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Ensuring Service Quality within Internal Environment of Railway Transport and the Role of Diagnostic Tools

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ABSTRACT

To increase the level of customer focus, it is necessary to improve the quality of transport services in the transport market using modern technology and engineering tools. The objective of the research was to describe and to analyse a model of interaction between transport service enterprises, based on satisfaction of mutually beneficial needs and responsibility of stakeholders in the transport market. To achieve this goal, the authors used general scientific and economic research methods.

The study focused on the quality system of transport services within the internal environment and on the concept of customer focus for railway transport. A model of interaction of business units within the internal transport service environment was developed, It was used to identify the interests and responsibilities of the parties (both consumers and providers) using the example of a locomotive complex of JSC Russian Railways.

The considered interaction model will increase the efficiency of the use of the locomotive fleet without increasing the model range. It was also revealed that one of the factors affecting the level of quality of transport services is a set of diagnostic tools providing high quality of the transportation process, reducing unproductive losses, increasing the efficiency of operations of all units involved. The evolution of diagnostics tools is presented in a table.

Keywords: transport, railway, transport services, quality, diagnostic tools, monitoring, locomotive complex, customer focus.

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Background. The goal of transport services consists in providing safe movement of goods and passengers while satisfying all the requirements of consumers on the transport market. But this is only the visible part of the work of railway transport. There is still the internal environment of the industry, where many structures of various industries work together to achieve the common result which is safe and uninterrupted train traffic [1].

Many foreign companies have positive experience in reforming and restructuring railways.

For instance, in the course of the restructuring of the German railways, independent business entities were separated, and then joint-stock companies were established within the framework of the railway holding Deutsche Bahn AG, carrying out freight transportation, long-distance passenger transportation, regional passenger transportation, providing infrastructure and other services [2; 3]. The concept of the new organization structure of railway transport is based on transfer of decision-making authority and responsibility for them to the level of enterprises. Thus, the management of DB Group focuses on the tasks of strategic management, coordination, and control. Currently, one of the most important factors determining the economic success is development of projects for intermodal transport systems.

In Russia, according to the Strategy for development of railway transport until 2030, transport enterprises highlight customer focus as a key value of any company, aimed at constantly improving the quality of transport services to consumers and enhancing mutually beneficial long-term partnership between the main modes of transport. This approach to railway management ensures attraction of new customers, transformation of business processes, optimization of interaction rules, effective internal and external communication, etc.

Hence, it is worth studying issues of customer focus and transport service quality not only with regard to external clients but also referring to interaction within transport companies.

The *objective* of the research is to develop a model of interaction between transport service enterprises, which is based on satisfaction of mutually beneficial needs and responsibility of stakeholders in the transport market. To achieve this goal, the authors used general scientific and economic research *methods*.

1. Approaches to the concept of customer focus

According to marketing consultant A. A. Zenkevich, «customer focus is a focused and systematic action of the company, the purpose of which is to exceed the expectations of its customers and make them happy» [1, p. 4].

The authors of the article offer the following understanding of this concept: *customer focus is the ability of an organization to create conditions for attracting a flow of new customers, maintaining loyalty of regular clients by meeting their needs, ensuring thus growth in labor productivity and profits*.

If we consider the example of Russia, then customer focus is a relatively young concept for the economy of railway transport, and its development is currently underway. Within the JSC Russian Railways it is based on following principles:

- «the client always knows what he wants and to what extent»;
- «the client himself evaluates the level of customer focus of the transport company»;
- quality of the personnel of the transport company directly affects the level of customer orientation;
- there are internal and external customers of the company;
- customer focus provides a synergetic effect in the holding company.

To implement those principles, JSC Russian Railways has formed vertical and horizontal ties between business units in the organization structure of management, which provide a synergistic effect.

2. Implementation of the customer focused attitude in locomotive complex

Locomotive complex[1] in most countries makes part of the railway companies' units most important for consistent train traffic.

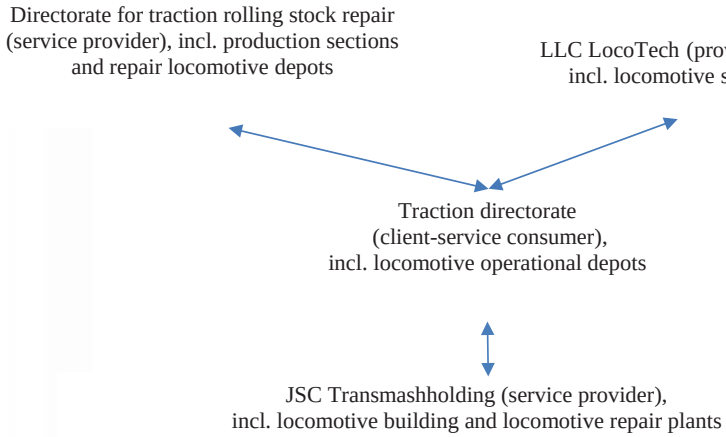
Since 2010, the locomotive complex of JSC Russian Railways has been restructuring:

[1] Locomotive complex is understood by the authors in conformity with Russian practices in the sense of a system of relationship between corporate divisions, affiliated companies and contracted external companies, involved in the operations related to designing, construction, maintenance and operation of locomotives used by JSC Russian Railways. – *ed. note*.

Table 1

Prospects for locomotive complex development

2020 year	2025 year	2030 year
Operational activity of locomotive facilities		
axle load of 25 tons	axle load of 27 tons	axle load of 30 tons
collector-free or collector traction motors	collector-free traction motors	collector-free traction motors
TRS management by a single person	use of automated control system (ACS) in TRS management by driver-operator	TRS movement is monitored and controlled by operator from a stationary workplace
information display system optimization	management is reduced to monitoring the automated control system and diagnostics of locomotive condition	management is reduced to monitoring the automated control system and diagnostics of locomotive condition
Repair activity of locomotive complex		
planned preventive maintenance system of TRS repair	planned preventive maintenance system of TRS repair with an adaptive approach to repair of individual components	maintenance according to real technical condition
Joint operation and maintenance		
use of the complex BLOCK-M for all types of TRS	integration of a safety system into a multifunctional control system	transition of a single multifunctional control and safety system to the requirements of SIL 4

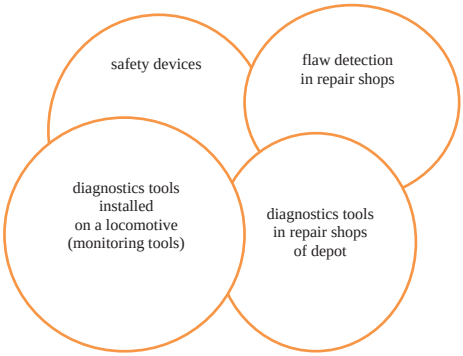


Pic. 1. Model of interaction of business units in the internal transport services environment (compiled by the authors).

various structural divisions are being singled out, the management structure is changing, interaction between divisions, branches, subsidiaries and affiliates is changing, and rules for the relationship between them are being developed.

Hence, based on the principle of dividing into external and internal customers, let us consider the approach of customer focus at the example of a locomotive complex.

Currently, in the locomotive complex there is no clear differentiation between the concepts of «producer» and «consumer» of the services provided in the internal transport service environment. Studying the scientific works of some Russian experts in railway economy, we can conclude that most of them consider transport services only from an external environment perspective, supposing that such concepts as «customer focus», «quality of transportation», «safety» are mainly aimed at meeting the needs of cargo owners and passengers. Although the internal environment plays a key role in issues of transport functioning, allowing to constantly improve the quality of work and increase the level of its customer focus (see, e.g. [4]). In this regard, the authors propose to use the example of a locomotive complex to build a model of transport services for the internal environment, where its business



Pic. 2. Diagnostics tools to ensure locomotive operability.

units can be divided into two groups: customer-consumer and service provider. Pic. 1 shows the scheme of their interaction if there is unconditional compliance with standards, norms, corporate policies.

According to the model proposed by the authors, service providers are:

• directorate for repair of traction rolling stock, repairing safety devices;

• LLC LocoTech and its structural subdivisions: locomotive service depots manufacture equipment, provide technical maintenance and repair of traction rolling stock (TRS);

• plants for manufacture and repair of TRS.

The consumer of «repair, equipment and maintenance of a locomotive» service is traction directorate, in particular, locomotive operational depots. The following functions are assigned to them:

• operation of a locomotive by highly qualified locomotive crews;

• ensuring the good condition of TRS [5, pp. 65–67; 6, p. 206].

Due to the fact that the locomotive economy is moving to a new mechanism of relations between providers and consumers, as well as to a new system for repairing (through assessment of actual condition of a locomotive), traction directorate becomes only a consumer of the services provided. Consequently, newly acquired TRS is under warranty service by factories and locomotive service depots, which allows for high quality manufacturing and repair of locomotives [7].

Since responsibility for operation and maintenance of TRS is assigned to specific business units, it becomes clear that now JSC Transmashholding and LLC LocoTech will be interested in updating design of a locomotive, aimed at increasing its efficiency, improving quality of work in order to reduce costs and improve transport services performance both in the internal and external spheres (Table 1).

The main development paths of the locomotive complex are identified in strategic programs providing for:

• renewal of traction rolling stock (TRS), aimed at reducing labor costs, energy and fuel consumption in the transportation process;

• construction, updating, additional equipment of repair infrastructure facilities [8, pp. 2–5].

Promising tasks of the locomotive economy are based on the implementation of the following principles: automation, reliability, safety, efficiency.

One of the main objectives is to increase the efficiency of using the locomotive fleet without increasing its model range, but using unification of models, a single modular platform based on three- and four-axle bogies, and radial installation of wheel sets [9, p. 25]. All those measures will reduce the cost of acquiring and maintaining TRS. By ensuring unification, downtime of TRS in repairs will be reduced, increasing the locomotive's performance. All these promising areas are reflected in Smart Locomotive project, developed and implemented by LLC LocoTech since 2016 [9].

3. The significance of diagnostic tools

The most significant basis of successful operation of locomotives is associated with advanced diagnostic tools for the control of locomotives' condition. Pic. 2 shows interaction of diagnostic tools that provide continuous improvement in quality of locomotives' operation.

Those of the tools shown in Pic. 2 that meet modern requirements must be used in the frame of a single system during repair and

Table 2

Diagnostic complex of locomotive facilities (compiled by the authors)

Name	Year of manufacture	Use
Safety tools		
ALS	1937	Automated locomotive signalling
SAUT	1985	Automated system of brake control
CLUB	1994	Complex locomotive safety tool to control driver's actions
USTA	1996	Control of traction engines of locomotives
Diagnostic tools installed on a locomotive		
MSU-TP	1989	Control and regulation of operation modes of main and additional equipment of a locomotive
ASUB Locomotive	1998	Control of a locomotive and collection of data on locomotive state on exchangeable cassette
System FIRE	2003	Control of technical state of TRS in real time, analysis of information and development of recommendation on elimination of recommendation on-line
GID Ural	2008	Increase in the level of operational work (control of dislocation and state of locomotives; accounting and analysis of respect of the schedule, section speed, weight and length of cargo trains and their downtime at technical stations)
Locomotive complex KVARTs	2013	Designed for automated registration and recording on portable data carrier of actions of locomotive crew, made in driver's cab when performing technological processes, defined by the current normative documents and regulations in JSC Russian Railways, and when emergency situations occur with their subsequent automated analysis [13]
Smart locomotive	2016	Locomotive control and use of diagnostics tools, interaction with safety tools. It allows to perform repair according to actual state of the locomotive
Electronic passport of a locomotive	2018	Single storage place of all information about locomotives, testing results, diagnostics, flaw detection, failures and repair of equipment for all enterprises, carrying out manufacture, repair and operation of locomotives
Flaw detection in repair shops		
Types of non-destructive control	Since 1950-ies until nowadays	Vortex-current, magnet-sintered, ultrasonic methods etc.
Diagnostic tools in repair shops		
Testing stands, stations	Since 1970-ies until nowadays	Vibroacoustic method, rheostat tests
ACS Network schedule	2018	Monitoring of technical state of a locomotive

operation of TRS. To monitor the work of locomotive crews, safety devices and diagnostic tools installed on the locomotive are used. Studying the statistics of TRS failures, it can be argued that during operation of locomotives, there are violations of train operating modes, significantly affecting reliability level of the locomotive throughout its life cycle.

Reliability of locomotives laid down at the manufacturing stage is realized in specific operating conditions. The parameters of the locomotive's equipment are influenced by both climatic and geographical conditions, indicators of the operating modes of the locomotive crew, the state of power supply devices and the track facilities [10].

Violations of the operating modes of locomotives significantly affect locomotive's performance, lead to premature wear of components and equipment, the risk of failure, an increase in time spent for locomotives' repair, additional distraction of repair personnel to works which are normally not scheduled. All those factors lead to reduction in performance of a locomotive and to increase in expenses of the holding company of JSC Russian Railways [11].

Using the means of technical diagnostics solves the problems of:

• establishing the technical condition of the locomotive;

• location of failure in the locomotive;

• performance forecasting [12, pp. 350–355].

Diagnostic tools evolve with locomotives. Table 2 shows examples of evolution of each set of diagnostic tools.

In recent years, LLC LocoTech has carried out work to introduce new diagnostic and monitoring tools to control the condition of TRS; locomotive construction plants have participated in this work. Already at the stage of locomotive construction, new approaches to monitoring and controlling the locomotive are being introduced, which helps reduce labor costs for both drivers and repair personnel, improves the quality of work of all structures of the locomotive complex.

Brief conclusions

Construction of a chart of interaction of the groups of providers and consumers of the services of the internal environment at the example of locomotive complex of JSC Russian Railways has allowed to conduct the analysis of the revealed relationship and to make a conclusion that the model being implemented will allow to raise efficiency of the use of locomotives' fleet without extending the range of the models used. The operation of the model should be followed by grown performance of introduction and use of a set of diagnostic tools, ensuring thus high quality of transportation process, reduction of non-productive losses, and grown efficiency of interacting business units.

REFERENCES

1. Zenkevich, A. A. Secrets of customer focus: a guide to acquiring loyal customers [*Sekrety klientoorientirovannosti: rukovodstvo po priobreteniyu predannykh klientov*]. Moscow, 2013, 42 p.

2. Gorbunov, A. A. Experience in development policy of foreign railway transport communications for modern Russia [*Opyt politiki razvitiya zarubezhnykh zheleznodorozhnykh transportnykh kommunikatsii dlya sovremennoi Rossii*]. Moscow, MIIT, 2008, 160 p.

3. Ratcliffe, B. Economy and efficiency in transport and distribution. 2nd ed. London, Kogan Page, 1987, Vol. IV, 170 p.

4. Potekhina, A. M. Assessment of the impact of the internal environment of trailway organisations on the implementation of customer focused strategy [*Otsenka vliyaniya vnutrenney sredy zheleznodorozhnykh organizatsiy na realizatsiyu strategii klientoorientirovannosty*]. Ph.D. (Economics) thesis. IrGUPS, 2015, 168 p. [Electronic resource] http://www.stu.ru/science/theses_show.php?theses_id=27. Last accessed 18.06.2019.

5. Nefedyeva, E. V. Quality of services of a locomotive service depot [*Kachestvo uslug lokomotivnogo servisnogo depo*]. Science today: reality and prospects: materials of international scientific and practical conference, February 27, 2019. Vologda, LLC Marker, pp. 65–67.

6. Nefedyeva, E. V., Shaltina, O. A. Optimization of preventive system for repair of traction rolling stock [*Optimizatsiya plnovo-predupreditelnoi sistemy remonta tyagovogo podvizhnogo sostava*]. Collection of articles of the 6th International scientific and practical conference «Transport infrastructure of Siberian region» (September 30–October 03), 2015. Irkutsk, ISTU, Vol. 2, pp. 205–210.

7. Silicheva, G. V., Pyzhyanov, N. I. Improving the system of interaction between locomotive repair enterprises and traction directorate [*Sovershenstvovanie sistemy vzaimodeistviya lokomotivoremontnykh predpriyatii i direktsii tyagi*]. *Economics and entrepreneurship*, 2019, Iss. 1, pp. 1029–1032.

8. Order of the Government of the Russian Federation of September 30, 2018 No. 2101-r «Comprehensive plan for modernization and expansion of the main infrastructure for the period until 2024» [*Rasporyazhenie Pravitelstva Rossiiskoi Federatsii ot 30.09.2018 № 2101-r «Kompleksniy plan modernizatsii i rasshireniya magistralnoi infrastruktury na period do 2024 goda»*].

9. Mikhalchuk, N. L. Prospective tasks of organizing train traction at JSC Russian Railways [*Perspektivnie zadachi organizatsii tyagi poezdov v OAO «RZD»*]. *Prospects for development of locomotive service: proceedings of the third international scientific and practical conference*, 2018, Moscow, LLC LocoTech, pp. 22–32.

10. Ivasenko, A. A. Reorganization of track complex management system in the context of industry reform [*Reorganizatsiya sistemy upravleniya putevym kompleksom v usloviyakh reformirovaniya otrasli*]. *Economics and entrepreneurship*, 2016, Iss. 3–2, pp. 192–194.

11. Ivasenko, A. A. Corporate governance as a way to increase production efficiency [*Korporativnoe upravlenie kak sposob povysheniya effektivnosti proizvodstva*]. *Transport infrastructure of Siberian region: Proceedings of the seventh international scientific and practical conference*, 2014, Irkutsk, ISTU, Vol. 2, pp. 229–233.

12. Khromov, I. Yu., Barkunova, A. A., Nikishkina, E. A. Monitoring of locomotive operation modes [*Monitoring rezhimov ekspluatatsii lokomotivov*]. *Prospects for development of locomotive service: proceedings of the third international scientific and practical conference*, 2018, Moscow, LLC LokoTekh, pp. 350–355.

13. Decree of JSC Russian Railways dated December 26, 2013 No. 2897r «On approval of temporary instruction on the procedure for using the system of automated collection, storage and analysis of data from KVARTs hardware-software complex» [*Rasporyazhenie OAO «RZD» ot 26 dekabrya 2013 No. 2897r «Ob utverzhdenii vremennoi instruktsii o poryadke polzovaniya sistemoi avtomatizirovannogo sbora, khraneniya i analiza dannykh apparatno-programmnogo kompleksa KVARTs»*].

14. Lazareva, V. I., Grigorieva, N. N. Innovation as a tool to improve efficiency and competitiveness [*Innovatsii kak instrument povysheniya effektivnosti i konkurento-sposobnosti*]. *Transport infrastructure of Siberian region: Proceedings of the ninth international scientific and practical conference*, 2016, Irkutsk, ISTU, Vol. 2, pp. 89–92.

15. Nefedyeva, E. V., Ivasenko, A. A. The essence of the policy of customer focus of Russian Railways holding company in the field of cargo transportation [*Sushchnost' politiki klientoorientirovnnosti kholdinga «RZD» v oblasti gruzovykh perevozok*]. Science today: theoretical and practical aspects: Materials of international scientific and practical conference, Vologda, December 26, 2018. Vologda, LLC Marker, pp. 83–84.