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**Mastering and development of industrial production of rolling stock in Ukraine  
(1991–2022)**

***Abstract.** The article attempts to investigate the historical circumstances of the mastering and development of the industrial production of rolling stock in Ukraine from 1991 to 2021. The aim of the article is to carry out a retrospective analysis of events and a historical and technical summary of the main measures, problems, and consequences of the development of industrial production of rolling stock in Ukraine from 1991 to 2021 on the basis of a comprehensive analysis of sources and scientific literature. In the course of the scientific development of the proposed research, materials from mass-circulation newspapers, industry publications of railway transport, as well as technical studies of employees of manufacturing plants were used. It has been determined that during 1991–2008, the engineering and design team of HC «Luhanskteplovoz», having a strong scientific and production potential, by order of the State Administration of Railway Transport – Ukrzaliznytsia – for the purpose of import substitution, designed and mastered the industrial production of innovative models of rolling stock for social purposes, namely diesel trains DEL-01 and DEL-02, as well as electric trains EPL2T and EPL9T to meet the needs of Ukrainian railways with high-tech equipment. It has been found that with the beginning of the economic and financial crisis of 2008 and a significant reduction in Ukrzaliznytsia's orders, the production of rolling stock at the facilities of HC “Luhanskteplovoz” was actually stopped, and the enterprise, privatized by a Russian investor, focused mainly on the production of locomotives. Instead, since 2012, the production of rolling stock on its own design platform has been mastered as part of the diversification of PJSC “Kriukiv Railway Car Building Works”. In the end, the historical experience of the formation*



*and development of the Ukrainian research and production base of railway engineering needs to be properly understood in the context of a retrospective analysis of the industry's production activities to clarify the reasons for its inefficient development, as well as the determination of conceptual ways of harmonizing the domestic design and technological potential with the actual needs for updating the fleet of traction rolling stock of global transport operators. Further research into the history of the development of railway mechanical engineering in Ukraine requires clarification of the historical circumstances of the institutionalization of design bureaus of individual enterprises in the direction of scientific research activities.*

**Keywords:** *rolling stock; Luhansk (Voroshilovgrad) Diesel Locomotive Plant; Kriukiv Railway Car Building Works; railway engineering; Ukrainian railways; State holding company "Luhanskteplovoz"*

### **Introduction.**

Today, the situation with suburban transport in Ukraine has reached a critical state. According to the technical documentation, despite the overhaul and extension of the service life, the wear and tear of the suburban electric train fleet of JSC "Ukrzaliznytsia" amount to more than 87.5%, and diesel trains – 97.2%. In particular, on the railways of Ukraine, electrified with direct current, the electric trains of the Riga Wagon Building Plant of models EP1 and EP2, which have reached a 60-year period of intensive operation, and, accordingly, have exhausted all possible laid resources, are in operation. During the times of the USSR, specialized Ukrainian enterprises produced only freight cars and main-line diesel locomotives. In the absence of convertible currency for the purchase of a sufficient amount of equipment abroad, the management of Ukrzaliznytsia decided to combine imports with the organization of the production of rolling stock at existing capacities and to make an attempt to solve the problem on the basis of domestic enterprises of railway engineering (Moskalenko & Mukminova, 1996, p. 94).

### **Relevance of the topic.**

The analysis of the history of the formation of the production activity of Ukrainian transport engineering enterprises is updated in the context of clarifying the causes of the systemic crisis of the industry in the early 2000s, searching for ways out of it for basic historical enterprises, determination of conceptual ways of harmonizing their design and technological potential with actual needs for updating the fleet of traction rolling stock of transport operators, based on the accumulated experience and the traditionally significant export potential of the industry.

### **Research and publication analysis.**

For a long time, the prerequisites for the formation and the circumstances of the development of the industrial production of rolling stock in independent Ukraine did not find comprehensive coverage in the national historiography. The works by

A. Shternov (Shternov, 1967), G. Zhdanov (Zhdanov, 1981), V. Shcherbakov (Shcherbakov, 1998), V. Rybinets (Rybinets, 1996), Yu. Tsygankov-Serebryakov (Tsygankov-Serebryakov, 2006), G. Kudiyarova (Kudiyarova, 2019), and others are devoted to the study of production activities of domestic railway engineering enterprises. A retrospective analysis of the technical characteristics of domestic railway equipment, forecasting its design and technological development is presented in the works of V. Rakov (Rakov, 1990), G. Basov, S. Yatsko (Basov, 2000, 2001, 2004; Basov & Yatsko, 2005), O. Buyanov (Buyanov, 2005), E. Abramov (Abramov, 2015a), as well as a number of investigations by authors (Ruban, 2020a; Ruban, 2020b; Ruban & Fomin, 2020; Ruban & Ponomarenko, 2021). However, these studies have been focused mainly on the Soviet period of the history of enterprises, do not show the completeness of the outlined topic, and require the introduction of additional new sources into scientific circulation. The analysis of the history of the production activity of the transport engineering enterprises of Ukraine acquires its relevance against the background of the general reform of the domestic industry, the prospects of innovative post-war development, the need to renew the traction rolling stock, taking into account the historical experience of solving the specified issue.

The source base of the research has been made up of the legal acts of the Verkhovna Rada of Ukraine, the Cabinet of Ministers of Ukraine and branch Ministries, as well as the branch publications “Magistral”, “Ukrainian Technical Gazette”, “Economic News”, “October Horn” and “Vagonobudivnyk”.

Therefore, the subject of the study is the organization of the production of rolling stock at the industrial facilities of domestic enterprises during the years of independence. The chronological boundaries cover the period from the declaration of Ukraine's independence in 1991 to the beginning of Russia's open large-scale military aggression in February 2022, which is divided into three main stages: 1) the production monopoly of HC “Luhanskteplovoz” (1991–2008); 2) diversification of production of PJSC “Kriukiv Railway Car Building Works” (2008–2022); 3) focus on European manufacturers (since 2022).

The purpose of the article is to carry out a retrospective analysis of events and a historical and technical overview of the main measures, problems, and consequences of the development of the industrial production of rolling stock in Ukraine in 1991–2022 (at the facilities of HC “Luhanskteplovoz” and PJSC “Kriukiv Railway Car Building Works” – hereafter PJSC “KRCBW”), on the basis of a comprehensive analysis of sources and scientific literature, which involves solving the following research tasks: first, to find out the technical condition of the rolling stock of Ukrzaliznytsia in the 1990s; secondly, consider the prerequisites for construction and technical features of the MU produced by HC “Luhanskteplovoz”; thirdly, to determine the circumstances and reasons for the formation of the current monopoly position of PJSC “KRCBW” in the field of rolling stock production in Ukraine.

### **Research methods.**

When writing the article, general scientific methods and principles of historical research have been used. The work is based on the principles of historicism, objectivity, continuity, multifactoriality, complexity, and pluralism. Historical-comparative, prosopographic, and problem-chronological methods (Fullerton, 2011) have been used in the study, which provided an opportunity to carry out a detailed analysis of the prerequisites, historical circumstances and development of the production of rolling stock in Ukraine in 1991–2022.

### **Results and discussion.**

In the early 1990s, one of the main problems of the development of the logistical and technical base of rail transport in the CIS countries was the need to renew the rolling stock fleet. Until 1991, the only producer of rolling stock in the USSR was the Riga Wagon Building Plant (Latvia), some diesel trains were supplied by the countries of the socialist camp. In these conditions, already in the early 1990s, given the lack of convertible currency for the export of railway equipment, the search for ways to create own production of the specified products began.

The Russian government decided to urgently deploy the capacity for the production of electric commuter trains on the basis of the Demikhov Machine-Building Plant, the possibility of repurposing into the construction of additional trailer cars for electric trains was considered since the early 1980s. In parallel with this, the production of electric trains was started at the capacity of the Torzhosk Car Building Plant (Abramov, 2015b, p. 344, 349, 350). In the fall of 1993, the first electric trains of both manufacturers were sent for testing to the experimental range of the Ministry of Communications of the Russian Federation, and the following year, the development of an electric train of its own design at the Novocherkassk Electric Locomotive Plant, as well as a diesel train of the Lyudinovsky Locomotive Plant, was started (Shcherbakov, 1998, p. 240; Abramov, 2015b, p. 248, 391).

In Ukraine, based on the mentioned circumstances, a scientific and technical cooperation section (STCS) was created at the State Administration of Railway Transport – Ukrzaliznytsia to coordinate the activities of manufacturers, scientific organizations, and railways, which included representatives of 6 railways of Ukraine, specialized departments of Ukrzaliznytsia, and factories – manufacturers of rolling stock and railway systems. The functions of STCS in the field of locomotive management were: development, testing, commissioning of traction rolling stock (TRS), modernization of existing TRS, changing the technology and rules of its operation, development of safety equipment systems on railways, etc. The first organizational meeting of STCS was held in Luhansk on August 19, 1992, during which the priority dates for the design and serial production stages of new equipment were agreed upon (Krayevoy, August 26, 1992; Lozovoy, August 26, 1992). In the conditions of the economic crisis of the 1990s and, accordingly, the decrease in demand for mainline diesel locomotives, the Central Design Bureau of Voroshilovgradteplovoz



was given the task of expanding the range of products in order to move away from single-purpose production with the maximum use of the available production capacities of the enterprise (Buyanov, 2005, p. 244).

Since the mid-1950s, the Luhansk Diesel Locomotive Plant not only specialized in the industrial production of mainline and shunting diesel locomotives with various types of transmission but also had successful experience in the development of gas turbo locomotives, conveyors for the transportation of oversized cargo with a carrying capacity of 160–320 tons (Shternov, 1967, pp. 113–117, 120). From 1976 to 1995, the Luhansk Diesel Locomotive Plant was called Voroshilovgradteplovoyz Production Association (in separate documents – PA “Luhanskteplovoyz”) (Zhdanov, 1981, p. 183, Rybinets, 1996, p. 340). The enormous experience of the staff of the Luhansk plant in the design and construction of experimental locomotives, as well as their research in experimental operational conditions, made an invaluable contribution to the world science of transport engineering. By the mid-1980s, PA “Voroshilovgradteplovoyz” produced 95% of main diesel locomotives in the USSR with a monthly schedule of 115–120 sections, and products were exported to the GDR, Bulgaria, Hungary, Czechoslovakia, Poland, the DPRK, Cuba, Syria, and Iraq (Zhdanov, 1981, p. 157; Tsygankov-Serebryakov, 2006, p. 323). The enterprise was of exceptional social importance, providing work for tens of thousands of Luhansk residents and supporting the social infrastructure of the city.

In July 1992, the Ministry of Machine-Building, Military-Industrial Complex and Conversion approved the “Railway Transport Development Program of Ukraine”, designed until 1998. During this time, PA “Voroshilovgradteplovoyz” was supposed to establish the production of 7 new types of rail cars, in particular electric and diesel trains, and at the enterprise itself, it was planned to create a testing ground for experimental rolling stock (Rybinets, 1996, p. 340). During the period from 1990 to 1999, the fleet of diesel trains in Ukrzaliznytsia drastically decreased – from 287 to 94 units, and electric trains – from 1512 to 1472 units (taking into account the almost complete development of the operational resource of this technique) (Fediushyn, 2001, pp. 7–8).

In 1992, the Central Design Bureau of PA “Voroshilovgradteplovoyz” began working on the drawings of the future diesel train, and already at the end of December 1993, at a meeting of the Technical and Economic Council of Ukrzaliznytsia in Luhansk, its preliminary project was discussed (Buyanov, 2005, p. 244). In accordance with the world practice of rolling stock development, an experimental diesel train with the electric transmission of alternating current and the use of asynchronous traction motors was developed, the release of which was planned to be established within 2 years (Moskalenko & Mukminova, 1996, p. 45).

On June 4, 1994, the Cabinet of Ministers of Ukraine adopted Resolution № 364 “On the organization of the production of diesel and electric train cars”, according to which the Ministry of Machine-Building, Military-Industrial Complex and Conversion was entrusted with the functions of coordinating work on the development of structures

of electric train cars, components for them, the creation of production facilities and the organization of their production, and PA “Voroshilovgradteplovoy” was determined as the main enterprise-manufacturer of final products. In 1995, the amount of funding for research on the development of a diesel train amounted to 20 000 000 000 UAK (over 1 100 000 USD), preparation for production – 22 000 000 000 UAK (over 1 200 000 USD) in the prices of January 1, 1994, the number of capital investments for the creation of production facilities was also determined, which, however, given the economic situation at that time, was subject to annual indexation. According to the plan, 400 direct current electric train cars and 280 alternating current electric train cars were to be manufactured by 1998 inclusive. The total amount of funding for research and design works, as well as capital investments for the renewal of the Association’s production facilities, amounted to 1 482 400 000 000 UAK (over 84 708 000 USD) in 1994 prices (The Cabinet of Ministers of Ukraine (June 4, 1994) Resolution № 364 “On the Organization of the Production of Diesel and Electric Train Cars”)<sup>1</sup>.

### **Luhansk Diesel Locomotive Plant in the conditions of market transformation of the economy of Ukraine.**

As a result of the gradual disintegration of the single economic complex of PA “Voroshilovgradteplovoy” into a number of independent enterprises, which led to the loss of controllability, unjustified diversification, and additional production costs, the prerequisites for deepening its crisis state were laid (Tsygankov-Serebryakov, 2006, pp. 265–266). On May 19, 1995, the State Holding Company “Luhanskteplovoy” was created on the basis of PA “Voroshilovgradteplovoy” by the decree of the President of Ukraine. On October 3, 1995, its state registration was carried out. On October 29, by order of the State Property Fund+ of Ukraine № 23 JSC “Voroshilovgradteplovoy” was transformed into the State Holding Company “Luhanskteplovoy”. At the proposal of the company's management, the State Property Fund decided to create a number of subsidiaries within it (Tsygankov-Serebryakov, 2006, p. 236).

In October 1996, the State Commission for Securities and the Stock Market registered information on the issue of the Company's shares. The State Property Fund of Ukraine has put up 24.9% of the Company's shares for a concessional sale, with all structural divisions of the Company and subsidiaries. At that time, the main problem, in addition to the decline in production, was excessively high costs for non-core assets of the social sphere. In particular, in 1996, not only the entire balance sheet profit of the Company was spent on their maintenance, but also partly the funds of product development and material incentive funds (Tsygankov-Serebryakov, 2006, p. 242, 245, 246).

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<sup>1</sup> It should be noted that in 1994 alone, the inflation rate was more than 400%, and in general, by 1998, it is possible to state a complete depreciation of the funds laid down by this Resolution.

As of 1995, more than 40% of diesel trains were subject to decommissioning. On May 13, 1994, by Resolution № 308 of the Cabinet of Ministers of Ukraine “On State Support of Railway Transport in 1994” the state budget provided for the allocation of 1 000 000 000 000 UAK (over 57 000 000 USD) o Ukrzaliznytsia in the second half of 1994 for the acquisition and development of the production of rolling stock. As of 1995, more than 40% of diesel trains in Ukraine were subject to decommissioning, and during 1994–1995, in order to urgently replenish the fleet of rolling stock Ukrzaliznytsia purchased 1 DR1A diesel train, 6 ER2T electric trains and 5 ER9T electric trains from Latvia on a barter basis. However, already in 1996, suburban rolling stock was determined to be the last in priority in the sequence of payment of Ukrzaliznytsia payments (Moskalenko & Mukminova, 1996, p. 66, 94).

The development of a new range of products, in particular rolling stock, required the modernization of the existing production sites of HC “Luhanskteplovoz”. In particular, the production of special test stands for complex testing of pneumatic and electric systems. Mastering the production of electric trains required the construction of a test electrified section with a direct and alternating current contact network, as well as a traction substation. In order to ensure the production of rolling stock in the volumes expected for the needs of Ukrzaliznytsia, there was a need for capital investments of 10 000 000 UAH (over 5 600 000 USD). Ukrzaliznytsia was ready to allocate funds for new equipment in the form of a commodity loan with subsequent payment in the form of product supply for a period of 3 years. At the same time, the situation of HC “Luhanskteplovoz” was greatly complicated by the insufficient work of the company's economic management, since a number of contracts were executed with serious losses, as a result of which the company's financial condition became critical (Tsygankov-Serebryakov, 2006, p. 266).

In 1998, the first tender for the sale of shares in HC “Luhanskteplovoz” was announced. Resolution № 769 of the Cabinet of Ministers of Ukraine dated June 2, 1998, approved the State scientific and technical program “Development of rail rolling stock of social purpose for railway transport and urban economy” for 1997–2002. The production of the products envisaged by the program was supposed to save foreign exchange funds in the amount of 890 000 000 USD and create about 60,000 jobs with a payback period of 2.4 to 5.1 years for various types of products. As of 1999, the company's export volume increased 2.1 times and reached a share of 41.2% in the total production volume. Expenses decreased to 12 700 000 UAH (over 7 000 000 USD). However, the main cause of losses was not resolved – the costs of maintaining the state housing fund, the main assets of which were not included in the company's statutory fund, but were on its balance sheet. Thus, in 1998, 8 600 000 UAH were spent on its maintenance, including 6 600 000 UAH at the expense of balance sheet profit. The Company's subsidiaries had negative profitability (Tsygankov-Serebryakov, 2006, p. 240, 274).

In 2000, the first competition for the sale of 76% of the shares of HC “Luhanskteplovoz”, took place, in which the only participant and winner was

CJSC “AvtoKraz”. This fact was negatively perceived by the management of HC “Luhanskteplovoyz”, which was supported by the local authorities of the region, and even by the Ministry of Transport of Ukraine at that time. The Company's management demanded a new open tender, giving preference to Russian investors. In the end, the results of the competition were canceled by the State Property Fund, and a number of attempts to sell a controlling stake in HC “Luhanskteplovoyz” to a Ukrainian investor were unsuccessful (Tsygankov-Serebryakov, 2006, p. 314, 338). Only on July 19, 2006, the State Property Fund of Ukraine again allowed the sale of a controlling stake of HC “Luhanskteplovoyz”, and on March 23, 2007, it was sold to the Russian company “Transmashholding” for 58 000 000 USD (Pavlyuk, June 22, 2010).

### **Circumstances of creation and technical characteristics of rolling stock manufactured by HC “Luhanskteplovoyz”.**

It was decided to time the release of the first DEL-01 diesel train with AC electric transmission and asynchronous traction motors presented in figure 1, consisting of 2 motor main and 2 trailer cars, to the 100th anniversary of the Luhansk plant in 1996 (Tsygankov-Serebryakov, 2006, p. 237).



**Figure 1.** DEL-01 diesel train on the territory of HC “Luhanskteplovoyz”, 1996. (Moskalenko & Mukminova, 1996).

During the preparation of the assembly of the diesel train, the team of HC “Luhanskteplovoyz” developed, manufactured, and implemented specialized equipment to ensure the temperature regimes of the technological process of painting, a new technology of cold oxidation in solutions that did not contain harmful substances was introduced, the process of processing wooden parts with a new flame retardant was introduced in the test and approval workshop, the production of original plastic and rubber products was mastered. Working drawings were also developed for an installation for automatic welding of the sidewalls of diesel train bogies, an installation for automatic arc spot welding along the perimeter of the frame decking sheets, and



automatic welding of the body roof (Tsygankov-Serebryakov, 2006, p. 240). On March 4, 1996, the coordination headquarters was established and the assembly of the main car of the diesel train began. The first section of the main carriage was to be assembled in March, and the second in April. However, this process was carried out in difficult conditions due to the absence of many nodes. As a result of late payment, the orders of the involved organizations of private ownership, created at the Company's production sites, were not provided (Torop, March 18, 1996). Nevertheless, in July 1996, the workers managed to conduct bench tests of nodes and complete the assembly of the diesel train, and already on August 3–4, 1996, the experimental model of the DEL-01-001 diesel train was presented at the exhibition “Railway Transport of Ukraine – 96” (Tsygankov-Serebryakov, 2006, p. 242).

The DEL-01 diesel train was designed for commuter transportation of passengers in regions with a temperate climate. The main component of a diesel train was 4 wagons (2 motor, 2 trailer). The control scheme provided the possibility of operating two articulated diesel trains from one control post. The transmission was electric, with asynchronous traction electric motors and frequency converters. The brake was electric, electro-pneumatic, and manual. The carriage of the motor car was non-pedestal with an individual drive of pairs of wheels. The suspension of the traction motor and traction reducer was support-frame. The torque was transmitted to the wheels through a hollow shaft and a rubber coupling. The two-stage spring suspension provided high smoothness of movement. The cars of the diesel train were equipped with the SA-3 auto clutch. The motor car had two, and the trailer had three external sliding doors on both sides. Passenger capacity – 416 people, including 72 in the motor car, and 136 in the trailer (Basov, 2004, pp. 108–110). For installation on the future diesel train by the Kharkiv Design Bureau of Engine Construction of the Plant named after V. Malyshev, on the basis of the six-cylinder tank engine, 6TD-1 of his own development in the mid-1970s, a 588DA diesel generator set with a capacity of 540 kW was created, which successfully passed factory and acceptance tests until 1996 (Budenny, 2001, p. 313, 364).

In the summer of 1996, the specialists of HC “Luhanskteplovoz” completed the development and began the production of an experimental batch of self-developed trailer cars in the amount of 8 units. On November 28, 1996, the running-in of the trailer car of the diesel train began on the Luhansk-Starobilsk section (Tsygankov-Serebryakov, 2006, p. 242). The frame elements of the cars were made of structural carbon or low-alloy steel; the cladding of the side walls, roof, and frame flooring were made of stainless steel. There were closed cylinder-type transition platforms between the cars, which ensured the safe passage of passengers from one car to another. The layout of the body is partially borrowed from Soviet electric trains: the main car had 2 on each side, and the intermediate car had 3 external sliding doors (Basov, 2004, pp. 177–192).

At the beginning of 1997, a training was conducted for chief specialists, heads of shops and services to implement the ISO 9000 international product quality assurance

standard. At the same time, the first launch was carried out and preparations for the tests of the DEL01-001 diesel train began (managers Yu. Kuzmenko, G. Glazunov, leading experts G. Pupinin, V. Myasnikov, G. Tikin). The general management of the activities was carried out by the head of the test center, deputy chief designer S. Hryshchenko (Tsygankov-Serebryakov, 2006, p. 244). On July 22–23, 1997, a meeting of the reception interdepartmental commission was held on the issue of diesel train tests. The commission reviewed the technical documentation and inspected the trailer wagons as part of suburban trains with a trial trip on the Luhansk-Northern – Transitna route. In some sections, the train reached a speed of 120 km/h. The commission approved the compliance of the wagons with the conditions for delivery and the possibility of operational tests on railways with passengers. At the same time, measures were outlined to improve the quality of wagons from the perspective of their serial production.

In the end, only at the end of 1998, with the participation of workers, designers, and chief specialists of the involved enterprises, in particular, NPO “Elektrotyazmash” (Kharkiv), NPO “Peretvoriuvach” (Zaporizhia) positive results were obtained from the settings and tests of the electric transmission on the first main section of the DEL-01 diesel train: it was possible to debug the system of work on two converters of traction asynchronous motors, there were prospects that in 1999 the DEL-01 diesel train would be able to start running tests. On July 29–31, 1999, the DEL-01 Luhansk diesel train was presented at the second International Exhibition “Railway Partners on the 1520 mm Track” (Kyiv) (Tsygankov-Serebryakov, 2006, p. 246, 257, 267). On September 5, 2000, HC “Luhanskteplovoz” was visited by the general director of Ukrzaliznytsia H. Kirpa on business, during which it was agreed to complete the testing of the prototype diesel train DEL-01 by November 1, 2000, and hand it over for operational tests to the Donetsk Railway (Tsygankov-Serebryakov, 2006, p. 279).

On October 24, 2000, HC “Luhanskteplovoz” presented the first Ukrainian-made eight-car direct current electric train EPL2T-001 presented in figure 2, which arrived at the Yasinuvata depot (Tsygankov-Serebryakov, 2006, p. 296). The electric train with a capacity of 960 kW is designed for the transportation of passengers on electrified sections of railways with a nominal voltage in the contact network of 3000 V direct current. And already on August 1, 2001, an eight-car suburban electric train of alternating current EPL9T was built at the enterprise. During the development of electric trains, the specialists of HC “Luhanskteplovoz” took as prototypes the electric trains of the Riga Wagon Building Plant EP2T and EP9T. The main difference between the Luhansk electric trains and similar models produced in Latvia and Russia was the increased length of the car to 25 m, as well as the division of the car into 2 cabins with entry and exit through vestibules (Basov, 2005, p. 123).

Electric trains EPL2T and EPL9T were designed for passenger transportation in regions with a temperate climate, in suburban traffic on electrified sections of railways (with a nominal voltage in the contact network of 3 kV direct current and 25 kV alternating current). The design speed was 130 km/h. The main component of electric

trains was 8 cars: 2 main, 4 motor, and 2 trailer. The length along the clutch axes was  $8 \times 25.275$  mm. The number of seats: in the main carriage – 118, in the motor carriage – 118, and in the trailer carriage – 130. The voltage in the onboard network was 220 V (Basov, 2005, p. 123). During the construction of prototypes of electric trains, trolleys manufactured by the Russian company BAT “Zavod Transmash” (Tikhvin), were used, instead, as the production of electric motors was mastered by NPO “Elektrotyazmash” (Kharkiv), motor trolleys manufactured by HC “Luhanskteplovoz” (Basov, 2001, p. 61).



**Figure 2.** Electric train EPL9T-001. June 18, 2002 (Tsygankov-Serebryakov, 2006).

The carriage of the motor car is two-axle with double spring suspension: axel-box non-pedestal with friction vibration dampers and central cradle suspension with hydraulic vibration dampers. The traction drive had a combined suspension, the traction engine – support-frame, and the gearbox – support-axle. The supporting carriage of the main and trailing wagons was two-axle, non-pedestal with two-stage spring suspension. The body suspension was a spring-type “Flexi Coil”. The two-stage spring suspension ensured a smooth ride and passengers’ comfort. Electric train was equipped with electric, electric pneumatic, pneumatic, and manual brakes, as well as an automatic fire alarm system, an aerosol fire extinguishing system, and an on-board computer that could quickly notify the driver of a passenger stuck in the door and possible technical malfunctions (Basov, 2005, p. 134; Dumkevich, November 2, 2010).

For the first time, the idea of creating locomotive-haul diesel trains by using trailer cars of dismantled diesel trains of the DR1 series and sections of two-section diesel locomotives 2M62 in order to save money arose in the mid-1990s. Since the power of the two-section freight locomotive was redundant, instead of one of the sections, a modified main car of the DR1 diesel train was used with a control cabin and a passenger cabin in place of the engine compartment. In 1998, the Demikhovo Machine-Building

Plant (Russia) created DDB1 diesel trains, for which, according to a similar scheme, modernized sections of 2M62U diesel locomotives and trailer cars of its own production were used (Demikhovo Machinebuilding Plant. (2006). Diesel train DDB1 (DPSAA3)). At the same time, HC “Luhanskteplovoz” developed own suburban diesel trains of locomotive traction of permanent formation, which consisted of 97% of details of domestic manufacture. (Segodnya – Today. (July 31, 1998). Instead of an electric train – a commuter train).



**Figure 3.** Diesel trains of locomotive traction DPL2 at Luhansk station (Diesel train DPL2-002 at Lugansk station, January 5, 2014).

Luhansk permanent formation diesel trains, 1st type (with modernized diesel locomotive section 2M62, power 1471 kW, main and 2 trailer cars – DPL1) and 2nd type (with modernized diesel locomotive section 2TE116, power 3060 hp, main and 3 trailer cars – DPL2 presented in figure 3), intended for suburban transportation of passengers on non-electrified railway sections, were equipped with three intermediate cars and one main car. The brake was electro-pneumatic and manual. DTL1 (based on DPL1) and DTL2 (based on DPL2) diesel locomotive traction trains equipped with 3, and sometimes 4 trailer cars and 2 locomotive sections were also created (Basov, 2004, p. 100, 101). Diesel trains of the DPL1 and DTL1 series have arrived for operation at the Kolomyia and Kovel depots of the Lviv Railway, and the DPL2 – at the Rodakove depot of the Donetsk Railway (Tsygankov-Serebryakov, 2006, p. 272).

As of 2001, the level of wear and tear of rolling stock of all types of properties of Ukrzaliznytsia exceeded 57%, in particular, diesel trains – 82%, and electric trains – 72%. During the period 1991–2001, the average annual number of purchases of rolling stock was: electric trains – 9.1 units, and diesel trains – 0.6 units. (Fedyushin, 2001, pp. 7–8). In 2001, a total of 577 100 000 UAH (over 108 000 000 USD) was raised by Ukrzaliznytsia for the modernization of rolling stock, which was 2.3 times higher than similar costs in 2000. (Kirpa, 2004, p. 32). In 2001, the specific weight of electric trains in the product nomenclature of HC “Luhanskteplovoz” was 49.3%, diesel trains – 15.5%, and diesel locomotives – only 14.2%. During the year, the growth rate of production was 151.3%, and the volume of manufactured products – 89 500 000 UAH



(over 16 700 000 USD) (Tsygankov-Serebryakov, 2006, p. 300–301). According to the testimony of the General Director of Ukrzaliznytsia H. Kirpa, the preparation and organization of the production of rolling stock at that time allowed to ensure their production of up to 200 units per year (Kirpa, 2004, p. 34).

However, already in the middle of 2002, the volume of financing of Ukrzaliznytsia's orders for the production of rolling stock was significantly reduced due to both the drop in transit of rail transport and the simultaneous participation of Ukrzaliznytsia in higher priority investment projects. In addition, in 2002, the management of the Donetsk Railway unexpectedly ordered 4 ED2T trailer head cars from the Russian Demikhov Machine-Building Plant (Abramov, 2015b, p. 350). HC "Luhanskteplovoz" felt an acute shortage of its own working capital. Attracting investments and bank loans was unrealistic at that time. In connection with the decrease in the amount of financing from Ukrzaliznytsia, the company planned to increase the volume of orders for a specific type of product – diesel locomotives, as well as to resume the production of trams (Tsygankov-Serebryakov, 2006, p. 306 – 307).

Meanwhile, the preliminary test results of the DEL-01 diesel train showed that the implemented technical solutions basically confirmed the correctness of the selected design parameters. In 2000, work was carried out on its improvement: revised design documentation of the main car, metal constructions of the body, interior, salon, chassis, developed drawings of bodies, the interior lining of the salon taking into account the updated ergonomic shape of the cabin, introduction of block windows and hidden fastening of the cabin. Based on the results of the tests, the control systems and equipment were updated and modernized. In 2001, on the basis of the DEL-01 diesel train, the development of the design documentation of the three-car DEL-02 diesel train with a new design of cars and underbody location of the POWER RACK power module (diesel generator set) manufactured by the German company MTU Aero Engines was started (Tsygankov-Serebryakov, 2006, p. 282).

The design of the motor car of the DEL-02 diesel train was determined by the futuristic cab of the driver, designed by the RDE "Rost" presented in figure 4. The main component of a diesel train was 3 cars (2 motor, 1 trailer). The control scheme provided the possibility of operating 2 articulated diesel trains from one control post. The number of seats was 336, including 100 in the motor car, and 136 – in the trailer car. The hourly power of the main diesel engines was  $2 \times 748$  hp. Design speed – 130 km/h. The transmission of the diesel train was electric of alternating current, which consists of a traction synchronous generator, a rectifier-inverter frequency converter, and 2 asynchronous traction electric motors of the AD-906 type. Traction motors were powered by autonomous voltage inverters. The microprocessor control unit ensured the optimal operation of the power transmission in various driving modes. The connection of the microprocessor unit with the control panel, the diesel engine, and the main transmission elements was digital. The diesel engine of the train was V-shaped twelve-cylinder four-stroke with gas turbine inflation and liquid cooling. The power of each of the 2 diesel engines was 550 kW (Basov, 2004, p. 134).

In December 2002, after acceptance tests, the DEL-01 diesel train began running tests at the Rodakove depot. On December 18, at a joint meeting with representatives of Ukrzaliznytsia, a decision was made to build a new DEL-02 diesel train, and on July 29, 2003, its ceremonial presentation took place (Buyanov, 2005, p. 249). In October 2004, HC “Luhanskteplovoz” built an experimental motor car EPL2T with trolleys designed for a speed of up to 160 km/h. There were plans for equipping future electric trains with these trolleys and converting all existing electric trains (Basov, 2005, p. 146; Tsygankov-Serebryakov, 2006, p. 310, 312, 317, 324). Further production of rolling stock was accompanied by an increase in the share of equipment of Ukrainian enterprises, hence the high degree of localization of production. HC “Luhanskteplovoz” also carried out work on the creation and mastery of the production of motor and non-motor rolling stock bogies with radial wheels, a design speed of 160–200 km/h and an axial load of 19 tons (Kirpa, 2004, p. 35).



**Figure 4.** Diesel train DEL-02 with managers of HC “Luhanskteplovoz” (DEL-02, 2002).

In December 2004, motor-car rolling stock produced by HC “Luhanskteplovoz” was awarded the State Prize of Ukraine in the field of science and technology “*For the creation, mastery of production and introduction of domestic motor-car rolling stock of social purpose for suburban passenger transportation*” (Stohniy, 2009, p. 200).

In 2006, the EPL2T-017 electric train was first equipped with a new plastic streamlined cabin, and in 2008, the first EPL9T-015 electric train was also equipped with a streamlined cabin. In 2008, the production facilities of HC “Luhanskteplovoz” allowed to ensure the production of up to 140 cars of suburban trains per month. In 2008, the plant team produced 56 cars of direct and alternating current suburban

electric trains. Together with the Donetsk Railway, the team of HC «Luhanskteplovoz» carried out a large amount of work on the proofing of the design of the crew and running parts of electric trains, which was foreseen by the decision of the interdepartmental commission. An improved trolley of its own design was developed, tested, and put into production. According to the results of 11 months of work in 2008, the volume of production amounted to 1 000 000 000 UAH which became a record economic indicator for 17 years. The increase in production rates was almost 200% (Spektor, February 5, 2009). However, soon the global economic crisis of 2008 significantly complicated the Company's situation. In particular, the construction of the EPL2T-036 electric train was interrupted already in November 2008 (all 8 cars were built entirely of metal, with the exception of the trolleys) and at the time of publication of the article, for 14 years, the unfinished electric train has been standing in one of the non-working workshops.

In 2009, the financial plan of “Ukrzaliznytsia” provided for the purchase of 4 electric trains from HC “Luhanskteplovoz”. At that time, work on restructuring and optimization of the number of employees was carried out on the basis of the order of Ukrzaliznytsia (Osobova, April 28, 2009). At the beginning of November 2009, the results of the auction for the privatization of the Luhansk plant were canceled by the decision of the commercial court of the Luhansk region. However, already on June 15, 2010, CJSC “Transmashholding” repurchased the controlling stake of HC “Luhanskteplovoz” for 51 000 000 USD (Pavlyuk, June 22, 2010).

### **Perspective developments of high-speed rolling stock.**

In October 2008, the Ministry of Transport of Ukraine approved the “Comprehensive program for the renewal of railway rolling stock of Ukraine for 2008–2020”. The program determined that in order to organize high-speed traffic by 2020, it is necessary to replenish the railway fleet of Ukraine with interregional electric trains at a speed of 160 km/h with 40 units, two-system electric trains with a tilting body at a speed of 200–220 km/h – 17 units. Planning the creation of high-speed electric trains, the management of HC “Luhanskteplovoz” held negotiations with the Siemens company. The main technical issues were resolved, and preliminary volumes of deliveries and prices for equipment sets were agreed upon. In addition, in August 2007, protocols were signed between HC “Luhanskteplovoz” and Ukrzaliznytsia for the creation, manufacture and purchase of 58 direct current electric trains with an asynchronous drive with a design speed of 160 km/h EPL5T and 85 modernized electric trains of interregional direct and alternating current connections EPL2TM and EPL9TM (Spektor, February 1, 2011).

On the eve of the 2012 European Football Championship, the Cabinet of Ministers of Ukraine decided on the purchase of high-speed rolling stock. HC “Luhanskteplovoz” proposed to create new models of high-speed interregional electric trains with a speed of over 200 km/h. 3 The deputy technical director of HC “Luhanskteplovoz” N. Naysh noted that the production of electric trains at a speed

of 160–200 km/h at the enterprise was possible if the experience of one of the international foreign companies was involved in the creation of a joint venture with the gradual localization of production in Ukraine (Spektor, February 1, 2011). However, during the visit to South Korea, an agreement was signed on the purchase by Ukrzaliznytsia of 10 Hyundai Rotem HRCS2 interregional electric trains and 4 diesel trains in the amount of more than 1 billion USD (Spektor & Masyuchenko, August 4, 2009).

Despite this, the specialists of HC “Luhanskteplovoy” continued to search for technical solutions that would allow the introduction of high-speed passenger transportation with minimal costs. The project of the EPL20T interregional electric train with a maximum operating speed of 140 km/h was developed. Calculations showed that with a race length of more than 18 km, the technical speed of such a train will be at least 120 km/h. In addition, at the current stage of track reconstruction under the current restrictions, it would not be possible to fully utilize the high-speed qualities of trains designed for a maximum speed of 160 km/h. The first samples of the EPL20T electric train could be released within a year after the conclusion of the supply contract. With an eight-car design, the electric train had a capacity of about 580 passengers, and its cost did not exceed UAH 95 million. (less than 9 000 000 euros). For a price comparison, the cost of the Hyundai Rotem HRCS2 electric train is 30 000 000 euros with a capacity of 580 passengers (Spektor, February 1, 2011). In the spring of 2010, Ukrzaliznytsia had plans to order the construction of two-system high-speed interregional trains with an asynchronous traction drive at the facilities of HC “Luhanskteplovoy”. According to preliminary data, it was supposed to be an all-wheel drive train without locomotive traction with improved dynamics and the highest level of comfort (Transport, March 30, 2010). In 2011, HC “Luhanskteplovoy” took part in a tender for the supply of 2 EPL20T interregional electric trains with a speed of 140 km/h (Yurova & Spektor, May 31, 2011). Due to the lack of funding from Ukrzaliznytsia, all work in this direction was canceled.

At the same time, before the 2012 European Football Championship, the team of PJSC “Kriukiv Railway Car Building Works” developed its own project of a high-speed two-system electric train with an estimated speed of 200–220 km/h. For comparison: as early as 1991, a rental company was created at the facilities of the Kremenchuk production association of wagon-building, and already on December 22, 1993, its property was privatized by a newly created joint-stock company (Kudiyarova, 2019, p. 21; The Cabinet of Ministers of Ukraine (December 17, 1994).

Order № 1120-r “On granting permission for the privatization of the property of the leased enterprise “Kriukiv Railway Car Building Works”). On October 11, 1994, by a resolution of the CMU, JSC “Kriukiv Railway Car Building Works” (hereinafter – KRCBW) was designated as the main developer of design documentation and a manufacturer of new competitive passenger cars of innovative design for Ukrzaliznytsia (The Cabinet of Ministers of Ukraine (October 11, 1994) Resolution № 703 “On the organization of the production of passenger cars”). In the early 2000s,



JSC “KRCBW” gained practical experience in the creation of subway cars, innovative freight cars, as well as locomotive-hauled passenger cars with a speed of 160 km/h (Kirpa, 2004, p. 178; Kudiyarova, 2019, p. 58). Until then, the Company had managed to stabilize its financial position due to the expansion of the product range, update the fixed assets with the most modern equipment, preserve the design and technological potential, having mastered the industrial production of new types of rail rolling stock (Danylyshyn, 2007, p. 187).



**Figure 5.** Electric train EKr1-001 “Tarpan”, 2012 (Kudiyarova, 2019).

Since 2012, PJSC “KRCBW” on its own initiative and with its own funds has started designing a new family of suburban, regional and interregional railcar trains of a new generation, in particular diesel trains, electric trains of various current systems with bodies of a similar design. The total amount of own investments in the project of creating a two-system high-speed interregional electric train with asynchronous traction electric motors amounted to more than 400 000 000 UAH (50 000 000 USD), and already at the beginning of 2012, the first 2 samples of the experimental electric train EKr1 (Kryukiv electric train, 1st type), which was named “Tarpan” presented in figure 5, were built and tested at PJSC “KRCBW” (Kudiyarova, 2019, pp. 290–291).

Electric train EKr1 consisted of 7 trailer and 2 main motor cars. Passenger capacity – 612 people. The design speed was 200 km/h. Brake – electric, electro-pneumatic, pneumatic (Kudiyarova, 2019, p. 290–291). The cars of the electric train were equipped with cradleless trolleys with a central pneumatic suspension of modifications 68-7072 (main car) and 69-7049 (intermediate car). The electrical equipment of these cars had a backup power supply system in case of failure of the main static converter. For the first time in Ukraine, the main cars of an electric train were also equipped with an energy absorption system in frontal collisions up to 2 MJ. The price of the EKr1 electric train was 20 850 000 USD). However, the company was unable to fully certify its train in time before the start of the championship, and only

on January 31, 2013, the interdepartmental commission put it into operation with a maximum speed of 160 km/h (Kudiyarova, 2019, p. 337).

The creation of the DPKr2 diesel train began as a result of the victory of PJSC “KRCBW” in the tender announced by Kazakhstan Railways. During the development, the designers also took into account the regulatory technical requirements in force in Ukraine. In the summer of 2014, a prototype of the DPKr2-001 diesel train presented in figure 6, was assembled and was named “Obriy”. The DPKr2 diesel train was intended for the transportation of passengers in suburban and interregional traffic on non-electrified sections of railways, equipped with both high and low platforms. The design speed of the DPKr2 diesel train was 154 km/h. The mask of the main car contained a “crash system”, which, in the event of a head-on collision, absorbed the main impact. The carriages are equipped with lifting equipment and places for people with disabilities. The undercarriage of each car was equipped with 2 two-axle bogies with pneumatic springs manufactured by PJSC “KRCBW”, 1 drive (model 68-7085), and one non-drive (model 68-7090). The trolleys were equipped with an electronic system of sensors: an anti-lock device, monitoring the heating of the axle assemblies, as well as speed. For more effective coupling of the train with the rails on the carts, a sand supply system was installed in the area of contact between the wheel and the rail. Each car was equipped with a power unit located in the undercarriage space. A diesel engine with a capacity of 390 kW drives a hydraulic transmission of the hydrodynamic type, which drives the wheel pairs, as well as an electric generator of its own needs of three-phase alternating current with a voltage of 380 V and a capacity of 70 kVA, which serves to power all the equipment of the car. The total number of seats in a three-car train was 283 ordinary and 6 folding, and the maximum capacity of the train including standing places was 637 people. A feature of this diesel train is the possibility of its operation at temperatures from  $-50$  to  $+50$  degrees (Kudiyarova, 2019, p. 315–317).



**Figure 6.** Diesel train DPKr2-001 on the Lviv Railway (Kudiyarova, 2019).

In 2014, PJSC “KRCBW” also developed technical tasks for suburban electric trains of AC EKr3 (Kryukiv electric train, 3rd type) and direct current EKr4 (Kryukiv

electric train, 4th type). Localization of rolling stock production of PJSC “KRCBW” amounted to 70%, which made it possible to create more than 5,000 new jobs PJSK “Kriukiv Railway Car Building Works” (February 1, 2019). KRCBW is ready to participate in the reform of suburban railway communication as a partner). In 2014, as a result of Russia's aggression and its declaration of the organization “Luhansk People's Republic”, Ukraine completely lost the HC “Luhanskteplovoz”. Consequently, competition among domestic manufacturers of railway rolling stock has ceased since 2015. The only manufacturer of this type of product remained PJSC «KRCBW». In the spring of 2017, JSC “Ukrzaliznytsia” announced another tender for the supply of 6 three-car regional diesel trains for the amount of 1,062,000,000 UAH (over 41,000,000 USD), in which PJSC “KRCBW”, the Polish company Pesa and LLC “Kharkiv Wagon Building Plant” participated. However, soon JSC “Ukrzaliznytsia” canceled the bidding, rejecting all submitted applications due to the inconsistency of the tender documentation (Center for Transport Strategies (November 17, 2017). JSC “Ukrzaliznytsia” again announced a tender for the purchase of 6 regional diesel trains).

In the end, following the results of the victory in the next tender, PJSC ‘KRCBW’ developed and manufactured a regional diesel train DPKr3 (Kryukiv Diesel Train, 3rd type) presented in figure 7, with a capacity of 170 seats and a maximum speed of 140 km/h. Its concept was based on the design of the cars of the DPKr2 diesel train, taking into account the experience of its operation, the manufacturer made a number of changes that were the most acceptable for the rolling stock operating in the suburban service of JSC “Ukrzaliznytsia”. The diesel train consisted of 3 cars – intermediate non-motor 63-7084A, main motor 63-7083A and main motor 63-7083A-01, equipped for transporting passengers in wheelchairs. The motor cars are equipped with power plants with a capacity of 588 kW, which in total will not be inferior in power to 3 units installed in each of the DPKr2 cars. A modular diesel-hydraulic power plant Voith RailPack 600 DH produced by the company “Voith” (Germany) is installed on the main motor cars in the underbody space. The intermediate, non-motor car was powered by 2 power plant generators located on the main cars. One of the main cars had 58 second-class seats, the other main car had 51 second-class seats, this car had an enlarged sanitary module for passengers with disabilities, and there was room for wheelchairs. In the intermediate carriage, 61 first-class seats and a sanitary module were provided. The cost of one DPKr3 diesel train was 176 970 000 UAH (about 6 300 000 USD) (PJSK “Kriukiv Railway Car Building Works” (August 20, 2019.) KRCBW presents the DPKr-3 regional diesel train).

Despite the successful construction as part of the tender of the first four samples of the DPKr3 diesel train and the possibility of production of electric trains by PJSC “KRCBW”, JSC “Ukrzaliznytsia” persistently attempts to hold a tender with the involvement of the Swiss company Stadler Rail AG or the supply of 80 electric trains with localization of production in Ukraine in the amount of 31 462 000,000 UAH (over 1 153 300 000 USD) (International exhibition Rail Expo (2022). Ukrzaliznytsia



cancel the tender for the purchase of electric trains). However, with the start of military operations on the territory of Ukraine on February 24, 2022, the prospects for this cooperation remain uncertain.



**Figure 7.** Diesel train DPKr3-001, 2019 (PJSC “Kriukiv Railway Car Building Works” (August 20, 2019.) KRCBW presents the DPKr-3 regional diesel train).

### **Conclusions.**

So, analyzing the dynamics of the development process of the industrial production of rolling stock, its following stages can be distinguished. The first stage was associated with the establishment of a production monopoly of HC “Luhanskteplovoyz” (1991–2008). For a long time OJSC “Voroshilovgradteplovoyz”, having a powerful research and production potential, carried out the development and created unique projects of railway equipment, which were exported to many countries of the world. In the early 1990s, in the absence of convertible currency in the country for the import of rolling stock, the Association had the opportunity to carry out conversion and diversification of production against the background of a gradual decrease in demand for main-line diesel locomotives and an aggravation of the economic crisis. In the conditions of falling demand for diesel locomotives, HC “Luhanskteplovoyz” was forced to work in a research and experimental mode, when serial production – the main source of profit was practically stopped, and the pace of development of new equipment did not allow to compensate objective costs. According to the technical director of HC “Luhanskteplovoyz” G. Basov (Basov, Naysh, Mishchenko, Gundar, & Lozovoy, 2002) the company acted in fact as a research and production association, which carried out the entire cycle of product creation from design to implementation into serial production without the presence of specialized research institutes, design bureaus and a minimal scientific department in the field of production of motor-carriage rolling stock of social recognition (Basov, 2000, p. 18). In addition, the parasitic approaches of the state monopoly were manifested during economic activity. The calculation made for the development of the production of new equipment exclusively on the budgetary basis of financing turned out to be wrong in the new conditions. The company's management



failed to refocus on resources that could be provided by customers and consumers of products. The preparation of new types of equipment urgently needed own funds, which were not enough for such a scale of investments (Tsygankov-Serebryakov, 2006, p. 266).

In order to implement a number of state programs in the period from 1996 to 2003, HC “Luhanskteplovoz” mastered the industrial production of rolling stock and created: a unified passenger trailer car for suburban transportation, DPL1 locomotive traction diesel train, DPL2 locomotive traction diesel train, DEL-01 and DEL-02 asynchronous traction diesel trains, EPL2T direct current and EPL9T alternating current electric trains. Designers of HC “Luhanskteplovoz” also started the development of promising high-speed electric trains of interregional connection EPL5T and EPL20T. However, in view of the protracted process of the corporatization of the enterprise, the low level of the company's management culture during the period of market transformation of the Ukrainian economy, as well as the uncertainty of further orders and the solvency of Ukrzaliznytsia HC “Luhanskteplovoz” was forced to curtail the diversification process and focus on the production of locomotives and their components under the contracts of the Russian Federation.

In parallel with this, the development of own projects of new generation rolling stock was carried out by the designers of PJSC “Kriukiv Railway Car Building Works” with the diversification of its production and the related second stage of development of MU in Ukraine. Unlike HC “Luhanskteplovoz”, having a more effective management model due to its own investments, PJSC “KRCBW” presented successful prototypes of the high-speed interregional electric train EKr1 “Tarpan”, DPKr2 and DPKr3, which technologically and cost-wise surpassed the products of HC “Luhanskteplovoz” and are now successfully operated on the tracks of JSC “Ukrzaliznytsia”. Today, PJSC “KRCBW”, having its own powerful design and technological basis and production facilities, has actually occupied a monopoly position as a supplier of rolling stock for JSC “Ukrzaliznytsia” among domestic manufacturers of railway equipment. The third stage of the development of MU in Ukraine is connected with persistent attempts of JSC “Ukrzaliznytsia” to advance the monopoly of PJSC “KRCBW” by localizing the production of one of the European manufacturers on the territory of our country.

The principal conclusion we reached during the research is that the main reason for the financial problems of HC “Luhanskteplovoz” was the lack of clear business processes in subsidiary units and excessive management costs for long-term maintenance of non-core social infrastructure, which is generally unthinkable in a market economy and healthy economic competition. This management model was not only a mistake of the company, but in general, it was a consequence of the social state policy of those years. If the Eastern European countries during the reforms of the 1990s resorted to strict restrictions on social spending, then Ukraine, like most of the CIS countries, continued to live with populism, as a result, having received an uncompetitive industry of the state sector of the economy. On the other hand, the

success of the diversification of PJSC “KRCBW”, which, moreover, was connected with the development of highly knowledge-intensive products practically from scratch, is due to rapid corporatization and more effective management of the company, which together made it possible to attract large investments and carry out the large-scale renewal of production assets and increase energy saving of production as a whole. Our next studies will be dedicated to proving this hypothesis.

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### **Conflicts of interest.**

The authors declare no conflict of interest.

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### **Освоєння та розвиток промислового виробництва моторвагонного рухомого складу в Україні (1991–2022)**

*Abstract.* У статті здійснено спробу дослідити історичні обставини освоєння та розвитку промислового виробництва моторвагонного рухомого складу в Україні 1991–2021 рр. Мета статті – здійснити ретроспективний аналіз подій та історико-технічне узагальнення основних заходів, проблем та наслідків освоєння промислового виробництва моторвагонного рухомого складу

в Україні 1991–2021 рр. на підставі комплексного аналізу джерел та наукової літератури. В ході наукової розробки запропонованої розвідки були використані матеріали багатотиражних газет, галузевих видань залізничного транспорту, а також технічні дослідження працівників заводів-виробників. Визначено, що протягом 1991–2008-х рр. інженерно-конструкторський колектив ХК “Луганськтепловоз”, маючи потужний науково-виробничий потенціал, на замовлення Державної адміністрації залізничного транспорту – Укрзалізниці – з метою імпортозаміщення здійснив конструювання й освоїв промислове виробництво новаторських зразків моторвагонного рухомого складу соціального призначення, а саме дизель-поїздів ДЕЛ-01 та ДЕЛ-02, а також електропоїздів ЕПЛ2Т та ЕПЛ9Т для забезпечення потреб українських залізниць високотехнологічною технікою. З’ясовано, що з початком економічної фінансової кризи 2008 р. та суттєвим скороченням замовлень Укрзалізниці виробництво моторвагонного рухомого складу на потужностях ХК “Луганськтепловоз” було фактично припинене, а приватизоване російським інвестором підприємство зосередилось переважно на виробництві локомотивів. Натомість з 2012 р. виробництво моторвагонного рухомого складу на власній конструкторській платформі було освоєно в рамках диверсифікації ПАТ “Крюківський вагонобудівний завод”. Зрештою, історичний досвід становлення та розвитку української науково-виробничої бази залізничного машинобудування потребує свого належного осмислення в контексті здійснення ретроспективного аналізу виробничої діяльності галузі щодо з’ясування причин її неефективного розвитку, а також визначення концептуальних шляхів узгодження вітчизняного конструкторсько-технологічного потенціалу з актуальними потребами в оновленні парку тягового рухомого складу світових транспортних операторів. Подальше дослідження історії розвитку залізничного машинобудування в Україні потребує з’ясування історичних обставин інституалізації конструкторських бюро окремих підприємств у напрямку здійснення науково-дослідної діяльності.

**Ключові слова:** моторвагонний рухомий склад; Луганський (Ворошиловградський) тепловозобудівний завод; Крюківський вагонобудівний завод; залізничне машинобудування; українські залізниці; Державна холдингова компанія “Луганськтепловоз”

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