«SAVING IN LABOR AND CAPITAL»

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ABSTRACT

The name of the Russian economist, the statistician Alexander Chuprov occupies an honorable place in the history of science. And above all, he is known for his interest in the problems of railways, which in XIX century became the main engine of social progress. The contribution of the scientist to the theory of costs of railway transport is analyzed in the article. It is shown that he prepared the basis for all subsequent studies in this field, including such areas as classification of costs, an assessment of their dependence on traffic volumes (traffic sizes) and other factors, an estimate of the cost ratio with various meters of transport work.

It was noted that as a result of development of the basic provisions of the railway economy laid down in those years, it was possible to create scientifically based tools for managing the efficiency of the industry.

Keywords: railways, economy, Alexander Chuprov, production costs, traffic size, cost classification, history.

Background. *In 2017, 175 years have passed since the birth of Alexander Ivanovich Chuprov, an outstanding Russian economist who made a great contribution to the formation of the economy of rail transport as a scientific discipline and identified a number of research areas in this new for that time sphere of production and economic activity.*

The future scientist was born on February 6 (18), 1842 in Mosalsk, Kaluga province. In 1866, he graduated from the Faculty of Law of Moscow University, one of the leading professors of which he became later and conducted training courses until 1899.

Interest in the railway problematic was finally formed for A. I. Chuprov shortly after graduating from the university. Based on extensive statistical data, he carried out in-depth studies of the regularities of the railway economy, including the formation of demand for transportation, the construction of tariffs, as well as factors affecting the revenue of railroads. The «classical» position of the economy of transport on the simultaneity, inseparability of production and consumption of transport services belongs to him.

Scientific researches of A. I. Chuprov in the field of railway transport were appreciated by contemporaries. He received an invitation to participate in the commission of Count E. T. Baranov on the study of the railway business in Russia and the development of the «General Charter of Russian Railways».

Karl Marx relied on the ideas of the Russian economist, forming in the «Capital» a provision on transport as a special branch of the economy.

One of the important areas of A. I. Chuprov's research is the study of the costs of the railway industry. He devoted a significant part of the capital work «Railway economy. Its economic characteristics and its ratio with the interests of the country», published in 1875, to this problem [1]. To a certain extent, he continued to study the same topic, preparing and defending his doctoral thesis in 1878, which was called «Conditions governing movement and collection on the railways. Gross income and its factors. Quantity of goods».

Objective. *The objective of the author is to consider life and work of the Russian economist, the statistician Alexander Chuprov.*

Methods. *The author uses general scientific methods, historical-retrospective method, evaluation approach.*

Results.

Necessity of costs

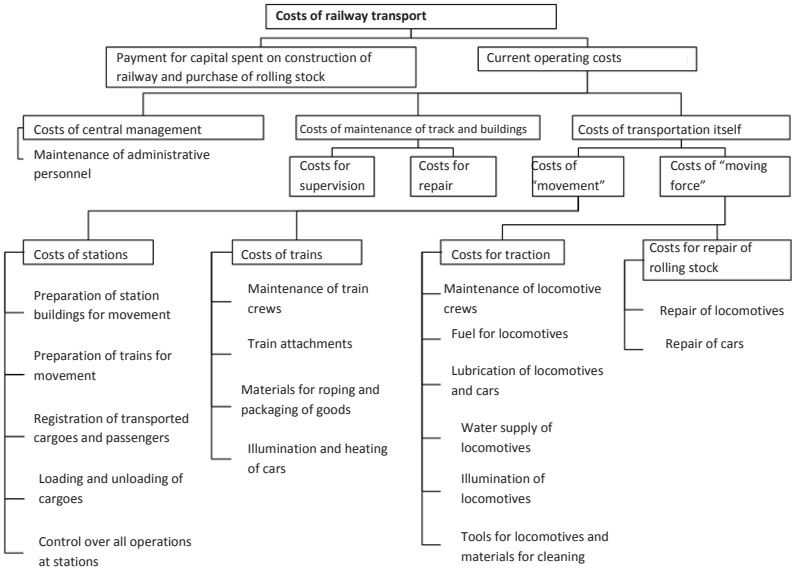
At that time, the railway industry was already half a century old, Russian railways for almost forty years, and significant experience was gained not only in their construction and operation, but also in accounting for and analysis of costs and revenues. However, the scientific comprehension of railway costs was only just beginning. As Alexander Ivanovich himself rightly noted, «the study of the current costs of production is still one of the most intricate and difficult tasks of railway economy ... Science, it can be said, has not yet touched on this subject ...» [1, p. 138].

Chuprov scrupulously summarized and analyzed the available at the time factual data on the costs of railways both in Russia and abroad. The results of the conducted research, most of which were carried out by foreign authors, it not only systematized, but essentially developed, revealing the peculiarities of the formation of railroad costs in Russian conditions, and created a solid basis for the continuation of the begun. Therefore, it can rightfully be considered one of the founders of the theory of railway costs.

In this area, such qualities of the scientist as scientific objectivity and the lack of dogmatism were clearly manifested. He did not strive at all costs to back the original theoretical postulates with facts by appropriate selection and interpretation, but seriously corrected the scientific positions with the help of empirical analysis.

Thus, A. I. Chuprov initially declares his adherence to the labor theory of value [1, p. 61], but then, starting from the realities of economic relations, notes that the costs of production should not exceed the «selling value of a single unit of goods» [1, p. 68], that is, prices, and in the event of non-fulfillment of this condition, costs must be brought into line with the price. The latter thesis, in fact, means that not the costs determined by the costs of living and materialized labor determine the price of the goods, but on the contrary, «the costs follow the prices» [2, p. 46]. To this theoretical conclusion came in the 16th century the Spanish philosophers – representatives of the Salamanca school, and then, already in the late 19th – early 20th century, it was supported by supporters of the Austrian economic school. And it is very revealing that, although in an implicit manner, their colleague from Russia came to the same position.

One more example. Initially, as a theoretical postulate, Chuprov says that in the railway economy constant costs are associated with the use of constant capital, and the costs «corresponding to current labor and working capital» fall in the same amount «for each unit of the product produced, in no matter how much it was produced» [1, p. 66–67], i.e. are variables. However, then, relying on the analysis of the real economy of the railways, the scientist thoroughly



Pic. 1. Classification of the costs of railway transport according to A. I. Chuprov [Compiled by the author on the basis of the contents of the book «Railway economy» (1875)].

corrects this initial position and reveals that the costs of the central railroad management are to a very small extent dependent on the volume of the transportation work, and in this their «substantial similarity ... with payment for capital» [1, p. 157]. Equally «costs of road supervision» depends little on the volume of traffic [ibid, p. 170], while the «costs of movement», as Chuprov calls the costs associated with station and train work, increase with the increase in traffic volumes not directly in proportion but rather slowly [ibid., pp. 203–204].

In this regard, it should be noted that the distribution of railway costs to volume-dependent transport (variables) and independent (conditionally-permanent) is one of the central and complex problems of theory and practice of managing the economy of the industry. It has been studied for many decades by such scientists as E. V. Mikhaltsev [3], A. I. Zhuravel [4], A. S. Chudov [5], A. P. Abramov [6], N. G. Smekhova [7] and others. The fact that almost one and a half centuries ago A. I. Chuprov not only posed this problem theoretically, but managed, based on very limited material, to reveal the nature of the dependence of individual elements of railway costs on the volume of traffic – a very valuable contribution to the designated scientific area.

Problematic issues

Alexander Chuprov formulated the main questions that require research in the field of interest:

«1. What are the costs of production of the railway enterprise? What categories of costs are required for railway transportation to take place?

2. How and to what extent is the size of different types of costs determined for a given movement?

3. How and to what extent do costs vary with the change in motion?» [1, p. 71].

Chuprov himself reasonably believed that «the answer to the questions posed is hardly overcomeable difficulties» [ibidem].

And indeed, railway economics has been looking for and clarifying the answers to these questions for many decades and continues to clarify to this day.

And in our time, the relevance of research in the field of the structure of railway costs remains [10]. Again and again there is a study of the factors affecting the amount of costs at a certain level of traffic, or, as was once said, the size of the traffic [11–13].

As part of studies of the impact of traffic volumes (dimensions of traffic) on the costs, the dependencies themselves are not only actualized, but also the «asymmetry» of the change in operating costs with increasing and decreasing traffic volumes [14, 9], which is important both for the theory of railroad economics and management practices of the industry.

A. I. Chuprov, it is necessary to give him his due, quite rightly posed the problem of choosing a gauge for allocating railway costs and considered various options for solving it. «The first most elementary way – in his opinion – was the comparison of expenditures with gross income, gross income was taken as the unit to which the expenditures were quoted» [1, p. 74].

This approach subsequently led to the widespread use of the «operating ratio» («cost ratio»), which is defined as the ratio of current operating costs to revenue from transport, to assess the efficiency of railways [15, 16] and shows how much of the revenue is absorbed by such costs. This indicator in the late 19th – early 20th century was one of the main criteria for economic evaluation of the railways in our country (and in the US – and in subsequent years).

At present, interest in its use in domestic research is reviving [17, 18], because unlike the profitability, the magnitude of which is influenced by purely financial factors, the cost factor in its pure form characterizes the economic efficiency of operational activities. That is, it can be a real tool for solving one of the most important tasks of the railway economy – system management of the industry's revenues and expenditures [19].

Chuprov considers other measuring instruments, which are used for comparing rail costs with them, – the train run («train mile»), the run of the car axles (the term «axle-kilometers of cars» later appeared [3]), as well as «gross cargo carried by the road (the weight of locomotives, passenger and commodity carriages combined)» [1, p. 74–81].

«The centner-mile of the gross cargo represents a natural unit both for measuring the work of the transportation instruments and for calculating the costs of production», the scientist considered [1, p. 81]. And he suggested using this meter to distribute the total costs between modes of transportation and

presented the calculation procedure for such calculations. It should be noted that in today's conditions, a method based on the calculation of the average prime cost of 10 tkm gross in freight traffic and the gross factor for a given type of cargo is recommended for an approximate estimation of the cost of transportation of various kinds of cargoes [7, pp. 338–340].

Thus, A. I. Chuprov not only clearly formulated the need «both for evaluation and for a variety of practical questions … to know what the transportation costs of each kind of transported goods, for example, the passenger-verst of each class or pood-verst of various goods for railways themselves» [1, p. 77], but also described approaches to the implementation of such estimates, which have remained relevant up to now, despite the emergence of more accurate methods.

Classification of costs

The first issue for the study of railway costs is their classification. A. I. Chuprov paid a lot of attention to it, considering in detail various categories of costs and factors affecting them. Unfortunately, he did not present a general visual scheme for classification of railway costs, but on the basis of his descriptions we managed to form such a scheme (Pic. 1).

It is noteworthy that when analyzing railway costs as their first element, Alexander Ivanovich took into account the payment for capital spent on construction of railway and purchase of rolling stock («payment for capital of the structure», in his formulation). At that time, the interest on the capital invested in construction and equipping of the objects represented an element of the explicit (external) costs of the railways. (For explicit (external) and implicit (internal) costs, see [11, p. 11].)

As A. N. Frolov noted, «the capital borrowed for one or another period, usually for a concession period, was repaid during this period, by mandatory payments derived from the enterprise's revenues» [20, p. 55]. After the revolution and the nationalization of the railways, they no longer had to «pay the capital of their construction and the subsequent strengthening». From this it was concluded that under the changed conditions «in determining the cost of production, it is as if to deal only with the costs of exploitation» [20, p. 58].

Indeed, since then, until now, the interest on capital is not considered as an obligatory component of railway costs. But even if there are no payments to borrowed capital as apparent (external) costs, the interest on capital should be taken into account as implicit (internal) costs of the functioning of railways, which makes it possible to assess the real effectiveness of their economic activities [21]. That is, in this part, the classification of railway costs by Chuprov is absolutely topical.

Another merit of A. I. Chuprov is that he focuses attention on the dependence of operating costs on the size of investments in the construction of the railway, noting that often «savings in labor and capital in the initial construction of the road entail an unnecessary waste of current labor, and hence the extra costs during the entire operation» [1, p. 168]. The development of this thesis can be considered the subsequent emergence of a method for assessing the relative effectiveness of investment [15, 22] and is now increasingly applying the assessment of the cost of the life cycle of railway transport facilities.

Of undoubted interest is the consideration by A. I. Chuprov of the influence of socioeconomic conditions on the requirements for railroad communication and the cost of building railways, and accordingly on the technical solutions used [1, pp. 103–105]. Now this aspect should be kept in mind when choosing the track designs for HSR and other solutions, the qualitative and cost-effective results of implementation of which should meet both the existing socio-economic conditions and the prospects for innovative development of the industry [23, 24].

Noting the profound analysis by A. I. Chuprov of the factors affecting the total value of railway costs and some of their elements, it is worth noting the assessments made by him:

– influence of non-uniformity of transportations on time and in a direction on intensity of use of a rolling stock and costs [1, pp. 107–108];

– impact of technical improvements in the track economy on operational costs [ibid, p. 176, 180];

– influence of speed of movement on expenses on repair of a track [ibid, p. 181];

– factors that determine the costs for traction [ibid., pp. 209–223].

Since then, economic science has constantly deepened the study of these issues. More recently, in particular, there have appeared new interesting publications on the analysis of costs associated with the operation of the infrastructure [25] and rolling stock [26].

Conclusion.

A. I. Chuprov not only laid the foundations for classification and analysis of railway costs, but also set the task of managing them, and, as a possible instrument, considered the impact on demand for transportation [1, p. 245]. However, he himself came to the disappointing conclusion that «the railway economy is unable neither to adjust labor and capital expenditures to the conditions of changing demand, nor to prune the most demand for costs determined by technical requirements. Therefore, the sum of production costs falling on a unit of transported goods depends entirely on the features of movement given to the railway» [1, p. 256].

The subsequent development of the theory of railway costs and the practice of governing them both in our country [27, 28] and abroad [29] did not confirm such a fatalistic conclusion. And in many respects, due to the fact that this development was based on the powerful theoretical foundation laid by professor Chuprov, rightly considered the founder of the economy of railway transport [30], it was possible to create those scientifically grounded management tools that are still helping to maintain and increase the efficiency of the industry.

On the grave of Alexander Ivanovich Chuprov (he is buried at the Vagankovskoye cemetery in Moscow) it is laconically and modestly marked: «Professor of Moscow University» and dates of birth and death are named (died February 24, 1908). Behind this stingy information is the life of a man who left us a considerable scientific heritage and a good memory for many years to come.

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