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RAIL-ROAD TRANS-SHIPMENT YARDS: LAYOUTS AND RAIL OPERATION[1]

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Abstract

This paper evaluates rail freight yards regarding the establishment of novel intermodal technologies. Rail yards are recognized as key factors for the smooth functioning of transportation service. The most of rail freight yards execute only the classification of railcars which do not satisfy contemporary needs. Therefore modern rail yards should be more oriented on the transshipment procedure between rail and alternative modes. In the shape of case study we analyzed the rail freight yard in Vršac. Vršac railway yard has a strategic position in the transportation network and for that reason is recognized as a potential location for establishing transshipment service.

Keywords–rail-road transshipment yards; layout design; yard operation

INTRODUCTION

Railways participate in transport market offering wagonload service or as a part of intermodal transport chain. Wagonload service consolidates wagon loads which are less than full train loads and are collected from different customers. These wagon loads are assembled to run as joint trains on the mutual routes throughout the railway network. Wagonload service is based on the system of marshalling yards that obtains economies of scale benefits. Within intermodal chain, railway participate as a fast and cheap transport solution in long distances combined with trucks as efficient solution for the ‘’last mile’’ segmentof accomplished transport service. In both, railway yards provide space and operational environment either for consolidation of

[1] Original scientific paper

freight trains on the rail network or transshipment of loading units between rail and road.

Technical and technological development of yards lead to increase of railway market share and to reaching the targets set by the White paper in the European transport area [1].In addition to transport technology development, it is important to establish a more efficient freight handling and train operating in railway yards.

This paper evaluates the layout andfunctional design of rail-road transshipment yard in Vršac. The railway yard in Vršac hasa strategic position in Serbian railway network but due to years of lack of maintenance it is in an inadequate state to perform the service relating consolidation of wagonloads and to serve as interface in the novel intermodal transport technologies.

RAIL-ROAD TRANSSHIPMENT YARDS

Rail-road transshipment yards serve as interchange points between rail and road where loading units (such as containers, swap bodies or semi-trailers) change transportation mode. In such a system, trains perform only the long haulage while pre-haulage and end-haulage is performed by trucks. Rail-road transshipment yards concentrate various track installations and mobileresources such as shunting locomotives and handling equipments. The rail-road transshipment yards were in details analyzed considering layout planning in e.g. [2] and [3].

LAYOUT OF TRANSSHIPMENT YARD

In order to process freight trains and loading units, the rail-road transshipment yards are consisted of:

- Track sidings for train arrival/departureinspection purpose;
- Transshipment tracks for the train loading/unloading operation;
- Loading and driving lines for the trucks;
- Storage area for loading units and
- Handling equipment (gentry cranes, reach stackers or forklifts et.).

In common, loading units are transported using block trains that run between transhipment yards. In the simplest rail- road transshipment yard, a block train directly arrives on the transshipment track and remains there until its departure. This simple type of yard enables direct transshipment of loading units between railcars and trucks without intermediate storage. In processing trains at yards, sets of operations could be fulfilled at additional track sidings. More precisely, the sidings are used for technical and additional inspection purpose during either arrival of inbound trains or departure of outbound trains. Access to the rail network could be organized from one or both sides of the yard. Also, railcars with loading units could be transported using conventional freight trains as a part of wagonload service. In this case, railcars with loading units are firstly consolidated at classification area and after that shunted to the transshipment area.

After delivering railcars to the transshipment tracks (either withina block train or as a block of wagonloads) the operational process oftransshipmentcan begin. A direct transshipment from the railcar to truck avoids double-handling, but requires the simultaneous presence of a respective railcar and truck at the yard. If the truck is not directly available, the loading unit is moved to the intermediate storage area. As soon as respective truck arrives, respective loading unit needs to be retrieved from the storage area requiring additional handling.The operational process of a rail-road transshipment yard is described in more detail in e.g. [4] and [5].

RAIL OPERATIONAL PROCESS

Operational planning provides specific plans for the use of yard's resources in line with objectives defined on higher levels of the planning hierarhy (strategic or tactical level). Operational planning requires information about railcar sequences for delivering to the transshipment tracks, tasks and schedules of shunting locomotives and handling equipment.

Block trains connect transhipment yards without intermediate stops in the most economical and fastest way. This concept reduces terminal rail operations to its minimum. In this case rail operational costs are related to costs of shunting railcars between track sidings for train arrival/departure and transshipment tracks. Atherwise, the wagonload service with railcar consolidation suffers the rail operational costs. These costs mainly depend on the number of shunting deliveries to the transshipment tracksand consist of the following basic components: the cost of railcar consolidation and the cost of shunting. The costs are in function of consolidation parameter (c_r), daily number of railcars for transshipment (n_r), the number of shunting deliveries to the transshipment tracks (x_{di}),freight rate per hour per railcar(c_{rh}); shunting rate per hour (c_{sh}); total duration of all shunting operations per day (T_{di}), duration of one shunting delivery to the transshipment tracks (t_{di}) and duration of handling operation per railcar (t_{hn}). Based on [6] and [7], total operational costs $C_{di}$of one shunting delivery can be roughly expressed as follows:

$$C_{di} = \frac{n_r c_{rh}}{x_{di}}(c_r + T_{di}) + x_{di} t_{di} c_{sh} - t_{hn} n_r c_{rh} [mon.units] \qquad (1)$$

CASE STADY: VRŠAC RAILWAY YARD

The current role of Vršac railway yard is to rearrange freight trains passing through the yard and to classify railcars for further distribution over railway network in Serbia and border crossing to Romania. Furthermore, it is expected that Vršac yard obtains additional role in Serbian transportation network through the development of intermodal transportation. The establishment of the intermodal terminal and revitalization of railway infrastructure are defined as top priorities for further development of transport service in the Municipality of Vršac. In this sense, the existing railway yard in Vršac should be redesigned (Figure 1) to fulfill the additional requirements for implementation of rail-road transshipment [8].

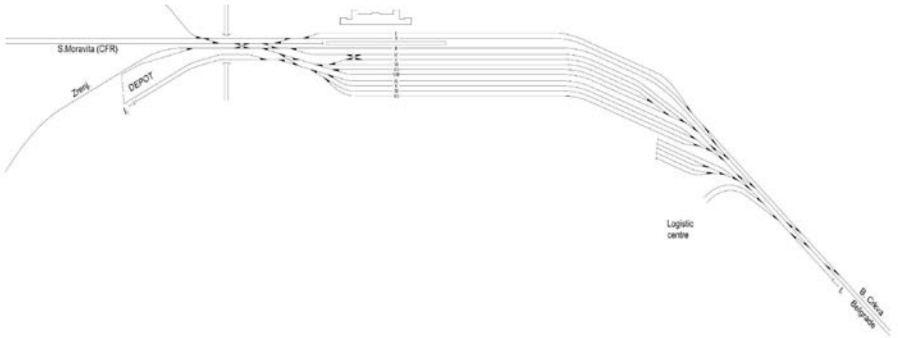

Fig.1. The reconstructed layout of Vršac railway yard

Initially, the transshipment yard would be designed with three tracks in the area of future logistic center with intermodal terminal nearby Vršac railway station (Figure 2). Two tracks would be used as transshipment tracks for the train loading/unloading and one track would be used as a passing track for the run-around operation of shunting locomotives. The minimum usable length of handling tracks would amount 650 m in order to ensure the smooth reception even of complete block trains. For the purpose of accompanied transport, the Ro-La loading ramp would be installed on one of transshipment tracks. Furthermore, after the establishment of logistic centre and initiation of intermodal transport it is possible to expand the capacity of the transshipment yard in terms of extending existing tracks or increasing the number of tracks.

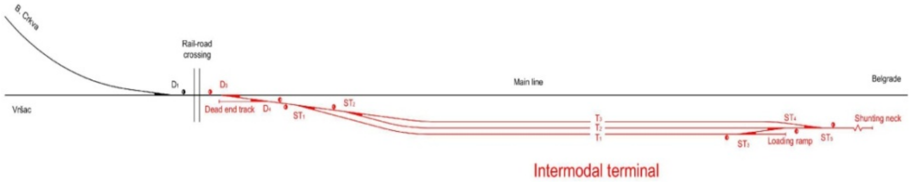

Fig.2. The layout of the rail-road transshipment yard

In the initial case loading units could be transported using wagonload service. Totalrail operational costs on annual level in this case are presented in Figure. 3. Rail operational costs are evaluated as a function of number of deliveries to the transshipment tracks.In addition to the assumed annual volume of 12800 TEU, a sensitivity analysis concerning the projected volume of transshipment was performed for pessimistic and optimistic scenarios, forecasting 9500 TEU and 25400 TEU respectively. The results show that the optimal number of deliveries in the case of realistic scenario is 4, while the other two scenarios reduce / increase optimal number of deliveries by one, and amount 3 and 5.

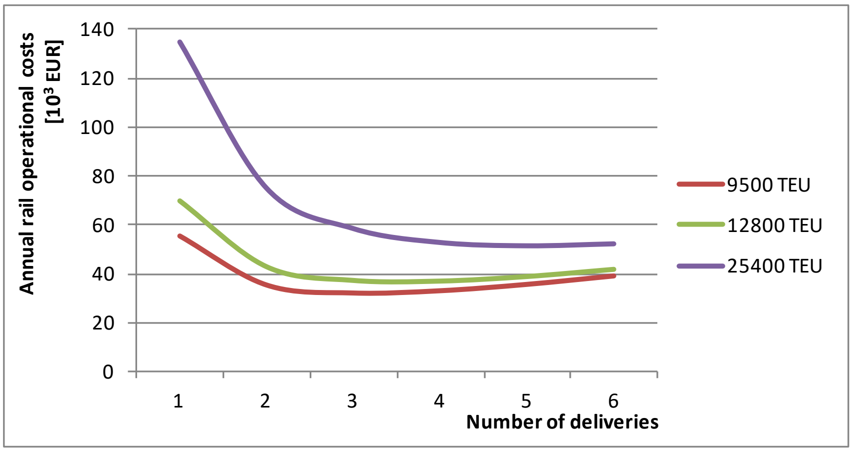

Fig.3.Total rail operational costs

CONCLUSION

This paper evaluates rail freight yards regarding the establishment of novel intermodal technologies. Rail yards are recognized as key factors for the smooth functioning of transportation service. The most of rail freight yards execute only the classification of railcars which do not satisfy contemporary needs. Therefore modern rail yards should be more oriented on the transshipment procedure between rail and alternative modes. In the shape of case study we analyzed the railway yard in Vršac which mainly performs the conventional rearrangement of freight trains over railway network in Serbia and border crossing to Romania. In addition, it is expected that Vršac yard obtains more significant role in Serbian transportation network through the development of intermodal transportation. The catchment area of the potential Vršac intermodal terminal widely exceeds borders of the South Banat District because of its favorable position in Serbian transportation network, near Corridors X, IV and VII. The paper presents the layoutproposed for transshipment yard end evaluates total rail operational costs for delivering loading units from classification area to transshipment tracks in the case of wagonload service.

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