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## DEVELOPMENT PROSPECTS OF A DIGITAL PLATFORM FOR KUYBYSHEV POWER SUPPLY CENTRAL OFFICE

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### *Abstract*

For the Russian Federation, rail transport has historically played an important strategic importance, being a link of a single economic system. Open Joint Stock Company “Russian Railways” contributes to the stable activity of the country’s industry, because millions of citizens prefer railway transport. At present, the program of innovative development of Russian Railways has been adopted for the period 2016–20, in which special attention is paid to the Digital Railway project. The goal of this project is to rationalize the use of modern digital technologies to ensure the sustainable competitive advantage of the company. There is a complete integration of intelligent communication technologies between the user, the vehicle, the traffic management system and the infrastructure, thus forming new, pass-through digital technologies for organizing the transportation process. Currently, an analysis of information technologies of the holding is being conducted, the result of which should identify bottlenecks in the automation of internal and external services. The elimination of all the identified deficiencies will allow Russian Railways to increase the efficiency of internal processes and ensure a high degree of customer focus. The development of the digital platform for the Kuybyshev Power Supply Central Office, proposed in this study, is aimed at implementing the digitalization process in the power industry of Russian Railways, which will attract new customers, improve and implement new services, optimize domestic costs and processes, ensuring the achievement of world-class standards.



**Keywords:** Digital platform, digital railway, power supply, counterparty, point of delivery centre.

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## 1. Introduction

Russian Railways is among the top three leaders of railway companies, as it carries out large volumes of traffic, has serious design and construction capacities, financial ratings, and a scientific and technical base. The company is characterized by significant experience in international cooperation, highly qualified specialists.

In Russia, there is a serious potential for the development of digital technologies in all areas of activity. The state program “Digital Economy” defines the process of digitalization in all areas, including infrastructure. Schneider Electric has opened 2 R & D centers in the Russian Federation - Innopolis (Tatarstan Republic) and Skolkovo, where they are developing software for the power industry.

The issue of development of the electric grid economy is quite acute - 261.9 billion rubles were spent on the industry in 2017, for 2019-2024 it is planned to spend 1.3 trillion rubles. It is planned to build thousands of power lines, thousands of megawatts of transformer capacity. According to Roscongress Foundation Deputy Chairman of the Government of the Russian Federation - “Transneft” will spend 1.1 trillion rubles on oil pipelines in 2018-2022, Gazprom - 5.7 trillion rubles, Russian Railways - 3.8 trillion rubles. And the main task is to increase the effectiveness of these costs, and it is important that these companies act in concert.

The functioning of all the facilities of JSC Russian Railways is currently impossible without providing them with electric power. All the processes necessary for the implementation of the main types of activities require uninterrupted and high-quality power supply. The electric power required for power supply to enterprises of JSC Russian Railways is centrally acquired from regional guaranteeing suppliers and energy sales organizations by the specialized branch of JSC Russian Railways - Transenergo. Within the boundaries of the Kuybyshev Railroad, the centralized purchasing, volume determination and settlement of electricity payments are performed by the Kuybyshev Power Supply Central Office - a structural unit of Transenergo - a branch of Russian Railways (hereinafter - the Central Office) (Efimov & Efimov, 2014).

When creating a digital platform of Kuybyshev Power Supply Central Office, the contract work department was chosen as the object of informatization. It deals with work on concluding and renegotiating contracts for the provision of power transmission services, energy supply, power sales and purchase, and preparing agreements concerning the organization of the accounting of electric power (Efimov & Efimov, 2014).

## 2. Problem Statement

Contract department engineers are dealing with conclusion and renegotiation of contracts for the provision of services for the transmission of electricity, power supply and purchase and sale of electric power. Their work consists of the following steps:

1. Development of draft contracts.

2. Consideration of protocols of disagreements under the terms of the agreement together with other departments of the Central Office. At this stage, the incoming contracts and protocols of disagreements to them, the formulation of the position of the Central Office, and its legal justification, as well as sending of

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the protocol of disagreements or the protocol of reconciliation of disagreements to the counterparty are considered.

3. Preparation, in conjunction with the linear departments of the Central Office, of Applications for the concluded contracts relating to the contractual values of electric power and the organization of electricity metering.

The last stage is the most time-consuming process, since applications can include more than one and a half thousand points of power supply, and they contain a lot of operational information. Up to 10 days with the participation of 2-6 people can be spent on preparing a new application or verifying an incoming application. Registration is done using MS Word and MS Excel.

To prepare the next application, the contractual work department instructs the linear departments to check the relevance of the data or to provide data on points of supply and (or) groups of points of power supply, as well as to define an algorithm determining electric supply volumes by specified points of supply.

Checking the relevance of existing data and collecting data on points of supply and (or) groups of points of electric supply is carried out by the linear department engineer from the following sources:

- Acts of the boundaries of the balance sheet attribution of the power supply network, containing data on the name of the point of the power center, the name of the point of delivery, the boundary of the balance and operational responsibility of the parties, the voltage level, the values of connected and maximum power (if any), the name of the grid organization, the name of the consumer, the name of the site of the consumer;
- Acts of technological connection containing data on the name of the point of delivery, the values of connected and maximum power by the point of delivery, the category of reliability of power supply, the name of the consumer, the name of the site of the consumer;
- Acts of putting metering devices into operation (or acts of sealing metering devices) containing data on the metering device at the point of delivery: the balance of the metering device, the installation site of the metering device, the type of the metering device, the number of the metering device, the year mark of the metering device, the month and year of regular calibration, current and voltage transformer ratings, as well as the estimated coefficient;
- Orders of the executive authorities of the constituent entities of the Russian Federation in the field of state regulation of tariffs, containing data on the names of power suppliers;
- An automated information and measuring system for the commercial accounting of electric power of the retail market of Russian Railways, containing data on the balance sheet of the metering device, the installation site, the type of the metering device, the number of the metering device for each point of electric supply included in this system.

To determine the sales markup, the line department engineer needs to sum up the maximum power of all points of delivery belonging to the same power center. This procedure is performed using MS Excel or manually.

Preliminary identification of metering devices with an overdue state calibration due to their large number is not possible. Accounting devices with an overdue period of state verification are detected only during targeted scheduled and unscheduled inspections.

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Comparing each time the data from the indicated sources, the linear department engineer updates the information on each point of electric supply. Data verification can be repeated many times depending on requests from the contract department, which leads to repeated identical actions by the linear department engineer.

The results of the work of the linear department engineer are made out by the contract department engineer as an annex to the contract. The form of appendices to the contract is not permanent and depends on the type of the contract being concluded.

With a large volume of documents processed, control over data supplied to linear departments by points of delivery on the part of the contract work department is not possible.

In order to have fast and organized work on registration of contracts, a digital platform is being created, which also allows checking data on electricity metering devices, generating reports on calibration of electricity metering devices, on the balance of capacities. The platform will allow controlling the work of linear department engineers, provide storage of primary documents.

## 3. Research Questions

Among the priority areas for the development of digital energy are:

1. Introduce “smart” measuring instruments (for example, meters with remote control, designed to meet all information security requirements, etc.).

2. Install advanced automated information-measuring systems operating in real time at the facilities. Such systems should track the processes occurring, carry out simple automatic regulation algorithms, and have developed means of information exchange with the outside world.

3. Create a wide network of integrated communications based on a variety of communication lines. All installed AIIS must be connected to at least two independent communication channels.

4. Introduce automated grid management systems of production operation in the companies involved in power grid activities related to the maintenance and repair management, commercial dispatching, customer service, and the main production management.

5. Develop integrated interfaces to AIIS and ASD AS for automatic data exchange with customers and partners with strict adherence to exchange protocols and information security standards for all categories of market participants.

Smart Grid (“smart grids of power supply”) are modernized grids that use information and communication networks and technologies to collect information about power production and power consumption, which automatically increase efficiency, reliability, economic benefits, and sustainability of production and distribution of electricity (Bogachev et al., 2012).

Smart Grid technology solutions can be divided into five key areas:

- Measuring devices and other devices (smart-meters, smart-sensors);
- Improved management practices;
- Improved technologies and components of the power network (flexible AC power transmission systems FACTS, superconducting cables, semiconductor, power electronics, drives);
- Integrated interfaces and decision support methods (Arduino, 2016), demand control technologies for electricity, distributed monitoring and control systems, distributed generation

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control systems, automated systems for measuring the processes, as well as new planning and design methods for both development and operation power system and its elements (Goaul, Cook, Kim, Montreuil, & Lafrance, 2016);

- Integrated communication tools.

The analysis of foreign sources suggests that the development of "smart" technologies in the power industry pursues the following goals:

1. For energy companies - reducing energy losses, ensuring timeliness and completeness of payment for consumed power, managing the unevenness of the power load graph, improving asset management, integrating renewable generation and distributed generation into the power grid, reliability of operation, visualization of power infrastructure facilities.

2. For consumers - improving access to power infrastructure, improving the reliability of power supply, the quality of power resources, creating a modern interface for interaction of power consumers with its suppliers, expanded opportunities for consumers to manage power consumption and reduce payments for consumed power resources.

3. For the government and regulators of the power industry - increasing the level of satisfaction of power consumers with the quality and cost of power supply, ensuring the sustainable economic situation at enterprises in the industry, ensuring modernization of fixed assets of the power industry without a significant increase in tariffs.

Kupriyanovskiy, Sukonnikov, Bubnov, Sinyagov, & Namiot (2016) studied the foreign experience of digitization of railways in detail - modern techniques (BIM) are considered in relation to various areas of the corporation's activities - traffic safety, logistics, etc. Key projects and directions for the development of transport digitalization are outlined in the works of Yartsev, Kupriyanovsky, Utkin, & Namiot, (2016), Shneps-Shneppe, Fedorova, Sukonnikov, & Kupriyanovsky (2017), Nikolaev et al. (2016) and Makovsek, Benezech, & Perkins (2015) set out their vision for the development of digital transport technologies in Paris at the transport forum.

## 4. Purpose of the Study

The purpose of the study is to develop a digital platform for the Kuybyshev Power Supply Central Office, which is aimed at ensuring the sustainable competitive advantage of Russian Railways through the use of digital technologies, reducing the influence of the human factor on the state of railway facilities, reducing paper workflow.

## 5. Research Methods

For the development of the digital platform, the duties of the Central Office, involved in the signing of contracts and related applications, workflow, business processes and technological features of the involved equipment were studied in detail. The proposals of domestic and foreign scientists were studied in detail, in particular, the opinion of D. G. Zamolodchiko regarding the need to create a comfortable environment and resource saving in the life cycle of digital railways assets (Zamolodchiko et al., 2017). The design was carried out by means of building UML diagrams: classes, cases, sequence of

actions, activity, states. The advantages and disadvantages of the existing software were studied, as a result, the MySQL DBMS was used to create the platform database, and the C # programming language was used to create the application.

## 6. Findings

The developed digital platform will allow the engineer to use the main menu "Power Center Points", which allows creating and editing data on the power center point, points of delivery, generating applications and reports, making changes and viewing directories, finding the necessary data. The main menu allows you to create new power center points, edit them or delete them, the corresponding form also implements the error hint function. Similarly, the creation and modification of data on points of delivery is done. Reference books are available: Voltage Level, Sales Leverage Group, Consumer Category, Counterparties (Efimov & Efimov, 2014).

Reports are generated by selecting the required view from the appropriate menu. It is possible to filter all available points of power centers by names, counterparties of a supplier and a network organization, a constituent entity of the Russian Federation. Then it is possible to select the necessary information, which is transmitted to MS EXCEL for further processing and forming applications to contracts. Similarly, the formation of reports on the points of delivery, on the verification of metering devices and the balance of power is done.

For the formation of an application to the contract in each case, you need your own set of data. The engineer determines a set of data needed to transfer Microsoft EXCEL for further processing. After transfer to MS EXCEL, the data on the name of the annex to the contract and other corrections are entered.

## 7. Conclusion

The developed digital platform will allow automating the work on the design of applications to power supply contracts, the sale and purchase of electric power and the provision of services for the transmission of electric power by introducing a new production technology for contract work, which ultimately will optimize the time and labor resources for preparing applications.

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