Economic assessment of the level of transaction costs of railway transport enterprises in terms of certification

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Abstract. The purpose of this study is economic assessment of the level of transaction costs of railway transport enterprises in the conditions of certification. Based on the results of the analysis of the main provisions of the new institutional economic theory, a number of methodological approaches to the economic assessment of the level of transaction costs of railway transport enterprises in the conditions of the certification procedure are proposed. Due to the fact that the transaction sector occupies a significant place in the state economy, the study of methods for assessing the level of transaction costs of economic subjects plays a significant role in the development of the transport services market conditions. The obtained research results generally confirm the possibility of developing certain provisions of the economic theory of transport as a result of considering the provisions of the theory of transaction costs in relation to the sphere of railway transport. The proposed methodological approaches to assessing the level of transaction costs can increase the level of reliability of cost calculations of participants in the transport services market that accompany the certification procedure for railway transport.

1. Introduction
The purpose of this study is to substantiate the possibility of economic assessment of the level of transaction costs of railway transport enterprises in the conditions of certification. The results of the analysis of the provisions of scientific works of domestic and foreign researchers in the field of institutional economics demonstrate that the conduct of a comprehensive economic assessment of transaction costs of railway transport enterprises in the conditions of certification has not been in the focus of attention of researchers until now.

Certification of repair companies of rolling stock of railway transport is a state institution that defines a set of rules and regulations for passing the certification procedure, a list of mandatory requirements for passing certification and obtaining a certificate of compliance. The institutional environment of certification is formed during the organization of interaction of various subjects of economic relations during the certification procedure. It is advisable to express graphically the main features of the organization of the institutional environment of certification of railway transport enterprises (figure 1).

The purpose of certification of repair production is to confirm the fact that the identified production process and the conditions for its implementation provide the possibility of repair, after which the technical means of railway transport meet the requirements of safety, environmental protection and maintain the stability of the main technical characteristics.

The Nobel prize winner in Economics Douglass North, in his work entitled “Institutions, institutional changes and the functioning of the economy” [1], considers institutions as the most
important, fundamental basis in the economy in conjunction with population, political regime, and ideology. Institutions - are restrictions developed by the society (state), as well as certain enforcement procedures. In turn, North’s approach defines the market as a complex phenomenon involving institutions: “rules of the game”, laws, certain types of relationships between market participants. In the course of their existence, institutions play not only the determining role of “behavior”, but also in the conditions of their limitations become a catalyst for the emergence of transaction costs of market participants.

Figure 1. Organization of the institutional certification environment of activities of railway transport enterprises.

The fundamental definition of transaction was given by John Commons in the book “Institutional economics”. According to Commons, any transaction is based on a conflict of interest, and the goal is to resolve this conflict by exchanging, alienating and appropriating property rights and freedoms created by society [2]. Certification as a service in the process of providing which the alienation of a part of freedom is carried out (compulsion to fulfillment of the mandatory requirements of the Institute) and sharing the same freedom on the actual access to the market (certificate of conformity), in its essential content is identified with the definition of “transaction” and is accompanied by the emergence of transaction costs.

The term “Transaction costs” was first introduced by Ronald Coase and, in its essence, became the foundation of a new institutional economic theory. In his work entitled “The nature of the firm” [3], Coase defines transaction costs as the costs that arise in connection with the conclusion of contracts, that is, the costs of collecting and processing information, negotiating and making decisions, monitoring and legal protection of contract performance. Unlike neoclassical economic theory, which considers the market as the perfect mechanism that does not require cost accounting for service transactions, neo-institutional analysis proposed by Coase showed that in the process of preparing a contract (agreement) it is necessary to negotiate, to resolve differences and establish mutually beneficial positions on the contract between the parties.

“The reason for transaction costs is born of the economic isolation of participants in transactions”. (R. Coase) [4] This, among other things, means that the market is a giant system with a huge number of “sellers” and “buyers” who must collect information about each other, for the purpose of buying and selling, conclude contracts, fix their rights and obligations for a specific transaction, etc. Each of these market participants, firstly, lacks the necessary amount of information about the number of market participants to perform a transaction, and, secondly, they have a so-called limited rationality. Limited rationality means that market subjects tend to act rationally, but in fact it is only partially possible to do so.

Ensuring the completeness of the economic assessment of the level of transaction costs of railway transport enterprises during the certification procedure as an administrative barrier to doing business in
the transport services market is possible only taking into account the total incurred users’ costs for the services to conduct the certification procedure.

It should be noted that if the level of costs for the implementation of activities, provided by the requirements of the document “Rules for certification of production for the repair of technical means of railway transport” will exceed the level of effective demand for services in repair of the rolling stock, the operation of the repair production will be discontinued, which could lead to a deterioration not only of the conditions of market of services in repair of rolling stock, but also to reduce the number of rolling stock on the railway network, because of their retirement from turnover because achieving a high level of wear, write-off period if no major repairs are performed. At the same time, it is necessary to achieve such conditions that the certification Institute allows regulating the scope of activities of railway repair enterprises with the minimum possible losses of these economic entities and, subject to the interests of society in terms of requirements for compliance by enterprises with all legislative and technical standards that compel high-quality repairs of vans and locomotives, their further safe operation on the railway network.

2. Method of research
The institutional nature of the certification process is due to the obligation to comply with the rules and regulations (requirements) dictated by State Institutions that provide public services in relation to the conditions for conducting business by participants in the transport services market that are subject to certification. In this regard, the basic research method is based on the possibility of adapting the provisions of the theory of transaction costs to the needs of the procedure for economic assessment of certification costs, proposed by the authors. During the analysis of the main provisions of scientific works in this area, the main types of transaction costs are identified:

- transaction costs of identifying alternatives and searching for information;
- transaction costs of contract’s concluding;
- transaction costs of measurement;
- transaction costs of specification and protection of property rights;
- transaction costs of opportunistic behavior

The authors analyzed these types of transaction costs, as a result of which the categories of each type were identified, and the calculation procedure and symbols for each component of the category of transaction costs were determined.

3. Results of the research
As a result of the conducted structuring of transaction costs, subtypes and key indicators were identified for calculating each such subtype of transaction costs for railway transport enterprises under certification conditions. The results are shown in tables 1-5.

Uncertainty arises in the course of almost any business activity and the transport services market is no exception. To carry out the certification procedure for the repair production of railway rolling stock, an economic subject is constantly faced with the choice of a certification body and involved entities. In conditions of uncertainty and asymmetry of information, the entrepreneur bears the costs that accompany the search for information about the most profitable cost of the certification procedure, about the list of aggregated entities (participating State Institutions) participating in the certification procedure, the procedure and features of the certification procedure.

The conclusion of a contract for the provision of production certification services is preceded by a significant amount of work. The company needs to assess the risks and opportunities that occur in the provisions of the contract, calculate the costs of meeting the requirements of certification of production. (Table 2).

In addition, due to limited rationality and lack of information, the company takes measures to assess the competence of specialists of the certification body and determine losses from possible
detection of non-compliance of its level of equipment production with mandatory certification requirements. These measures are carried out by measuring parameters, indicators that allow identifying qualitative characteristics of measurement objects (Table 3).

**Table 1.** Calculation of transaction costs for determining alternatives and searching for information.

| Type | Categories of type of transaction costs | Procedure of calculation | Convention |
|------|-----------------------------------------|--------------------------|------------|
|      | Search for information about certification bodies and the cost of certification (ISO) | ISO = Nsb * Cs; Cs = Cs + Cm + Ccs + Coth; Cs = Cl + HRav | Nsb - number of certification bodies in the public services market; Cs - salary costs; Cm - the cost of the necessary materials; Ccs - expenses for communication services; Coth - other expenses; Cl - labor costs; HRav - average hourly payment rate. |
|      | Search for information about the procedure and features of the certification procedure in each specific certification body (IPS) | IPS = Cls + Cspp. | |
|      | Search for information about other potential participants in the certification procedure (testing laboratories, attracted experts from railway transport organizations, etc.) (IPP) | IPP = Nppp * Cspp; Cspp = Cs + Cm + Ccs + Coth; Cs = Cl + HRav | |

**Table 2.** Calculation of transaction costs of contract’s concluding for the provision of certification services.

| Type | Categories of type of transaction costs | Procedure of calculation | Convention |
|------|-----------------------------------------|--------------------------|------------|
|      | Concluding financial and legal expertise of the contract (FLE) | FLE = NC * CEC; CEC = Cs + Cm + Ccs + Coth; Cs = Cl + HRav | NC - number of contracts; CEC - costs for expertise of a single contract; Cs - salary costs; Cm - the cost of the necessary materials; Ccs - expenses for communication services; Coth - other expenses; Cl - labor costs; HRav - average hourly payment rate. |

Transaction costs of specification and protection of property rights can be considered as losses related to the lost volume of services provided by the certification body. In this case, this leads to the
termination of the contract, often accompanied by legal proceedings, and in general leads to losses associated with downtime, as well as the possible loss of part of the company’s assets (Table 4).

Transaction costs of opportunistic behavior arise mainly due to the unfair provision of services, “shirking” and self-interest of service providers. (Table 5).

**Table 3.** Calculation of transaction costs of measurement.

| Type | Categories of type of transaction costs | Procedure of calculation | Convention |
|------|----------------------------------------|--------------------------|------------|
| EQE  | Costs associated with assessing the qualifications of members of the expert commission for conducting the certification procedure | \( EQE = C_{ss} \times N_{ec}; \)  
\( C_{ss} = C_{s} + C_{m} + C_{cs} + C_{oth}; \)  
\( C_{s} = C_{l} + H_{Rav}. \) | \( C_{ss} \)-the cost of studying the competence of specialists of the certification body; \( N_{ec} \)-number of the expert commission; \( C_{s} \)-salary costs; \( C_{m} \)-the cost of the necessary materials; \( C_{cs} \)-expenses for communication services; \( C_{oth} \)-other expenses; \( H_{Rav} \)-average hourly payment rate. |
| MPL  | The cost of measuring possible losses due to the identification of non-compliance with requirements during the certification procedure | \( MPL = ((N_{nr} + N_{rc}) - N_{rr}) \times C_{en}. \) | \( C_{en} \)-costs for eliminating non-compliance of production with certification requirements; \( C_{s} \)-salary costs; \( C_{m} \)-the cost of the necessary materials; \( C_{cs} \)-expenses for communication services; \( C_{oth} \)-other expenses; \( H_{Rav} \)-average hourly payment rate. |

**Table 4.** Calculation of transaction costs of specification and protection of property rights in the certification process.

| Type | Categories of type of transaction costs | Procedure of calculation | Convention |
|------|----------------------------------------|--------------------------|------------|
| CLP  | Costs of conducting legal proceedings for the restoration of violated rights | \( CLP = El_{p} + E_{plp}; \)  
\( E_{plp} = C_{s} + C_{m} + C_{oth}; \)  
\( C_{s} = C_{l} + H_{Rav}. \) | \( El_{p} \)-expenses for ongoing legal proceedings; \( E_{plp} \)-expenses for planned legal proceedings; \( L_{p} \)-lost profit of the enterprise; \( F_{pr} \)-forecast profit of the enterprise; \( D \)-discount Rate, \%; \( D_{d} \)-days of downtime; \( C_{s} \)-salary costs; \( C_{m} \)-the cost of the necessary materials; \( C_{oth} \)-other expenses; \( C_{l} \)-labor costs; \( H_{Rav} \)-average hourly payment rate. |
| LIS  | Losses from improper specification | \( LIS = L_{p}; \)  
\( L_{p} = F_{pr} \times D \times D_{d}. \) | |
Table 5. Calculation of transaction costs of opportunistic behavior in the certification procedure.

| Type | Categories of type of transaction costs | Procedure of calculation | Convention |
|------|----------------------------------------|--------------------------|------------|
|      | Costs incurred as a result of identifying the responsible person responsible for violating the certification procedure and contractual obligations (CVP) | CVP = Lc + Lp; Lp = Fpr * D * Dd. | Lc - legal costs; Lp – lost profit of the enterprise; Fpr-forecast profit of the enterprise; D-discount Rate, %; Dd-days of downtime; |
|      | Costs incurred as a result of punishing a person guilty of violating the certification procedure and contractual obligations (CPP) | CPP = Cls + Cs + Cm + Coth; Cs = Cl + HRav | Cls - the cost of legal support; Cm – the cost of the necessary materials; Coth – other expenses; |
|      | Costs incurred in connection with the unfair provision of services by certification bodies (CUS) | CUS = Lp + Cls + Cs + Cm + Coth; Lp = Fpr * D * Dd. Cs = Cl + HRav | Cl-labor costs; HRav-average hourly payment rate. |

4. Discussion of results

The development of new methodological approaches to economic assessment of the level of transaction costs in the conditions of certification on a railway transportation, including the expansion of the list of criteria, a set of tools of economic assessment of fulfilling the requirements of the certification procedure, contributes to the level of authenticity of assessment of results of economic activities, objective assessment of the level of attractiveness of the market of transport services, improve transportation safety. At the same time, the level of transaction costs allows us to reflect financial and economic losses in a comprehensive manner, from several sides of economic and legal relations – both the economic efficiency of certification bodies activity and the level of administrative barriers to entry into the transport services market.

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