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## DEVELOPMENT OF INTERMODAL TRANSPORT AT CROATIAN RAILWAYS

### ABSTRACT

*Deregulation of the railway transport in the EU, in particular the acceptance of the EU instructions which regulate the right of "the open access to the railway" is the reason for changes on the European intermodal transport market. The Community of European Railways creates the Trans-European Rail Freight Freeways which will exclusively perform rail freight transport. That freeway net has been created in EU member countries, but they are also extended to the countries with the candidate status for the membership in the EU, as well as to the countries outside the European Union where the quality of the railway infrastructure enables transport service to be performed at the required level. Transport at the Trans-European Rail Freight Freeways will be performed, for the most part, by the contemporary technologies which enable redirection of the goods from the roadways to the railways. Croatian Railways is planning to build and open truck terminals by the beginning of the year 2007 in Spačva, Split, Rijeka, Koprivnica and Zagreb. This is necessary in order to introduce its own trains for the transportation of trucks (so called Ro-La trains), which will help redirect approximately 150,000 heavy trucks a year from the roads to the railways. That way Croatia will profit at the ecological and economic level, as well as regarding transport safety.*

### KEY WORDS

*Croatian railways, intermodal transport, combined transport, development, progress*

### 1. INTRODUCTION

The result of the integration of the European countries in the EU is economic development, which is directly related to the freight transport. Accordingly, the requests for more complex services as well as

for the shorter transport time with the security guarantee at all domains are increased.

A quick development of the individual road and air transport in the second half the last century led to an overuse of the main roads and the airspace near the main airports. All that resulted in lower transport security, longer travel time and longer transport time of goods as well as the environment pollution. A change of proportions between each transport subdivision demands a comprehensive focus on these transport problems and shows the necessity of intermodal transport. In cargo transport the intermodal systems should be further developed, and in passenger transport there has to be a bigger portion of long distance transport. The first condition for that is to create a better quality of infrastructure, especially in the EU member countries and in the countries with the candidate status.

Political, technical and economic changes induced a heavily increasing freight transport in Europe. The positive effects of the international and interregional exchange of goods can be felt in several ways: new products, new markets, new business relations, etc.

At the same time the negative effects (ecological and social problems with noise, pollution, accidents) of freight transport are increasing as well. The majority of negative effects are caused by truck freight transport on the roads. In the opinion of the policy and the public the ecological and social benefits of rail transport seem to be evident. The transfer of freight transport from road to rail is a frequently published target of European, national and regional policy.

The traditional way of handling goods in the railway system is obviously not an efficient and economic solution. The intermodal transport can be a promising

solution, because in the intermodal transport the advantage of both transport-systems (road and rail) can be united.

On the one hand, intermodal transport improves the efficiency since over long distances trains can move large amounts of freight at low staff costs and relatively low energy consumption. On the other hand, there is a reduction in efficiency because two trans-shipments are needed to bring the freight from the short-distance transport system (i. e. trucks) to the long-distance transport system and back. The objective of intermodal transport, compared to the classical transport, is to reduce the costs offering the highest service quality, and in that way to reduce the participation of transport costs in the total product price.

In intermodal road transport more players are involved than in pure road or rail transport. The key for a successful intermodal transport service is to coordinate the players and the interfaces:

*sender – road – terminal – rail –  
– terminal – road – receiver*

By definition, Intermodal transport is the movement of goods in one and the same loading unit or road vehicle, which uses successively two or more modes of transport without handling the goods themselves in changing modes.

The interfaces influence the costs and the quality and consequently the price and the market share of intermodal transport service.

## 2. CURRENT SITUATION

In the past 20 years cargo transport in Europe has increased significantly, primarily due to the change in work pattern – with plenty of inter-storage and creating stock in continuous production and supply. The removal of borders within the EU countries has enabled the introduction of Just-In-Time system. The expected economic growth in EU member countries and better connections with distant regions lead to the increase in transport connections, especially in road cargo transport. Although the transport system which came about with the development of the railway transport in Central and Eastern Europe still exists, since the 90's there have been significant changes in the distribution of the volume of transport within individual transport branches, and mostly to the benefit of road transport.

The current system of individual railway wagons used for assembling and disassembling the train compositions at assembly stations is not competitive compared to the road transport, especially if one considers the speed. Railways in CEE countries account for about 40 percent of the total freight transport, (V. Mojžiš, T. Molková, L. Bina: *Perspektiven des Eisen-*

*bahn-und intermodalen Verkehrs im zusammenwachsenden Europa*, ZEVrail 5/2004, p. 183) which is about four times more than the railway share in EU countries. Although a certain decrease is expected in the countries entering the EU, it would be optimal if by the year 2010 a share of at least 35 percent was maintained. Widely spread and fixed railway network, systematic transport safety and tradition of these countries make a good base for it. These basic conditions will be aided by the upcoming reforms of the railway including the transformation of the state railway into a stock company.

The support of combined and intermodal transport is closely connected with the railway transport as an alternative to road transport. For the past 10 years the share of combined transport in the total cargo transport of that area could not increase significantly.

If the railway transport in Europe should live to see the renaissance, then it is necessary to make available real international transport paths in the form of modernized infrastructure with lines that can offer something to the market, i. e. realize transport in the same appropriate timeframe. EU directive 2001/12 defined the Trans European Railway Freight Network for cargo transfer (TERFN), which includes ca. 50,000 km of railway tracks for cargo transport in Europe. Each European railway company which is registered as such can use the services of this railway network, while the other railway companies can compete with the offer of new transport services. There is a possibility that this network will expand to 150,000 km of railway tracks by 2008.

### 2.1. SITUATION IN CROATIA

Terminals are considered to be places where larger quantities of work with containers are performed (yearly transfer of 5000 or more TEU). These are meant to be used for working with containers and truck cases and are equipped with adequate infrastructure (platforms, roads, flat surfaces for storing containers, business buildings, outdoor lights, sewage system, phone lines, water, fence around the terminal, etc.), transfer and other mechanical equipment (forklifts, handling equipment, portal cranes, trailers, trucks, etc.) and permanent staff. The terminals provide full service regarding the container handling, as well as the entire shipping service together with customs and other inspections (police, sanitary, etc.), storage and safeguarding containers and interchangeable cases.

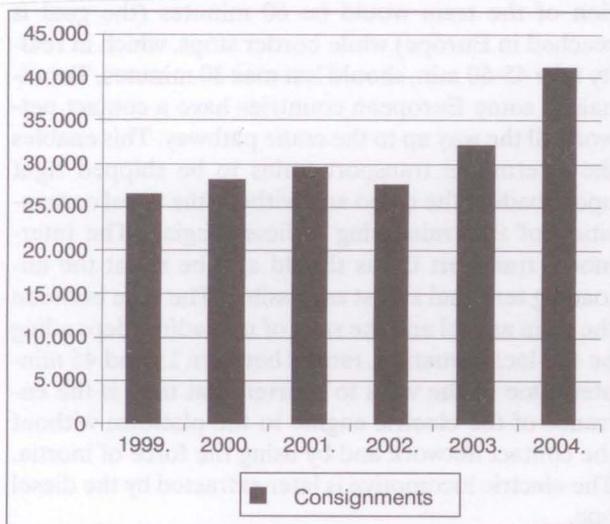
Container terminals at the Croatian railways are situated in Zagreb Vrapče, Osijek, Slavonski Brod, Zadar, Solin Luka (transferred form Split Suburb), Ploče and Rijeka Brajdica. According to the definition, the terminal in Brajdica (Rijeka) and terminal in

Vrapče (Zagreb) can be considered terminals, while other use improvised mechanical equipment and surfaces next to the platforms for admitting and shipping containers. Table 1 shows the index of transported consignments, tons and TEU units by HŽ between 1999 and 2004.

**Table 1 - Index of transported consignments, tons and TEU units by HŽ in combined transport**

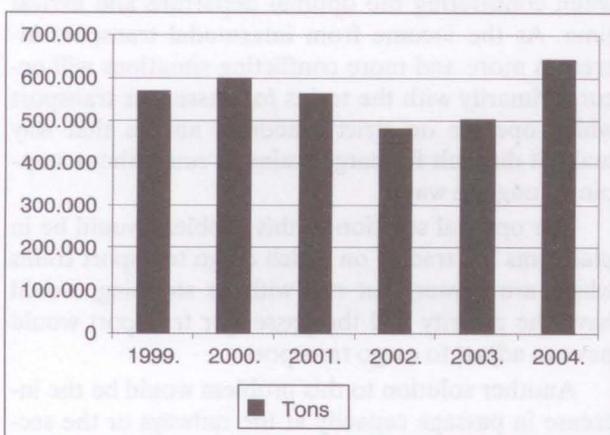
Year	Consignments	Tons	TEU
1999	26,599	567,015	34,578
2000	28,091	600,373	36,519
2001	29,632	564,297	38,522
2002	27,715	480,149	38,801
2003	32,215	501,401	45,101
2004	41,026	641,446	57,436

Source: HŽ internal statistics



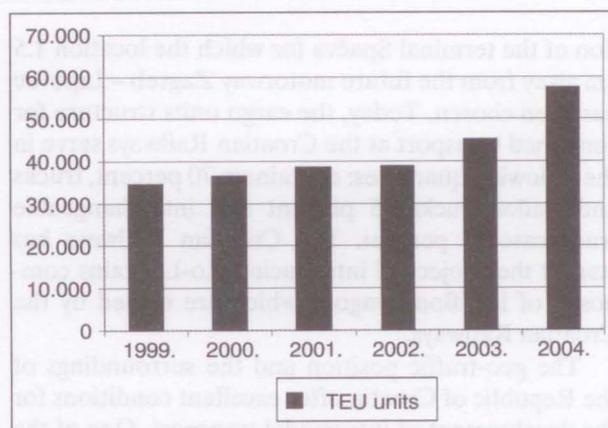
**Figure 1 - Number of transported consignments by HŽ**

Source: HŽ internal statistics



**Figure 2 - Number of transported tons by HŽ**

Source: HŽ internal statistics



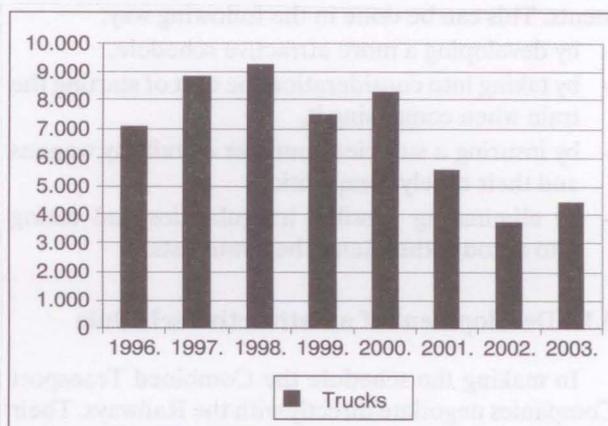
**Figure 3 - Number of transported TEU units by HŽ**

Source: HŽ internal statistics

**Table 2 - Index of work in intermodal transport at HŽ 1996 - 2003**

Statistic Ro - La between 1996 - 2003	Trucks	Tons	Average truck weight (t)
1996	7,055	146,595	21
1997	8,812	181,938	21
1998	9,255	205,680	22
1999	7,463	197,059	26
2000	8,256	220,505	27
2001	5,539	167,533	30
2002	3,734	81,774	22
2003	4,463	122,335	27

Source: Ž. Cindrić: Nove tehnologije predujvet racionalnog poslovanja HŽ-a, Željeznice 21, No. 3, Sept. 2004



**Figure 4 - Number of transported trucks at HŽ 1996 - 2003**

The basic condition for high-quality development of combined and intermodal transport at the Croatian Railways is the construction of the container and Ro-La terminal at the Zagreb Assembly railway station which is situated at the intersection of the Pan-European transport corridors Vb and X and the construc-

tion of the terminal Spačva for which the location 1.5 km away from the future motorway Zagreb – Lipovac has been chosen. Today, the cargo units structure for combined transport at the Croatian Railways serve in the following quantities: containers 70 percent, trucks and trailer trucks 25 percent and interchangeable truck cases 5 percent. The Croatian Railways has started the project of introducing Ro-La trains composed of low-floor wagons which are owned by the Croatian Railways.

The geo-traffic position and the surroundings of the Republic of Croatia offer excellent conditions for the development of intermodal transport. One of the conditions for the development of intermodal transport is the position of the river ports of Vukovar, Slavonski Brod and Sisak. The Vukovar port has the tendency of increasing cargo transport and the construction of Ro-La container terminal has been planned. At Slavonski Brod port there is a container terminal which is in poor condition and not functioning at the moment. The Sisak port gave the initiative for constructing a container terminal.

### 3. CONDITIONS FOR GROWTH AND DEVELOPMENT OF INTERMODAL TRANSPORT

For the purpose of increasing the attractiveness of combined, or intermodal, transport and increasing its share at the Croatian railways it is necessary to pay attention to speed and punctuality of transport and delivery of intermodal transport units, the goods which were loaded onto them and the corresponding documents. This can be done in the following way:

- by developing a more attractive schedule,
- by taking into consideration the cost of starting the train when composing it,
- by insuring a sufficient number of railway wagons and their timely composition,
- by eliminating possible irregularities and taking into account the clients' best interests.

#### 3.1. Development of an attractive schedule

In making the schedule the Combined Transport Companies negotiate directly with the Railways. Their demands come from their experience and are related to the increase of max and average speeds as well as the optimal departure and arrival time.

Max speed in the 1960s was 80 km/h. In the 1970s it rose up to 100 km/h, and in France on some lines even up to 120 km/h. In the 1980s and 1990s the trains for intermodal transport gained speeds on long distances from 140 to 160 km/h. In practice the increase of max speed proved successful only for several long-distance

lines. Expenses of carriage maintenance did not grow proportionally in relation to short-term transport. Therefore, intermodal transport trains in Europe today maintain the max speed of 100 km/h, apart from some long-distance lines where max speed is 120 km/h. Exceptions are trains at SNCF and DB, which run at higher speeds.

More important than the max speed is the increase in average speed, from the end of the loading on the shipping platform to the beginning of unloading at the reception platform. The average speed in the 1980s, in most cases, came up to only 40 km/h, and for the greater number of Ro-La trains it has not increased much. In road transport the average transport speed came up to 65 km/h and more.

The basic condition for higher speed of Ro-La trains is spending less time on starting and finishing operations and shorter stays in the stations along the way.

The optimal time for composition and decomposition of the train would be 60 minutes (the goal is reached in Europe) while border stops, which in reality take 45–60 min, should last max 30 minutes. Terminals in some European countries have a contact network all the way up to the crane pathway. This enables the intermodal transport trains to be shipped right upon loading the cargo and without the usual composition of the train using a diesel engine. The intermodal transport trains should also be set at the unloading terminal as fast as possible. The time between the train arrival and the start of unloading, depending on the local situation, ranges between 15 and 45 minutes. One of the ways to shorten that time is the entrance of the electric engine to the platform without the contact network and by using the force of inertia. The electric locomotive is later extracted by the diesel one.

The problem of stopping along the way in order to let the higher ranking trains pass is a common one when considering the optimal departure and arrival time. As the income from intermodal transport increases more and more conflicting situations will occur, primarily with the trains for passenger transport which operate on strict schedules and in that way make it difficult for cargo trains to run without stopping along the way.

The optimal solution to this problem would be in platforms (or tracks) on which cargo transport trains which are slower, but run without stopping, would have the priority and the passenger transport would have to adjust to cargo transport.

Another solution to this problem would be the increase in passage capacity at the railways or the sections where transport congestion occurs. Since the Croatian Railways are still not experiencing that, although the increase in the number of trains is obvious

and the construction of Ro-La terminal and the introduction of trains for intermodal transport is expected, maybe this should be considered and preventive actions taken.

### 3.2. Train composition with regard to costs

Priority in cargo transport, both for the Croatian Railways and Combined Transport companies, are direct trains, one-group or trains with two groups of railway wagons. One-group trains run from point A to point B. When it comes to trains with two groups of railway wagons, one group is taken or left at the short stop C along the way. The so-called Y trains are also acceptable. In such trains two carriage groups are transported together on a more important part of the way and then separately with different trains.

Shuttle trains were developed from the one-group wagons. That includes trains which are not decomposed at the arrival but are unloaded and then immediately loaded and shipped in the same composition. That saves time and lowers the costs, but the trains and carriages are exploited to their maximum.

A train which weighs 1100 t can be between 350-500 meters long depending on the cargo which is loaded. When increased to 1500 t the train length is between 500-750 meters. In international transport the trains cannot be longer than 450-500 meters to max 550 meters, because the passing platforms are of that length.

According to that, trains heavier than 1500-1600 t serve no purpose in international transport. Therefore, international shuttle trains (intermodal transport) need terminals which are 400-500 meters long. Such long terminals can be found in Germany, France and Italy. In other countries the introduction of shuttle trains is limited by the gross weight, if there is not enough cargo for the whole train, the shuttle train cannot be introduced. In case the gross weight exceeds the volume of one train, the remainder waits for the next train or it is forwarded in a train with more wagon groups.

From the point of view of the Croatian Railways, trains with more wagon groups are just a necessity and they are, if the gross weight is adequate, substituted by through-trains. The through-trains prevail in international transport. In the year 2003 in German national transport through-trains accounted for 25 percent in the combined transport railway-road and 35-40 percent in the container transport. In international transport more than 70 percent of intermodal transport trains were through-trains.

Indirect trains, for economic reasons, tend to have bigger capacity (length and weight). A research on DB shows that a Ro-La train, 1500 m long and with 4000 tonnes (gross weight) with the utilization level of 70

percent completely covers the costs. However, the question is, how high are the expenses emerging on that train's route and on the terminal. Apart from that, additional problem could be the accumulation of gross weight (in this case 75 trucks) at the specific time at the terminal, as well as their departure from the destination terminal.

If better profitability of railways is to be achieved and only larger terminals and always 1500 tonnes trains used, the road transporters will be forced to take longer distances instead of using the nearest terminal. The result is: more transporters on the roads instead of less. The introduction of shorter trains (with less load) gives the possibility of more departures a day. The consequences are easier accumulation of gross weight (trucks) and avoidance of big congestion.

### 3.3. Providing required number of wagons

If there is a shuttle train on one route, providing the required number of wagons is not a problem. The number and type of wagons are determined in advance, except if a wagon has to be suddenly disconnected. If shuttle trains do not run, a sufficient number and type of wagons has to be provided for each day in advance.

The return of freight units to the departure place is typical of the un-accompanied combined transport (technologies B and C). In that way, there are the same types of trains in both ways, and a disposition of wagons should be taken care of only on routes which are not used very often. The deficit of wagons could occur only in single cases when a regular wagon cycle has been stopped because of the various holidays for example.

Thanks to the data-processing today, it can be seen in time, whether a wagon is available, or at revision, or undergoing repair. In order to improve a wagon cycle time, small repairs should be organized at the terminals.

### 3.4. Elimination of irregularities and taking into account clients' best interests

The majority of irregularities occurring in intermodal transport have been delays, damages and lost documents, in particular customs papers.

Delays of 15 minutes and 1 hour are of great importance in passenger transport, but in the combined and intermodal transport they can still be tolerated. However, delays of several hours damage the company's image and considerably affect the combined and intermodal transport. Trucks that wait for loading at terminals cause expenses because of waiting (in combined transport), wagon cycles for shuttle trains are late, trucks cannot continue to drive due to legal

restrictions (in some countries), a receiver is late with goods distribution, connections are late, etc.

The greatest problem is if clients are not informed about the delay. That way they accumulate additional costs which are not included in calculation, therefore they lose interest in railway transport and leave.

In cases of damage or theft the Combined Transport Company is responsible for the investigation and pays the damage, because it made a treaty with the client and most damages occur by handling the weight at terminals.

Lost freight documents are more annoying than being a real problem. However, without freight documents, especially customs documents, a receiver cannot process the consignment.

The loss of documents is mostly temporary, e. g. they tend to show up after a while, but all the same it has to be considered as a mistake, which should be corrected and eliminated. One way of doing it is to set a mailbox on each wagon with freight documents.

#### 4. CONCLUSION

In the last several years the developed European countries, especially the EU member countries, have set great store by the development of railway traffic. Based on such attitude towards the railways, which is above all a reflection of considerable financial backup, it is changing and making technical, technological and organizational progress. In order to reduce the traffic on main roads, protect the environment, make good use of rail infrastructure, reduce transport costs and shorten the transport time the intermodal and combined transport stand out as an optimal solution to a great deal of technical and organizational problems that the railway is facing.

Taking a look at the combined and intermodal transport in our country we can see many problems: lack of precise development strategy for intermodal transport, lack of legal regulations, disused rolling-stock for the container transport, shortage of Ro-La terminals, inadequately equipped container terminals.

In order to include the Republic of Croatia in the process of liberalization of the transport market it is necessary to:

- define the intermodal and combined transport development policy in the context of the entire transport policy at the state level, because the social interest in the development of that type of transport, except declaratively, is not adequately supported by the efficient state policy measures;
- coordinate activities of the carrier and the participants in the combined and intermodal transport;

- invest a considerable amount of funds in mobile and solid capacities;
- determine at the state level the actual infrastructural costs as well as the environment pollution costs, which occur as the consequences of pollution in the process of transport and are fixed later on by other services (health services, forestry, agriculture, water resource management, etc.);
- find the way to subsidize that type of transport on the whole, and in particular the railway transport by making a realistic evaluation, determining expenses and transport prices in combined and intermodal transport;
- educate professional personnel.

It could be concluded from the abovementioned that the former investments in combined and intermodal transport were not sufficient or timely. This is the reason why the process is not complete and is not giving adequate results.

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#### SAŽETAK

#### RAZVOJ INTERMODALNOG TRANSPORTA NA HRVATSKIM ŽELJEZNICAMA

*Deregulacija željezničkog transporta u Europskoj zajednici, a naročito prihvaćanje EU direktiva kojima se regulira pravo «otvorenog pristupa željeznici» uzrok su promjena na europskom tržištu intermodalnog transporta. Zajednica europskih željeznica (Community of European Railways - CER) formira transeuropsku pružnu mrežu na kojoj će se isključivo obavljati željeznički teretni prijevoz (The Role of Trans-European Rail Freight Freeways- TERFF). Ta mreža formira se u zemljama članicama Europske unije, ali se širi i na zemlje koje imaju kandidatski status za ulazak u EU, kao i na zemlje izvan Europske unije gdje kakvoća željezničke infrastrukture omogućuje da se prijevozna usluga pruža na zahtijevanoj razini. Na TERFF-ovoj mreži prijevoz će u najvećoj mjeri biti obavljan suvremenim tehnologijama koje omogućuju da se što veći dio roba s cestovnih prometnica preusmjeri na prijevoz željezničkim prugama. Hrvatske željeznice do početka 2007. godine planiraju sagraditi i otvoriti kamionske terminale u Spačvi, Splitu, Rijeci, Koprivnici i Zagrebu. To je potrebno učiniti zato da bi se u promet uveli vlastiti vlakovi za prijevoz kamiona (tzv. vlakovi Ro-La) pomoću kojih će oko 150.000 teških kamiona*

na godinu s cesta biti preusmjeravano na prijevoz željeznicom, što će hrvatskomu gospodarstvu značiti ekološki, prometno-sigurnosni i višestruki gospodarski dobitak.

#### KLJUČNE RIJEČI

Hrvatske željeznice, intermodalni transport, kombinirani prijevoz, razvoj, napredak

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