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NEW FEEDER LINE RAIL FREIGHT PARADIGM FOR THE EUROPEAN RAILWAYS

ABSTRACT

The article deals with the development of the new paradigm of the European rail freight system predominantly suitable for the feeder lines (market niches). Taking into consideration the so far adopted legal solutions of the EU Commission for internationalisation (liberalisation) of the European railway system, the concept of the new rail freight model was developed in order to contribute to the increase of the quality, as well as to the growth of the volume of the rail freight services in Europe. Based on the findings about the disadvantages of the existing rail freight paradigm, the new solution consisting of the three interrelated and interconnected subsystems: institutional, technical/technological and organisational, is proposed. New liberalised access to the entire European rail infrastructure network will increase the competition and most probably attract new railway freight service providers. The introduction of the suggested innovative solutions in form of small, self-propelled, bi-directional train formation that can be automatically coupled and decoupled and equipped with the innovative loading and unloading equipment (enabling loading/unloading operations wherever the truck can stay parallel to the train), is to be expected predominantly on the feeder lines (market niches) of the European railways.

KEY WORDS

rail freight, EU transport policy, liberalisation, new rail freight paradigm, innovative freight technological solutions

1. THE EXISTING FREIGHT PARADIGM OF THE RAILWAYS

With reference to Bukold [1], who has analysed the transformation of different systems of freight transport due to technical/technological, organisational and political factors, the core of any transportation system consists of at least three elements:

- Institutional elements: directives, laws, norms, technical standards, market regulations etc.
- Technical/technological elements: locomotives, wagons, transhipment technologies, trains, terminals etc.
- Organisational elements: organisational functions of different segments of the freight transport such as: timetable planning, slot management, modal and intermodal organisational transport solutions, slot attribution, priority attribution systems etc.

Railway freight transport is a specific combination of the above listed elements. The basic characteristics of the present railway freight transport paradigm are:

- powerful locomotives,
- long trains,
- large shunting areas for classical terminals
- large volumes of low value goods,
- long distances,
- fixed schedules,
- large specialised terminals for intermodal transport, etc.

It may be summarised that the rail's major problems are also originating from the characteristics of the predominant rail freight paradigm, which is facing the following disadvantages:

- Poor reliability and precision.
- Poor availability and responsiveness to shipper's imperatives under JIT expectations.
- Low asset utilisation reflecting unclear "ownership".
- Lack of flexibility and responsiveness on scheduling and routing to meet shipper/receivers requirements.
- Slow loading, unloading operations.
- Heavy (over-engineered) equipment resulting in the excessive length and weight of the trains.
- Poor transport progress and status monitoring (tracking and tracing).
- High entry costs for new players using orthodox equipment.

Today's railways freight production system typically reflects the principles of mass-production within the framework of transportation principles based on economies of scale. The economic logic of this paradigm goes back to the period when the predominant freight volumes were constituted by heavy and bulky raw materials. This paradigm includes requirement for considerable capacities on the railway network, highly specialized know-how and expertise ranging from the production of locomotives to the design of schedules. This knowledge has proved to be very resistant to innovations and is concentrated in a few (mainly monopolistic) enterprises [2].

The same applies to railway companies and their strategies. In the period of restructuring of the railway sector, railway companies tend to emphasize their "corridor strategy" and the development of long trains and huge terminal or shunting infrastructures. The results of the abovementioned strategy are obvious; less than 22% of the railway network length carried in 1992 about 60% of the volume of traffic [3].

The core strategy of the railways is the concentration on the rail freight flows on the few corridors and usage of large terminals, where economies of scales is achieved. The consequence of the abovementioned strategy was a decrease in the importance of railways in the modern door-to-door freight services and rapid shift of non-bulk cargo to other modes, mainly road.

The response of the railways to falling revenues was a nearly continuous process of reduction of costs by slimming or removal of the feeder freight services and networks.

2. INSTITUTIONAL SOLUTIONS OF THE EUROPEAN COMMISSION FOR REVITALISATION OF THE RAIL FREIGHT MARKET

For further development of the European rail freight services in terms of better quality of services and also desired and foreseen[1] increase of the transport volume, comparable conditions to the road freight sector are to be developed. In order to achieve the foreseen changes and achieve sustainability of the freight transport, the European Commission has adopted so far two groups of the strategically important legislative solutions. The first group includes:

- the first two "liberalisation packages"

and the second group contains:

- the legislative solutions for the interoperability of the European railways.

2.1. Liberalisation and deregulation

Liberalisation and deregulation of the rail transport sector are regarded in the European Union as the key issues to achieve better rail performance and consequently, better intermodal performance.

The EU Commission enacted the directive 91/440 [4], which aims at separating the rail infrastructure from the rail operating systems and to create equal market conditions for all railway companies for the usage of the (not owned) railway network. The EU-directive 91/440 was intended to provide the necessary legal background for the liberalised railway market that should have led to a better efficiency of the involved railway companies, for the benefit of the transport customers.

In order to improve the quality of the rail freight services, liberalisation was expected to overcome the national monopolies, to bring more competition on the market and to increase the overall productivity of the rail transport sector. Finally, liberalisation could bring more private investments into rail transport. The liberalisation could have made the rail transport sector more competitive to the already deregulated road transport market.

Free access of railway operators to the international market (and to the vacant railway infrastructure), is a crucial prerequisite for bringing more competition and for providing eventually better services for the railway freight customers, which means also better rail freight services in intermodal transportation systems [5].

On 23 January 2002 the Commission adopted new measures for "revitalisation of the European railways" in the so-called Second Railway Package. With this, so called, "Second Railway Package" the European Union has opened up both national and international freight services on the entire European railway network. According to the new directives the access to the entire European international railway network should be possible from January 2006 and also to (local) national networks starting from January 2007. All member states should adopt the new directives by 31 December 2005 at the latest.

2.2. Interoperability of the European railways

Different technical solutions and standards of different European national railway systems prevent the railways to perform interoperable activities throughout Europe. Differences in signal systems, overhead current systems or legislation make it necessary to recognize national borders for changing locomotives, engine drivers or invest in expensive interoperable equipment. This is at the moment still an important competitive disadvantage of the European railways.

Lack of international interoperability of the European railway system was recognised also on the political level. The result of the development process was adoption of the following directives on interoperability of the European railways:

- Directive 96/48: the Trans-European high speed rail system (passengers),
- Directive 2001/16 on the Trans-European conventional rail system.

The main aim of the Commission is the creation of a single railway system through harmonisation of the

European technical and operating standards and approval processes.

Both above started directives apply a standard set of the so-called Technical Standards for Interoperability (TSI).

3. INNOVATIVE TECHNICAL SOLUTIONS FOR NEW RAIL FREIGHT MARKET NICHES

The scale of the market potential in the field of high value and perishable goods and in the field of feeder services[2], (next to the existing rail freight paradigm on the corridors) is such as to suggest that rail can re-assert itself as a player on the markets where it has not been a credible partner so far, if and only if, some fundamental technical, organizational and operational limitations that restrict its competitiveness under existing rules of engagement are seriously challenged and rolled back.

The ongoing process of the liberalisation of the rail freight market and the foreseen interoperability of the European railway systems are going to provide access to the rail freight market by the new actors. This is supposed to create the necessary competition to improve the quality and increase the volume of the rail freight services.

For rail, to seriously address the new freight market niches and to meet the modern market requirements, a fundamental shift in the overall product and service performance is required. In order to be able to match the road freight competition in terms of reliability, quality of services and costs the implementation of innovative vehicle concepts is required.

The development of the innovative rail freight solutions is not internationally coordinated on the European level. In order to be able to proceed, as soon as possible, towards the possible implementation of the existing innovative solutions, the author of this article has developed a model of the new rail freight system[3], which would be based on the integration of the existing innovative partial solutions. The suggested solution represents only a rough framework, as basis for further development and further perfection.

The ideal rail freight technology for the above mentioned market niches, would be a combination of the truck (high flexibility) on the rail (mass production), which can easily be coupled if necessary to a long train and/or uncoupled to single self-propelled fast moving "railway-truck(s)".

The core concept of the suggested innovative rail freight paradigm would consist of:

- Small, self-propelled, bi-directional train formations like Truck Train ® in Great Britain or Cargo Sprinter of the German company Windhoff, which would be recognised generically by the infrastructure operators as a fast train and not as a freight train that is accorded low priority on the system.
- Equipped with simple and effective loading/unloading equipment such as Mobilier, Windhoff, System Kugel, System ALS etc.
- Free access to the vacant railway infrastructure (the concept and the possible technical solutions will be explained in the next chapter).

The combination of the "Truck Train, Cargo Sprinter – Mobilier, Kugel type" solutions suggests that this type of technologies could make rail freight a more competitive, profitable and attractive option for shippers, receivers and operators in the field of feeder services, city logistics, inter logistics centres transport etc. In general, it may be said that the rail freight operators have potential capability to implement this type of innovative rail freight solution predominantly outside the main European corridors.

4. NEW ORGANIZATIONAL SOLUTIONS OF THE TIMETABLE PLANNING FOR THE FREE ACCESS TO THE VACANT RAILWAY INFRASTRUCTURE

Railway scheduling (timetable planning) is the process by which the "demand" for rail transport (passenger and freight) is brought together with "supply side" constraints (such as available infrastructure capacity, rolling stock, and staff) to produce timetables and resource plans that meet the demand at an appropriate level of cost[4].

One of the most important elements in the implementation of the new suggested rail freight paradigm is the dynamic access to the vacant railway infrastructure (possibility to use free gaps of the railway infrastructure). The realisation of the suggested idea requires also fundamental reorganisation of the standardised way of the timetable planning system of the railways. An adequate organisational solution should be developed by the rail infrastructure managers, which enables the "Truck Train" solution to drive between the fixed timetables, taking advantage of the vacant railway infrastructure.

Free access of the logistic operators to the vacant railway infrastructure in the future, (especially for feeder services and new innovative city logistic solutions based on the suggested "truck-train" technical solutions) is an important precondition for the success of the suggested new (additional) rail freight paradigm.

The idea of the new rail freight model will be in the future, in the author's opinion, strongly supported also by the railway infrastructure managers, because it enables more effective and more profitable use of the existing railway infrastructure. The same holds also well for the existing and for the new rail freight providers, which will be able, according to the "second railway package", to take advantage of the entire European railway infrastructure and provide freight services wherever they find promising market niches.

Advanced electronic data-processing has created possibilities to realistically simulate rail traffic on ordinary computers. Rail timetable planning is particularly challenging because of different improvements that can be used to improve project objectives [6].

Advanced software solutions such as: Railsys, TPS/ /Strax, Opentrack etc. enable object-oriented modelling of railway traffic flow. Predefined trains run according to the timetable on a railway network. During the simulation, the software program calculates train movements under the constraints of the signalling system and timetable. After a simulation run, e. g. OpenTrack can analyze and display the resulting data in the form of diagrams, train graphs, occupation diagrams and statistics. The tasks such as: determining the requirements of railway network infrastructure, analysis of the capacity of lines and stations, rolling stock studies (future requirements), timetable construction (single, multiple simulation runs, Monte-Carlo simulation), analysis of the effects of system failures and delays, calculation of power and energy consumption of train services etc., can be studied and solved [7]. Data needed for the simulation can be divided into 3 different areas: rolling stock data, network data and timetable data.

After all the data are interposed into the model, the simulation can be started. During the simulation, trains try to follow the prescribed timetable. The signalling system of the railway network poses constraints. Occupied tracks and restrictive signal aspects may impede a train's progress. The user can watch the simulation in animation mode, which shows a simulation of a train's course and lets the user analyze the occupied tracks, reserved tracks and signal aspects. During the simulation, data (i. e. acceleration, position, power consumption, etc.) for each train are continuously logged. These data can be evaluated after the simulation has run. Evaluations of the train, line or station are possible. For a train, OpenTrack offers diagrams such as acceleration vs. distance, speed vs. distance, and obstructions. For a line, there are evaluations in the form of diagrams of train movements, route occupation and line profiles. Every station produces output about all the trains that stopped at their premises, including arrival, stopping and departure times. Many other evaluation diagrams can be presented, like the occupation rate per hour and peak occupation rate. This is important for the process of finding vacant railway infrastructure capacities, which can be used for setting addition trains on a railway network.

OpenTrack's dynamic nature allows users to assign certain attributes to specified times in the simulation. Thus, users can assign a delay to a particular train at a given station and time, rather than being limited to assigning a delay at the start and using it through the entire simulation. Similarly, users can define other types of incidents (i. e. infrastructure failures, rolling stock breakdowns, etc.) for particular times and places.

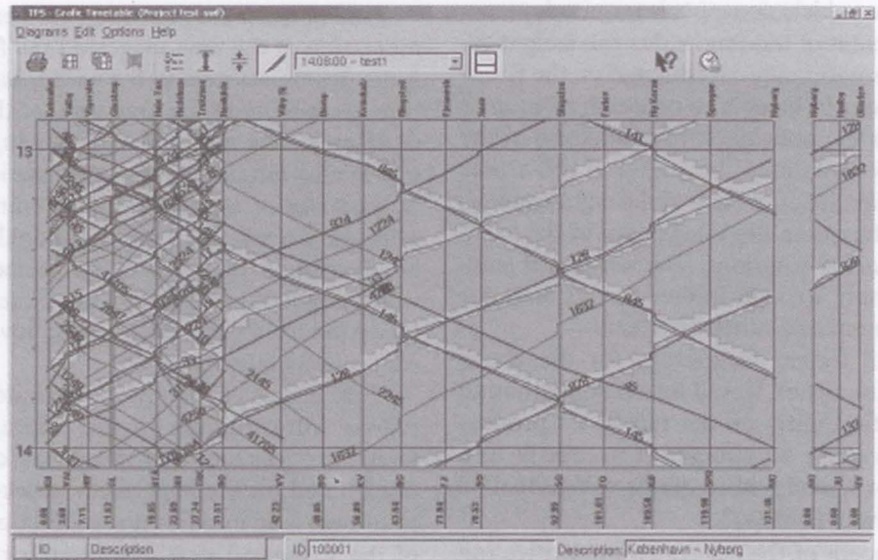

Figure 1 - Interactive Graphical Timetable Section [8]

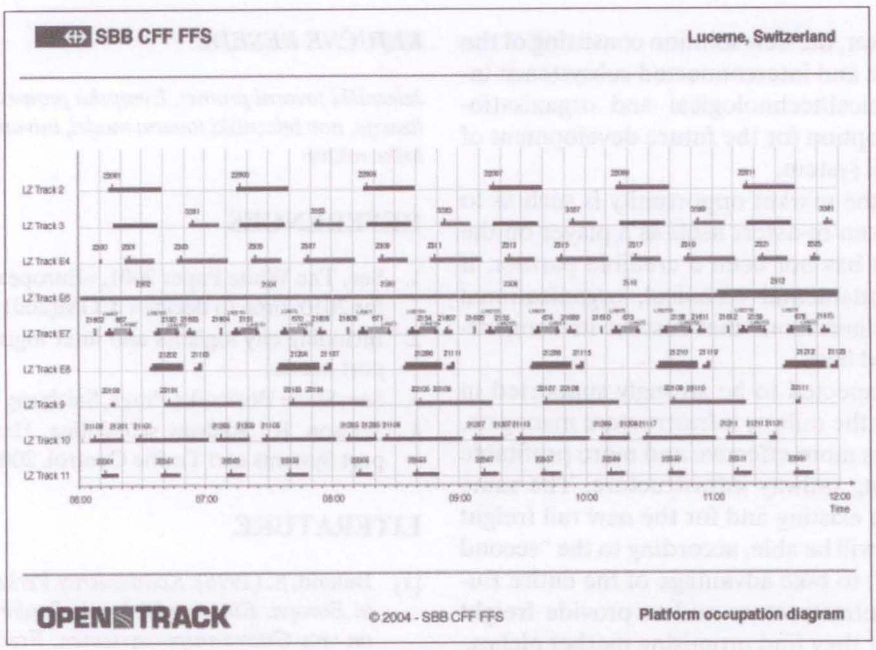

Figure 2 - Occupation of selected platform tracks [7]

Taking into consideration the available software solutions for calculating online access to the vacant railway infrastructure, none of the analyzed software packages offers perfect solution for the required function yet. But it may be stated also, that the achieved technological level in this field is already mature enough to be able to solve the problem, if this specific task would be required, provided that all the other needed technical and organizational problems are solved by the railways.

5. CONCLUSIONS

The ongoing process of liberalisation and development of the interoperability of the European railways is supposed to create the necessary competition to improve the quality of the railway freight services. Liberalisation and deregulation in the rail transport sector is regarded as the key issue to achieve a better rail freight performance. The aim of the EU directives (the First and the Second railway package) is the separation of the rail infrastructure from the rail operating systems and creation of equal market conditions for all railway freight service providers by means of free access and use of the international interoperable railway network.

The opening of the railway network i. e. the free access to the international railway infrastructure could not only help to overcome the institutional settings, which have guaranteed the monopoly of a few operators, but also constitute the necessary framework for radical innovation of the dominant freight paradigm and to create competition by increasing the number of stakeholders on the rail freight market.

The introduction of the new rail freight paradigm, for the high-value and perishable goods, which would be based on the systematic integration of the today still atomised individual innovation processes calls also for urgent reorganisation of the railways in the field of the on-line timetable planning. Free access of the logistic operators to the vacant railway infrastructure (especially for feeder services and new innovative city logistic solutions based on the suggested "truck-train" technical solutions) is an important precondition for the success of the new proposed rail freight paradigm.

The optimal suggested rail freight technology for the feeder railway freight services (market niches), would be a combination of the truck (high flexibility) on the rail (mass production). Under the innovative "Truck-Train" concept, the new system is proposed, which suggests deployment of a small, self-propelled, bi-directional train formation that can be automatically coupled and decoupled and equipped with the innovative loading and unloading equipment, which enables loading/unloading operations all along the railway tracks, wherever a truck can stay parallel to the train. The integration of the innovative solutions into a new modern rail freight paradigm suggests that the proposed technologies could make rail freight a more competitive, profitable and attractive option for all involved shippers, receivers and operators.

For rail to seriously address the freight markets and market requirements requires a fundamental shift in the overall freight services performance to be able to compete with road transport in terms of reliability, quality of services and costs.

Based on the findings about the disadvantages of the existing rail freight paradigm and realising the needs of the market, the new solution consisting of the three interrelated and interconnected subsystems: institutional, technical/technological and organisational, is a realistic option for the future development of the European rail system.

The scale of the market opportunity is such as to suggest that rail can re-assert itself as a player on the markets where it has not been a credible partner, if some of the fundamental technical, organizational and operational limitations that restrict its competitiveness are rolled back.

The idea is expected to be strongly supported in the future also by the railway infrastructure managers, because it enables more effective and more profitable use of the existing railway infrastructure. The same holds also for the existing and for the new rail freight providers, which will be able, according to the "second railway package", to take advantage of the entire European railway infrastructure and to provide freight services wherever they find promising market niches.

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POVZETEK

NOV MODEL ŽELEZNIŠKEGA TOVORNEGA PROMETA PRIMEREN ZA STRANSKE PROGE EVROPSKIH ŽELEZNIC

Članek obravnava predlog novega modela železniškega tovornega prometa, ki je prvenstveno primeren za stranske železniške proge (za tržne niše) na evropskih železnicah. Upoštevajoč sprejete pravne ukrepe Evropske komisije za pospešeno internacionaliziranje (liberalizacijo) evropskega železniškega sistema, smo razvili modelno zasnovo novega možnega sistema tovornega prometa, ki bi dvignil kvaliteto železniških storitev in prispeval k rasti obsega prepeljanega tovora na evropskih železnicah. Na osnovi analize slabosti prevladujočega obstoječega modela železniškega tovornega prometa v Evropi smo za oblikovanje novega združili spoznanja iz treh medsebojno povezanih in soodvisnih podsistemov: institucionalnega (pravnega), tehnično-tehnološkega in organizacijskega. Nov svoboden dostop na celotno evropsko železniško infrastrukturno omrežje bo gotovo povečal konkurenco in pritegnil nove ponudnike železniških prevoznih storitev. Realno je pričakovati uvedbo (novega modela) združenih parcialnih inovativnih rešitev v obliki kratkih, v obe smeri voznih vlakov z lastnim pogonom, ki se lahko samodejno priklapljajo in razklapljajo in so opremljeni z inovativo nakladalno/razkladalno opremo, ki lahko izvaja operacije natovarjanja in raztovarjanja kjerkoli na železniški progi lahko vzporedno stojita vlak in tovornjak. Nov model bo prišel do izraza predvsem na stranskih železniških progah (pokrivanje tržnih niš) evropskih železnic.

KLJUČNE BESEDE

železniški tovorni promet, Evropska prometna politika, liberalizacija, nov železniški tovorni model, inivativne tovorne tehnološke rešitve

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