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ECONOMY OF BOTTLE NECKS

Macheret, Dmitry A. *– D. Sc. (Economics), professor, head of the department of economics of construction business and property management of Moscow State University of Railway Engineering (MIIT), Moscow, Russia*

ABSTRACT

Traffic jams significantly increase the uncertainty and risks for commodity owners and passengers negate the key advantages of modern transport such as speed, regularity and urgency. Congestions on the roads essentially contradict the objectives of transport, worsen the business environment, reduce the quality of life, lead to the loss of the most precious resource – time. The reason for traffic jams is a chronic lack of offer and demand balance, long-term shortage due to failure of the market mechanism of pricing on services of road and rail infrastructure. As a result losses are suffered by the whole society, and the investment attractiveness of transport infrastructure and its advanced development, required for high economic dynamics, cannot be achieved. To avoid this, the dependence of the cost, necessary to provide infrastructure services from the intensity of demand and

its timely change in accordance with market conditions should be ensured. The article presents the model, developed by the author, which determines a reasonable level of fees for the use of transport infrastructure.

ENGLISH SUMMARY

Background.

Traffic jams on the roads have become an adversity in many metropolitan cities of the world. They occur in smaller cities, and sometimes, especially in adverse weather conditions, even on motorways outside the cities.

A typical example of such a situation was a long traffic jam on the highway Moscow – St. Petersburg in winter 2012. Of course, cases of this kind can be considered extraordinary, however, and they lead to significant losses, and their very basic possibility poses serious risks for commodity owners, passengers and carriers who have taken the responsibility for movement of people and goods.

Daily traffic jams mean regular losses and permanent risks.

Traffic jams appear not only on the roads, but also on railways, although such a term is not used here. In railway science and practice term «confusion in the movement» was used. It referred to «such a situation in transportation, when the number of trains in motion at this section of the line exceeds its carrying capacity» [1, p. 106]. Even with timely measures to address this situation it is impossible to escape the consequences, certain delay in the performance of transportation plan; if timely action is not coming, «loss of carrying capacity and the delay in the performance of transportation plan defies calculation» [1, p. 112]. Speaking even tougher, if arisen «confusion» failed to be promptly solved, it leads to a true traffic jam with severe consequences, up to trains, left without movement (the so-called «abandoned»).

Objective.

The aim of the author is to investigate the problem of traffic jams, in particular of bottle necks at railways, taking into account economic aspects.

Methods.

The author uses historical method, scientific description, economic analysis and comparative method.

Results.

I.

More than a century ago, experts in the field of railway affairs believed that the railway should have reserves of carrying capacity; if speed reduces, there is «confusion in motion», which with increase in the filling level of carrying capacity becomes a traffic jam. Moreover prime cost of transportation (sector losses) increase, slowing the delivery of goods (losses of commodity owners), which in turn leads to penalties for delayed delivery of goods (losses of carriers) and decrease in market competitiveness of rail transport (long-term sector losses).

It is scientifically proven that the optimum filling level of carrying capacity does not exceed 70–75% [2–5]. At a higher level, all listed negative phenomena occur.

Meanwhile, on the Russian railways length of limiting areas (with filling level of carrying capacity of about 100%) is more than 7.5 thousand km [6]. That is, these sections are operated in a mode in which, as it was clear more than a hundred years ago, they cannot «perform movement for a long time».

One of the reasons for this situation is the absence of proportional development of infrastructure and rolling stock.

Dynamic business involvement in operation of cars, achieved through deregulation of this activity and influx of private capital, led to an increase in rolling stock for the period 2003–2011 for more than 26% [7, p. 250].

At the same time, railway infrastructure, operating under strict state regulation of tariffs and, accordingly, not having sufficient investment attractiveness, not only did not have adequate development, but also to ensure breakeven of current activities in a period of deep recession in traffic in 1990 was deprived of part of its capacities. Where the total operational length of railways in the background of increasing car fleet has not changed significantly, and the station capacity, sidings, sidings items were significantly reduced [8, 9].

The result was that railway network was «equipped with» rolling stock in excess of its carrying capacity, which naturally reduced its carrying capacity. Therefore it should not be surprising that the difficulties in transportation process occur when traffic volumes do not reach the previous highs.

In 2010–2012, service speed of freight trains in Russia decreased by 13.5%, and speed of delivery of goods – by 24.5%. Proportion of shipments, delivered out of time, increased in 2012 by 27% [10]. In 2013, these figures were improved, but their previous decline was only partially compensated.

Characteristically, consignors find infrastructure development level and timing of shipments the most problematic indicators of rail transport performance [11, 12].

It is the lack of guarantees of delivery of goods at a specified time, and often even the inability to predict the actual delivery time is one of the major factors that weakens the competitiveness of railways in the transport market [13, 14].

Not accidentally, significant traffic volumes, primarily – of particularly sensitive to the urgency of delivery of goods, but in some cases and not characterized by high cost, «move» from rail to road transport. [15]

The situation with «bottlenecks» in the railway infrastructure is exacerbated due to market fluctuations in world commodity markets, which in situation of a considerable share of export shipments in turnover (about 48%) cause rather sharp redistribution of freight traffic on the network. [16]

For example, in the crisis of 2009, against the backdrop of a deep decline in the total volume of industrial production and transport, redistribution of export cargo flows to China led to a marked slowing of the transportation process at the site of four railroads: the Far East, Trans-Baikal, East Siberia and Krasnoyarsk [17].

Traffic jams on the roads, especially specific for metropolitan cities, to a greater extent negatively influence passengers and on railways, where passenger trains have priority, the greatest losses are suffered by commodity owners.

However, regardless of this, in the major cities the preferred alternative of vehicles is often the railways and transportation of many goods, on the contrary, moves from railway to road transport.

II.

Economic assessment of losses from traffic jams, in the author's opinion, should consider:

– Additional operating costs of transport associated with downtime of rolling stock (attributable in calculating the prime cost of transportation by car-, locomotive-, automobile- hour), remuneration of relevant staff (locomotive crews, drivers, etc.);

– Additional fuel and energy costs;

– Environmental damage, which should be assessed in a broad sense – as the deterioration of the environment;

– And finally, the key element – time loss of passengers (including drivers of private cars), and damage from slowing the delivery of goods (the last assessment is described in [18, 19]).

Traffic jams substantially increase the uncertainty and risks for commodity owners and passengers.

If transported goods are used in the production process (as raw material, semi-finished products or component parts), the unexpected delay of delivery may cause failure of the production cycle of a consignee, the damage from which can be very large. If this product is intended to be marketed as a finished product, the commodity risk is associated with the possibility of a sharp deterioration in market conditions during the delivery delay. More detailed assessment of the risks in freight transport is disclosed in [20, 21].

As for passengers, the quality of their lives in conditions of frequent, but totally unpredictable «congestion» is significantly reduced.

Thus, if a regular, reliable transport organizes human existence in time and makes it comfortable [22], traffic jams, depriving people of the opportunity to accurately plan their time, making their lives chaos and discomfort.

To reduce the risk of delays due to traffic jams (and their consequences can be very serious, for example, if this is delay for an important event, long distance train or plane), people are forced to pledge in advance to schedule these maximum possible delays. In this case a faster arrival often does not eliminate this loss of time, productive work time or comfortable leisure.

The Roman philosopher Seneca wrote that «with the transience of time you have to fight rapidity of its use» [23].

Rapid, regular, reliable transport that reduces the distance, making habitat commensurate to an individual [22], successfully helps people in this fight. Traffic jams, on the contrary, increase the time gaps between different points in space; reduce the extent of the anthropic environment.

In addition, traffic jams significantly increase gaps between design speeds of vehicles and permissible speeds on the one hand, and the actual speeds of freight and passenger transportation – on the other.

Analysis shows that these speeds may vary considerably. As a result costs associated with an increase in design and permissible speeds are «catchpenny» – incurred in vain, completely ineffective. [24]

III.

Development of means of transport has always been aimed at weakening the natural barriers created space for the movement of passengers and goods. [25]

Traffic jams are artificial barriers to movement, leveling key advantages of modern transport, such as speed, regularity and urgency. Thus their appearance essentially contradicts the objectives of transport, worsens the business environment, reduces the quality of life, and leads to the loss of the most valuable resource – time.

They have become an everyday, commonplace, peculiar element of transport activities and life in general, because there is a chronic imbalance in demand for transport infrastructure and supply, long-term infrastructure gap.

In analyzing this issue, attention should be paid to one of the essential features of the transport market. It is multilayered [20], and the basis of this multilayering is a division of transport resources that are used to form offers of transport services, infrastructure and rolling stock. This division has no analogues in other economic activities.

At the same time transport infrastructure services, are usually referred to naturally monopolistic sphere and are subjected to state regulation (primarily – to price), which is typical of rail infrastructure services, or removed beyond market relations, considering the infrastructure resources as public goods, i. e. benefits, the use of which is not considered as something exceptional. [26]

It is worth recalling likening made by «the architect» of economic reforms in the post-war West Germany Ludwig Erhard: «One, who wants to exclude a function of free prices, deadens competition and promotes stupor of economy ...» [27].

To transport the concept of «stupor» applies literally. As a result of growth of demand for transport infrastructure over the highest possible level of its offers arises the so-called phenomenon of excessive consumption or «overload» [28].

If the deficit of any goods whose prices are regulated by the state, or goods whose consumption is formally free, leads to the formation of queues, the shortage of transport infrastructure capacity leads to a traffic jam. Vehicular traffic slows down to «stupor» and the real costs of infrastructure users that are formally free or have limited price increase dramatically.

Deficiency of any other goods puts a choice – to queue or to abandon the acquisition of the good. There may be other ways to solve the problem of shortage, e. g. to buy with overpayment from the one whose turn came.

From this perspective, the effects of transport infrastructure deficit are unique – in case of traffic jam, it is impossible to provide an extraordinary drive for any money.

So traffic jam not just leads to extremely negative economic consequences for all those who are caught in it, but can move them to a kind of «non-economic dimension», i. e. generates in the full sense of the word an abnormal situation. The conversion of this anomaly to normal life only emphasizes the seriousness of the problem.

In fact, the lack of market pricing mechanism for the services of the transport infrastructure leads to the fact that instead of competition among infrastructure owners to attract customers there is a competition, carried out by nonmarket means, between users for access to limited resources infrastructure.

The result is a loss for both the owners of transport infrastructure, unable to convert the high intensity of demand in the additional funds required for high-quality maintenance and timely development of this infrastructure, and for users, suffering excess costs and losing income because of poor quality and insufficient infrastructure services.

As a result, losses are suffered by the whole society, and the investment attractiveness of transport infrastructure and its advanced development, required for high economic dynamics, are not provided, which hinders economic growth.

IV.

Because of the specificity of the transport infrastructure, which, as Adam Smith pointed out, is in the highest degree useful to society as a whole, but often cannot reimburse private investors with its profits, the natural solution seems to charge the state with its construction and maintenance, and that was proposed by the founder of market economy theory [29, p. 675–676]. Based on the fact that the transport infrastructure is a prerequisite of any economic activity [30, 21], the state support of such a condition does not contradict market paradigm. World experience shows the necessity and fruitfulness of the state's role in the creation and maintenance of transport infrastructure, including – railway.

However, due to non-market allocation of public investment, even in countries with the most powerful budget headroom and high impact taxpayers on the use of budget funds such costs of the state are not always rational, and can lead to distortions in the development of infrastructure and economic losses.

To prevent both chronic shortage of transport infrastructure, and excessive costs of its development, to avoid losses for direct users of infrastructure services, it is necessary to provide the dependence of price for the use of the infrastructure from the intensity of demand and its timely change with market fluctuations.

According to the U.S. economists, the introduction of road toll on busy highways would save billions of dollars by reducing the cost of construction of highways and losses caused by traffic jams [32, p. 191].

V.

As a theoretical basis for implementing the flexible pricing for the use of transport infrastructure a rational model for determining the level of fares is formed and shown in a graphical form in Pic. 1.

This fare is designed to be such as to ensure rational level of transport infrastructure load, i. e. maintaining the necessary reserves. On rail lines such reserves, as already noted, can be 25–30% of the rated carrying capacity. On motorways, obviously, the level of reserves should be comparable. And on the car parking it is likely enough to have always at least one free place. (It is for this criterion flexible regulation of charges for car parking is carried out in San Francisco, where an experimental system for monitoring occupancy and differentiated payment for parking spaces is tested [33]).

For transport infrastructure to be loaded on a rational level, the cost of its use must conform to the intersection graph of demand for the use of transport infrastructure and the vertical line, showing the level of its load (Pic. 1).

The cost of transport infrastructure includes not only fees for its use, but also its own «internal» costs of users, including costs associated with travel time. (In this aspect, the «external» or «obvious» costs can only be fees charged for the use of infrastructure. All other costs for travel or transportation of goods, including both fuel and energy costs, funds for repairs and depreciation attributable to the trip, so value appraisal of time consumption, can be referred to the «internal» costs of users).

Conclusion.

When loading level of infrastructure does not exceed rational one, these costs can be considered constant. If they exceed a reasonable level of loading, speed rapidly reduces, and time costs and «internal» user costs are growing respectively. If the calculated level of carrying capacity is exceeded, speed tends to zero, and «internal» user costs – to infinity.

At sufficiently low demand for the use of infrastructure (e. g., C1) the rational level of its load will not be exceeded in the absence of user fees. Consequently, in this case the use of transport infrastructure provided budgetary financing of its construction and operation can be free. (Fare level $П_1 = 0$).

However, with increasing demand in the case of free use of infrastructure, its rational load level is exceeded.

In case of demand C_2, conditionally called «high» in terms of free use of infrastructure, «exorbitant» filling level of its carrying capacity is expected, i. e. traffic jams will occur.

To have at this level of demand a rational load level of transport infrastructure, fee for its use should reach the value $П_2$, summation of which with «internal» costs of users will provide a rational level of the total cost of transport infrastructure use. That is, if there is a growth in demand from C_1 to C_2, level of rates should rise from zero to $П_2$.

With increasing carrying capacity, using budget funds, interval of free use of transport infrastructure can significantly expand. However, such investments must be supported by relevant socio-economic effects. More details on this issue are in [34]. Here it is important to emphasize once again that even with budgetary financing construction and maintenance of infrastructure in the context of high demand for its services the use itself must become paid, but always with a flexible regulation of prices depending on the level of demand. Otherwise payment will serve primarily fiscal, but not rationalized function.

On the other hand, the introduction of differentiated payment for the use of transport infrastructure makes it potentially attractive to private capital (and more intense is demand, the higher is attractiveness), and thus allows using for the development of self-regulatory infrastructure market mechanisms, that is the best solution from an economic point of view.

Keywords: *transport, traffic jams, bottle neck, economy, infrastructure, uncertainty, risks, infrastructure's use costs, rational model of payment.*

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Координаты автора (contact information): Мачерет Д. А. (Macheret D. A.) – macheret@vniizht.ru.

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