Assessment of Decision-Making at Substantiating the Strengthening of the Railway Capacity of Uzbekistan in the Conditions of Uncertainty and Risks

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ABSTRACT: The results of a study of the main risk uncertainty factors that influence decision making when substantiating the strengthening of the railway capacity of Uzbekistan with the aim of switching transit freight traffic between China, Central and Southern Asia are presented. The authors has developed a methodology that allows to assess decisions made in various macroeconomic situations, and, as a result, to identify the area of effective decisions in substantiating the strengthening of the railway capacity of Uzbekistan in the conditions of uncertainty in the initial information.

KEYWORDS*:* risk, uncertainty, strengthening of power, decision-making, freight traffic, China, Central and Southern Asia, AngrenPap line.

I.INTRODUCTION

Risk and uncertainty factors in substantiating the strengthening of the railway capacity of Uzbekistan are currently not taken into account as indicators requiring special attention.

At substantiating the strengthening of the capacity of the railways of Uzbekistan with the purpose of switching transit freight traffic between China, Central and Southern Asia, which exert influence on decision-making the following types of uncertainty and risks are represented.

1. The uncertainty associated with time of switching of transit freight traffics between China, Central and Southern Asia.

2. Uncertainty of volumes of freight traffic, risk with instability of the current economic situation in China, Central and Southern Asia.

Based on the developed mathematical model, the following results of the freight traffic forecast from 2020 to 2035 were obtained [1]:

☐ projected freight traffic by the railways between China, South Korea and Uzbekistan for 2020 - 4,30 million tons, for 2025 - 4,84 million tons and for 2035 - 6,61 million tons;

☐ projected freight traffic between China and Tajikistan, Turkmenistan, Afghanistan and Iran for 2020 - 2,82 million tons, for 2025 - 3,47 million tons and for 2035 - 6,17 million tons;

☐ projected local freight traffic through the pass of Kamchik for 2020 - 8,87 million tons, for 2025 - 10,43 million tons and for 2035 - 15,16 million tons.

The results of the obvious presentation of thetask of choosing the most competitive schemes for mastering rail transportation and the optimal way to increase the capacity of the Angren-Pap line with the aim of switching transit freight traffic between China, Central and Southern Asia are presented on graphics for mastering traffic. Two schemes (fig. 1) are considered.

According to the scheme I it is assumed $(1 \rightarrow 2 \rightarrow 4 \rightarrow 6)$: 1 - the initial state; 2 - introduction of the third section of the VL locomotive 80c (an increase in the mass of the composition to a possible by useful length along the pick-and-drop ways); 4 – the device of automatic block system and organization of train traffic with partially batch schedule; 6 - construction of the second tunnel.

<u>According to the scheme II it is assumed</u> ($1 \rightarrow 3 \rightarrow 5$): 1 -the initial state; 3 - construction in a tunnel of a double-sided insert, the device of automatic block system and use of additional locomotives on stages "Halt 2 - Halt 3" and "Halt 3 - the st.Koshminar"; 5 - introduction of the third section of the VL 80c locomotive (an increase in mass of structure to a possible by useful length along the pick-and-drop ways) at preservation of a double-sided insert.
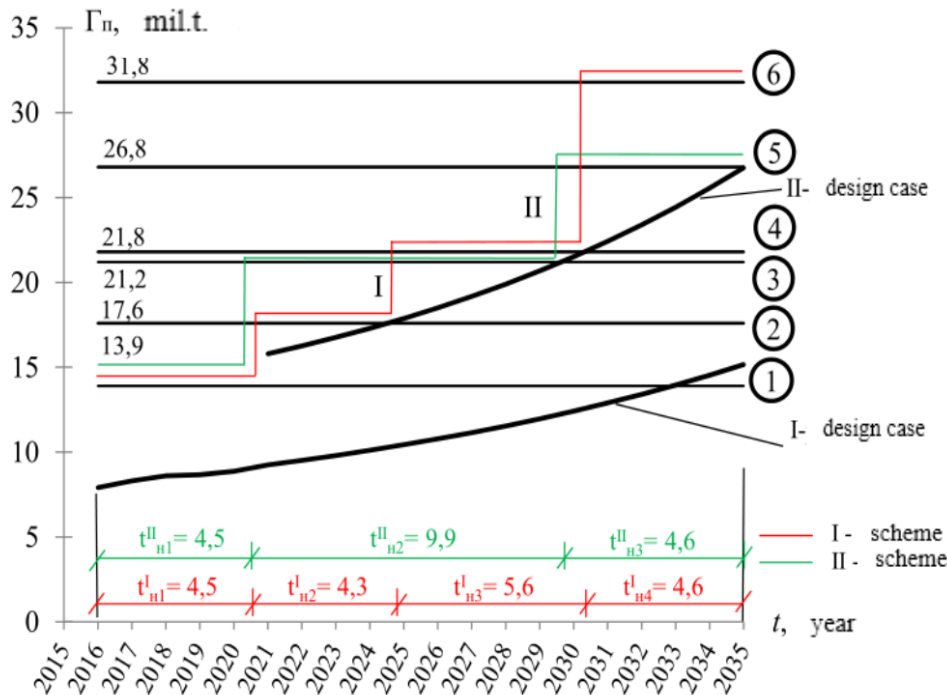

Figure 1 - The schedule of acquirement transportations in each calculation case

Apparently from schedule 1, when choosing a variant of the scheme for mastering transportations, a sufficiently long period (for 15 years) of operation of the line is considered, in this case, obviously, deviations in volumes of transportation are possible, both in time periods, and in general on the calculation horizon (it is connected with time of switching of transit freight traffics between China, Central and Southern Asia). The same can be said about schemes for enhancing the operation of the railway, i.e. there are conditions of uncertainty .Obviously, the larger calculation horizon, the higher the level of uncertainty and risk when adopting a particular scheme based on the results of an economic assessment of investment efficiency.

Before starting to consider the issue of decision-making when substantiating the strengthening of the railway capacity of projects under conditions of uncertainty and risk, formulate the concepts of "uncertainty" and "risk", establish the differences between them.

Uncertainty assumes existence in the information block of factors on which it is impossible to give the determined (unambiguous) values, i.e. incompleteness or inaccuracy of information takes place. In our case it is possible to carry to such factors, for example, information on volumes of transportations or the amount of the movement on prospect which depends on formation of a corridor between China and Central and Southern Asia.

Uncertainty factors can be divided according to their genetics into external and internal. External factors include information, for example, on the size and structure of transportation, which depend on the macroeconomic development programs for the region in China, Central and Sothern Asia, the legislative base, the actions of competitors in the transport services market, etc. It is known that the project to strengthen the capacity of the railways of Uzbekistan is designed to provide transit traffic between China and Central and Southern Asia. Thus, the effectiveness of the project to strengthen the capacity of the railways of Uzbekistan, and accordingly the profitability, the adoption of design decisions depends on the growth of transit volume of transportations between China and Central and Southern Asia. Let's note that the share of China in the general freight traffic between China and Central and Southern Asia makes 70%

of freight traffics of all considered countries. These circumstances must be taken into account in the current market economic situation in the region.

Internal are, first of all, competence of the office of managers of the railway company at the choice of strategy of its functioning, and here, in our opinion, it is important to attract science and educational institutions to the solution of this problem. The existing condition of a question of scientific research in the field of development of railway transport does not satisfy the practical requirements of quickly developing national economy because of:

- lack of a master plan and insufficient scientific justification of the tendenciesin the development of railway transport on prospect;

- lack of the sole coordinating center in practical work and scientific research;

- the insufficient accounting for the increase in the capacity of the railway network on prospect, taking into account the country`s geopolitical position;

- the insufficient accounting and scientific-economic justification for strengthening of railway transport in the conditions of uncertainty in the source information, need to revise of methods of scientific research and ways for introducing the achievements of scientists into the work of railway transport.

Economic risks are caused by adverse changes in the economy of countries. At the choice of design parameters forenhancing the capacity of the operated railways of Uzbekistan with the aim of switching transit freights between China and Central and Southern Asia, the following types of uncertainty and economic risks appear to be most significant:

- lack of the state budget and own means of the Uzbek railways for strengthening the power of the railways;

- decrease in volumes of freight traffic due to the fall of the state economy and the economic crisis in the region;

- need for additional investments in the infrastructure and rolling stock of railways due to their high-quality service;

- lack of capacities and low technological level for development of the locomotive and carriage park;

- lack of development infrastructure (warehouses, terminals, etc.);

- the reductions of transit freight trafficsdue to development of alternative railway routes passing the territory of Uzbekistan;

- high rate of inflation;

- a lack of converting for foreign investors.

As noted, the successful development of the project to strengthenen the capacity of the railways of Uzbekistan in order to switch transit freights between China and Central and Southern Asia largely depends on a stable policy of the economic situation in the region. Instability of a situation in Central Asia will exert negative impact on efficiency of the made decisions. Construction of a new railway line through Afghanistan is continued that will provide to Central Asia an exit to seaports of Iran and Pakistan on the coast of the Indian Ocean. However today encounters lack of regulation of a situation in Afghanistan.

NPV (Net Present Value) is the sum of difference between the operational effect and investment for the calculation period, reducedto a single (usually initial) year [2]:

$$NPV = \sum_{t=0}^{T_p}(R_t - K_t) \cdot \eta_t, \qquad (1)$$

whereT_p- the calculation period (the calculation horizon), years;R_t- economic effect of operational activity in *t-m* to year;K_t- investment expenses in *t-m* to year;η_t- discounting coefficient.

The Dependence of the mathematical expectation of the integral effect on the probability of changes in the dynamics of freight traffic for theoption of strengthening the capacity of the railways of Uzbekistan in order to switch transit freight traffic between China, Central and Southern Asia can be written down in the following form:

$$M(Э_{exp}) = \sum_{t=0}^{T_p}\left(\left(\sum_{i=1}^{n_t^{(r)}} R_{it}p_{it}^{(r)} - \sum_{i=1}^{n_t^{(k)}} K_{it}p_{it}^{(k)}\right)\eta_t\right) \qquad (2)$$

where$n_t^{(r)}$- number of possible values of results which are estimated by the probabilistic characteristic;$n_t^{(k)}$- the same on investments;R_{it}- economic result at change of dynamics of freight traffic in *t* probability;$p_{it}^{(r)}$- *i-ya*is probability that *t*year the result will be equal in R_{it};K_{it}- investments at change of dynamics of freight traffic in *t-y* year with *i-y* probability.

Evaluation of the solutions for the phased increase of the Angren Pap railway line capacity with the aim of switching transit freight traffic between China, Central and Southern Asia with a change in freight traffic dynamics taking into account various options for the mathematical expectation of the integral effect are given in Table.1.

Table 1 – The mathematical expectation of the integral effect when changing the dynamics of freight traffic,

p=0,5	p=0,6	p=0,7	p=0,8	p=0,9

taking into account various variants of probabilities.

3885	5641	7392	9161	10331

For the first version of the phased strengthening scheme

3911	5510	7266	9015	10768

For the second version of the phased strengthening scheme

From table. 1. it is visible that the probability of occurrence of forecasting freight traffic is 87,5%, it is expedient to make the decision on the second version for the phased increase in the capacity of the Angren – Pap railway line in order to switch transit freight traffic between China, Central and Southern Asia.

The following method of risk assessment in substantiating the strengthening of the capacity of the railways of Uzbekistan in order to switch transit freights between China and Central and Southern Asia is to analyze development scenarios. The analysis of development scenariosinvolvesthe consideration, as a rule, three scenarios of events making a decision in justifying the strengthening of the railway capacity of Uzbekistan in order to switch transit freights between China and Central and Southern Asia: "pessimistic", "moderate" and "optimistic".

The analysis of statistical data shows that untill 2015, China`s GDP growth rate was 8%-10%.Since 2015, China has seen a slowdown in GDP growth. According to IMF forecasts, the growth rate of the Chinese economy will slow down until 2020. In this regard, it becomes necessary to take into account the promising rate of economic growth in freight traffic between China, Central and Southern Asia. According to IMFestimates, China`s GDP growth was slowed down to 6,5% in 2016 and predicted at the level of 6% in the current year. The IMF expects that after 2019, Cina`s GDP growth will not exceed 7% and untill 2020 it is predicted at the average level of 6,5%. China`s economy will grow at a slower pace in the coming years. After 2020, there remains very uncertainty about the rate of GDP growth in the region.

Let's assume that depending on instability of various economic conditions at change of growth rates of GDP in the region in general three versions of the made decisions in justifying the strengthening of railway capacity of Uzbekistan in order to switch transit freight traffics between China and Central and Southern Asia.

1. "The pessimistic scenario" when growth rates of GDP in the region do not exceed 5-6%.
2. "The moderate scenario" when growth rates of GDP in the region reach 6,1 - 7%.
3. "The optimistic scenario" when growth rates of GDP in the region make 7,1 - 9%.

As a result of the executed calculations, scenario trees were obtained for both options with a change in the GDP growth rate in the region. NPV values of a total series are given in table. 2.

Table 2 - NPV values with a change in the GDP growth rate in the region

Growth rate of GDP in the region, %								
δ=1%	δ=2%	δ=3%	δ=4%	δ=5%	δ=6%	δ=7%	δ=8%	δ=9%
For the first version of the phased power amplification scheme, the NPV value,*one billion ammount*								
8636	9112	9655	10250	10760	11007	11741	12599	13480
For the second version of the phased power amplification scheme, the NPV value,*one billionammount*								
8441	8937	9481	10077	10723	11438	12222	13085	13956

From table. 2 it can be seen that at the GDP growth rate of thisregion in the first version of the phased capacity amplification scheme of scheme of1%-5% and in the second option - 5,1%-9%, NPV is more efficient.

The processing of theresulting total series of values of the integrated effect can be performed accrding to the formula 3. The processing of the resulting total integrated effect is performed for three options of the developmentof events in the region: "pessimistic", "moderate" and "optimistic".

$$Э_{ожд} = \alpha \cdot Э_{max} + (1 - \alpha) \cdot Э_{min} \qquad (3)$$

where$Э_{max}$ and$Э_{min}$ - the greatest and smallest integrated effect according to the considered scenarios;α- the special standard for the accounting of uncertainty of effect (an optimism indicator).

The analysis of development scenarios assumes the consideration, as a rule, of three scenarios of events,decision-making when substantiatingthe strengthening of the railway capacity of Uzbekistan in order to switch transit freights between China, Central and Southern Asia: "pessimistic", "moderate" and "optimistic". Processing of the received NPV values according to the scenario variants yielded the following results. Results are presented in table. 3.

Table 3 - The expected integrated effect at change of growth rates of GDP in the region

Number of option	Type of an initial element of a tree of the scenario	SizeSize$Э_{exp}$,one billion ammount
I	pessimistic	10908
	moderate	11446
	optimistic	12784
II	pessimistic	11152
	moderate	11908
	optimistic	13262

From table. 3 it is visible that the second option of the staged capacity increase of the Angren-Pap railway line is more expedient for eah development scenario in China, Central and Southern Asia.

II.CONCLUSION

1. The main factors of uncertainty and risks that influence decision-making are examined when substantiating the strengthening of the capacity of the railways of Uzbekistan in order to switch transit freight traffics between China and Central and Southern Asia, and stability of decisions made when the GDP growth rate in the region changes.

2. A methodology has been developed that allows to assess decisions made in various macroeconomic situations, and as a result, to identify the field of effective decisions in substantiating the strengthening of the railway capacity of Uzbekistan in the face of uncertainty in the initial information.

3. Based on the studies, the following rational staging of strengthening of power amplification of the Angren – Pap line was established: construction in a tunnel of a two-acceptable insert and the automatic lock-out device on all line during realization of design capacity of the project and use of additional locomotives on stages "Halt 2 - Halt 3" and "Halt 3 - the station. Koshminar"; introduction of the third section of the 2VL 80c locomotive (increase in mass of structure to possible on the useful length of reception and dispatch tracks).

4. The second option for a phased increase in the capacity of the Angren – Pap railway line is advisible, provided that the probability of approach of the predicted freight traffic is 87,5%.

5. After 2021, with a GDP growth rates of more than 5,1% in the region under consideration, the variant of the phased increase in the capacity of Angren-Pap railway line is optimal, which will save construction and operational costs for 2035 in the amount of up to 662 billion in total.

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