

CONTROVERSIES CONCERNING CENTRALIZED AND DECENTRALIZED APPROACH FOR ALLOCATION OF THE RAILWAY INFRASTRUCTURE CAPACITY¹

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Abstract

The introduction of competition in the railway market affects the procedure of infrastructure capacity allocation. Despite the new entries in the market, timetable drafting, proposing and capacity allocation remains in the infrastructure manager's responsibility. In the literature, this method of capacity allocation belongs to centralized approach. However, when railway operators request the same infrastructure capacity at the same time, the infrastructure manager is often not able to meet all requests. In such cases, conflict requests can be resolved using a market mechanism. This means that railway operators are proposing their timetable as a request and infrastructure manager organize auction for capacity allocation –the decentralized approach. This paper presents discussion of controversies concerning centralized and decentralized approach in order to underline their main disadvantages for increasing the railway infrastructure efficiency.

Keywords-capacity allocation; criteria; railway market; auctions

INTRODUCTION

The current concept for allocation of the railway capacity in Europe dates back from the time when railway sector was organized as a monopoly. The concept relies on a central authority in charge for train timetabling and it is closely involved in re-scheduling (centralized approach). The main criteria in determining priorities on capacity allocation, is defined trains ranking that

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are not in correlation with the market demands. Deregulation of the railway sector and introduction of competition on the track makes the current capacity allocation mechanism a limiting factor in fostering on-track competition and effectiveness of the railway infrastructure utilization.

In Directive 2001/14/EC, the European Commission has defined guidelines for the allocation of capacity. Actually, Directive only regulates the framework for capacity allocation procedure. However, in situations where there is conflict among train path requests of the different railway operators (RUs), the infrastructure manager (IM) may not be able to meet the requirements of all interested railway operators. Directive in such cases suggests finding a compromise solution without clear criteria for resolving conflicting demands.

Following deregulation of the railway system in Europe, the idea of implementing the market-based mechanism for capacity allocation requires solving certain controversies. The paper discusses controversies of current capacity allocation mechanism using priority and market-based mechanisms using auctions.

CENTRALIZED APPROACH FOR CAPACITY ALLOCATION IN THE DEREGULATED RAILWAY SECTOR AND DECENTRALIZED APPROACH

Before railways market opening in Europe, capacity allocation or train timetabling² was considered not as an economic or political problem, but primarily as a technical problem [1]. Vertically integrated railway companies solved train-timetabling problem using priority of train service. Moreover, the order of drawing train paths in timetable depends from established rules, usually based on service hierarchy. Eventually the intern authority resolved remaining conflicts between train paths³ of different railway service. In order to resolve conflict demand, intern authorities mainly used their experience and an intuition. Therefore, the literature considers this methodology as an administrated mechanism of railway capacity allocation [2].

²In this paper, the train timetabling is considered as a train-path bundle designed from each RU that request infrastructure capacity from IM. Generally, RUs are designing their train timetable requests using technical specification of railway infrastructure from IMs Network Statement, rolling stock performances and service demand and organization. This paper is not considering the technical aspect of the train-timetabling problem as minimum line headway assessment, train timetable stability assessment etc.

³Train-path means requested railway infrastructure capacity needed for train running between two stops over a given period [6]. Apart from Directive 2012/34/EC, the similar definition of the train-path can find in UIC code 406.

Although the advanced software, models and tools for train scheduling are available, the planning process is still relying on intuition of planners and manually [3]. In most cases, the train timetable designed using this holistic approach could achieve optimized utilization of rolling stock and infrastructure. Still, the solution obtained with this method does not maximize the objective function: is it neither profit maximization nor meeting any other objective of social efficiency.

Generally, the size of requested RUs train path bundles depends on the demand and a service pattern for previous, current and next year. Besides, the number of requested train paths depends on availability of the rolling stock and infrastructure capacity. In the past, the availability of a rolling stock in vertically organized railway companies used to reduce service offer on the transport market.

The European Commission has defined framework for railway capacity allocation in Directive 2001/14/EC, later amended with Directive 2012/34/EU. Both directives define subjects in charge for infrastructure capacity allocation, as well as conditions for subjects allowed to apply for infrastructure capacity. Article 39 of Directive 2012/34/EU enables Member States to apply their own framework for capacity allocation procedure with specific rules, respecting the principles of fairness and non-discrimination. The Directive also foresees procedures for settlement of conflict demands for infrastructure capacity, as is coordination procedure and dispute resolution procedure. If RUs are not satisfied with draft working timetable, they could initiate one or both procedures, in order to mitigate their complaints.

However, a few Member States⁴ Network Statements are showing that IMs still do not publish specific rules, priorities or criteria they are using for designing draft timetable and drawing alternative solutions. Therefore, we assume that IMs still have a certain flexibility in drafting train timetable, which is in line with Article 39 of Directive 2012/34/EU. Otherwise, this procedure lacks transparency and in some cases brings uncertainty especially to private RUs. Moreover, no one can expect that once published draft-working timetable will take a capital revision.

The railway market for on-track competition is formally open. On the other hand, IMs are still largely use the “grandfather rights” on train timetable drafting. Even after the introduction of vertical separation for national railway companies in Europe, the IM keeps drafting timetable using the same criteria from the era of national railway companies. In other words,

⁴Network Statements of IMs from Austria, Belgium, Czech Republic, Hungary, Germany, Poland, Romania, Switzerland and Sweden for 2016.

this traditional concept relies on a single authority, responsible to draft and offer train-paths to RUs. In the next step, RUs could respond by accepting, rejecting or to request a limited revision of draft working timetable. Rather, this approach belongs to the centralized approach of train timetable drafting because the IM has the main role in capacity allocation and often it has a big influence on final timetable design [4]. In the very first years after the separation between infrastructure and operations, the incumbents are usually not ready for challenges on the open market with on-track competition. In addition, the accompanying institutional mechanisms and frameworks are not highly developed for dynamic business environment, especially for drafting train timetable for numerous RUs under the equal conditions. It means that incumbents need some period to realize changes. Hence, they are still keeping the traditional – centralized approach of capacity allocation in use.

Following the vertical separation, IM is missing information about potential and true value of transport service, now collected by RUs. In the same time, RUs do not have an incentive to reveal their true train-path valuation because they are motivated to pay lower access charge to IM for using railway infrastructure [5].

Decentralized approach of train timetable drafting is based on RUs assessment of potential service demands in order to determine a number of train-paths. Next, the each RU attaches requested departure and arrival time, with possible stops for every train-path. Therefore, the each RU is drafting their train timetable as a request that depends from the specific service pattern. For every train-path request, RU has to assign their private valuation⁵. Following the train timetable designing, RUs are now applying their requests for infrastructure capacity to IM. In situations when a conflict emerges between different RUs train-paths requests, an IM attempts to find a compromise solution. If compromise still does not satisfy involved RUs or IM simply could not settle RUs complaints, the IM organize an auction for capacity allocation, which represents market-based mechanism.

CONTROVERSIES CONCERNING CENTRALIZED AND DECENTRALIZED APPROACHES FOR CAPACITY ALLOCATION

The first attempt to shift from centralized to decentralized approach for capacity allocation occurred in early 1990s. The Swedish Parliament was deciding that central railway administration Banverket should conduct the transition of capacity allocation from administrative to market-based

⁵RUs could have their private valuations for train-paths, whereas valuations assigned by other RUs do not affect to particular RU's valuation to the same train-path [7].

mechanism by 1995 [1]. This question triggered a certain controversy that initiate a discussion between proponents of traditional or centralized approach from the one side, and market-based or decentralized approach from the other side.

Proponents of centralized approach for capacity allocation claim that decentralized approach for railway capacity allocation is not viable in practice, especially for dense networks [1]. Furthermore, they declare that it is almost impossible to allocate capacity those RUs with highest private values for train-paths, only by auctions. In addition, they raise question is it possible to coordinate decentralized train-path requests from numerous RUs in case they want to use capacity in the same time? If this is true, which form of capacity allocation mechanism will take place in order to suits RUs preferences, IM's objectives, and in the same time to be fair and efficient? How much will cost RUs to participate in this procedure in terms of collecting information for demand, preparing requests and alternatives, forming private values for each request and defining bidding strategy?

Opponents claim that the centralized approach for capacity allocation is obsolete on liberalized railway market. Hence, its replacement is inevitable in order to improve the allocation of railway capacity efficiency. Proponents of decentralized approach show that some features of centralized approach are in favour of inefficient RUs. Actually, inefficient RUs have advantage over the competition because they usually run services that have priority in capacity allocation, but low true value. Besides, the centralized approach largely relies on preceding train timetable with considerably high share of train-paths designed by IM. Such a situation gives private RUs less railway capacity to design train-paths and to form requests (Fig.1.). Therefore, development and implementation of market-based mechanism for capacity allocation that uses auction could avoid inefficiency and foster competition in terms of congestion.

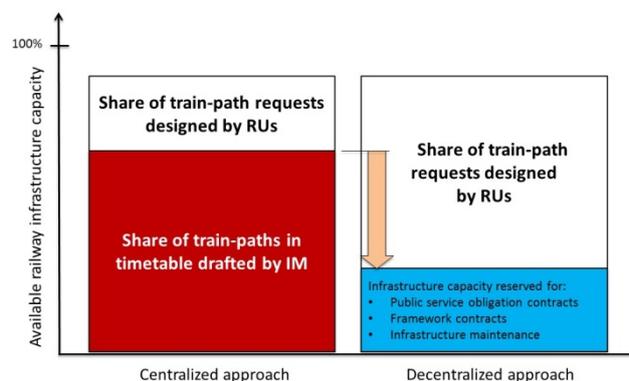


Fig.1. Two competing approaches of train timetable production in terms of train-paths shares drafted by IM and RUs

The previous discussion of the concerns related to centralized and decentralized approach for railway capacity allocation creates several controversies of both approaches. Initially, we will emphasize three controversies of decentralized approach for capacity allocation.

The necessity that other RUs adopt their train-path requests to the auction winner presents the first controversy. With elimination of the central authority for timetable drafting and capacity allocation, creates a different positions for current stakeholders in railway sector. Nowadays, there are several RUs drafting timetable separately and they could participate to auction. The consequence is strong interdependence among RUs requests because the auction winner could be the only one RU. The other RUs have to adjust their initial requests for capacity to the auction winner's timetable. In order to avoid other RUs requests withdrawal, the IM should initiate adjustments for requests so that use remaining infrastructure capacity, after the auction. In that case, RUs needs to accept or reject possible changes proposed by IM as longer train running time, changing departure/arrival time, etc. With this procedure, the IM offer to those RUs that failed to win the auction a chance to fulfil their requests partially.

The second controversy is related to the railway market fragmentation. In order to maximize its profit, the IM could divide railway network on railway lines and offer its usage separately to RUs. Due to the railway market fragmentation, RUs and IM could face with considerably high transaction cost⁶. However, with determining the optimal number of infrastructure segments and number of possible combination for bidding, the IM could avoid high transaction cost for RUs. The limitation of possible combinations will make allocation mechanism less uncertain. On the other hand, the imposing limitations may not hinder RUs to apply for railway capacity.

Finally, the third controversy of the decentralized approach is related to the possibility that competitive equilibrium might not exist in every case. Moreover, some auction types issue is the winner determination, especially with combinatory auctions⁷. Therefore, in case of using combinatory

⁶Transaction cost is a cost incurred when company makes an economic exchange, procuring resources and offering goods and services on the market. Transaction cost comprises costs for information collecting about object of exchange (value, quality and procurement conditions), negotiation cost and cost of procurement [7].

⁷Combinatorial auctions are the sort of auction, where bidders can choose their own packages they want to procure. In these auctions, bidders are trying to buy one or more goods or services that are interconnected. Next, bidders apply for one or more bids for different

auctions, it is important to determine rules and criteria for winner determination. However, even without competitive equilibrium existence, the solution obtained from market-based mechanism is still more efficient than solution obtained from current administrative mechanism [1].

On the other side, the experience shows that the centralized approach is not functioning well in cases when numerous RUs request the same capacity at the same time, under the equal treatment. It does not recognize private values for train-paths, and this criterion is not included during railway capacity allocation. The central authority, which runs administrative mechanism, fails to achieve social efficiency. Rather, the social efficiency could not be achieved due to information lacking between IM and RUs. To assign priorities correctly, the track authority must gather the necessary information from independent RUs, in order to make these decisions. It may not always be in the interests of the RUs to reveal truthfully this information. Furthermore, as circumstances change, the information must be gathered repeatedly.

The centralized approach could not release of defined service priority rules for capacity allocation. This criterion dates back from a single railway companies' era, with legislative protection of the monopoly position at the national railway market. In that period, the infrastructure capacity was allocated accordingly to available rolling stock of the single vertically integrated railway company. Besides, the use of service priority criterion for capacity allocation still relies on flexibility of the railway freight over passenger transport. The rule had sense in time when the railway mode was the only alternative for passengers on long distances, and the monopoly position of the railway on the transport market. Nowadays, the situation is considerably different on the market and it is not in favour of railways. Railway stakeholders should have different objectives, for example improving of service quality that end-users will recognize and value the most.

CONCLUSIONS

This paper presents and examines controversies of centralized and decentralized approaches for the railway capacity allocation in terms of deregulated railway sector. Nevertheless, it seems that the discussion is still at the beginning. Objective of examining of the controversies is to reveal weakness of the both approaches in the liberated market conditions. The main problem is to how to adopt mechanism for railway capacity allocation in order to mitigate the requirements of end users of rail transport. Allocation

combinations of goods or services that they require, and usually the number of bids that one bidder is limited [7]

of the railway capacity to RUs with highest private values for train-paths leads to efficient usage of the railway infrastructure.

Accordingly, mechanism for railway capacity allocation has to rely more on RUs private values for train-paths, which is the reason to introduce new criteria for capacity allocation. Strength of the newly designed market-based mechanism shall depend on foreseen obstacles and difficulties. Due to complexity of this problem, the purpose of controversy discussion for these approaches is to reveal those difficulties in order to help in development of a new mechanism for efficient railway capacity allocation.

REFERENCES

- [1] P. J. Brewer and C. R. Plott, "A binary conflict ascending price (BICAP) mechanism for the decentralized allocation of the right to use railroad tracks," *International Journal of Industrial Organization*, vol. 14, pp. 857–886, 1996.
- [2] S. Gibson, "Allocation of capacity in the rail industry," *Utilities Policy*, vol. 11, no. 1, pp. 39–42, 2003.
- [3] J.-E. Nilsson, "Towards a welfare enhancing process to manage railway infrastructure access," *Transportation Research Part A: Policy and Practice*, vol. 36, no. 5, pp. 419–436, 2002.
- [4] S. G. Klages, "Algorithmic railway capacity allocation in a competitive European railway market," (PhD thesis) RWTH Aachen University, 2010.
- [5] P. Perennes, "Use of combinatorial auctions in the railway industry: Can the 'invisible hand' draw the railway timetable?," *Transportation Research Part A: Policy and Practice*, vol. 67, no. 1370, pp. 175–187, Sep. 2014.
- [6] European Commission, Directive 2012/34/EU of the European Parliament and of the Council of 21 November 2012 on the establishing a single European railway area (recast). *Official Journal of the European Union L343* (14.12.2012), 2012, pp. 32–77.
- [7] D. Trifunović, "Kombinatorne Aukcije", *Aukcije*, 1. ed. Beograd, Srbija: Centar za izdavačku delatnost Ekonomskog fakulteta u Beogradu, 2012, ch. 5.5, pp. 162-163.