of European transport policy (Kukacka, 2007) for over a decade. The reasons for the relative and absolute decline of rail's share of the growing freight transport market are variously but centre on inappropriate service and product offers, poor asset productivity and a high cost base which is reflected into pricing (ECMT, 2003; ERC, 2004; EC, 2001; EC, 2006b). The inappropriate service offer and price make rail unacceptable and uncompetitive using the existing supply side business model. Allianz pro Schiene et al (2008) reports some examples of successful rail freight operations that contribute to modal shift from road to rail.

The mid-term review of White paper 2001 (EC, 2001; 2006c) in 2006 introduced the policy of co-modality. This policy aims to optimise each mode's strength separately and together. It does not exclude the operational technique of intermodality. In the context of sustainable growth and jobs, as defined in the Lisbon Agenda, there is a drive to achieve intermodal, cross border rail freight services to compete on pan-European corridors or networks. RETRACK aims to fulfil this need through research, development, and demonstration of commercial train services along the East-West trans-European corridor of Constantza to Rotterdam through Hungary, Austria and Germany (see figure 1) (RETRACK, 2008). The service will be operated by private rail companies and not the incumbent operators.

This paper identifies commercial rail freight service issues through an in-depth literature review and 48 field survey interviews amongst the stakeholders including rail operators, infrastructure managers, terminal operators (both port and inland), and national rail regulators (RRs) (details in table 1). The literature review included best practices, technology use, private research, and prior expert

[3] http://www.sustainabilitydictionary.com/
[4] http://en.wikipedia.org/wiki/Sustainability

knowledge. The findings on different essential aspects of rail freight services are discussed in the following sections.

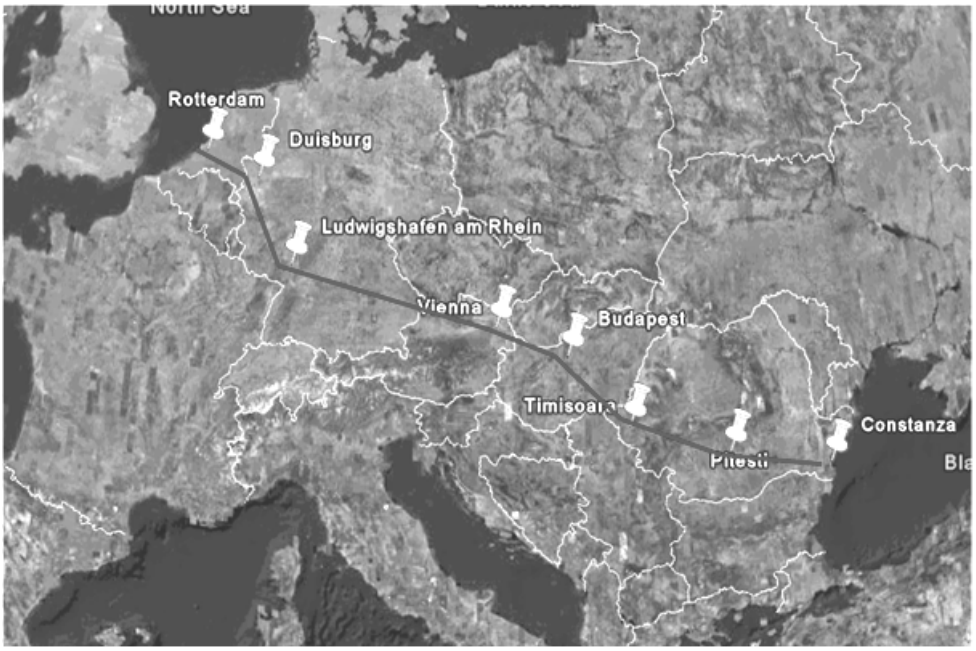

Fig. 1. RETRACK Constantza to Rotterdam rail freight corridor
Рис. 1. Коридор железнодорожных грузоперевозок RETRACK Констанца - Роттердам

Table 1

Survey interviewees along the RETRACK corridor

	Romania	Hungary	Austria	Germany	The Netherlands	Total
Rail regulator/ Ministry	2	2	2	2	2	10
Rail operator	1	1	1	3	3	9
Terminal operator	2	1	5	9	2	19
Port authority	1	-	1	2	1	5
Infrastructure manager	1	1	1	1	1	5
Total	7	5	10	17	9	48

2. TRANSHIPMENT TECHNIQUES AND SYSTEMS

Every table Major terminals (e.g. Rotterdam, Duisburg, Ludwigshafen, Vienna, Budapest, Timisoara, Pitesti and Constantza) along the RETRACK corridor (see in figure 1) are largely differentiated between those are competent to handle ISO, non-ISO, swap body and trailers and terminals dedicated to specific high volume commodities (chemicals in liquid, powder or granular format or fuels), semi-bulk commodities (wood, building materials etc). In the former option the ability to transfer cargo efficiently between modes (rail/road/water) within terminals is available using

an array of technologies, methods and systems often tailored to specific terminal configuration constraints or the requirements of key commodities. Within the port areas (Rotterdam and Constantza) at the outer end of the corridors different issues come into play largely as a consequence of the sheer volume of cargo being moved through the maritime terminals and a differing set of imperatives being in play. The RETRACK trains will operate between significant cargo origin/destination nodes but the balance of cargo on the trains is likely to be a mix of unitised traffic and bulk traffic.

To maximise train performance, productivity and competitiveness the movement of cargo on and off the trains to and from other modes appears to be achievable under prevailing operating conditions. This may require the manipulation of the train formation to satisfy the differential speeds at which unitised and bulk/semi-bulk traffic is handled. In turn this implies a requirement for a strategic overview of vehicle asset management across the whole corridor and the full set of services being run. The overwhelming number of terminals inspected use orthodox Lift on-Lift off (LOL) cranes, front end loaders and reach stackers in varying proportions reflecting local terminal configuration and existing traffic/commodity activity. In terms of the long aspired efficient intermodal horizontal transfer techniques for unitised cargo on RETRACK corridor the study finds that this domain remains still largely unproven in full scale commercial services and remains to be developed further in terms of technology, cost and general performance capability before it can be realistically accepted and deployed as a credible technique.

The INHOTRA (2002) project identified some developing horizontal transfer technology but this has not yet reached maturity or widespread commercial application. All of the terminals are bi-modal and a small number are able to offer tri-modal service with linkages to inland waterway. Some new terminals are being commissioned and/or being extended in several locations (e.g. Vienna, Budapest) to accommodate high levels of deep sea ISO container traffic demand. Major traffic generation sites such as chemical plants in Germany are highly automated. Individual terminal operational planning methods and systems have generic similarities and some of the terminals use internationally recognised tools for this purpose. The integration of shipper's planning and operational systems with terminal and train operators is limited. Some of the terminals visited were evidently running close to their operational limits. Improvements in productivity and extended operational hours may be a short term solution. There are environmental constraints on terminals in or close to city centres that effectively cap this option. The road traffic generation flowing from terminal activity is a major issue. Terminal security was adequate in most cases in relation to unauthorised access although there were some notable exceptions.

3. INFORMATION AND COMMUNICATION TECHNOLOGY (ICT)

An efficient routine delivery of rail attractive and competitive freight services needs systems for command, control and communication among all parties to plan, implement and monitor traffic activities and to link this to business processes. The ability of the systems within various domains to allow information to be exchanged as required without conversion or transcription is a key requirement. Against this set of requirements the current research found that there remained a complex mass of differing documentation systems often specific to individual organizations and bespoke in terms of formats and content. This position was reinforced by the use of differing systems, technologies, protocols, methods, techniques, communications technologies and with varying priorities. There were manual-electronic interface problems with the risk of delay, cost in transcription and error. There was no existing commercially available system that was capable of supporting the full array of RETRACK ICT requirements covering planning, marketing, operations planning and operations monitoring, track and trace, asset management and financial outputs in an integrated or linked format. Thus for RETRACK purposes there is a need for controlled and secure access to operational and commercial data exchange. This is particularly important for real time track, trace and condition monitoring and active intervention in the event of disruption and re-scheduling and re-routing. There is a real need to ensure continuous traceability of high value, time sensitive cargo and this could be developed as a marketing device to put rail on par with road transport. Notably no single

actor in the proposed RETRACK venture had organisational and systems dominance. This, combined with competition between partners as well as co-operation, suggests the need for decentralised many-to-many ICT systems that support 'co-opetition'.

4. SAFETY AND SECURITY SYSTEMS

A review of safety and security of rail cargo was undertaken. The scope of current study did not include the safety and security issues of rail infrastructure and power supplies. The safety and security issue of hazardous cargo is covered by existing active international protocols and response measures with local reinforcement. The major threats to the proposed new services are theft, damage in transit to cargo and railway rolling stock and traction, people and illegal substance smuggling. The use of containerised cargo is likely to mitigate some of these concerns. In particular, border crossing points and technical stop points are seen as a high risk points on any transit with the train stopped on a routine basis for formalities. There is a need to integrate and streamline or eliminate the border formalities or bureaucracies. The option of spot checks remains as a device to deter wrong doings. This point equally applies to the railway's requirement for inspections and crew changes to be undertaken in a different way, time and place to avoid routine train stoppage and exposure to external risks. The integration of check and clearance processes and their completion at departure/arrival points might be a useful model to develop to recognise a borderless Europe.

Enhanced in-transit security implies a cost burden but could be used to good effect as a marketing tool to provide reassurance to shippers and cargo interests that this is available as an integral part of the new service offer. The safety and security measures taken in the US in terms of cargo issues have potential extra-territorial implications. To prevent such vulnerability the supply chain will need through transit traceability and condition monitoring with real time intervention. This will have an extra cost implication to ensure compliance. However, the use of existing road borne security systems might offer some guidance on what is available to support this aspect. It would also reinforce customer confidence in any new service as it matches what is routinely available in the road transport sector.

5. OPERATIONAL ISSUES

The aspiration of European Railways is to operate a fully electrified service despite the variations in power supply (1.5kv d.c./25kv a.c./15 kv a.c.) on the RETRACK corridor. The field visits undertaken in all of the corridor countries found that this aspiration appears to be feasible and traction and rolling stock working diagrams have been developed to maximise productivity. As a consequence of this variability the traction resources will need to be equipped with control mechanisms that permit maximum flexibility. Locomotive productivity is targeted from 180k to 220k km per annum. Wagon productivity will be 140k to180k km per annum. An end-to-end transit time of 80 to 100 hours appears feasible and would confer significant competitive advantage. The train is potentially available to operate at 120kph between Rotterdam and Hungary. Gradients and single line operation in Romania slow average speeds significantly. There are varying limits on train length and weight along the route. The preferred 750m length is not feasible in Romania and heavy trains require additional traction resources in the severely graded route sectors. Routines to 'slip' the excess train length as empty stock have been investigated as a means of mitigating the train length variability.

A range of terminal stops for cargo operations has been identified for unitised cargo and some semi-bulk traffic. Cargo operations will need to be tightly planned and implemented to maintain the overall punctuality of the train schedule. The ability of positioning the trains within the terminals without detaching the main line locomotive will be useful in this regard. Access to terminals and the availability of a siding to hold the main line power if it is necessary to detach this for terminal operations is still a contentious issue with the incumbent train and infrastructure operators. Command, control and communications systems vary at national levels with the use of individual national practice/technologies largely underpinning the proposed operation. This has obvious implications for

cross border crew operations. The European Rail Traffic Management Systems (ERTMS) is planned for development in the sections of Austria-Romania. The adoption of ERTMS at above the basic Level 1 for the complete corridor is still under development. National control models will apply in Germany and The Netherlands apart from the Betuwe line which is fully fitted out for ERTMS Level 3.

6. DRIVER TRAINING AND CERTIFICATION

The ability of train crews to operate in territories other than their own national domains is now an option designed by the EU to reinforce the liberalization and future competitiveness of rail freight services. It is designed to give rail the same potential freedoms as the road and aviation sectors. The field visits to direct stakeholders reveals that the rate of implementation and acceptance of this has been mixed along the RETRACK corridor. There has been some local cross border operation between Germany and The Netherlands. There are issues over the cross acceptance of national competence certification sometimes backed by national legislation and rules that constrain the potential value of this initiative. Other constraining aspects include language issues, international benchmarking on competence, training standards, certification and testing/updating, route familiarization and liability arising from driver error in 'foreign' railway territory or territories.

7. LEGISLATION AND REGULATION

The field visits undertaken in all of the countries on the RETRACK corridor indicates a mixed array of implementation status of the railway reforms rolled out progressively by the EU to make rail a more competitive and attractive option for shippers and cargo interests. There are differing degrees of competence, involvement and effectiveness in terms of railway regulation, the enforcement of liberalization measures and the constraint of discriminatory activity by the incumbent national railway service providers and infrastructure managers. The discrimination-free open access is nominally in place along the entire corridor but in terms of enforcement these are in a mixed and variable situation. The new member states now have many more new entrants than "old Europe" indicating a greater degree of preparedness to take commercial risks against the incumbent operators and to develop new services. The rising number of new entrants (sometimes very small and localised) has brought about some growth in the overall level of rail traffic but the new entrants appear to be focusing more on "rail-on-rail competition rather than growing or attracting the overall share of the market held by competing modes. Such introduction of new entrants will not realise the re-balancing or shifting of the freight market share unless the reforms are completed across the EU at a common level enforcement.

Germany and The Netherlands have sophisticated structures and mechanisms in place to manage the reform packages' implementation. The German RR is intending to extend the powers to intervene on discriminatory or anti-competitive commercial issues, cross-subsidisation and predatory pricing to stifle competition. There are evolving regulatory regimes in Hungary and Romania. In Austria a wholly different model of railway regulation has been adopted and there are some concerns over the effectiveness of this in relation to the incumbent train operator and infrastructure manager's activities. Arguably the EC should be aiming for a full measure of implementation to secure full and adequate compliance in line with the directives by an agreed deadline to ensure a level playing field exists to encourage new international freight services. Without this the distortions in the market in terms of access charges and access on a discrimination free basis will remain and will constrain rail's attractiveness and commercial competitiveness. In 2006 EC found that some of the member states did not take sufficient measures to ensure an effective regulatory framework as well as the satisfactory functioning of the railway markets. In 2008 the EC sent letters of formal notice to 24 member states for non-compliance with railway directives and the authors opine that the degree and type of compliance varies widely across Europe (EUROPA, 2008).

8. INFRASTRUCTURE ISSUES

Well-performing capacity is a pre-condition to operate an efficient freight service (Posner III, 2008; NEW OPERA, 2008). The RETRACK corridor is well over 2000km in length and passes through five railway domains of widely varying levels of technical sophistication and activity levels. Competition for train paths with other services (high speed, long haul passenger, regional and suburban trains) varies. Traffic activity in The Netherlands is dense and similar position applies in the Ruhr and central sections of Germany. The sheer volume and level of national traffic activity raised concerns that RETRACK rail freight service may be obliged to use less attractive routings to avoid congestion in Germany. Tactical operational issues arising from the announcement of planned maintenance activity as a constraint have been relayed to the RR in Germany as being anti-competitive. There is the risk of congestion in the West of Vienna until additional track capacity is commissioned. There is significant congestion, albeit temporary, in and around Constantza as the infrastructure is modernised and augmented to accommodate additional rail borne traffic. There will be a requirement to adopt flexible port and terminal access arrangements to accommodate train schedule divergence. The inadequacy of the infrastructure in Hungary and Romania to support high quality routine and fast freight services gives some causes for concern. The potential need to reduce train length and weight on gradients and single track lines with restricted passing loops in Romania are crucial issues to be resolved as is the need for additional traction resources to haul heavier train formations.

9. SUMMARY AND CONCLUSIONS

The findings of the state-of-the-art literature reviews and field surveys suggest that there are adequate terminals with necessary equipment and technology for the operation and handling of inter-modal traffic at strategic points along the RETRACK corridor. The ability to operate trains end-to-end or part way along the corridor as well as intersecting with other major links all appears to be feasible. However, this will require transforming the train operators' and individual terminal operators' commercial positions into an integrated supply chain. A number of terminals along the corridor are of world class terminals. Others are less well developed but could usefully allow access to markets less well served through the big terminals and also allow market testing without major commitments to big operations. Several larger terminals are being expanded or have expansion plans for development. All of the terminals visited are using established conventional terminal transfer equipment with no evidence of the use of horizontal transfer systems. This is still largely novel technology and not appropriate to high volume terminal operations. Terminal management methods vary but not significantly. There are some environmental issues arising from terminal activities largely focused on noise and traffic generation activities. The new terminals are fully compliant on hazardous cargo containment.

No unique ICT platform for the transport chain exists along the RETRACK corridor. In fact, the ICT systems along the corridor consist of complex mass of documentation, systems, technologies, protocols, methods, communications technologies and priorities. No existing systems fully support RETRACK requirements. The RETRACK rail freight operation will require a common platform for data entry, recording, transmission and receipt. It will have to integrate cargo documentation with track and trace, command, control and communications and also will have to establish continuous traceability of high value time sensitive cargoes. It will also need to be linked to planning, budgetary, variance analysis and other commercial business systems. It needs to be decentralised, many-to-many, allow multiple roles per partner and service so as to support competition amongst partners.

The safety and security issues of cargo, not infrastructure, are reviewed along the corridor. The safety and security of hazardous cargo is governed by international protocols with international standards and any national reinforcement. Major threats to cargo are theft, damage in transit, smuggling (people and substances). Borders points are the high risk areas with delay and train vulnerability exposed on a routine basis. It needs for integration of check and clearance processes. It also needs for linkage to all involved national bodies with relevant interests such as Customs,

immigration and security. There is a need for through transit traceability and condition monitoring with real time intervention to prevent vulnerability of the supply chain. This will impose an extra cost. The bordering countries need to accept inspections beyond borders as an integral part of transit without need for national inspection (airline can be an example). The system needs for driver integrity checks and access to train and existing road borne security systems can be used.

The power supply for traction purposes is based on three different voltages and two different systems and enforces the need for multi-system traction/locomotives for RETRACK operation. The corridor is all electrified which is a 'Green' selling point for the rail service. The adoption of ERTMS at above the basic Level 1 for the complete corridor is still under development. National control models apply in Germany and The Netherlands apart from the Betuwe line which is fully fitted out for ERTMS. There has been some local cross border operation between Germany and The Netherlands. The issues related to crews are language issues, international benchmarking on competence, training standards, certification and testing/updating, route familiarization and liability arising from driver error in 'foreign' territory.

The transit time may range from 80 to 100 hours depending on the number of stops. There are differences in train length and speed. The productivity of wagon and locomotive may range from 140k to180 k km and 180k to 220 k km per annum.

There are mixed arrays of implementation of reform packages. German and Dutch railways have sophisticated structures and mechanisms in place to intervene on commercial issues, cross subsidization and predatory pricing below cost to fend off competition. There are some concerns that the incumbent rail operators could restrict access and operations in terminals as a defensive commercial measure. If these situations arise there are in most of the countries adequate defence measures through the RR to intervene this. There are also concerns about Austrian (as well as Hungarian) RR over effectiveness and willingness to intervene. EC needs to monitor and secure full and adequate compliance in line with directives by a common agreed deadline to ensure a level playing field.

Experts suggest (e.g. Hrivnák and Krizanová, 2007; Heymann, 2006; Posner III, 2008) that a new kind of rail freight service is needed in Europe that will be first and foremost a business. This business will be run by an independent management who are free to exploit opportunities, but answerable for any failure. Keeping on board these recommendations the current research concludes that the demonstration of a commercial train service along the RETRACK corridor will be feasible, competitive, and environmentally benign and will help achieving the long aspired modal re-positioning of freight. Quality management commitment and implementation to customer requirement will be vital for such cross country rail freight operations to overcome the deficiencies in terms of punctuality, reliability and proactive customer services. Also a corridor competence centre should be established to act as an information turntable for all stakeholders including shippers and consignees.

References

1. Allianz Pro Schiene, CER, and UNIFE, *From Truck to Train thirteen Examples of successful modal shift in European freight transport*, April, 2008.
2. EUROPA, *Commission calls on Member States to ensure correct implementation of the First Rail Package*, IP/08/1031, Brussels, 26th June, 2008.
3. European Conference of Ministers of Transport, *The European Integration of Rail Freight Transport, Conclusions of Round Table 125*, Paris, 28-29 November 2002, 2003.
4. European Research Centre, *European Integration of Rail Freight Transport: Round Table 125,* European Conference of Ministers of Transport, OECD, Paris, 2004.
5. European Commission*, Rail Transport and Interoperability*, in http://ec.europa.eu/transport/rail/market/index_en.htm, 2007.

6. European Commission, *EU Energy and Transport in Figures: Statistical pocketbook 2006*, Directorate-General for Energy and Transport (DGTREN), in http://ec.europa.eu/dgs/energy_transport/figures/pocketbook/doc/2006/2006_transport_en.xls, 2007.
7. European Commission, *Sustainable Urban Transport, Technical Report- 2007/018, Environment*, 25 September 2007.
8. European Commission, *Green paper,* Directorate-General for Energy and Transport, 2006.
9. European Commission, *Keep Europe Moving- Sustainable mobility for our continent*, Directorate-General for Energy and Transport, 2006.
10. European Commission, *Keep Europe Moving- Sustainable mobility for our continent: Mid-term review of the European Commission's 2001 White Paper* {COM(2006)314 final}, 2006.
11. European Commission, *White Paper – European Transport Policy for 2010: time to decide*, Directorate-General for Energy and Transport, 2001.
12. EUROSTAT, *Transport Statistics*, European Commission, 2005.
13. Heymann, E., *Competition in European Railway Market: Morning has broken*, Deutche Bank Research, 21 November, 2006.
14. Hrivnák, M. and Krizanová, A., *Position of Rail Transport in EU Common Transport Policy*, VADYBA/Management, Nr 1(14), 2007.
15. INHOTRA, *Interoperabile Intermodal Horizontal transhipments*, WP 2 Final Report, 2002.
16. Kukacka Mag, H., *The (De)regulated Railway Market in an Enlarged European Union*, in http://www.scg.gv.at/SCG/SCG-VERANSTALTUNGEN/OSTEUROPA/REF_02.htm, 2007
17. Maibach, M. and others: *Handbook on Estimation of External Cost in the Transport Sector,* Report produced within the study 'internalisation measures and policies for all external cost of Transport' (IMPACT), Version 1.0, Delft, 2007.
18. NEW OPERA, *The Rail Freight Dedicated Lines Concept, Operating Project for a European Rail Freight Network,* Final Report, 2008.
19. Posner III, H., Rail Freight in the USA: Lessons for Continental Europe, CER Essay Series, January, 2008.
20. RETRACK, *Reorganisation of Transport networks by advanced Rail freight Concepts*, in http://www.retrack.eu/, 2008.

Received 14.05.2009; accepted in revised form 21.09.2010