UNION OF INDUSTRIES OF RAILWAY EQUIPMENT

RAILWAY EQUIPMENT

September 2008

Special issue for InnoTrans 2008

объединение
производителей
железнодорожной
техники
ОПЖТ

UNION OF INDUSTRIES OF RAILWAY EQUIPMENT

Non-profit Partnership

UIRE was established in June 2007 in Russia
by the following companies:

Russian Railways OJSC

Transmashholding CJSC

Corporate Company Management
Concern 'Tractor Plants' LLS

Mordovia Car-Building Company OJSC

Today UIRE consists of approximatety 80 members,
which totaly produce more than 80%
of raiway equipment in Russia.

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Dear Friends,

The economic revival of Russia sets new, sophisticated problems for the country's infrastructure. Growth in production of various goods and services, development of entrepreneurship and new opportunities becoming available to citizens continuously raise the requirements to the whole system of institutions that support everyday life in modern society.

Transport, load on which in recent years has grown rapidly, becomes a key factor in terms of economic growth. In Russia railways, a reliable year-round means of transport linking the major centres and the most remote areas of the country, have played a special role in economic development for over a century and a half. Rail transport today is the most important element of infrastructure for economic growth.

Recently a large amount of work has been done: serious reforms are realised and priorities for further development of rail transport and railway engineering are identified.

Practical work in creation of the modern rolling stock, expansion and modernisation of production capacities has started in Russia. Russian engineering introduces new technologies into production, switches to fundamentally new methods for assessing performance efficiency, particularly introduction of the criterion of rolling stock lifecycle cost into everyday practice. New specimens appear every year and significant progress has been achieved in the development of base platforms for locomotives of the new generation. Many of challenges facing the industry are reflected in the journal, a special issue of which you are now holding.

Now it can be stated that despite difficult times the Russian railway engineering industry has succeeded in preserving its creative and productive potential. It has moved from problems of survival to fundamental development tasks and it now looks into the future with confidence.

Valentin Gapanovich
President of the Union of Industries
of Railway Equipment

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KEY EVENTS IN RUSSIAN RAIL TRANSPORT AND RAILWAY ENGINEERING IN 2007–2008

THE RUSSIAN GOVERNMENT ADOPTS THE RAILWAY ENGINEERING DEVELOPMENT STRATEGY UP TO 2015

The Railway Engineering Development Strategy of the Russian Federation for the period of 2007–2010 and up to 2015 was adopted in September 2007. The Strategy is designed to encourage Russian industrial and technological potential, attract advanced foreign technologies and implement a public-private partnership mechanism for sectoral scientific research and engineering developments.

As a result of Strategy implementation, it is supposed that by 2015 the share of the Russian railway engineering in the world market will reach 18% (the figure currently stands at about 10%), and the export turnover of Russian railway engineering production will amount to more than €1bn (in 2007 – about €0.5bn). ■

THE RUSSIAN GOVERNMENT ADOPTS THE RAIL TRANSPORT DEVELOPMENT STRATEGY UP TO 2030

In June 2008 the Rail Transport Development Strategy – the document defining trends of development of Russian railways until 2030 and setting reference points for the development of related industries – railway machinery and equipment suppliers – has been adopted.

According to the Strategy, by 2030 it is assumed that more than 20,000 km of new railway lines will be introduced and about 7,500 km of railways electrified. Strategy implementation will help to provide eighteen potential mineral deposits and industrial areas with rail transport. The network range intended for circulation of passenger trains at speeds of up to 350 km/h should make 1528 km by 2030.

A large-scale updating of the rolling stock fleet is planned: over 23,000 locomotives, approximately 1 million freight cars, 23,000 passenger coaches and about 24,500 commuter train cars will be procured by 2030.

In order to implement the Strategy it is planned to use a public-private partnership mechanism. The volume of investments into the development of Russian rail transport up to 2030 will exceed €370bn, 75% of which fall to the private sector. 40% of investments will be spend on new railway lines construction, 31% on development of existing infrastructure and 29% on rolling stock modernisation.

Strategy implementation will reduce transportation costs in ecomony and increase transit traffic volume by 3.3 times. ■

RZD APPROVES THE WHITE BOOK

Russian Railways (RZD) approved in September 2007 the Strategic Directions of Scientific and Technical Development of the company and the Russian railway industry as a whole up to 2015. The document is titled ‘The RZD White Book’. According to the White Book, the main guidelines of the scientific and technical development of RZD are:

- Transport logistics and transport operations automated control system based on new information technologies (such as distributed information processing, remote monitoring of geographic information systems and tracking and identification systems). At the same time shippers should have access to such information in real time.
- Rail safety management system.
- Improvement of performance reliability and broadening the operating lifetime of technical equipment.
- Development of a corporate quality management system.

As a separate guideline the White Book specifies the development of high speed train operations.

The White Book assumes maximum use of the leading Russian inventions alongside with attraction of foreign technologies.

RUSSIAN MANUFACTURERS BRING NEW ROLLING STOCK INTO PRODUCTION

Russia’s first EP2K passenger DC electric locomotive was produced in 2007 at Kolomna Plant (Kolomna, Moscow Region), a subsidiary of Transmashholding. In November 2007 production of the pilot batch of these electric locomotives began. By 2010 RZD plans to acquire 178 such locomotives.

Russian manufacturers are launching the production of freight DC electric locomotives, never previously manufactured in Russia. In 2008 Novocherkassk Electric Locomotive Plant (Novocherkassk, Rostov Region), a subsidiary of Transmashholding, started preproduction of 20 ‘Donchak’ 2EP4K locomotives (14 of which will be set to work this year).

Ural Railway Engineering Plant (Verkhnyaya Pyshma, Sverdlovsk Region) has manufactured 2EP6 electric locomotive. A contract has been signed with RZD on preproduction of 25 units.

In 2007 the Torzhok Car-Building Plant (Torzhok, Tver Region) constructed a diesel electric train which can be used in suburban operations both over electrified and unelectrified lines. The diesel generators installed on these trains were manufactured by German firm MTU Friedrichshafen. By 2015 RZD plans to purchase 168 diesel electric cars for multiple unit trains.

In 2007 a GT1 gas-turbine locomotive running on liquefied natural gas in construction of which many Russian development and engineering organisations took part, was manufactured for the first time. A 8,300 kW gas-turbine engine was developed by Kuznetsov Samara Scientific and Technical Complex (Samara), while the locomotive was assembled at Dzerzhinsky Voronezh Locomotive Repair Works (Voronezh).

In December 2007 a ‘Vityaz’ 2TE25A freight diesel locomotive, constructed at Bryansk Engineering Plant, a subsidiary of Transmashholding, completed a test run during which it handled a 7500-tonnes freight train, loaded with rubble. The 2TE25A is the first Russian diesel freight locomotive with an asynchronous traction motor. The locomotive is completely constructed on a Russian technological base. A traction converter which is a key innovative element is developed at VNIKTI Institute (Kolomna, Moscow Region) and manufactured by ElectroSI (Moscow). The modernised diesel engine with electronic injection produced by Kolomna Plant and new model of bogies were used in the construction of this diesel locomotive. Delivery of these locomotives to RZD will begin in 2008. In April 2008 RZD declared its intention to acquire 100 2TE25A diesel locomotives.

RZD ACQUIRES BLOCKING SHAREHOLDING OF TRANSMASHHOLDING

Russian Railways acquired a blocking shareholding of The Breakers Investments B.V. which owns 100% of the shares of Transmashholding CJSC in the end of 2007, thus becoming a shareholder of the largest railway equipment manufacturer in Russia. The deal is worth €255m.

Due to this RZD which is the basic consumer of railway engineering products in Russia- will directly participate in defining technical and innovative policies of the leading Russian rolling stock manufacturer.

CORPORATE TRANSFORMATIONS IN RUSSIAN RAILWAY ENGINEERING

In November 2007 Russkiye Mashyny Engineering Corporation and Mordovia Car-building Company (VKM) set up the joint venture on production of freight cars and component parts named Russian Railway Engineering Corporation. Founded in 2005, Russkiye Mashyny Holding comprises the car-building enterprise Abakanvagonmash which specialises in the production of large-capacity containers and railway platforms.

Russkiye Mashyny OJSC paid for its share in cash, and VKM Group contributed assets into the authorised capital, among which the most significant are Ruzkhimmash (Ruzaevka, Republic of Mordovia), manufacturing freight cars, three car-assembly enterprises and metallurgical company VKM-Steel (Saransk, Republic ofMordovia), manufacturing car casting.

In July 2007 Sinara Group acquired Lyudinovo Locomotive Plant (Lyudinovo, Kaluga Region), which produces diesel shunters, maintenance vehicles and DMU trains. In August Sinara Group founded Sinara – Transport Machines, an affiliated holding, to manage its Ural Railway Engineering Plant (Verkhnyaya Pyshma, Sverdlovsk Region) and Lyudinovo Locomotive Plant.

In April 2008 the transformation of Uralvagonzavod Industrial Assossiation (Nizhny Tagil, Sverdlovsk Region) into a joint stock company and the formation of Uralvagonzavod Research and Manufacturing Corporation on its base, was finished. Up to this point the largest manufacturer of freight cars in Russia was a state enterprise. Transformation into a joint stock company began in last October according to a President of the Russian Federation Decree signed in August 2007.

Thus, domination of state unitary enterprises in the Russian freight car building market has ceased.

JOINT VENTURES WITH LEADING FOREIGN MANUFACTURERS EMERGE IN RUSSIA

In May 2007 Transmashholding and Canadian Bombardier Transportation signed joint venture agreements on production of traction converters and a joint engineering centre to develop new components, equipment, technical and technological solutions for railway machinery. The traction converter joint venture is based at the production facilities of Novocherkassk Electric Locomotive Plant (Novocherkassk, Rostov Region), while the joint engineering centre is located in Moscow. These organisations are equally owned by Transmashholding and Bombardier Transportation. Earlier, in April 2005, a joint venture on production of static converters for cars and locomotives between Siemens AG and Transmashholding was founded. Start of commutatorless traction electric motor production is planned at this enterprise in the long term.

In October 2007 a long-term cooperation agreement was signed between Sinara – Transport Machines and Siemens AG. Launch of production of a six-axle diesel electric shunter with a power of 2,000–3,000 kW for each section with an asynchronous traction motor was scheduled at Lyudinovo Locomotive Plant production facilities. The Russian company will develop the basic design, configuration and the truck of diesel locomotives, while the German counterpart will provide the traction equipment and control systems.

In the early 2008 Russian European Bearing Corporation initiated establishment of a joint venture with American Brenco Company (a subsidiary of Amsted Group), which will specialise in production of taper journal-box bearings. Partners will receive equal shares in the joint venture: the Russian side will bring in the production facilities of Saratov Bearing Plant (Saratov) and cash assets, and Brenco – cash finance and technologies. Partners have agreed to invest €45m into the joint venture over a three-year period and the plant will produce 300,000 bearings a year.

RUSSIAN RAILWAYS ACQUIRE FOREIGN-MADE EQUIPMENT

Serial production of Velaro RUS high-speed electric trains for RZD was launched at Siemens AG plant in Krefeld-Ürdingen, Germany in July 2007. It is planned that by the end of 2009 these trains will start running between Moscow and St. Petersburg with a speed of 250 km/h.

In 2007 RZD began negotiations with Chinese Southern Industrial Company on delivery of casting and component parts for freight cars. Their certification is now nearing completion, the supplies are likely to begin in 2008.

In 2008 French company Alstom won a competitive tender for delivery of high-speed passenger trains for the St. Petersburg – Helsinki line. OY Karelian Trains (a joint venture of RZD and Finnish VR Ltd.) is going to acquire 4 trains. The electric train has a dual-voltage system that enables to operate it in the trolley systems of both countries and it is expected to have a maximum speed of 220 km/h. Each train consists of seven cars (including a dining-car) and has 350 passenger seats. The company plans to organise four trips daily with departure from St. Petersburg and four from Helsinki. Project cost is about €140m. For its realisation it is planned to involve bank loans for a 25-year period. ■

NEW RAILWAY EQUIPMENT PRODUCERS EMERGE IN RUSSIA

In February 2008 Mechel concluded an agreement with RZD on the supply of rails in a volume of at least 400,000 tonnes a year over the period of 2010–2030. For this purpose Mechel will construct a rail-beam mill at Chelyabinsk Metallurgic Plant. At present Russia has only one supplier of rails – Nizhny Tagil Metallurgic Plant, a subsidiary of Evraz Group, which supplies RZD with 850,000 tonnes of rails a year at a demand of 1.15m tonnes. The need for a second rail-production factory is related to the large-scale plans for building new railways and modernisation of railway track facilities.

In 2008 Promtraktor-vagon began serial production of gondola cars on the basis of the Kanash Car-Repair Plant (Kanash, the Chuvash Republic). The plant plans to manufacture a first serial car by this December, and reach rated capacity (9,000 cars a year) by 2010. Apart from low-sided cars, the company also plans to launch production of automobile carrier wagons, hopper cars and flat cars. ■

UNION OF INDUSTIES OF RAILWAY EQUIPMENT IS ESTABLISHED

Several largest Russian engineering companies jointly with RZD founded in June 2007 the Union of Industries of Railway Equipment non-commercial partnership (UIRE). UIRE foundation was aimed at integrating the efforts in improving the quality of railway equipment and its components, implementation of innovative technologies, realisation of interbranch projects and introduction of quality management systems at engineering enterprises in order to meet international standards. As of August 2008, UIRE consists of 68 members, including the main rolling stock and component manufacturers of Russia. ■

COOPERATION OF RAILWAY OPERATORS AND RAILWAY ENGINEERING MANUFACTURERS MOVES TO A NEW LEVEL

The Technical Audit Centre was founded in the structure of RZD in November 2007, which replaced the previous Centre for Inspections of Quality Control and Acceptance. The Centre is responsible for technological auditing of quality management systems of suppliers of railway equipment and its components. Such transformation will help to substitute in part inspections with an internal audit of the production process of suppliers.

Besides, in August 2007 the Centre for Innovative Development was founded in the structure of RZD. The centre is responsible for technical training and presentation of innovations to experts, as well as for drawing public attention to the railway sector. The centre is supposed to become a basis for the cooperation of manufacturers and maintainers. ■

A SIGNIFICANT PART OF RZD FREIGHT CAR FLEET IS TRANSFERRED TO A NEWLY FORMED COMPANY 'FRIGHT ONE'

In July 2007 RZD founded a new subsidiary – Freight One.

RZD passed 200,300 freight cars from its fleet to the new company, including 75,000 tank-cars, 47,000 gondola cars, 15,000 flat cars, 14,000 box-cars and 49,000 special-type cars. The creation of First One is aimed at rolling stock modernisation and consolidation of RZD market positions by maintaining equal pay scale provisions with other market participants and improving of client relations. ■

THE FIRST 'EXPO 1520' INTERNATIONAL SHOW TAKES PLACE IN RUSSIA

In September 2007 the first 'EXPO 1520' International Show of railway engineering and technologies took place in Scherbinka (near Moscow), in which more than 400 major Russian and foreign transport firms took part. Over 150 samples of new railway equipment were presented at the exhibition. ■

RZD INTRODUCES PRACTICE OF SIGNING LONG-TERM CONTRACTS WITH ROLLING STOCK MANUFACTURERS

RZD has begun concluding long-term contracts with manufacturers for the delivery of railway engineering products since 2007.

In 2007 a three-year contract was signed between RZD and Uralvagonzavod for 40,000 of freight cars (mostly gondola cars), which are to be supplied by 2010, with contract price of €1.8bn.

In 2007 RZD and Transmashholding signed a €360m contract on the production and supply of 212 new main line electric locomotives in 2007–2009. Under the contract RZD will recieve 109 E5K fright AC electric locomotives manufactured by Novocherkassk Electric Locomotive Plant and 103 EP2K passenger DC electric locomotives, manufactured by Kolomna Plant.

In 2007 Ural Railway Engineering Plant (subsidiary of the Sinara – Transport Machines) and RZD signed a €60m supply contract for 25 2ES6 freight DC electric locomotives with a commutator motor. In 2008 9 two-unit locomotives will be supplied, with further 16 in 2009. ■

RZD SELLS NON-CORE ASSETS

As a part of the railway structural reform, in July 2008 RZD sold 13 car-repair depots, raising a sum of more than €85m. The principal buyers were major Russian companies or their subsidiaries.

In 2008, according to the reform programme, RZD plans to put 49% of shares in its Elteza subsidiary, uniting 8 electrotechnical plants, out to tender. ■

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MATCHING OF RAIL TRANSPORT AND RAILWAY ENGINEERING DEVELOPMENT STRATEGIES

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Steam locomotives and passenger cars for the first Russia's railway, 26.7 km long, connecting St. Petersburg and Tsarskoe Selo (1837), were manufactured in England and Belgium. Six 70–75 horsepower engines, capable to develop a speed of up to 60 km/h, ran for 20 years. Later locomotives were also purchased abroad. Only 20 years later (in 1856 and 1857) two domestically made locomotives manufactured at Leichtenberg plant in St. Petersburg were purchased. As for passenger cars, some of them were bought abroad and some were manufactured by local works.

Developments in industries of rail transport and railway engineering in Russia have been closely related for already 170 years.

It is not widely known, but it was the decision of the Emperor Nicholas I of Russia to use steam locomotives and cars manufactured in Russia over the railway under construction between St. Petersburg and Moscow that laid the foundation for vast development of railway engineering in Russia. Thus, principles of the national rail transport policy were clearly defined at the initial stage of rail transport development in Russia by Nicholas I. These principles were triggered by the strategic importance of rail transport for the national economy and policy in the 19th century. And these principles remain true in the 21st century.

One of the main principles of rail transport development was construction of railway lines on strategic routes primarily sponsored by the state. This ensured control over such lines and the implementation of a tariff policy aimed at stimulating state and regional economic development.

One more principle following the idea mentioned above is that most of rolling stock should be supplied by Russian manufacturers. Domestic engineering development resulted in the development of related industries and an increase in the scientific and technical level. Foreign locomotive and car producers' experience was actively used and foreign experienced professionals in this field acted as top managers.

Principles laid by Nicholas I remained in practice till the end of World War II. After the USSR had expanded its influence in Eastern Europe, close cooperation was established between Council for Mutual Economic Assistance (Comecon) countries, which resulted in placing railway equipment manufacturing orders at works of Czechoslovakia, German Democratic Republic and Poland (Table 1). Despite the fact that the track gauge in these countries was predominantly 'European' (1435 mm), railway equipment was customized to meet Russian technical conditions.

Table 1. Production of railway engineering in Comecon countries in 1970–80s

Product type	Manufacturing country
Passenger electric locomotives	Czechoslovakia
Passenger diesel locomotives	Russia
Freight electric locomotives	Russia, Georgia
Freight diesel locomotives	Ukraine
Diesel shunters	Russia, Czechoslovakia
Freight cars	Russia, Ukraine
Refrigerator cars	Russia, Germany
Passenger coaches	Russia, Germany
EMUs	Latvia

Because of political cataclysms followed by economical collapse there was a pause in the development of Russian rail transport and railway engineering industries. In the first years after the USSR disintegration the Russian Ministry of Railways and later Russian Railways joint stock company (RZD), purchased virtually no railway equipment, and this caused transport engineering stagnation (Table 2). Reduction of rolling stock renewal rate resulted in exploiting a great number of overdue rolling stock (Table 3). As a result expenditures for the renewal of overdue rolling stock came to €14bn. In fact this sum corresponds to the amount of investment that has not been spent in the recent 15 years.

Table 2. Reduction in railway equipment procurement in 1990–2000

Railway equipment	Reduction
Locomotives	more than 20 times
Freight cars	more than 15 times
Passenger coaches	more than 6 times
Track machines	more than 10 times

Table 3. Overdue rolling stock as of December 2005

Type of rolling stock	Quantity
Main line locomotives	4,000
Shunters	3,000
Freight cars	120,000
Passenger coaches	2,300
MU passenger cars	3,000

The development of railway network also stopped. Due to a railway traffic decline, the existing capacities were not fully loaded. Furthermore, because of developed economic relations between Comecon countries and the former USSR republics in the second half of the 20th century there were no facilities for production of some types of rolling stock, for example main line freight electric locomotives and diesel locomotives in Russia at all. So by the time when the USSR and Comecon collapsed, Russian engineering manufacturers did not possess all necessary technologies to produce the whole range of rolling stock required by Russian railways.

Significant growth of the Russian economy in the beginning of the 21st century led to an increase in volumes and change in structure and routes of freight traffic. As a result, by the period of 2004–2006, RZD faced serious lack of cars and locomotives. The situation was even more serious in terms of technological gap between Russian and foreign railway engineering, reflected in a low carrying capacity and efficiency levels, traveling speed etc. Railways could not be satisfied with new but technically imperfect rolling stock that could not reduce maintenance costs and energy consumption. Railway engineering was seriously thwarting progress in rail transport development (Table 4).

Table 4. Comparative analysis of technical and technological level of rolling stock in Russia and foreign countries (European, Asian countries and the USA)

Type of rolling stock	Russia	Foreign countries
Locomotives	• Absence of serial production of main line freight DC electric locomotives, main line freight diesel locomotives, dual system electric locomotives and commutatorless motors • 11 EP10 electric locomotives with asynchronous driving motors and development of a 2TE25A 'Vityaz' diesel locomotive series with asynchronous traction motors • Lack of rolling stock after-sales service by manufacturers • Overhaul run – about 50,000 km • Maintenance frequency – every 1,500 km	• More than one third of the rolling stock is equipped with asynchronous traction motors • Use of satellite communication and Internet to get real-time information about a locomotive's location and status to detect possible malfunction and make a decision on preventative maintenance • Locomotive after-sales service by the manufacturer during equipment lifecycle • Overhaul run – about 100,000 km • Maintenance frequency – every 10,000 km
Freight cars	• 67 tonnes carrying capacity • 23.5 tonnes axial load • car empty weight – 24 tonnes • small overhaul run, low specialisation and handling capacity level of freight cars • availability of automatic couplers is an advantage when forming stocks, and a disadvantage when exploiting at high speed • overhaul run – 160–250 thousand km	• Manufacturing of eight-wheel cars with a 90 tonnes carrying capacity • 30–35 tonnes axial load • Exploiting a car fleet with a 35 tonnes axial load for carrying 12–20 thousand tonnes trains • Exploiting aluminium alloy cars (car empty weight up to 17–23 tonnes with 117–120 tonnes of carrying capacity) • Using specialised container traffic cars • Using screw joint • Overhaul run up to 1.2m km
Passenger rolling stock	• Distributed drive application • Lack of double-deck coaches, low passenger coaches comfort level, a lot of open-planned coaches in a passenger fleet, low relative density of comfortable stock with seats • Absence of RITZ-sized car production • Shortage of passenger rolling stock (diesel locomotives, DMUs) for low-intensity lines • Use of freight locomotives for passenger operations	• Coaches-'hotels', luxury cars, double-deck passenger fleet, first class cars are widely used • Use of composite materials in production to reduce passenger car net weight • Exploiting passenger cars with pneumatic spring suspension and tilting
High-speed rolling stock	• Regular speed up to 200 km/h, exploiting old and out-of-date passenger rolling stock (operating life of the only two ER200 high speed EMUs expires in 2008, and of ten ČS200 electric locomotives – in 2009) • A shortage of domestic developments and lack of proper productive capacity force RZD to set up contracts on high-speed rolling stock supplies with manufacturers from abroad	• Regular speed up to 300–350 km/h, essential relative density of a high-speed rolling stock in passenger car fleet • Large-scale replacement of high speed passenger coaches with MU fleet • Introduction of magnetic levitation passenger rolling stock

We should note that the Russian Ministry of Industry and Energy[1], responsible for railway engineering predicted such a situation and in 2005 initiated the work on the Railway Engineering Development Strategy by the Institute for Natural Monopolies Research. Initially, the term for its realisation was set by 2010, but taking into consideration the fact that this planning term is rather short for the industry with a long-time investment cycle and that this planning is highly important for rail transport operation, a decision was made to extend the planning term till 2015. As a result work on the Russian Railway Engineering Development Strategy for the period of 2007–2010 and up to 2015 has entered an active phase.

Almost simultaneously with these activity, having considered increasing problems in rail transport development and work, in summer 2006 RZD had a research-and-technical council devoted to discussing the revised Railway Network Development Master Plan[2]. In future this document was further revised and working out the programme of rail transport development was transformed into

IN RUSSIAN LEGAL TERMS, INDUSTRY DEVELOPMENT STRATEGY IS A MULTITUDE OF GOAL-ORIENTED PROGRAMMES, SEPARATE PROJECTS AND EXTRACURRICULAR ACTIVITIES OF ORGANIZATIONAL, LEGAL, ECONOMIC AND DIPLOMATIC TYPE, ENSURING THE INDUSTRY'S DYNAMIC DEVELOPMENT IN THE NEAR FUTURE. THE STRATEGY CLASSIFIES PROBLEMS OF INDUSTRY AND WORKS OUT MAIN MEASURES OF STATE SUPPORT PROVIDING FAVOURABLE CONDITIONS FOR INDUSTRY DEVELOPMENT. STRATEGIES ARE ADOPTED BY THE RUSSIAN GOVERNMENT.

1 Since May 2008 – Russian Ministry of Industry and Trade.

2 The railway Network Development Master Plan is a document stating the main long-term guidelines for railway network technical and technological development (earlier developed by the Ministry of Railways).

RUSSIAN RAILWAY ENGINEERING DEVELOPMENT STRATEGY FOR THE PERIOD OF 2007–2010 AND UP TO 2015 WAS ADOPTED BY THE RUSSIAN GOVERNMENT IN SEPTEMBER 2007.
RUSSIAN RAIL TRANSPORT DEVELOPMENT STRATEGY UP TO 2030 WAS APPROVED BY THE RUSSIAN GOVERNMENT IN SEPTEMBER 2007 AND ADOPTED IN JUNE 2008.

Russian Rail Transport Development Strategy up to 2030. Ministry of Transport was in charge of this document developing.

In fact the state, represented by two ministries, the Ministry of Industry and Energy and the Ministry of Transport, for the first time in the modern history performed the development of such large-scale, complex and long-term documents in the field of rail transport. Of course, this work could not be done independently, without considering the mutual interests of manufacturers and railways.

On the one hand, RZD being both the main developer of the Rail Transport Development Strategy and main consumer of railway engineering products worked out requirements for the production volumes of current equipment models and for the parameters and production volumes of the future equipment. On the other hand, capabilities of domestic engineering were considered in terms of modern equipment development rate and its production development rate. What is more important is that both strategies' realisation mechanisms were coordinated.

‘RAIL TRANSPORT DEVELOPMENT STRATEGY IS OUR CONTRIBUTION TO THE PROGRESS OF THE STATE AND RUSSIAN SOCIETY AS WELL AS TO GLOBAL DEVELOPMENT’.

Extract from the speech of Vladimir Yakunin, President of RZD at the Railway Congress, October 24, 2007

One of these mechanisms assumes introduction of signing long-term contracts into practice, stating specific features, volumes, deadlines and, what is most important, prices. Recently only long-term agreements were concluding, which did not contain specific delivery terms inherent in contracted forms of cooperation. In fact, parties signed these agreements on a free-will basis and they did not contain any financial obligations. As a result, manufacturers could not work out long-term plans on the design and production adaptation of this equipment and, hence, without an assured market and defined product operating requirements they could not reckon on a return on investment. For this reason it became very difficult to raise external investment.

After analysing the development process and coordinating the Railway Engineering Development Strategy, an interesting fact can be noted. The provisions of the Strategy began to be implemented before it was officially approved, which once again highlights the necessity of the realisation mechanisms provisioned by the Strategy. Thus, just during the coordination stage of the Railway Engineering Development Strategy by the executive authorities, the largest industry consumer, RZD, had already signed long-term contracts. In May 2007 the first long-term contracts on locomotives development and supplies were signed in Russia. Contracts signed between RZD and Transmashholding for the delivery of 800 units of four new locomotive models are valid till 2015. In September 2007 contracts were signed between RZD and Transmashholding for the delivery of additional locomotives along with a long-term contract for freight car delivery between RZD and Uralvagonzavod. According to the contracts, over the next three years, Uralvagonzavod will deliver 40,000 freight cars to RZD for a total sum of €1.8bn. In its turn Transmashholding will deliver more than 200 locomotives for a total sum of €360m.

Both Strategies provide for a leading and stimulating role of the state. RZD is really acting as a state customer, ensuring long-term and considerable demand for transport engineering products. This grants Russian railway engineering the opportunity to demonstrate one of the highest growth rates in the world. For example, according to the Railway Engineering Development Strategy, locomotive manufacturing will gradually increase and by 2012 will run up to 1000 units per year. New models of traction equipment that has never been manufactured in Russia will form the main part of the produced equipment.

The Rail Transport Development Strategy also worked out coordinated requirements for future railway engineering products, considering both qualitative and quantitative features (Table 5). At the same time definite delivery dates were stated for the supply of transition and prospective locomotive and car models. The Strategy also provides for the rail infrastructure to prepare to use modern equipment.

Table 5. Principal specifications of new locomotives

Parameters	Foreign locomotives	Russian locomotives of the transition stage	New-generation Russian locomotives
Locomotive run between repairs			
Maintenance	10,000 km	3 - 5 days	15,000 km
Servicing (thousand km)	100	30 -50	100
Mid-life repair (thousand km)	1,000	600 - 800	1,000
Overhaul (thousand km)	3,000	1,600 – 2,400	3,000
Locomotive reliability comparative indices			
Number of failures for every run of one million km	5	14 – 18	4
Availability ratio	0.95	0.93 - 0.95	0.96
Life time (years)	30	33	40

Source: Railway Engineering Development Strategy

For example, Tver Carriage Works has been delivering passenger coaches to RZD since 2008 only with modern disk brakes. One of the features of their exploitation is that it is mandatory to have pits for servicing disk brakes as well as specialised depots for servicing modern passenger rolling stock, including the servicing of conditioning systems, dry closets, heating systems, water supply etc. As a result, in response to the engineers' readiness to provide railways with modern rolling stock, RZD has developed and is implementing now a servicing depots building programme. According to this programme 24 depots will be built during 2006–2011 at the cost of €520m.

Strategy implementation mechanisms have their own distinctions, resulting from structural peculiarities and the functioning of rail transport and railway engineering.

The application of public-private partnership mechanisms in railway network development is one of the main universal mechanisms of the Rail Transport Development Strategy.

The railway engineering organisational structure, unlike rail transport structure with RZD occupying the leading position, is characterised by a large number of participants with a varying form of ownership. For example, apart from joint stock companies, a large share of production belongs to federal state unitary enterprises[3]. Production of locomotives, freight cars and track equipment is characterised by a varied technological, cooperation-based and organisational process specification. Locomotive manufacturers are characterised by a relatively small output: in future up to a thousand units per year. Here, locomotives belong to capital- and science-intensive products, characterised by many cooperation-based links. Freight car manufacturing is characterised by a steel intensity, relatively simple (as compared to locomotives) construction with a small amount of component parts and high quantitative indices (it is planned to produce 50–70 thousand cars per year in the future). A specific feature of passenger car manufacture is close to that of locomotives. Track equipment manufacture is a matter of single projects or small-scale serial production. At the same time the degree of cooperation-based links is considerable.

Such industry structure has resulted in the need to develop universal methods for realisation of the Railway Engineering Development Strategy, applied by different manufacturers, irrespective of the ownership type or industry affiliation of the producers. One of these methods demand stimulation at the internal market, ensured by long-term orders from railways.

Both strategies have something in common though. Both railway engineering and rail transport have comparable profitability indices based on the state regulation of railway tariffs. Low profitability of railways is transferred to the engineering industry as a result of RZD purchasing price limitation not only on current products, but also on new developments. Such a situation results in a limitation of manufacturers' financial capabilities in terms of development of future locomotive models, scien-

3 Federal state unitary enterprises – companies with all material property belonging to the state and which are run by government appointed managers.

tific research and development activities and reinforcement of production facilities. And this stands true not only for railway engineering, but also for component parts industries, reflecting the low production profitability of component parts production. And again, RZD's low economic efficiency cannot ensure independent financing of new railway lines.

The financial problem of Strategies can be solved in different ways. In railway engineering the state can partially finance R&D field, while manufacturers should act as co-sponsors with a bigger share invested in the introduction of new rolling stock models. At the same time, RZD should guarantee sales of these products, which meet technical, performance and economical requirements. For rail transport, the problem of insufficient financing is solved using federal and regional budgets meant for financing the building part of rail lines, given a strategic and social importance status by the Rail Transport Development Strategy.

Another common problem of the two strategies is human resources. In the Rail Transport Development Strategy this problem is a result of a low income level. At the same time there is no vivid direct competition as railway men as a rule are employed either by RZD or by special commercial railway companies. Railway engineering is known for its inter-industry staff competition. For example, a highly qualified turner is wanted not only by this industry, but also by other industries. That is why labour market competition is really high. The situation is even more difficult due to the fact that, unlike railways that

have managed to maintain a professional learning system, there is no such a single system in railway engineering. Hence, the Rail Transport Development Strategy provides for modernising and upgrading the existing system, while the Railway Engineering Development Strategy makes provisions for reconstructing the system, taking into account the existing economic and organisational environment.

WHAT IS THE MOST IMPORTANT?

Perhaps, the main result of the coordination of the strategies is the fact that after their implementation rail transport will have at its disposal a new domestic rolling stock based on modern technologies. It can be stated that new Russia has a clearly formed industrial policy in railway engineering or in the words of Russian Vice Prime Minister Sergey Ivanov, 'a market in exchange for technologies'. The main idea of this policy is giving favour in the transport engineering industry to foreign companies which will establish joint ventures with Russian companies with further obligatory transfer of technologies. With the market volume (more than €5bn in 2010) and growth rate of Russian railway engineering products, foreign companies are attracted to enter the market and stay for a while. To ensure that Russian engineers can master new technologies, state policy gives priority to those foreign companies that are willing to transfer new technologies rather than to the companies interested particularly in finished goods delivery or arranging screwdriver assembly.

This attitude to industrial assembly in railway engineering was made public in autumn 2006, followed by foreign partners either establishing joint ventures with Russian manufacturers or expressing their interest in creating similar cooperation mechanisms in 6 months time. In May 2007 an agreement establishing two joint ventures, an engineering centre for new modern component parts, equipment, rolling stock technical and technological solutions development and a joint venture producing traction converters, was concluded between Transmashholding and Bombardier Transportation. In June 2007 Russian media reported that Siemens AG expressed an interest in establishing a joint venture with Transmashholding to produce Russian EMUs, metro cars and locomotives on the basis of the German concern's technology. In September Alstom Transport, a French company, expressed interest in establishing joint business in Russia with Russian manufacturers.

In this situation it was the provisions of the Railway Engineering Development Strategy and the position of RZD, based on the state industrial policy, that persuaded foreign manufacturers to view Russia, a country capable of standing up for its economy and society, as a 'technological partner'.

Expanding cooperation with foreign partners will ensure that domestic rail transport is equipped with modern rail infrastructure elements and advanced rolling stock models. At the same time it is obvious that domestic product quality and appropriate price should be one of the most important indices.

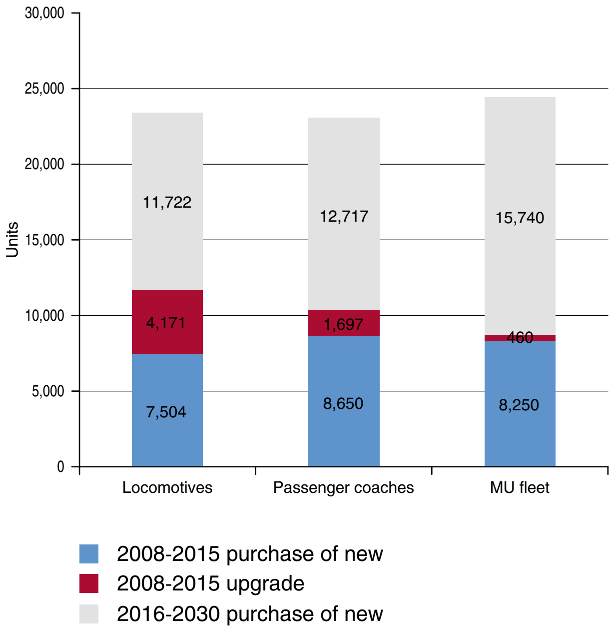
Matching of the strategies has ensured not only the elaboration of clear guidelines for rail transport and railway engineering development, but also the design of practical mechanisms of their technical and technological reequipment. In fact, with the successful implementation of strategies, rail transport has every prospect for not only reaching the level of developed countries in this area, but also becoming a world leader with developed export prospects of freight and passenger transportation technologies while securing their high level of safety and reliability along with proper pricing and service.

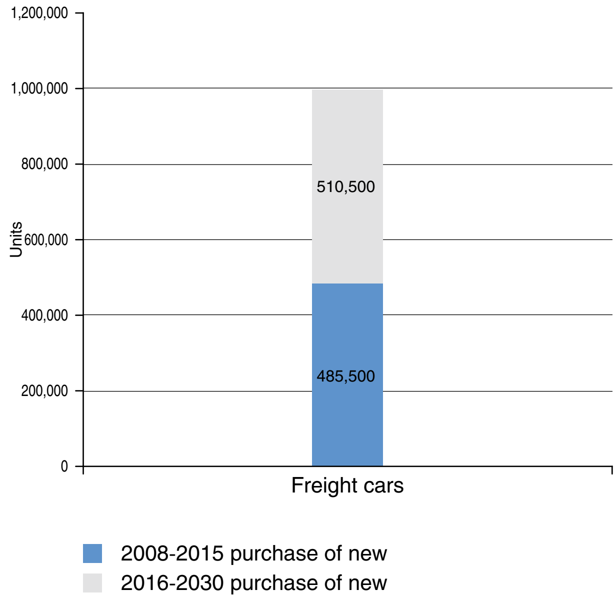
ORDERS OF RAILWAY ENGINEERING PRODUCTS IN ACCORDANCE WITH THE RAIL TRANSPORT DEVELOPMENT STRATEGY UP TO 2030

Rail transport needs in rolling stock renewal during 2008–2030 (in units)

Type of rolling stock	Main line transport	Industrial transport	Total
Locomotives – total	23,397	19,273	42,670
Including upgrade	4,171	14,355	18,526
Main line freight cars	996,000	142,240	1,138,240
Industrial freight cars	-	77,250	77,250
Passenger cars – total	23,064	-	23,064
Including upgrade	1,697	-	1,697
MU fleet – total	24,450	-	24,450
Including upgrade	460	-	460

Needs in main line rolling stock renewal during 2008-2015 and 2016-2030



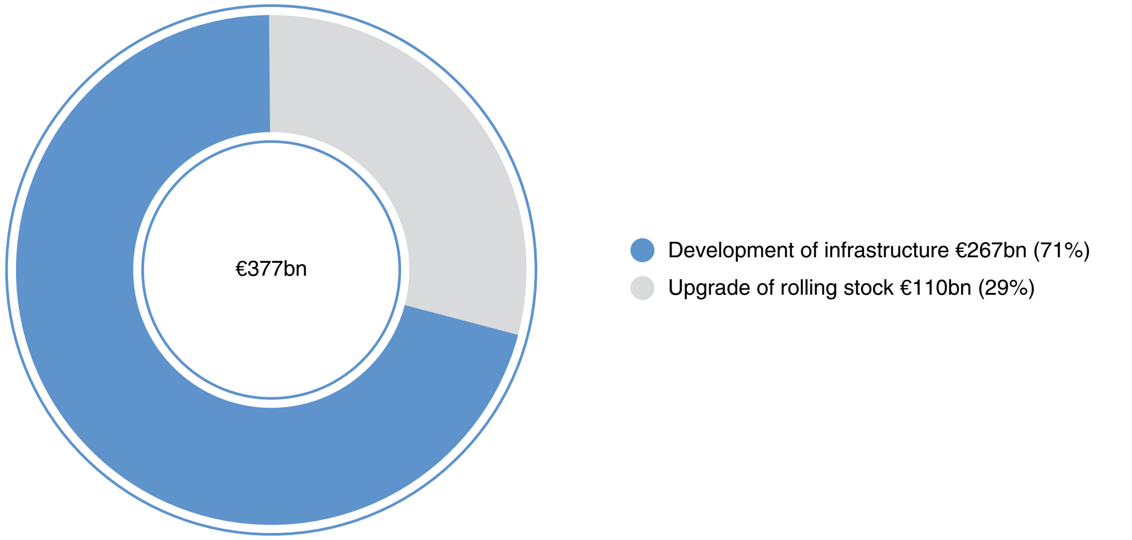


Main line rolling stock renewal level during 2008-2030

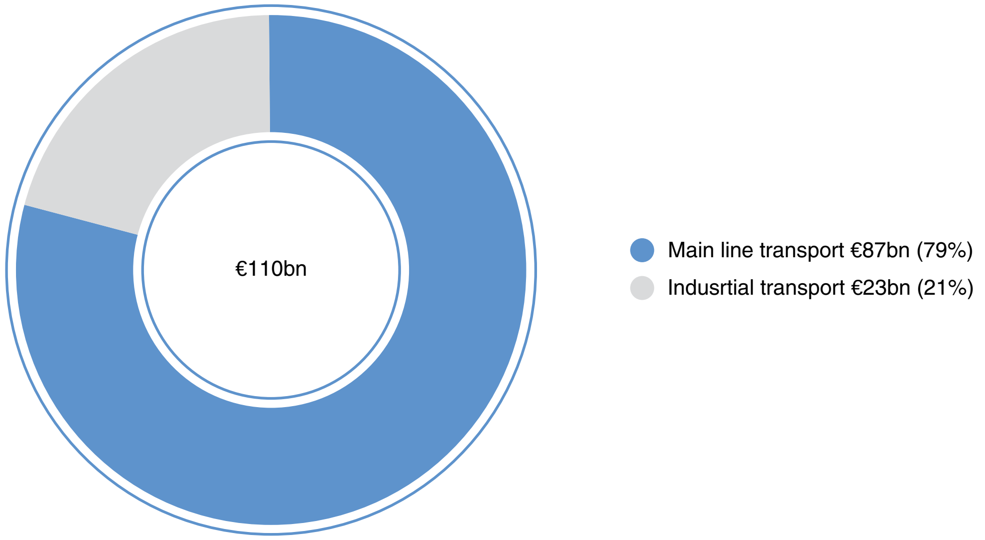
Type of rolling stock	Renewal level
23,000 locomotives	117% of existing fleet
990,000 freight cars	106 % of existing fleet
23,000 passenger cars	90% of existing fleet
24,000 commuter trains cars	160% of existing fleet

FINANCIAL AND ECONOMIC EVALUATION OF LONG-TERM ORDERS

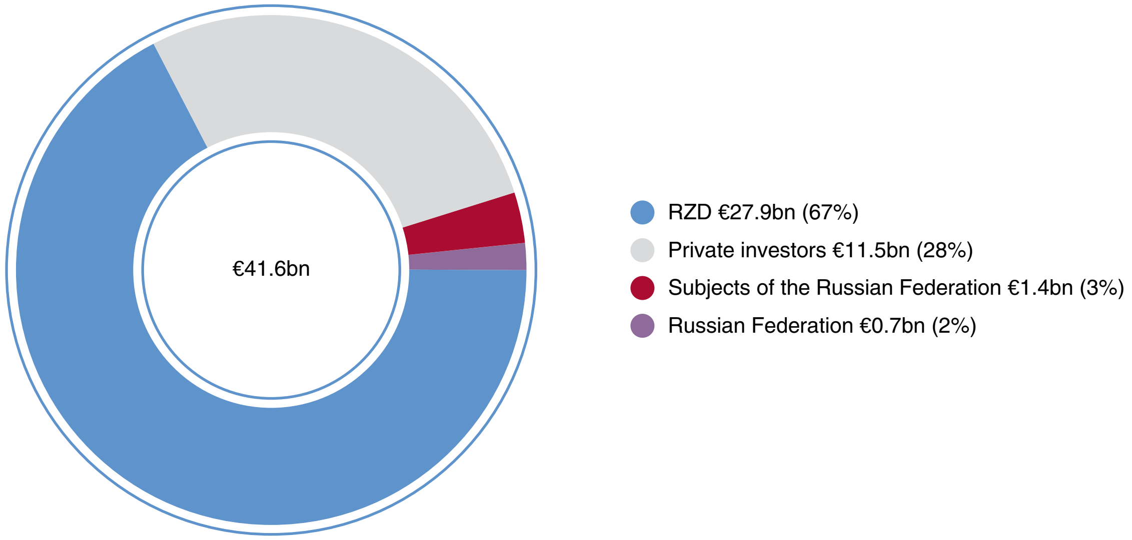
Structure of the overall volume of investment into main line and industrial rolling stock renewal for the period of 2008-2030



Structure of investments in rolling stock by type of transport for 2008–2030



Distribution of investments in main line rolling stock by finance source for 2008-2015



THE RUSSIAN RAILWAYS PROGRAMME FOR UPDATING ROLLING STOCK FLEET DURING 2008–2012

Compiled from the report made by Vice President of Russian Railways OJSC Valentin Gapanovich at the meeting of the RZD's Scientific-and-Technical Council held on March 25, 2008

In compliance with the Rail Transport Development Strategy up to 2030, approved by the Russian Government, Russian Railways OJSC (RZD) has elaborated a Programme of rolling stock supplies from 2008 to 2012.

This Programme has been synchronized with the Russian Railway Engineering Development Strategy up to 2015.

At present, national railway equipment, as far as key performances are concerned, lags notably behind its foreign counterparts. To overcome the engineering technological gap an urgent innovation breakthrough is required, both in the railway engineering industry and in the allied industries that ensure the complete package. A point of reference for this should be the RZD's Innovation Development Strategy up to 2015 realised via the company's scientific-and-technical development plans, elaborated last year and called 'The RZD White Book'.

Supplies of new equipment with somewhat different consumer properties requires a fundamental revision of the standard framework. Work is now being performed under the Federal law 'On Technical Regulation', including the elaboration of the core document (Engineering Regulations), the national and sector-based standards, safety standards and test procedures.

At the same time, a set of documents is being elaborated, facilitating a new approach to purchasing rolling stock basing on lifecycle costs. Unlike today's policy where the only criterion used is purchase costs, the lifecycle cost includes the total sum of expenditures on machinery development and production, its maintenance and repair and, finally, its recovering. The lifecycle cost estimation allows a more precise determination of the rolling stock overall expenses and their minimization.

CORE DOCUMENTS ON THE RZD'S INDUSTRIAL POLICY

Proceeding from the existing standard, RZD has created a multi-purpose matrix, specifying the activities of all participants in the production of new types of equipment, from the elaboration of the operating and commercial requirements up to commissioning. This procedure was introduced in a project with Siemens AG for the purchase and servicing of high-speed trains.

It is hardly possible to implement the RZD's industrial policy using the old innovation control model. This is why it was decided in 2007 to form an innovative activity unit within the RZD's Technical Policy Department to coordinate efforts in each direction. This allowed to separate functions of the customer and the contractor and to significantly enhance the efficiency of the decisions made.

The efficient implementation of the Rail Transport Development Strategy and the Railway Engineering Development Strategy requires special attention to be paid to the quality of purchased products. With this aim in view, RZD has reorganized the factory acceptance system and established the Technical Audit Centre with its primary objectives to manage the quality control at all stages of the rolling stock and sophisticated equipment production and to implement the Company's policy of the strategic supervision over manufacturers in the field of products quality.

The railway equipment obligatory certification system, introduced in 1998, continues to be used but it is clearly insufficient. What is required now is to ensure an objective assessment of product quality and operating efficiency.

The mechanism for implementing this approach is both well known and widely used abroad. This is a voluntary form of product certification combined with a quality management system. Combined efforts of railway operators and manufacturers are required for the development of sophisticated technical systems. Coordination of efforts between manufacturers and consumers, among other things could be useful to select high-quality components, systems and materials, to develop a new standard base and to introduce new control standards.

To solve the listed problems, RZD has worked with leading manufacturers to create the non-profit partnership 'Union of Industries of Railway Equipment', which currently consists of 68 member organisations.

OVER €17BN WILL BE SPENT IN 2008–2012 ON THE PURCHASE OF ROLLING STOCK.

Russian locomotive manufacturing plants have switched over to production of transition-period locomotives for both freight and passenger operations.

RZD'S INDUSTRIAL POLICY IMPLEMENTATION

In freight car production, a new 12-132 series of gondola cars has been brought into production and also production of long-base flat cars carrying two 40-feet containers has been started.

Passenger car manufacturers have mastered the production of a new car model range with improved commercial properties. The production of 'Nevsky Express' type 200 km/h cars has been ensured.

Suburban rolling stock will be supplemented with an innovative project of the RA2 rail bus (DMU) using advanced technologies. At the same time, the machinery plants have not mastered the production of the MU fleet with power-saving equipment, which is extremely important for reducing energy costs in the passenger transport.

The systemic limitation which thwarts the progress in the effective upgrade of the rolling stock fleet involves lack of production capacity, low engineering level of specialised national machinery due to insufficient financing in the 1990s and in the early 2000s.

THE PRIMARY OBJECTIVE IN SUBURBAN TRAVEL IS TO DEVELOP SERIAL PRODUCTION OF NEW-GENERATION DMUs AND ED10 EMUs WITH ASYNCHRONOUS TRACTION MOTOR.

Russian Railways OJSC today has worked out a clear-cut well-balanced plan for the investment it needs to acquire rolling stock for the mid term, devided by the year and the type of rolling stock. Over €17bn will be spent on this in 2008–2012. The decisions made by RZD enjoy complete financial backing and form a guaranteed demand for rolling stock purchases. This sends an important signal to business to develop production, not only in the manufacture of final products, but, what is especially urgent, in the production of rolling stock component parts. The wide range of used components and high demand for them bring about conditions, which attract a great number of manufacturers of the most diverse components as well as small and medium businesses.

RZD plans to work together with manufacturers to address the following problems in the development and production of new-generation rolling stock.

Locomotive engineering

The primary objectives are as follows:

- Putting diesel locomotives with an asynchronous traction motor drive into commercial production in 2009;
- Joint development and initiation of serial production of EP20 dual-system passenger electric locomotives in 2010 at Novocherkassk Electric Locomotive Plant;
- Development and initiation of serial production of 27 tonnes axial-load main line DC and AC electric locomotives with an asynchronous traction motor in 2011;
- Development of production capacities and introduction of new-generation diesel locomotives in 2013.

Freight car production

The main issues in the short term with freight rolling stock are the production of cassette-type axle box bogie cars and a complete changeover in 2009 to the production of gondola cars with the load per axle of 25 tonnes.

This year, the development of the first Russian gondola car with maximum capacity of 83 tons and maximum load per axle of 27 tonnes for coal transportation has been started and, by the end of this year, the first one will be constructed at Roslavl Car Repair Plant.

Passenger car production

The primary objective in this field is to develop the commercial production of two-floor passenger cars with an aluminium-alloy-based body.

High-speed rail travel between Moscow and Western Europe requires a permanent rolling stock fleet. Preliminary assessment indicates that using tilting cars on Moscow – Berlin line will allow not only a 160 km/h running speed but it will also prevent both RZD and Belarus Railways from the excessive investment of about €830m and €300m respectively to upgrade infrastructure due to this high speed.

Investments into renewal of rolling stock by 2012 (in billon of rubles)

2008	27,6	24,6	12,4	21,8	86,4
2009	40,9	26,5	14,7	27,5	109,6
2010	52,5	24,7	18,0	31,8	127,1
2011	63,0	24,0	28,8	33,3	149,1
2012	74,1	24,0	28,8	29,3	156,2

Total:
628,4

MU passenger fleet

In 2009 the start of serial production of rolling stock with the power-saving equipment is planned, which will help to reduce power consumption by 15%.

The primary objective in suburban travel is to develop serial production of new-generation DMUs and ED10 EMUs with asynchronous traction motors, including the construction of rolling stock to service the Sochi Winter Olympic Games in 2014.

Complete and timely realisation of the above measures will reinforce the Russian rail industry with a rolling stock fleet, that meets the up-to-date technical requirements. It will also ensure the development of the engineering complex and allied industries.

LIFECYCLE COST ESTIMATION — A NEW APPROACH TO RAILWAY EQUIPMENT PRICING POLICY

Konstantin Kostrikin
Expert analyst
Institute for Natural Monopolies Research

The Rail Transport Development Strategy up to 2030 and Railway Engineering Development Strategy up to 2015 adopted by the Russian Government charge railway engineering with the task of making crucial improvements in railway engineering technical and economic performance. In a fairly short period of time manufacturers will have to come up with engineering solutions to increase locomotive overhaul life by 50%, passenger car and freight car overhaul life up to 600,000 km (increase of 33%) and to 500,000 km (in the future – up to 1 million km; an increase of 100–200%) respectively. Other issues facing railway engineering are to decrease specific traction energy consumption by 5% and traction fuel consumption by 6.7%.

In many respects achievement of these figures depends on equipment operating conditions: infrastructure condition, traffic management, maintenance and repair. However, when coordinating the Railway Engineering Development Strategy up to 2015 with the main issues of the Rail Transport Development Strategy up to 2030, infrastructure modernisation plans and traffic management improvement prospects were taken into consideration. It helped to structure main consumer requirements for economic indicators of rolling stock operations.

Railway Engineering Development Strategy was preceded by industry status analysis. This analysis revealed that industry-specific pricing has its distinctive features caused by the following factors:

- the existence of a large customer – RZD, which purchases more than 90% of main line locomotives and passenger cars;
- the main types of railway engineering products are produced by one or two large manufacturers, i.e. a monopoly or oligopoly exists (except freight car production);
- the restriction (due to government rail transport tariff regulation) of RZD investment resources, which could be used for buying new rolling stock.

In most cases market participants employ cost-plus methods of pricing. On the one hand this is due to the traditions from the times of the planned economy, and on the other it is the result of well-developed relationships between manufacturers and consumers. In product and service markets, where RZD is, as a rule, the only buyer, term contracts with a fixed purchase price were signed. The price was calculated according to a ‘cost-plus’ plan based on the product net cost when price negotiations began.

Price revision due to changes in cost of key parts or components while the contract is in effect requires approval of the RZD Pricing Committee. The price revision agreement procedure includes several stages and is rather lengthy (on average it takes from one to several months). In addition, RZD doesn't always agree with manufacturers' arguments.

Price increases in raw material and energy markets together with increased demand for the rolling stock significantly influence supply prices. Unlike other industrial sectors where it is possible to balance demand and supply without damaging the economy of the entire country, when all transportation process participants have insufficient rolling stock due to limited investment resources, this may cause structural limitations in economic growth. Given these conditions, a thorough review of pricing approaches, which had worked in the past, was necessary.

Internationally, lifecycle cost estimation (LCE) methods are used more and more often to evaluate the efficiency of complex technical capitalised product procurement. In fact, this method is a formulation of a business plan for procurement and opera-

tion of a certain technical product or group of products with a forecasting depth that covers their entire service life. Although there exists a general understanding of the lifecycle cost estimation concept among professionals, various companies develop their own methods, depending on the type of equipment and its operation specifications, on the basis of which a decision is made regarding the selection of a supplier.

LCE methods are widely used to evaluate innovative activities: introduction of more efficient equipment, selection of technical systems modernisation options, etc. An important feature of this method is its exclusive application in functionally complete technical systems, such as rolling stock units, processing machines, production lines, and means of transportation. Applying LCE methods to separate parts, units and components is difficult since it is necessary to consider not only technical features of these items but also the effect their alteration may have on technical system performance as a whole.

Another specific feature of LCE method application is the required existence of comparable alternatives. In situations when there is a lack of alternative supply of such equipment on the market, it is necessary to make a comparison with the equipment purchased in the past, which significantly distorts the results obtained.

Applying LCE methods allows avoidance of cost-plus pricing methods, but requires special research activities to determine the link between the technical characteristics of rolling stock and its economic performance. In this process it is completely natural that the price of more productive and more operationally efficient equipment should be higher: this is in favour of both the manufacturer and the consumer.

An example of comparative price estimation of lifecycles of various types of rails is provided by research and tests carried out by Deutsche Bahn AG (Germany) and VoestAlpine Schienen Company (Austria). Research results obtained on the example of a curve with a 3300 m radius with trains moving at high speed proved the economic efficiency of using heat-treated rails instead of standard rails of carbon steel.

Similar research is conducted for products used in a range of the most diverse industries, from public services to electrical power construction sites.

Union of Industries of Railway Equipment (UIRE), a non-profit organization which unites major domestic rolling stock and complex technical systems manufacturers, actively participated in developing methods for determining lifecycle cost estimation for rolling stock along with RZD.

By RZD resolution under December 27, 2007 'A methodology of determining lifecycle cost and price limit of rolling stock and complex technical systems of rail transport (basic regulations)' (hereafter referred to as Methodology) was approved.

In January 2008, a scientific and technical seminar 'Application of lifecycle cost estimation methods for evaluation of new rolling stock and complex technical systems competitiveness' was conducted on the initiative of UIRE at RZD's Innovative Development Centre. Lifecycle cost estimation methods were presented at the seminar. Companies participating in LCE methods development, All-Russian Rail Transport Technology Research Institute (VNIIZhT) and All Russian Rolling Stock Design and Technology Research Institute (VNIKTI), gave detailed explanations, provided examples of lifecycle cost estimation and introduced software for lifecycle cost and competitiveness estimation.

At the 2nd All-Russian Council of Chief Designers, held on March 21, 2008 at the RZD Innovative Development Centre, innovative developments of the railway engineering and railway industry were discussed and a stage-by-stage transition to usage of the LCE method when determining prices for products supplied to Russian Railways was unanimously approved.

One important feature of the approved method should be noted: according to Clause 8 of the Methodology, 'The present Methodology is subject to occasional adjustment during acquisition and synthesis of experience in lifecycle cost estimation of rail transport rolling stock and complex technical systems. In the process of its evolution, the development of guidelines reflecting ways of lifecycle components cost estimation, a list of conditions and allowances used for forecasting, recommended forms of benchmark data and result estimates, examples of lifecycle cost and price limit estimates of rail transport rolling stock and complex technical systems are anticipated'.

Development and stage-by-stage transition to usage of this methodology shows that RZD has begun the development of a scientifically grounded decision-making system on the selection of suppli-

LIFECYCLE STAGES

↓

Working out concepts and definitions

↓

Research and development

↓

Machine production

↓

Putting into operation

↓

Operation and service

↓

Liquidation

ers of rolling stock and complex technical systems. Therefore, participation of manufacturers themselves in the revision and adjustment of this technique on the one hand will allow their current and future manufacturing capabilities to be taken into consideration more fully, while, 'on the other hand', it will allow them to gain complete information about operating conditions and maintenance of the products they produce.

The Methodology provides terminology used in lifecycle cost estimation, the LCE formula, composition of expenses included in LCE, and methodological approaches used while determining various kinds of LCE. Apart from this, the Methodology contains a large number of ratios, estimation formulas and guidelines, ensuring comparable results in LCE for various types of rolling stock of different manufacturers.

However, it is necessary to note those regulations of the Methodology implementation which may give ambiguous results.

DETAILED EXAMINATION OF THE INVESTMENT EXPENSES DURING ROLLING STOCK LIFECYCLE COST ESTIMATION REVEALS SERIOUS CONTRADICTIONS WITH RAIL TRANSPORT ECONOMICS LOGIC.

These regulations include:

1. Invariability of methodology.

Only the purchase of new equipment to replace retired is considered an innovative project while the possibility of purchasing new equipment to replace completely usable but out-of-date is not considered.

In fact in this Methodology only the purchase of new equipment to replace retired rolling stock and the increase of the fleet to ensure transport volume growth are envisaged. However, those tasks that are set forth for rail transport might require complete modernisation of current equipment or replacement of the rolling stock that is still usable with new and highly efficient rolling stock. There is no ready-made solution for this problem at this time. Taking into consideration current conditions of the fleet – a high level of deterioration and accumulated unsatisfied demand – solving this problem is not a primary concern. However, as the situation relating to the preparation of the Rail Transport Development Strategy up to 2030 shows, events may develop very quickly and, in such a case, the question on how to evaluate the efficiency of projects aimed to replace the obsolete equipment will inevitably arise.

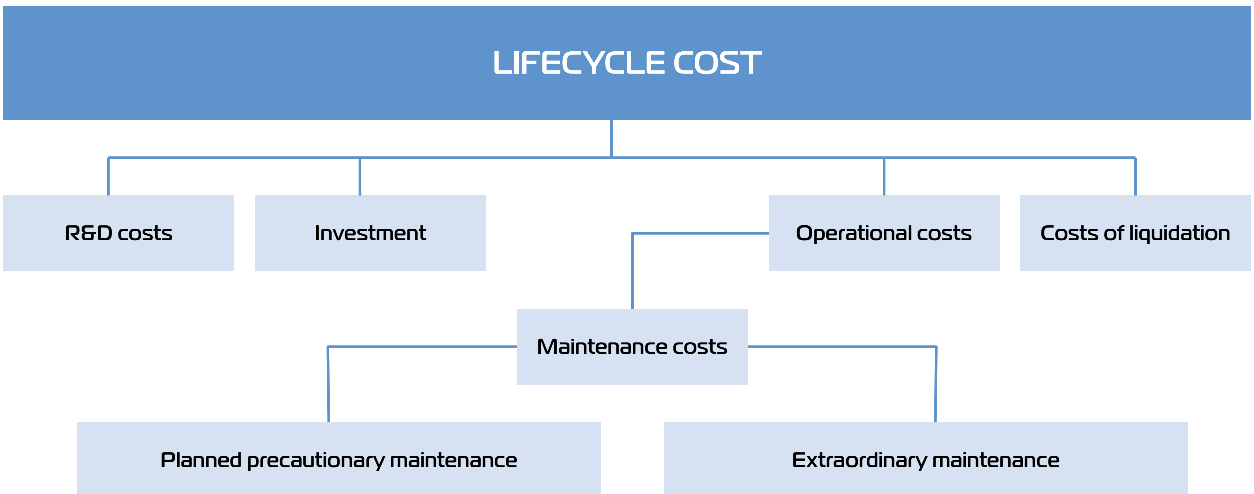
2. Combining railway equipment and rail transport infrastructure lifecycles.

The Methodology contains regulations, according to which expenses of infrastructure modernisation (in order to meet new rolling stock requirements) are included into lifecycle expenses. One of such regulations, the concept of "accompanying investment expenses when estimating the lifecycle cost of rolling stock", requires serious clarification and, perhaps, review.

According to economic logic, growth of transportation demand requires, above all, the elimination of infrastructure restrictions followed by utilisation of more efficient equipment which allows the implementation of improved infrastructure capabilities. This refers to an increase in traffic speed, load per axle, and expansion of travel routes of heavy trains. Based on the Methodology regulations it can be assumed that manufacturers of old equipment models will be economically stimulated, since costs of rolling stock are not comparable to costs of infrastructure modernisation, and manufacturers of new, highly efficient railway equipment will not be able to bear expenses of infrastructure improvement to meet the requirements of new developed rolling stock.

Detailed examination of the investment expenses during rolling stock lifecycle cost estimation (Appendix 8 to the Methodology) reveals serious contradictions with rail transport economics logic. Therefore, when operations of new modern locomotives start, investment in acquiring an additional fleet of cars (clause 4 of Appendix 8) is included in total costs.

Costs for the service base renovation, caused by the purchase of new rolling stock, require additional clarification. Adjustments to these expenses may be necessary since there may be cases when a service base will be used for repairing both new and old rolling stock.



3. Discrepancy between costs for equipment maintenance being declared by the manufacturer while being carried out by the RZD as the consumer.

The methodology of forecasting rolling stock current operation costs (Appendix No.1 to the Methodology) requires clarification. The manufacturer cannot affect internal processes that take place in RZD and the level of these costs. This may cause unreasonable lifecycle cost over- or underpricing. Apart from this, in lifecycle cost methodology it is necessary to justify in more detail or exclude some expenditure from operating costs.

For example, in locomotive segment this refers to expenditures on remuneration of passenger car service staff, repair, cars renovation, rolling stock equipment, yard tracks, maintenance and depreciation expenditures on the permanent way. It is necessary to specify the composition of expenditures included in the "raw and other materials payments" clause in track segment.

When specifying the composition of operational expenditures it is necessary to highlight the technical and organisational part in each variable, since manufacturers are not able to influence transportation process organisation.

Despite these internal contradictions, the advent of the lifecycle cost estimation Methodology is undoubtedly an important step forward to improving the quality of railway equipment and optimising costs on its operation. To eliminate the indicated contradictions of the Methodology, the following areas should be specified and detailed:

- specifying composition and detailed elaboration of items included in lifecycle cost;
- development of a system of registration, accounting and analysis of operational activities indicators and a feedback system from consumers to manufacturers;
- conducting research aimed at detecting economic efficiency from the improvement of certain technical parameters, which will allow to separate technical and organisational components of the economic effect and to forecast lifecycle cost more accurately;
- development of a performance review system which will allow manufacturers to certificate sections, carry out rail transport rolling stock and complex technical systems maintenance and repair. It will allow to share more efficiently best practices, to bring improvements into the modern equipment operations process.

As stated above, the main distinctive feature of this Methodology is that inner development mechanisms are incorporated into it. The joint work of RZD and members of UIRE will allow, on the one hand, to develop and improve the lifecycle cost estimation methodology itself and, on the other hand, to provide railway transport with modern highly efficient rolling stock to meet the needs of the Russian growing economy.

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STATISTICS

All statistical data, provided in this section, are based on official information of federal executive bodies, adjusted in accordance with the data of Russian Railways and manufacturers.

BASIC MACROECONOMIC INDICATORS OF RUSSIA

Basic macroeconomic indicators, 2001–2007

Indicator	Measure	2001	2002	2003	2004	2005	2006	2007
Nominal GDP	RUR bln							
Real GDP growth rate	% to the prev. year							
Investment growth rate	% to the prev. year							
Real household disposable income growth rate	% to the prev. year							
Consumer price index	% to the prev. year							
Federal budget								
Revenue	RUR bln							
	% of GDP							
Surplus	RUR bln							
	% of GDP							
Consolidated budget*								
Revenue	RUR bln							
	% of GDP							
Surplus	RUR bln							
	% of GDP							
Export	US$ bln							
	% of GDP							
Import	US$ bln							
Net Export	US$ bln							
	% of GDP							
External national debt (in the end of the year)	US$ bln							
	% of GDP							
Stabilisation fund (in the end of the year)	RUR bln							
	% of GDP							
Gold and foreign currency reserves	US$ bln							

Data available in printed version only

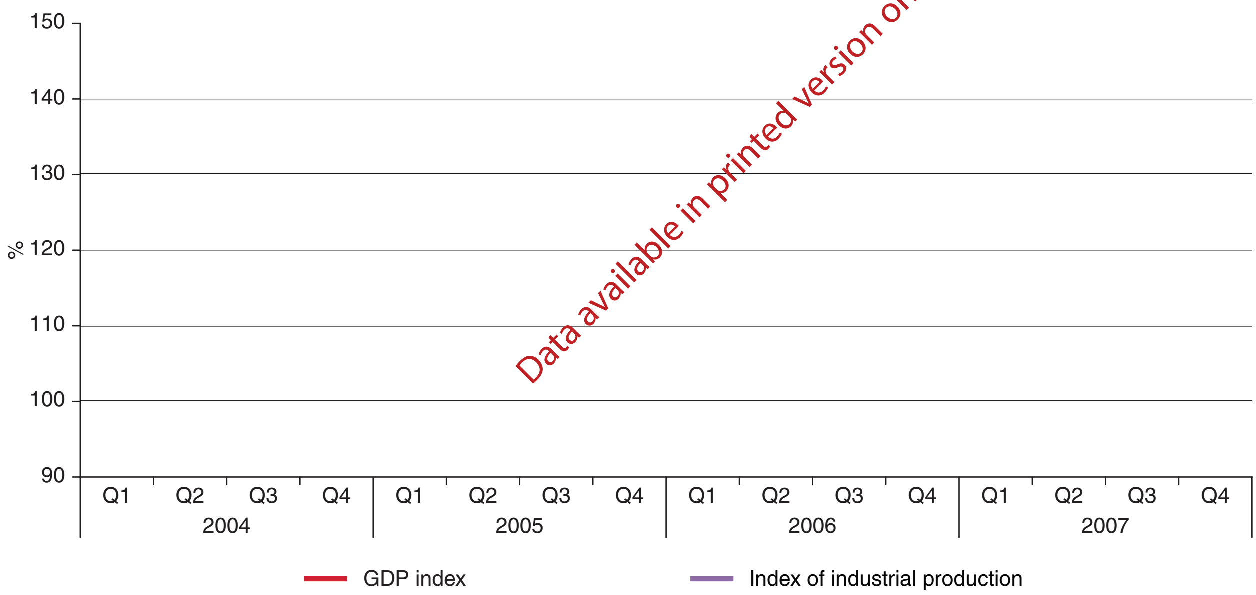
* *Consolidated budget is the joint budget of the Russian Federation, subjects of the Federation and municipalities.*

Basic macroeconomic indices, quarterly

Indicator	Measure	2004				2005				2006				2007			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
GDP Index	% to an average quarter of 2003*																
Index of industrial production	% to the previous quarter																

* one fourth of GDP-2003

Basic macroeconomic indices dynamics



Russian ruble exchange rate, 2001—2007 (RUR per currency unit)

Currency unit	2001	2002	2003	2004	2005	2006	2007
US Dollar							
Euro							

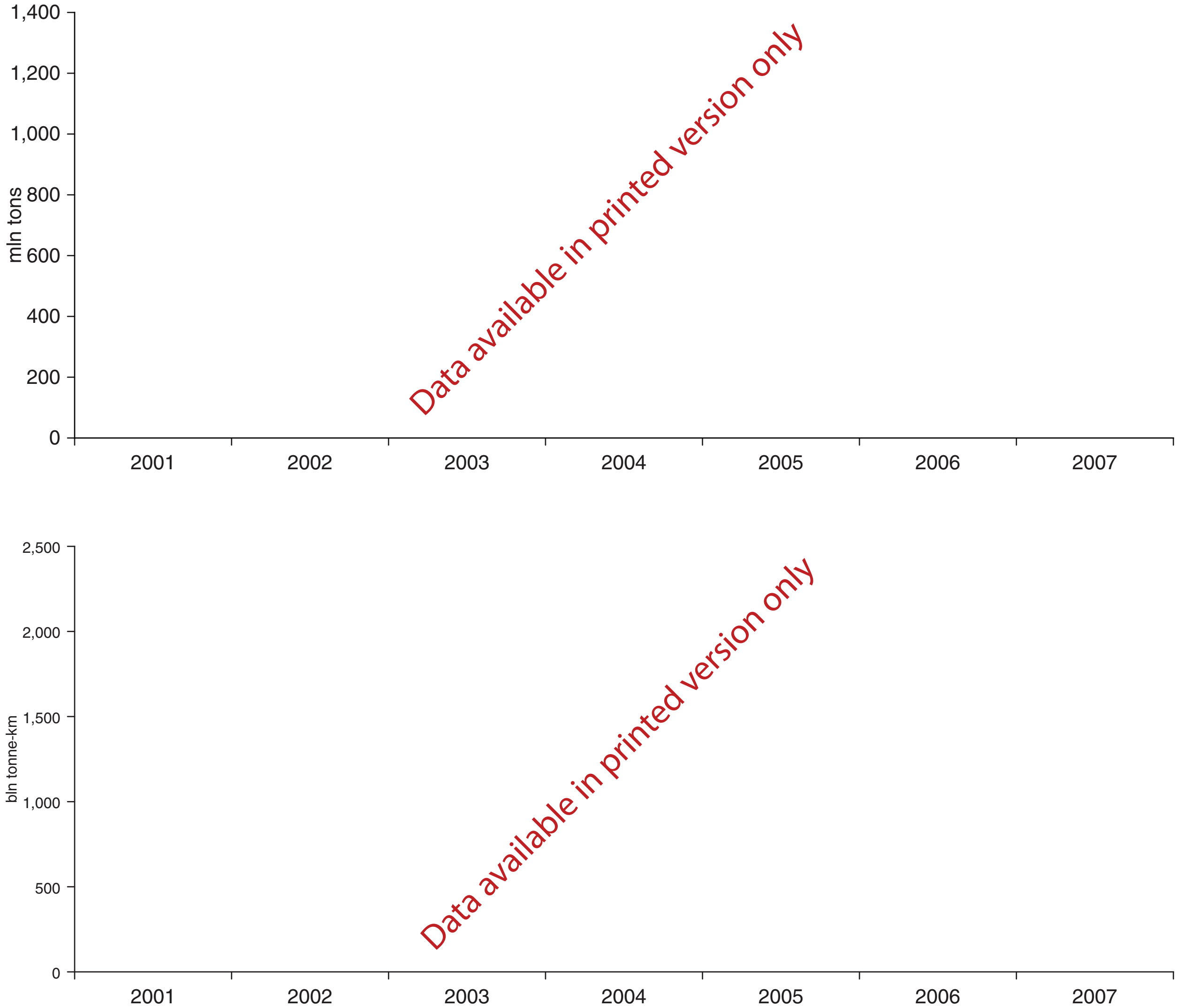
RAIL TRANSPORT OF RUSSIA IN FIGURES

Basic performance indicators of rail transport, 2001–2007

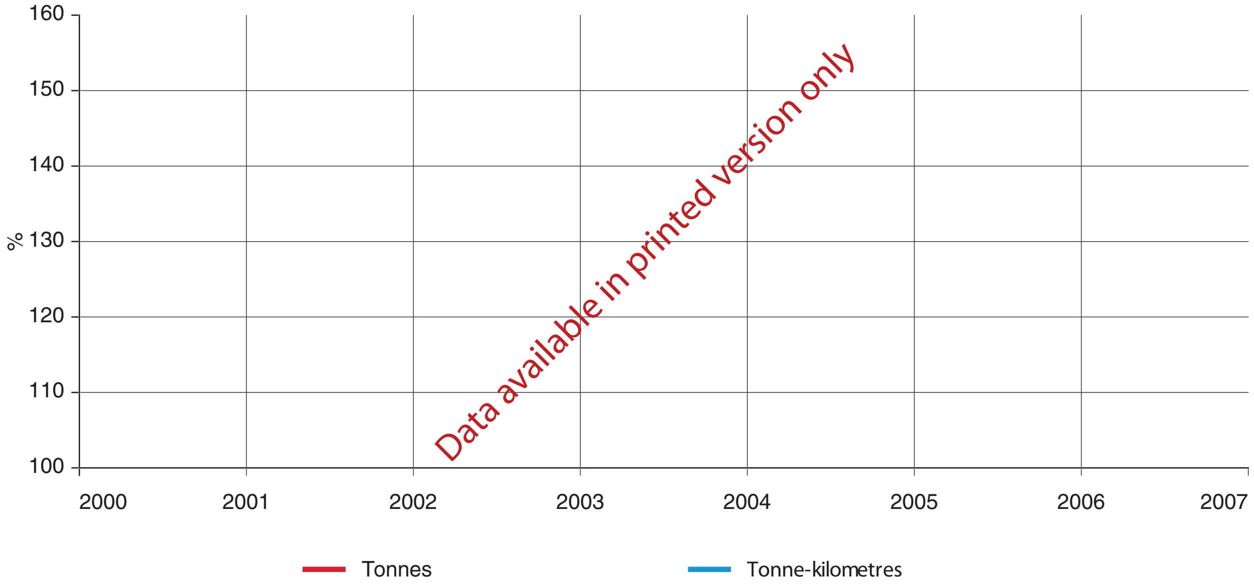
Indicator	2001	2002	2003	2004	2005	2006	2007
Freight carried, million tonnes							
Tonne-kilometres, billion							
Passengers carried, million							
Passenger-kilometres, billion							

Data available in printed version only

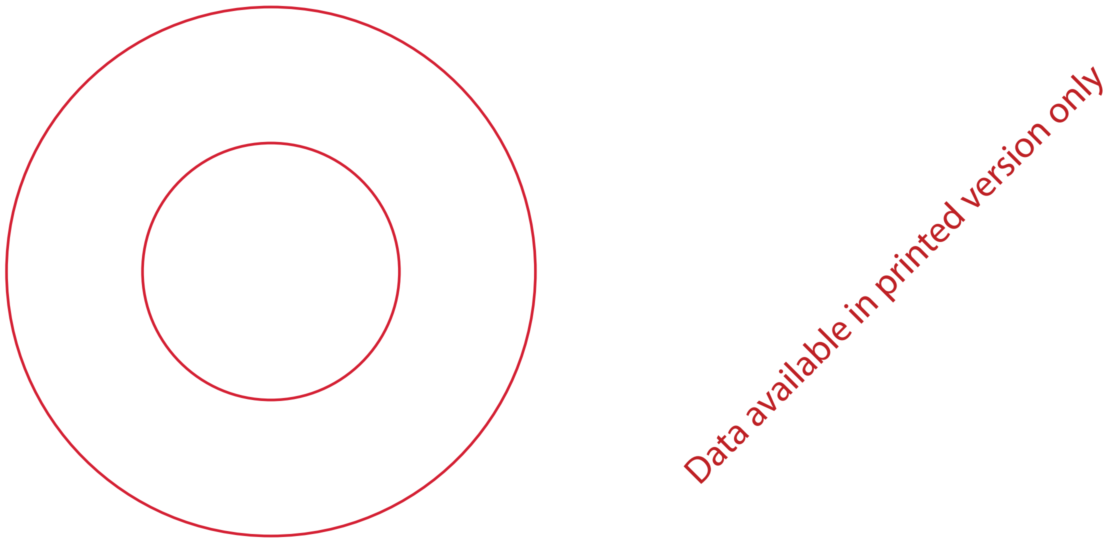
Freight traffic dynamics, 2001–2007



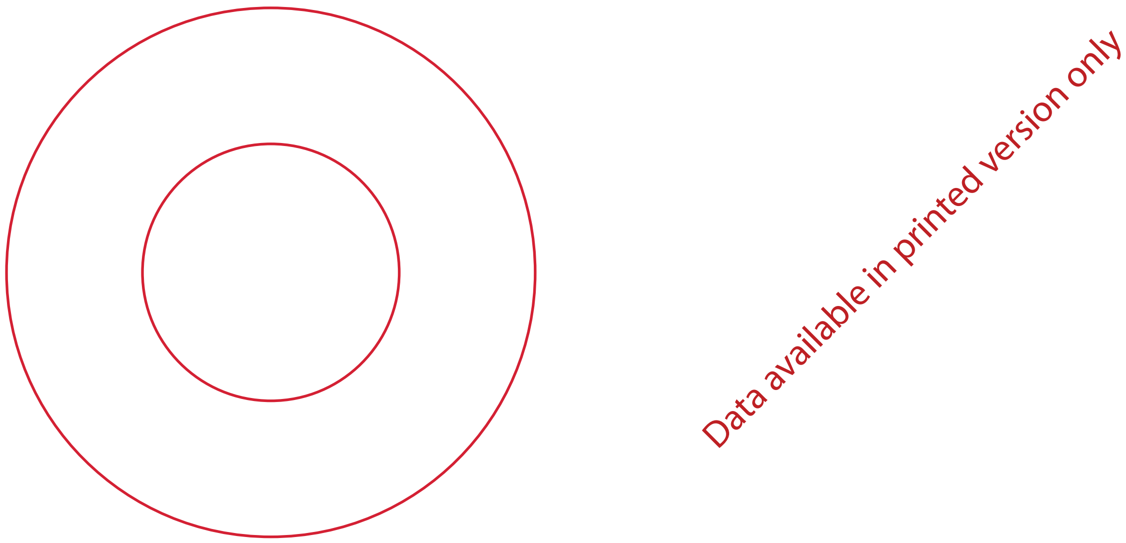
Freight services growth since 2000 (2000 = 100%)



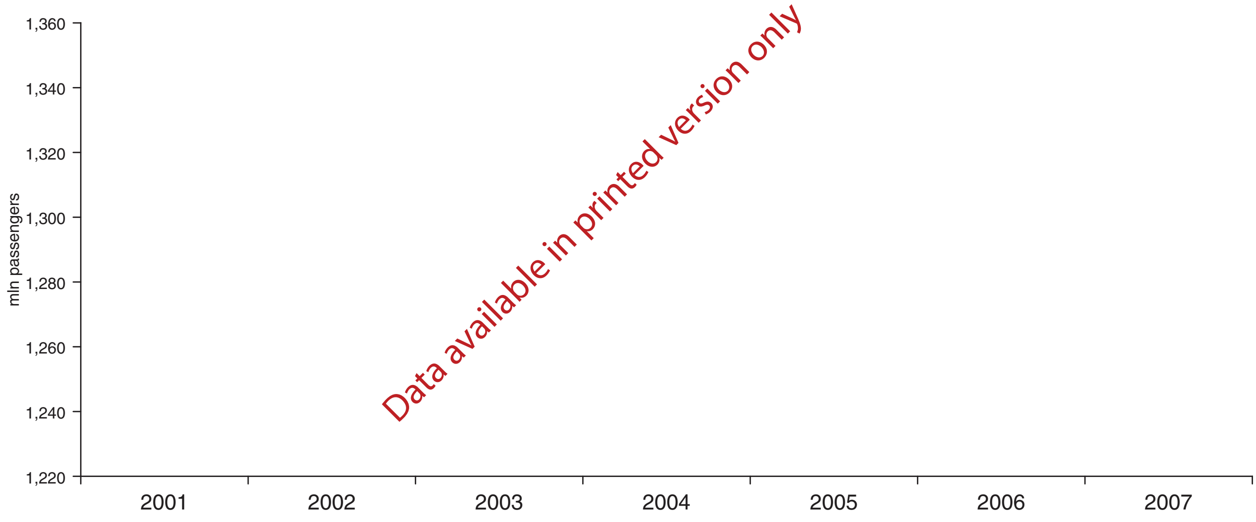
Freight traffic structure by type of freight, 2007

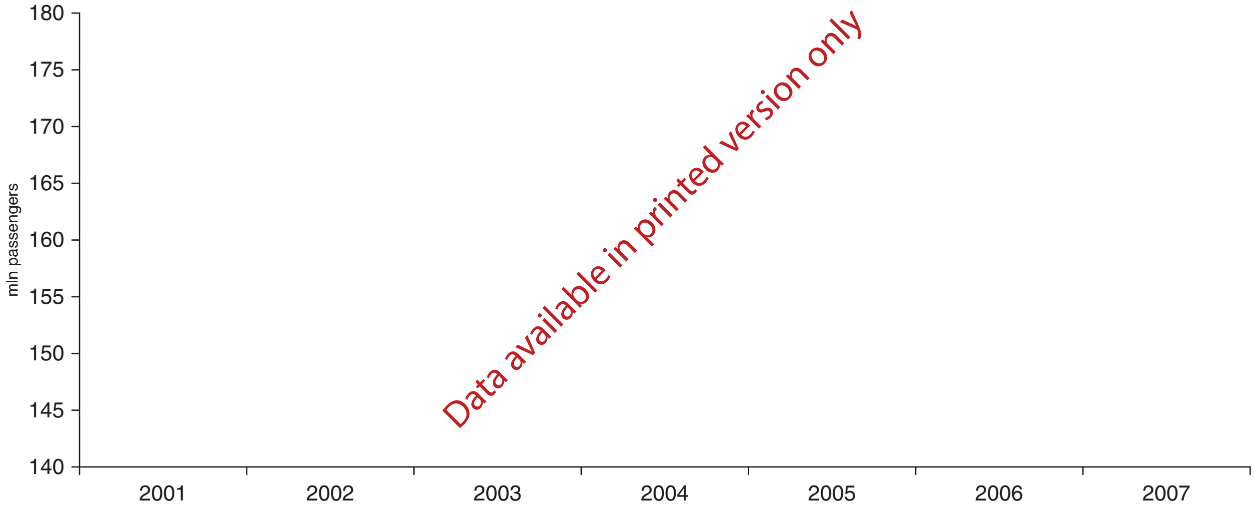


Freight traffic structure by transportation mode, 2007

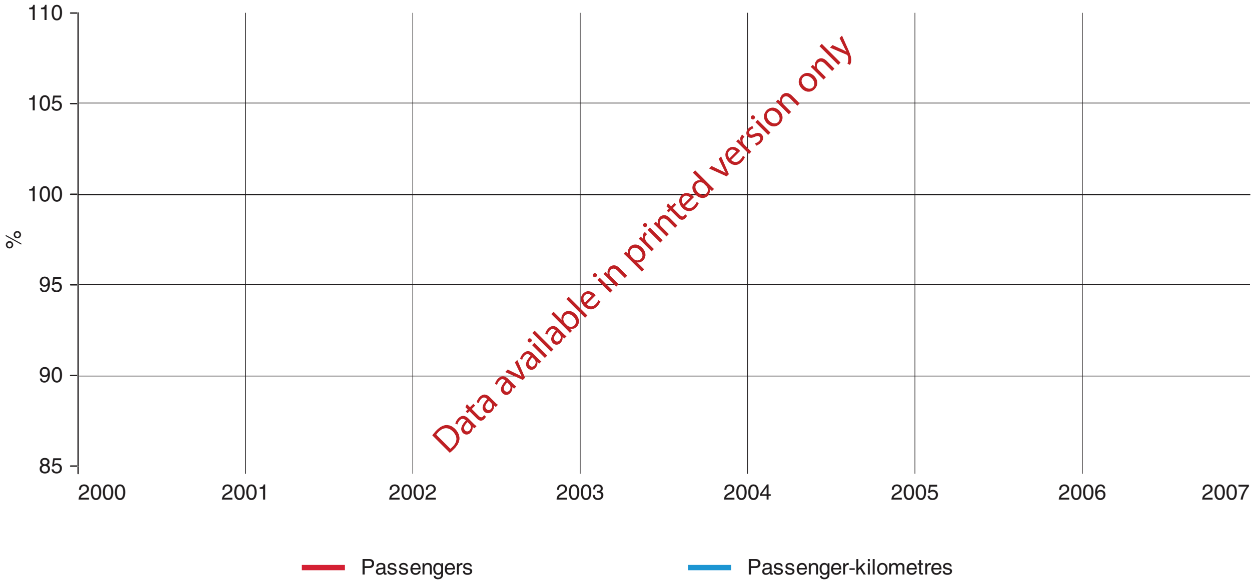


Passenger traffic dynamics, 2001–2007

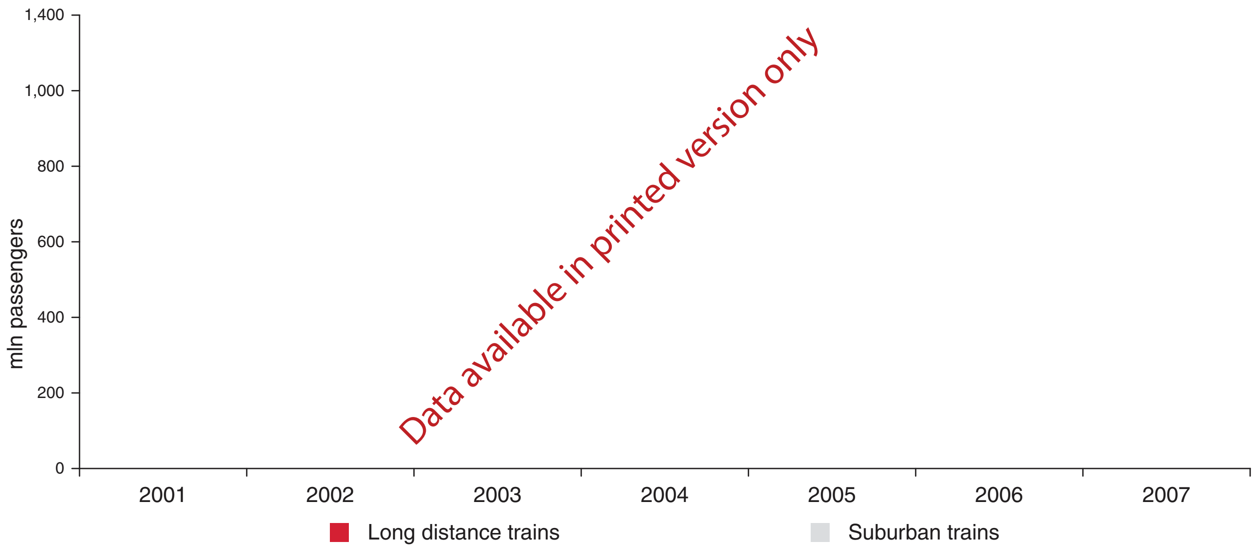


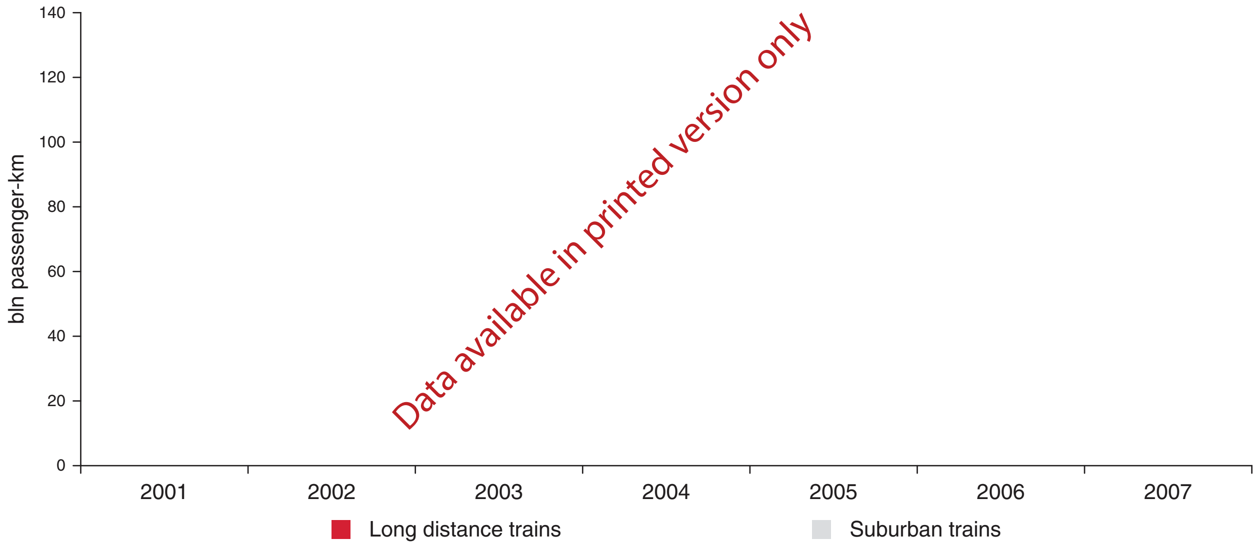


Passenger traffic dynamics, 2001–2007

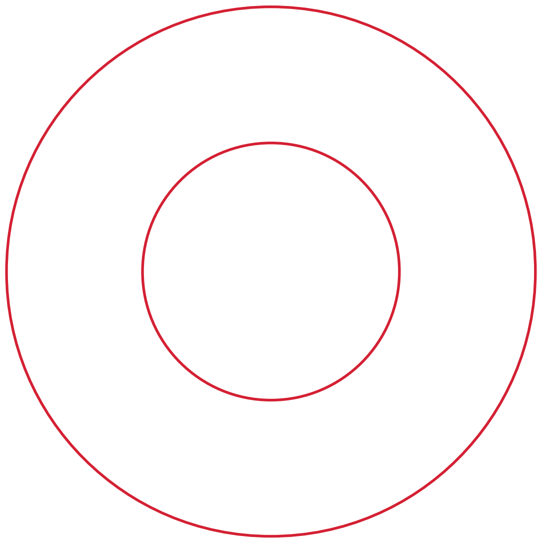


Passenger traffic by types of service, 2001–2007





Total passenger-km by transportation mode, 2007



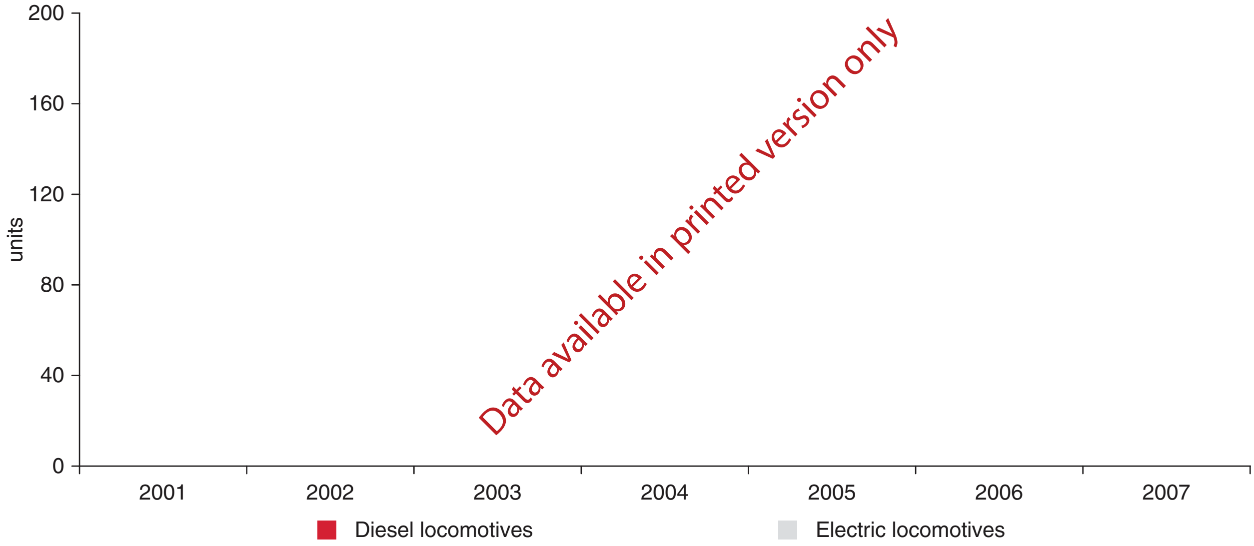
RUSSIAN RAILWAY ENGINEERING IN FIGURES

Production of railway engineering, 2001–2007

	2001	2002	2003	2004	2005	2006	2007
Locomotives							
Main line electric locomotives							
Main line diesel locomotives							
Diesel shunters							
Mine electric locomotives							
Cars							
Freight cars							
Passenger coaches							
EMU & DMU cars							
Metro cars							
Tram cars							
Track machines							
Vehicles for track constriction and repair							
Vehicles for track maintenance							

Locomotives

Main line locomotive production, 2001–2007

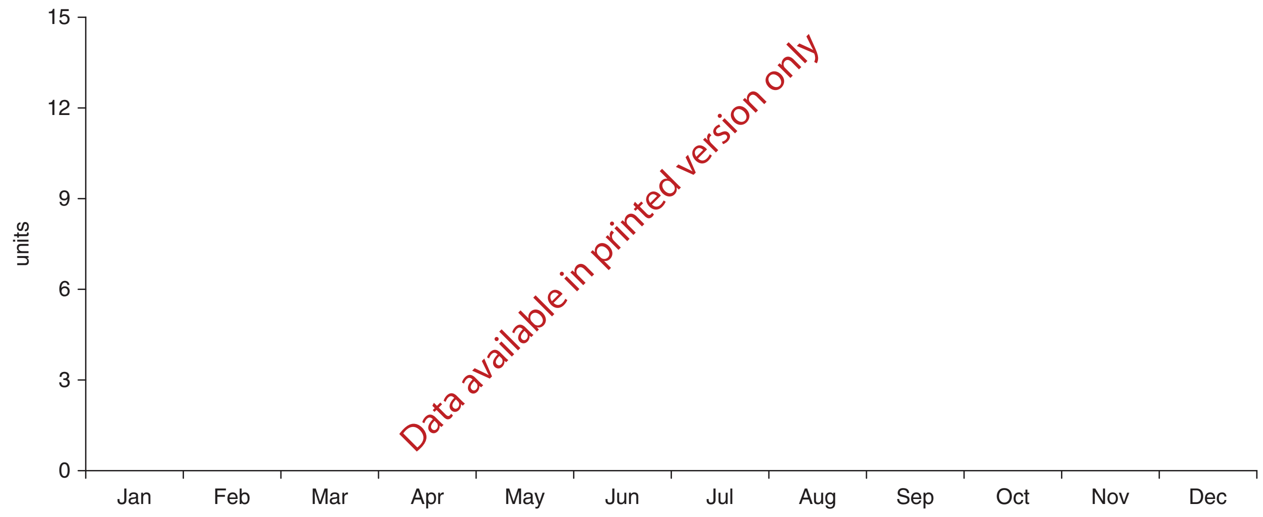


Locomotive production, 2007

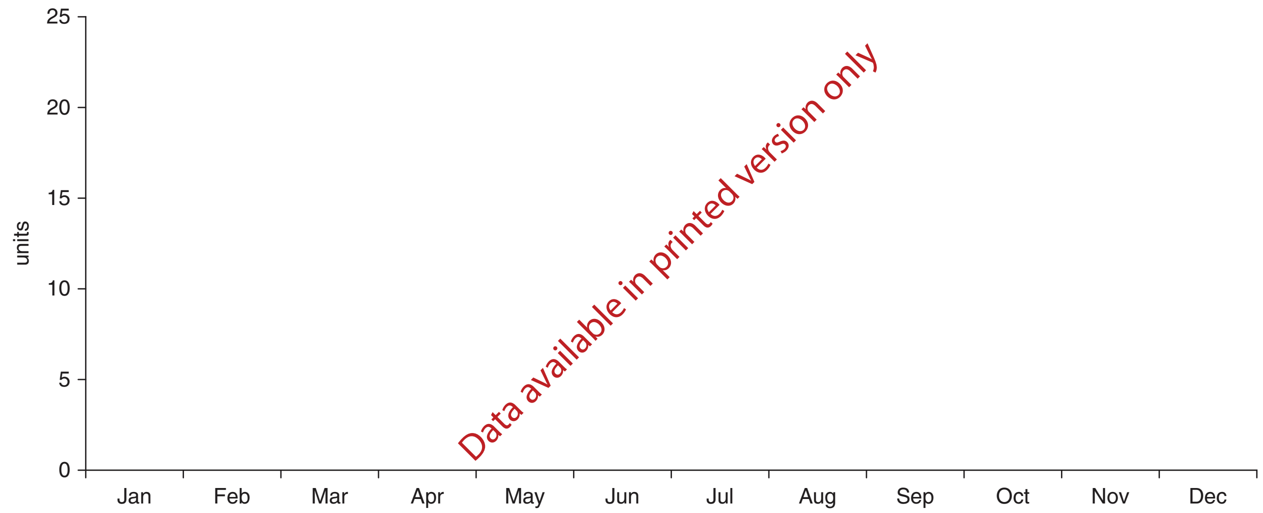
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Main line electric locomotives												
Main line diesel locomotives												
Diesel shunters												
Mine electric locomotives												

Main line electric locomotive production, 2007

Main line diesel locomotive production, 2007

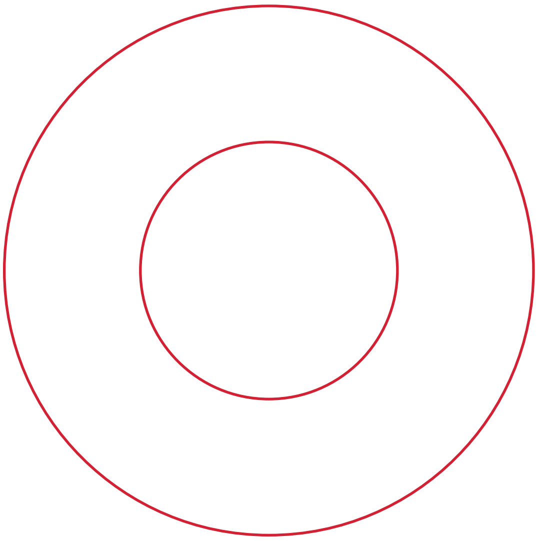


Diesel shunter production, 2007



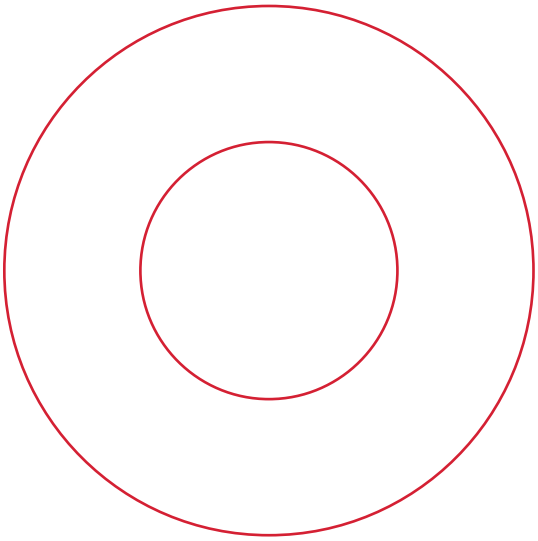
Main line electric locomotive production by manufacturers, 2007

Main line diesel locomotive production by manufacturers, 2007



Data available in printed version only

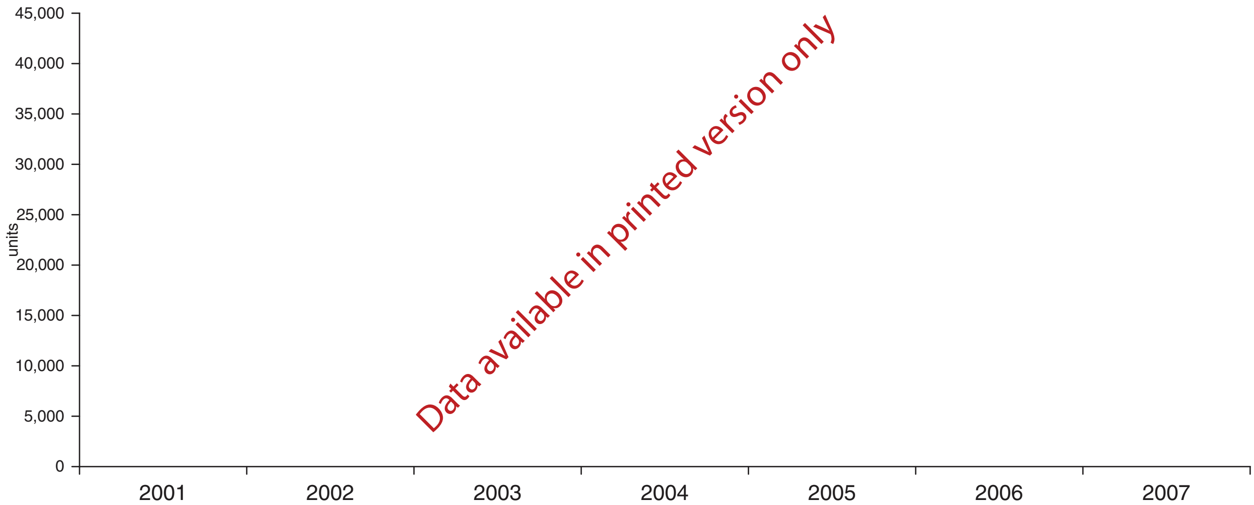
Diesel shunter production by manufacturers, 2007



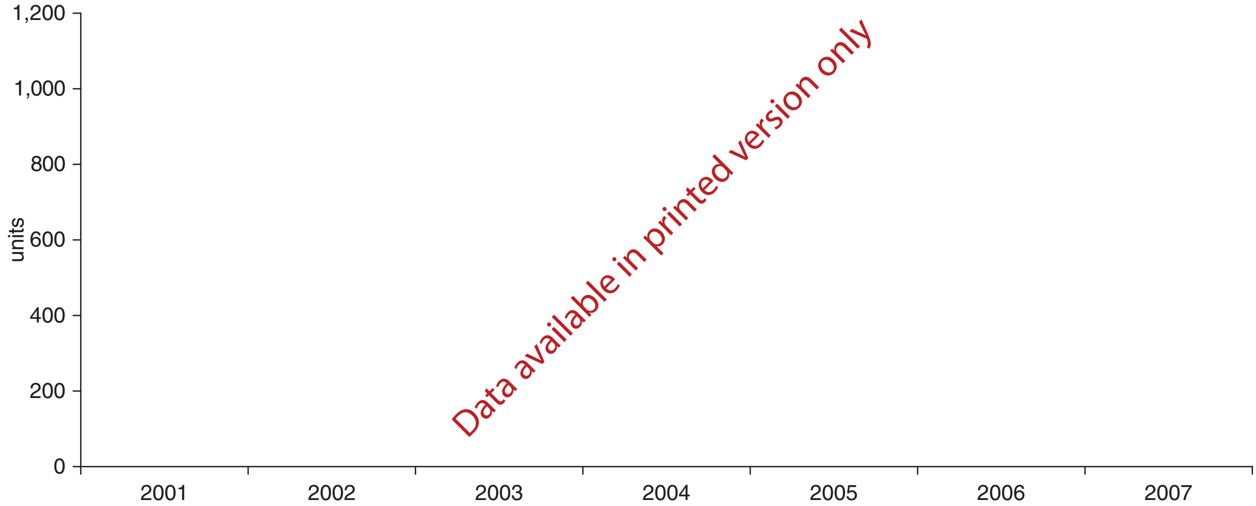
Data available in printed version only

Cars

Freight car production, 2001–2007



Passenger car production, 2001–2007



Car production, 2007

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Freight cars												
Passenger coaches												
EMU & DMU cars												
Metro cars												
Tram cars												

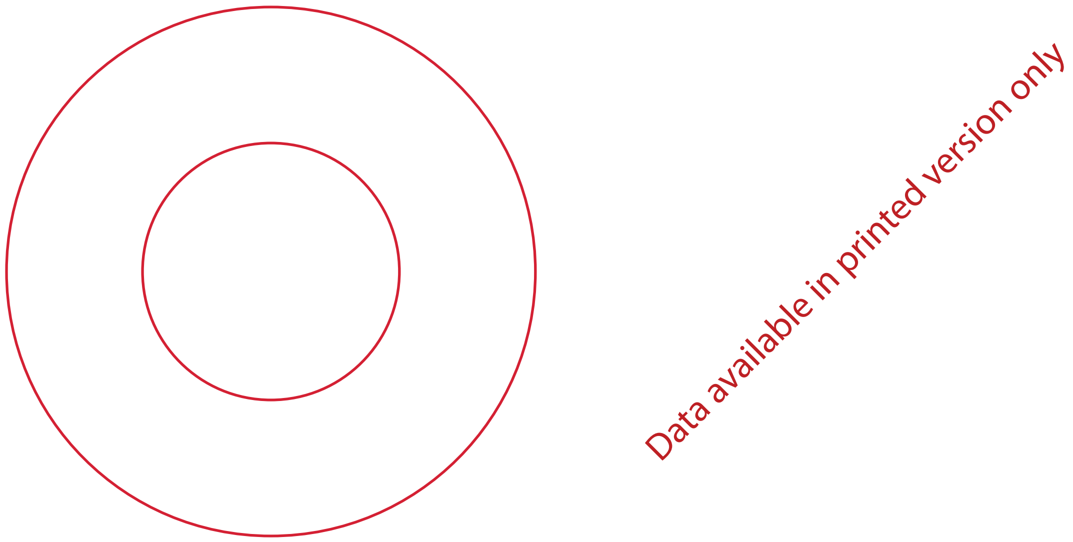
Freight car production, 2007

Passenger car production, 2007

Freight car production by manufacturers, 2007

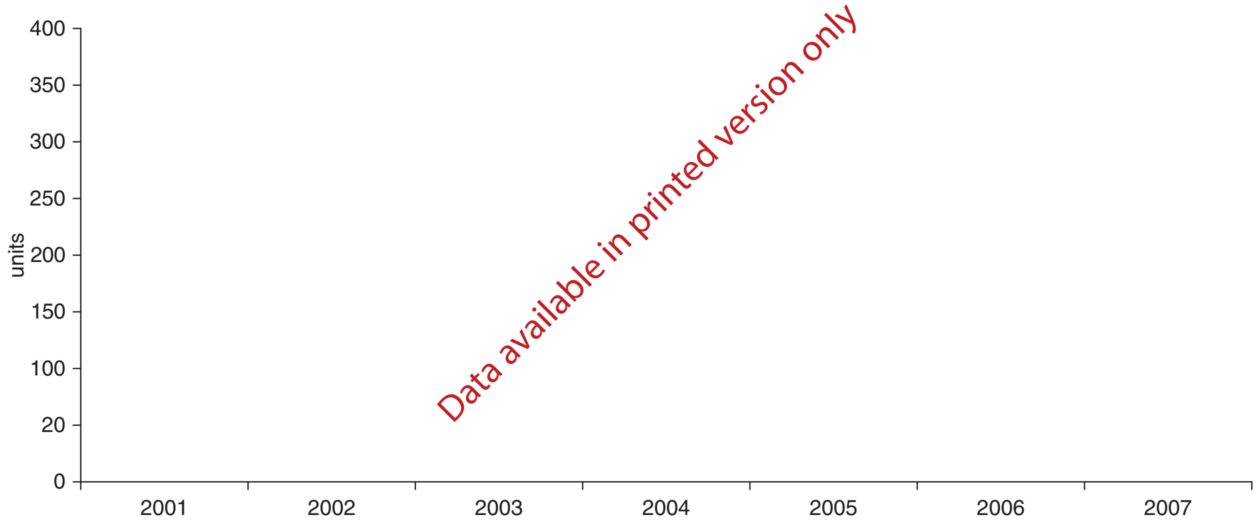
Freight car production by types, 2007

Passenger car production by manufacturers, 2007



Track Machines

Production of vehicles for track constriction and repair, 2001–2007

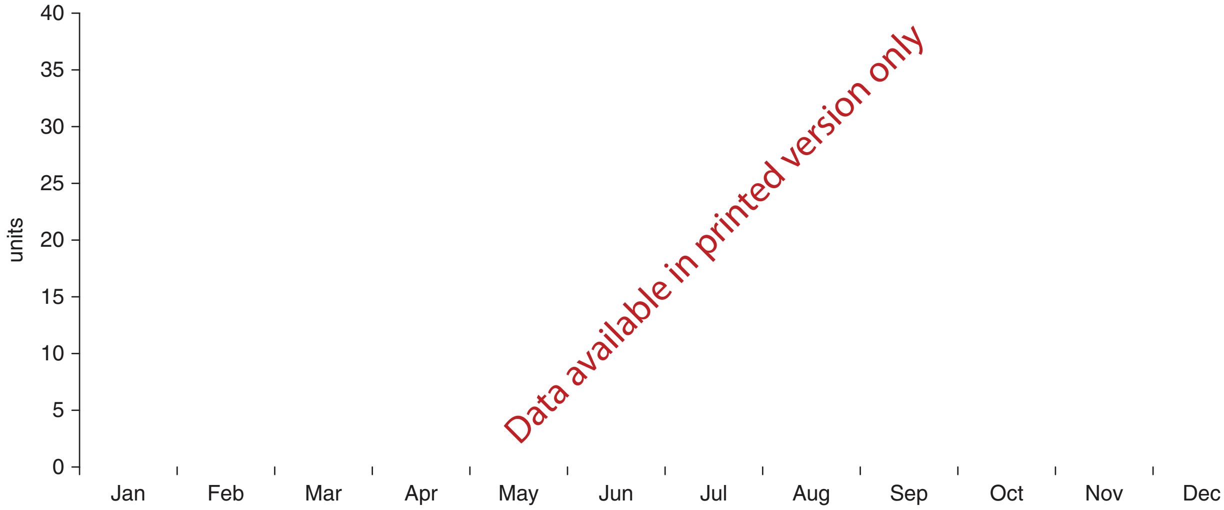


Production of vehicles for track maintenance, 2001–2007

Production of track machines, 2007

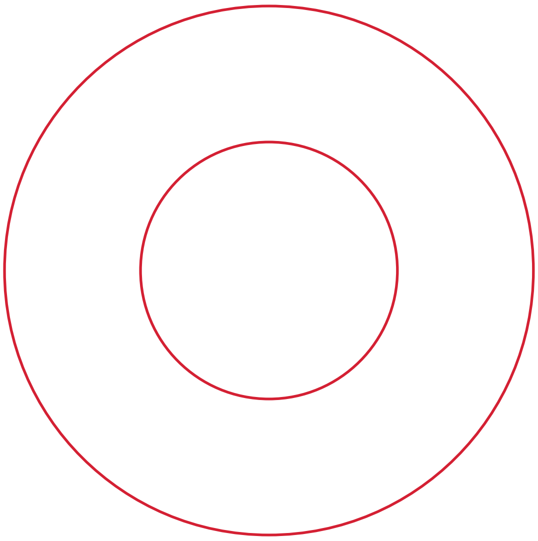
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Vehicles for track constriction and repair												
Vehicles for track maintenance												

Production of vehicles for track constriction and repair, 2007

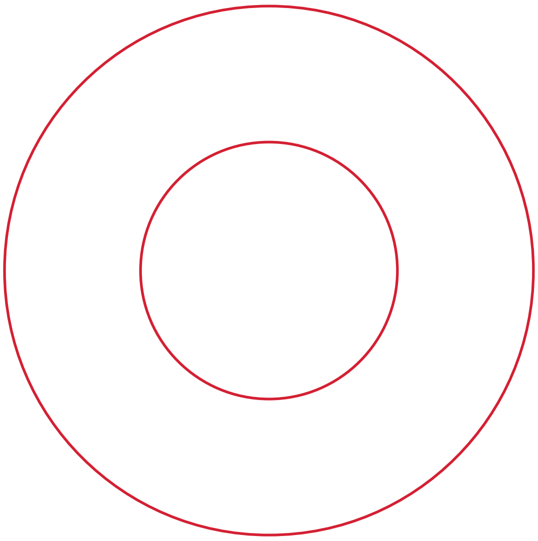


Production of vehicles for track maintenance, 2007

Production of vehicles for railroad constriction and repair by manufacturers, 2007



Production of vehicles for railroad maintenance by manufacturers, 2007



Amount of railway engineering production and services sold, exclusive of VAT, million RUR

	2006	2007
Production of rolling stock		
Locomotives		
EMU cars, DMU cars, metro cars, tram cars, locotractors		
Freight cars		
Passenger coaches		
Track machines		
Production of spare parts of rolling stock and track		
Repair and maintenance of rolling stock		
Total		

RUSSIAN RAILWAY ENGINEERING MANUFACTURERS

The format of this special issue does not allow a detailed discussion of all areas of railway engineering, which make an important contribution to the development of the sector and to railway operations. That is why only a brief overview of the main Russian railway engineering manufacturers is included into this issue. More details about other equipment manufacturers and repair facilities can be found in archived and future issues of our journal.

REGIONAL STRUCTURE OF THE SECTOR

The primary facilities of leading railway rolling stock manufacturing companies are concentrated in the European part of Russia. The fundamental inequality of the geographic distribution of rolling stock manufacturing facilities is driven by two key factors:

- unequal rail network density in the European and the Asian parts of Russia;
- construction of the majority of plants took place in those years when principal freight and passenger traffic was concentrated in the European part of Russia.

The only exception is that the principal facilities for manufacturing freight cars are concentrated in the Siberian and the Ural region where the primary freight traffic of Russian railwas is currently taking shape.

As a whole the geographic distribution of railway engineering plants currently corresponds to the requirements of principal users – rail transport entities. Substantial changes in the regional structure of railway engineering will be possible only after corresponding changes in rail transport take place.

RZD'S REMPUTMASH GROUP

Remputmash Group is the leading manufacturer of track maintenance vehicles in Russia and the CIS.

In 1997 the state-owned Remputmash Kaluga Plant, which included 10 more track maintenance vehicle manufacturing and repair plants as well as plants manufacturing spare parts for these vehicles, was created on the basis of Kaluga Track Maintenance and Engineering Works.

In 2003 the plants of the Group were included into the assets of Russian Railways OJSC (RZD) and operated as RZD affiliates in 2004 and 2005.

In 2005, according to a decision of the RZD's Board of Directors, 8 subsidiary companies were created as part of the Remputmash affiliates:

- Remputmash Abdulino Plant;
- Remputmash Vereshchagino Plant;
- Remputmash Kaluga Plant;
- Remputmash Moscow Track Machine Pilot Plant;
- Remputmash Orenburg Track Repair Plant;
- Remputmash Perm Locotractor Repair Plant;
- Remputmash Sverdlovsky Vehicle Repair and Engineering Works;
- Metallist-Remputmash Experimental Plant;
- Remputmash Yaroslav Car Repair Plant.

It should be noted that in order to preserve continuity, Remputmash Kaluga Plant manages all the other plants on this list.

Remputmash Group manufactures a diverse mix of state of the art track maintenance vehicles designed for improvement, capital repair and operational maintenance of rail tracks: readjustment, reclamation, clean-up, anti-hunt, snow clearing and others. Some types of machines are manufactured jointly with foreign companies which are leaders in the field of track maintenance vehicle engineering: Plasser & Theurer (Austria), MTH Prague (Czech Republic), and Compel (Slovakia).

TRANSMASHHOLDING GROUP

Transmashholding Group was established in 2002 to attract investment to Russian railway engineering by integrating domestic plants, which produce railway rolling stock and its component parts.

Currently more than 10 major plants in this sector, which have a leading position in all segments of railway engineering, are included in Transmashholding Group, which manufactures a large majority of Russian main line locomotives. Transmashholding also manufactures most of passenger coaches, metro cars and diesel shunters.

At the same time Transmashholding manufactures only 5% of Russian freight cars. However, it should be kept in mind that among all freight cars Transmashholding produces mostly hopper cars, which constitute a share of more than 20% of the total Russian hopper cars market.

According to 2005 results, Transmashholding was included to the top ten world's railway engineering manufacturers and maintains this position to this day.

At the end of 2007 RZD acquired a blocking share holding (25%+1) of Transmashholding.

The main performance indicators of Transmashholding are shown in Table 1.

Novocherkassk Electric Locomotive Plant (NEVZ)

Part of Transmashholding Group since 2003.

NEVZ is the largest manufacturer of main line electric locomotives, industrial electric locomotives, electrical equipment and spare parts for electric locomotives and EMUs in Europe. About 80% of all main line electric locomotives used in Russia are produced by NEVZ.

In the 1990s a main line passenger DC electric locomotive EP1, which currently remains the only industry standard model of passenger electric locomotive in Russia, was developed and launched into full scale production at the plant.

In 2005 a new main line freight AC electric locomotive 2ES5K 'Ermak', was produced at NEVZ. Currently, the plant performs a batch production of freight AC electric locomotives 2ES5K 'Ermak' and 3ES5K.

Simultaneously, NEVZ is working to create state of the art main line freight and passenger AC electric locomotives with asynchronous traction motors which will allow an improvement in the cost effectiveness of locomotive operation on the rail network.

Bryansk Engineering Plant (BMZ)

Part of Transmashholding Group since 2002.

Currently BMZ is the largest Russian manufacturer of diesel shunters. Freight cars and marine diesels are also manufactured at BMZ.

Currently, the main railway engineering products at BMZ are diesel shunter locomotives with power transmission (TEM18 in various modifications) and freight cars (hoppers and flat cars). The plant exports TEM18 diesel shunters both to the CIS and to other countries.

Table 1. Production of rolling stock by Transmashholding Group in 2004–2008

Indicator	Measure	2004	2005	2006	2007
Electric locomotives	units	59	114	211	233
Diesel locomotives	units	64	122	190	226
Passenger coaches	units	547	701	799	928
Emu cars	units	506	396	571	669
Diesel engines	units	381	445	431	581
Metro cars	units	108	169	223	265
Rail buses (DMUs)	units	21	56	47	60
Car casting	tonnes	145,412	151,075	146,600	156,025
Freight cars	units	689	1,630	1,902	1,926
Other production	€ thousand	252,453	239,545	332,086	271,594
Sales volume, total	**€ thousand**	**826,810**	**1,141,460**	**1,594,618**	**1,852,847**

In 2005 the prototype of the main line freight diesel locomotive with commutator traction motors 2TE25K, which is intended to replace Ukraine-manufactured diesel locomotives on Russian railways, was produced at the plant.

Apart from this, there was intensive work at BMZ to create the first Russian main line freight diesel locomotive with an asynchronous traction motor 2TE25A, a pilot batch of these diesel locomotives is currently being launched into production.

The volume of freight car production at the plant achieved 1,610 units in 2005, 1,051 units in 2006, and 2,112 units in 2007.

The volume of shunter locomotive production at the plant demonstrated steady growth: 80 units in 2005, 138 units in 2006 and 160 units in 2007.

6 main line diesel locomotives were produced in 2007; this product is being manufactured in pilot batch amounts.

Kolomna Plant

Part of Transmashholding Group since 2005.

Kolomna Plant is the only manufacturer of main line passenger diesel locomotives in Russia and one of the major manufacturers of diesel engines for diesel locomotives. Marine diesel engines and modular portable power plants are also produced at the plant. Kolomna Plant has a modern engineering, research and experimental complex.

In 2002 Kolomna Plant specialists developed and produced a state of the art Russian passenger diesel locomotive TEP70BS which can supply passanger cars with power. The TEP70BS locomotive became the first Russian diesel locomotive developed in the last decade.

The volume of main line diesel locomotive production at the plant in 2005 and 2006 was 45 units per year and in 2007 – 55 units.

Tver Carriage Works (TVZ)

Part of Transmashholding Group since 2002.

Tver Carriage Works is a major developer and manufacturer of passenger coaches in Russia and the CIS.

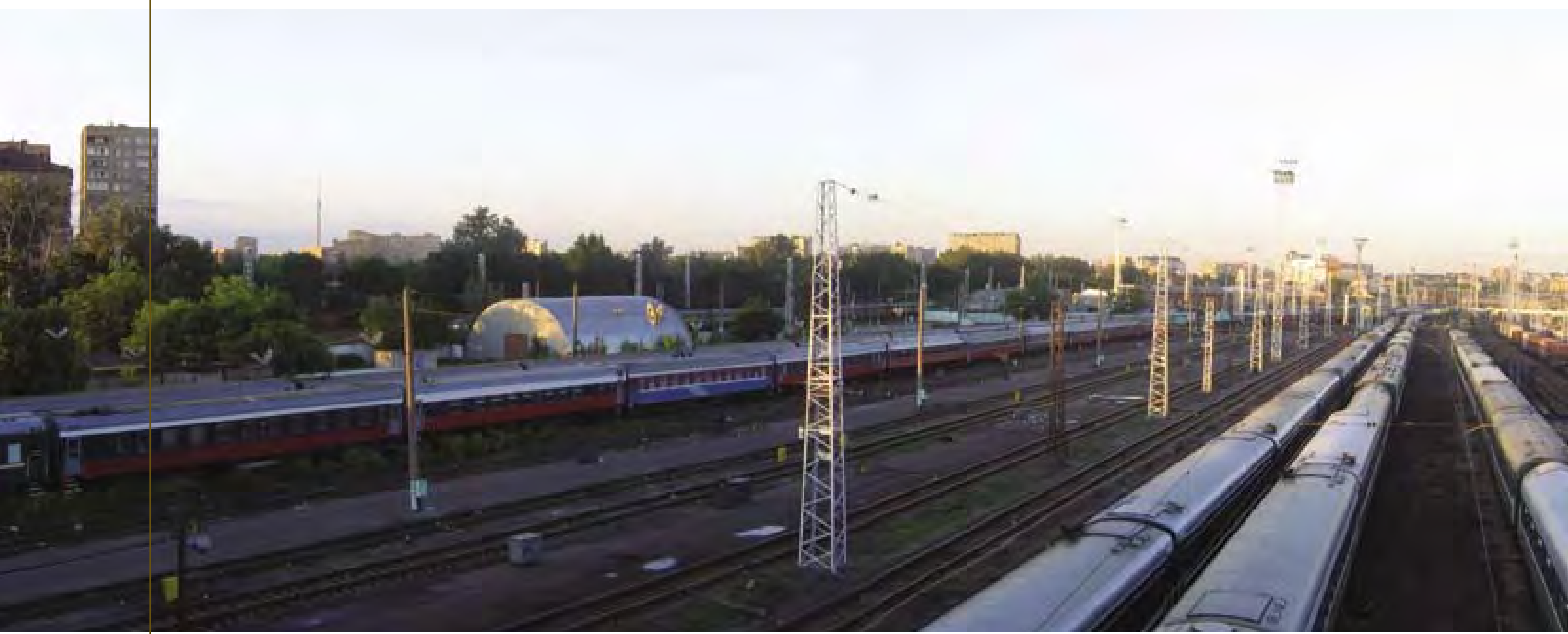
Production facilities allow simultaneous work in manufacturing several models of passenger cars (compartment cars with berths and with seats, and open-plan cars) and cars for special purposes.

Tver Carriage Works is a complex enterprise, which is simultaneously a scientific institution, a pilot factory, a testing facility and a large-scale production plant capable to solve any tasks in passenger car manufacturing.

Tver Carriage Works currently produces:

- passenger cars (compartment cars, open-plan cars, dining-cars and others) for speeds up to 160 km/h with bodies that have crimped side sheets;
- compartment passenger cars for speeds up to 160 km/h with bodies that have flat side sheets;
- passenger cars (compartment cars and dining-cars) for speeds up to 200 km/h with bodies that have flat side sheets;
- special purpose cars including luggage cars, cars for transportation of money and valuables, laundry cars and others.

The main user of the plant's production is RZD. Apart from this, the plant supplies car sets for assembly to Kharkov Car Manufacturing Plant and Tashkent Passenger Car Repair and Manufacturing



Plant. It also supplies Russian company ‘Tsirkon-Service’ with cars for luxury interior ordered by private operators.

The principal area of the future development of TVZ is creating new models of passenger cars that comply with modern requirements of passenger travel conditions: speed, comfort and quality of services provided on the train.

New models development programme foresees the phased transition to large-scale production of modern rail cars, the construction of which embodies the most recent developments of rail car manufacturing: bodies made of corrosion-resistant materials, improved design, and new rail car interiors complying with all ergonomic requirements.

Demikhovo Engineering Plant (DMZ)

Part of Transmashholding Group since 2005.

DMZ has been manufacturing AC and DC EMUs since 1992. During this time, 17 types of trains have been developed and brought to production by the plant and more than 3,000 rail cars, operated in Russia and the CIS countries, have been produced. The plant is a major manufacturer of EMUs in Russia and the CIS countries.

Since 1999, along with trains ED4M and ED9M, the company has been producing improved trains ED4MK and ED9MK for operation as passenger express service trains.

Work is being done at the plant to develop and organise large-scale production of EMUs with energy saving drive systems and for speeds up to 160 km/h, as well as dual-system EMUs which will also be operated on routes with interchangeable types of currents.

Metrovagonmash

Part of Transmashholding Group since 2005.

Metrovagonmash is a plant that manufactures military products and apart from this is a major manufacturer of rolling stock for mass rapid transit systems of Russia and the CIS. During seventy years of metro car manufacturing more than 7,500 metro cars have been produced, 4,900 of which were supplied to the Moscow Metro, while more than 1,000 cars were exported to the underground systems of Budapest, Prague, Sofia, Warsaw and many other cities of Russia and the CIS countries. Currently almost 51% of all cars used in metro systems in the cities of CIS were manufactured by Metrovagonmash.

Railway engineering product mix of the plant contains:

- metro cars;
- rail buses (DMUs);
- narrow gauge cars for juvenile railways.

The most significant of recent developments in the area of mass rapid transit cars is the creation and assimilation of the plant’s own production of an asynchronous traction motor drive.

Active work at the plant in creation of a model series of one/two/three-car rail buses (DMUs) with the use of domestic component parts is being carried out. The prototype of a three-car diesel train RA-2 with an MTU diesel engine was sent for testing in 2005.

At the beginning of 2006 the production capacity of the plant came to almost 200 cars and 60 rail buses. The main consumers of the manufactured cars and rail buses are the Moscow Metro and RZD respectively.

URALVAGONZAVOD RESEARCH AND MANUFACTURING CORPORATION

URALVAGONZAVOD IS A MAJOR CAR MANUFACTURING PLANT IN RUSSIA AND EUROPE. CURRENTLY URALVAGONZAVOD MANUFACTURES MORE FREIGHT CARS THAN ALL OTHER RUSSIAN MANUFACTURERS COMBINED.

Uralvagonzavod is a major car manufacturing plant in Russia and Europe. It covers the entire production cycle from receipt of cast sections and stamped blanks to assembly and testing of finished products.

Until recently the plant remained a federal state unitary enterprise as its main production – armored vehicles – was for military purposes. However, in 2007 the Russian Government made the decision to reincorporate it as a joint-stock company and on March 31, 2008, Uralvagonzavod Research and Manufacturing Corporation was registered with the state.

Uralvagonzavod is the leading manufacturer of tank cars and gondola cars in Russia and in 2003 the plant began to produce flat cars.

The plant produced 109,000 freight cars of all types during the period from 1998 through 2007. The highest rates of growth in production were shown in 2003 and 2004 (in comparison with the previous year), which constituted 43% and 42% respectively.

Currently Uralvagonzavod manufactures more freight cars than all other Russian manufacturers combined.

Uralvagonzavod supplies its products, particularly road building equipment as well as equipment for military purposes, to the near and far abroad countries (India, Iran, United Arab Emirates, Italy, Estonia, Belarus, Uzbekistan and Kazakhstan).

In 2005 Uralvagonzavod produced 19,539 freight cars, in 2006 – 16,681 and in 2007 – 17,115.

Uralvagonzavod created two joint ventures for freight car assembly:

- Wagon Assembling Plant Ltd. (Astana, Kazakhstan) for gondola cars assembly (since 2002).
- UCZ&AVR JSC (Akhtma, Estonia) for tank cars assembly (since 2003) with planned capacity of 3 thousand oil tank cars per year.

SINARA – TRANSPORT MACHINES

The newest group in the sector, it includes Ural Railway Engineering Plant, Lyudinovo Diesel Locomotive Plant and Ural Diesel Motor Plant.

Ural Railway Engineering Plant

Until recently the plant was participating in a freight DC electric locomotive modernisation programme for RZD.

In December 2006 a prototype of a new generation freight DC electric locomotive with a commutator traction engine, 2ES6 series, was developed and released, in 2007 a contract was signed with RZD for delivery of 25 2ES6 electric locomotives.

In the first six months of 2008 two first models of the 2ES6 electric locomotive were released.

Lyudinovo Diesel Locomotive Plant

Lyudinovo Diesel Locomotive Plant manufactures industrial and shunting diesel locomotives with hydraulic and electric transmission systems and track maintenance vehicles. The planned capacity of the plant is 150 diesel locomotives per year.

Apart from a large-scale production of shunters, maintenance vehicles and rail cars the plant is ready to produce main line diesel locomotives and DMUs (prototypes have already been produced).

In 2005 the plant produced 36 shunters,in 2006 – 41, in 2007 – 64.

VAGONMASH

Part of Dedal Group since 2003.

Vagonmash is the second largest manufacturer of metro cars and passenger coaches in Russia. Currently the plant produces passenger cars including interregional, luggage, dining-cars, special purpose cars and mobile power station cars.

The production capacity of the plant is 150 metro cars and 100 passenger cars per year. The plant traditionally supplies metro cars to the St. Petersburg Metro.

Due to its limited production capacity, the plant is looking to release a large scale line-up of limited edition products.

In 2005 Vagonmash produced 51 passanger cars, in 2006 – 43, in 2007 – 130.

TORZHOK CAR-BUILDING PLANT

Torzhok Car-Building Plant is one of two Russian EMU manufacturers producing:

- ET2L and ET2ML DC EMUs;
- Mobile laboratories (observatory and radiochemical modules);
- Luggage and freight cars;
- Armored cars for transportation of especially valuable items or dangerous freight.

EMUs are supplied exclusively to Russian railways. The plant doesn't export its production, supplying RZD with EMUs, the Ministry of Defense, the Central Bank and business corporations with special purpose cars.

In 2007 Torzhok Car-Building Plant produced a diesel electric train.

During 2005 80 EMUs were produced, while in 2006–2007 136 and 132 EMUs respectively were manufactured on Torzhok Car-Building Plant.

ABAKANVAGONMASH

Abakanvagonmash is a rail car manufacturing plant. It is part of Russian Machines Holding. Its principal product is bulk containers, while flat cars are also produced.

The planned capacity of the plant allows to manufacture up to 30,000 containers yearly. However, currently the plant manufactures almost 1,000 containers per year, both of general purpose and specialised (for any type of freight), and the plant has the capacity to produce up to 2,500 flat cars per year. In 2006, 3,800 container cars were produced.

In August 2007 Abakanvagonmash received Certificates of Conformity for two types of flat cars models, 13-9004 and 13-9015. The certification confirms the conformity of this product with the requirements established by federal railway transport.

RUSSIAN RAILWAY ENGINEERING CORPORATION

In December of 2007 Russian Machines (part of Base Element Holding) and Mordovia Carbuilding Company created a joint venture – the Russian Railway Engineering Corporation (RKTM).

Mordovia Car-building Company owns Ruzkhimmash (one of the major Russian freight cars manufacturers), transportation and leasing companies, manufacturers of component parts for rail transport as well as foundry production.

Ruzkhimmash

Currently Ruzkhimmash produces gondola cars as well as twenty models of tank cars for transportation of light and heavy oil products, liquefied natural gas and chemicals.

Apart from this, new freight cars never before manufactured at the plant are being prepared for batch production. The prototypes of hopper cars were produced, while a process to set up large-scale production of 80-feet flat cars has been launched.

Future expansion of a product series is a part of company's plans: the plant is developing a specialised container flat car for transportation of 40- and 60-feet containers and box cars.

In 2005 Ruzkhimmash produced 4,589 freigth cdrs, in 2006 – 4,402, in 2007 – 5,322.

KALUGAPUTMASH

Kalugaputmash is the second largest plant producer of track machines in Russia after RZD's group of subsidiary companies. The plant manufactures:

- heavy track machines used for repair and construction of railways (track cranes, track maintainers, rail-welding machines, track traction machines, detector electric rail cars, ballast leveling machines, and others);
- shunters (PTM-630, TGK-2M);
- DMUs.

Kalugaputmash is the only Russian manufacturer of track cranes for track laying and dismantling on wooden and ferroconcrete sleepers, transport and replacement of railway points and rail-welding machines.

In 2005 Kalugaputmash produced 73 track machines, in 2006 – 73, in 2007 – 84.

ALTAIVAGON

The plant's principal production is all-steel boxcars, gondola cars, closed bottom gondola cars, tank cars for light and heavy oil products and sulfuric acid, flat cars for general and special purposes.

During 2000–2005 the volume of production of freight cars of various types grew by 30 times at the plant. The plant is actively expanding its production capacity. In 2007 affiliate began the production of freight cars. In order to provide for its own needs in car casting the plant organised its production at Rubtsov affiliate's facilities.

The volume of freight cars production at the plant taking into consideration Kemerovo affiliate's production was 6,600 units in 2005, 7,409 units in 2006, and 7,941 units in 2007.

PROMTRAKTOR-VAGON

The plant produces tank cars for transportation of petroleum products, trucks for tank cars, longitudinal and freight car trucks, mounted wheels, brake beams, car cast pieces, rail car truck springs, and gondola car appertures.

Promtraktor Group is a part of Tractor Plants Group; at the present time a production centre, which will allow the production of up to 6,000 cars per year, is being constructed at the plant. According to the results of 2007, the number of freight cars produced reached 1,105 units. ■

UNION OF INDUSTRIES OF RAILWAY EQUIPMENT – MOVING FORWARD

Sergey Palkin
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Union of Industries of Railway Equipment

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Vice-President
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The Non-Profit Partnership 'Union of Industries of Railway Equipment' (UIRE), was founded in June 2007 to unite railway equipment manufacturers in solving the following problems:

- Protection of rights and legal interests of railway equipment manufacturers, promotion of competition, development of business activities and expanding mutually beneficial cooperation.
- Consolidation of the efforts aimed at increasing competitiveness by improving the product quality and technical development of railway equipment manufacturers.
- Integration of resources for implementing science-intensive system-technical projects, creation of an up-to-date technical regulatory framework that meets international standards' requirements.
- Achieving product quality level up the world standards and ensuring to the maximum satisfaction of the demand of the national economy for high-quality railway equipment and infrastructure components.

The general comparison of the machinery operated on Russian railways with the foreign analogues reveals huge reserves for increasing the efficiency of rolling stock. This is why the solution of the problem of attaining engineering parity with leading countries requires an innovation breakthrough in the national railway engineering and in allied industries.

A feature of the Partnership lies in the participation of Russian Railways OJSC – both a customer and an end user of railway equipment products. RZD is, at the same time, a railway operator, an infrastructure owner and the largest rolling stock owner in the Russian Federation. RZD owns a number of affiliated engineering undertakings and is a shareholder in the largest railway equipment producer in Russia, Transmashholding.

The aforesaid factors define the long-term and mutually beneficial cooperation between RZD and UIRE and also designers and manufacturers at all stages of development, commissioning, operation and post-operation utilisation as far as all future rolling stock models are concerned. Consolidation of efforts is a necessary action to solve the above mentioned problems successfully. An important factor in this respect is that RZD is one of the founders of UIRE.

Now, when the Partnership is one year old, it integrates 68 enterprises. Its structure incorporates 11 committees responsible for major directions of the railway equipment production, which have succeeded in establishing a civilized dialog between participants of the equipment market. It successfully cooperates with governmental executive bodies in the implementation of joint projects and proposition of amendments to federal legislation, aimed at developing rail transport and railway equipment production. In this field, the Partnership features considerable advantages, such as a fast response to emerging problems and the influence of a serious organisation in the industry.

During the previous year, the Partnership has achieved positive results, among which the following are worth mentioning:

- Overcoming the dissociation of the owners and shareholders of the railway equipment manufacturers.
- Signing the License Agreement with the IRIS Group on granting to the Partnership exclusive rights for introducing IRIS standards on the territory of Russia.
- Registering a volunteer certification system within the framework of the Partnership and creating the affiliated undertaking, the Technical Competence Centre, both capable to increase product quality on the basis of competence, independence, trust and absolute transparency.
- Forming its own industry regulatory framework and participating in the elaboration of the regulatory framework in the field of technical regulation.
- Attaining a new level of mutual relations based on supplier-to-manufacturer feedback. Application of a product quality monitoring information system at locomotive plants, allowing a real-time examination of locomotive operating behaviour that allows transition to other stages of the life cycle.
- Publishing the ‘Railway Equipment’ journal, the most topical in railway engineering, reflecting the latest analytical and statistical data on situation in the industry.

Some of these positive results are now covered in more detail.

MEMORANDUM ON COOPERATION AND LICENSE AGREEMENT BETWEEN UIRE, UNIFE AND IRIS GROUP

It is well known that railway operators and owners of track infrastructure do not take part in the European Union of Railway Equipment Manufacturers (UNIFE) that, to a certain degree restrains the development of cooperation between railway equipment producers and consumers since many problems related to insufficient readiness of the infrastructure to operate new rolling stock arise during the operation process.

Russian railways welcome a start of discussion between UNIFE leaders and all European operators and infrastructure owners on the creation on a unified standard of requirements both to railway equipment and to infrastructure conditions, as well as to rolling stock operation organisation. The first meeting of the UNIFE international working group to discuss these issues was held on December 13, 2007 in Paris. RZD's delegation and representatives of Russian railway equipment manufacturers were invited by UNIFE to participate in the work.

The historically important documents on the development of cooperation between the Russian and European railway equipment manufacturers in order to improve rolling stock and railway equipment production quality were signed on November 26–27, 2007, at UNIFE General Headquarters in Brussels.

As a result of negotiations between UIRE Vice-President Sergey Palkin and IRIS General Manager Bernard Kaufmann, a Memorandum on Cooperation and a License Agreement were signed.

The above documents provide for exclusive rights to be granted to UIRE for the transfer and distribution in Russia and the CIS countries of the new version of the European Standard of Railway Equipment Industry (IRIS).

In compliance with the adopted obligations, the European UNIFE specialists will train over 100 national managers over two years, for them to gain a profound knowledge of the IRIS standard and the methods, defined by the said standard, for final product quality estimation. They will make up the core team of specialists in development of modern analysis methods and for selecting optimum ways to increase efficiency of the existing quality management systems at Russian enterprises. In future, under a cascade training system it is supposed that the European quality standard will be implemented at all leading national railway engineering production plants.

The necessity for the Russian engineering industry to implement the IRIS standard is determined by goals and objectives formulated in the Rail Transport Development Strategy up to 2030. The forthcoming almost complete renewal of rolling stock requires the urgent development and production of an entire new range of modern locomotives and cars, meeting the objectives for efficiency, both now and in the future.

The implementation of the IRIS standard, alongside with solving the problem of the engineering and the advanced foreign technologies transfer, will allow RZD to meet their demands for domestic-made, high-quality railway equipment.

These signed documents acquired special importance during the preparation of the RZD's delegation for the December 2007 session of the International Union of Railways (UIC), held in Paris.

THE IRIS STANDARD, IF IMPLEMENTED BY THE RUSSIAN INDUSTRY, WILL ALLOW RZD TO SATISFY THEIR DEMANDS FOR DOMESTIC-MADE RAILWAY EQUIPMENT OF THE HIGHEST QUALITY.

At this session, discussions continued on the proposal of the President of RZD Vladimir Yakunin, made at the July UIC session (Moscow, 2007) on the unification of international requirements for rolling stock and infrastructure on the basis of international standards. Active introduction of the IRIS standard, acknowledged not only by European but by the international community as well, marks is important step in the actual implementation of the decisions of the above mentioned UIC Moscow session and sets an example for other national railway companies to follow.

AGREEMENT ON STRATEGIC COOPERATION BETWEEN UIRE AND UNIFE

To ensure mutually beneficial long-term commercial and technical cooperation, UIRE and UNIFE members initiated the elaboration and signing of the Agreement on the Strategic Partnership. On February 28, 2008, this document was signed in Brussels.

The Agreement provides for a strengthening of relations between the aforesaid members and unification of their products. The parties of this Agreement will develop joint cooperation in standardisation, promotion of market systems integration processes and facilitation of access of their products to the world markets, opening new international rail transport markets.

In compliance with the adopted obligations, UNIFE and UIRE specialists confirmed their readiness to inform each other on the modern political, technical and business aspects of their activities in appropriate fields.

In the scope of this Agreement, it is planned to concentrate cooperation on facilitating the UIRE members' understanding of the existing European rail transport standards. In its turn, the Russian party will provide the European party with the technical standards of national rail transport and present the information requirements to adequately understand the major principles and direction of the activities.

A programme of seminars on RZD's standards will be made for UNIFE members and on European railway standards for UIRE members. At these seminars, it is proposed to concentrate on joint consultations on the modern policies of entering the market and the principles of estimating product conformity.

DEVELOPMENT OF COOPERATION BETWEEN UIRE, RAILWAYS SUPPLIERS INSTITUTE AND AMERICAN ASSOCIATION OF RAILWAYS

During the period of April 6–13, 2008, UIRE's delegation had several business contacts with leaders of American Association of Railways (AAR) and Railways Suppliers Institute (RSI) as well as with representatives of the technical supervisory body of the Federal agency for railway transport and with the leaders of the Transport-and-Technology Centre (TTCI).

On April 7, 2008, negotiations were held between the UIRE's delegation and leaders of RSI, Thomas Simpson and Bob Kliment, who represent RSI interests in the US Congress. They have agreed that the objectives of these organisations had much in common and that RSI, in a way, was some kind of analogue to UIRE. Means of further cooperation were defined, in particular, in advertising the associations when organising exhibitions.

During the negotiations with the AAR Vice-President Robert Van der Kluite, a Protocol on Intentions between the parties was signed, aiming at establishment of a data communication system to promote the development of both associations and increase their influence in the American and Russian markets of railway equipment manufacturers.

TO INCREASE THE EFFICIENCY OF CERTIFICATION, IT IS IMPORTANT TO ESTIMATE ITS CONFORMITY BY THE END USER, OR ITS REPRESENTATIVE, AND NOT BY A THIRD PARTY, AS IMPLIED BY THE ISO STANDARD.

The parties came to mutual consent regarding the implementation of the work process integration of the AAR auditors and those of RZD's Technical Audit Centre that would allow auditing in the USA by the AAR in the interests of UIRE, and, respectively, auditing in Russia and the CIS states by Russian auditors in the AAR's interests. Thus, for example, the AAR is forced to periodically audit Russian enterprises. The parties acknowledged the practicability of conducting such seminars with the help of Russian auditors.

The UIRE's delegation was acquainted with the AAR structure and its main objectives. The Association integrates all the major USA railways. To coordinate the requirements of the standards it recruits the main producers (RSI) of the railway equipment for work in its committees. The AAR standards are to be obligatorily observed on all railways of the USA. The manufacturers use only these standards. Federal laws and regulations are used only as the least necessary requirements to safety measures which, in most cases, are surpassed by the AAR standard requirements.

The AAR subjects the railway equipment production enterprises to auditing once a quarter, while complete auditing is effected once every two years, with involvement of AAR representatives in all tests as well.

The railway equipment producers control the product quality using the AAR M-1003 standard, which is preferred to the ISO standard in the internal market.

The aforesaid M-1003 standard is of great interest for the Russian industry since it helps to overcome the existing unwillingness for an efficient introduction of separate classic ISO principles. To a great extent, it is caused by a low level of competition and a monopolism in the production of a number of key industrial products.

For the Russian engineering industry, it is of prime importance that the M-1003 standard section of requirements to the products is obligatory for application, while ISO does not contain such a section at all (only in the standards of enterprises). Another positive factor in the conditions of the market development and appearance of new players thereon involves the fact that the M-1003 standard makes it incumbent to allow for the entire complex of engineering requirements to not only the products but the manufacturing processes as well.

To increase the efficiency of certification, it is important to estimate its conformity by the end user, or its representative, and not by a third party, as implied by the ISO standard.

The M-1003 standard obliges the end user to effect product monitoring in operation and to obligatorily take a decision in the case of product failure.

PERFECTION OF THE OBLIGATORY CERTIFICATION SYSTEM

In Russia the product certification, in the framework of the obligatory certification system, is effected by the Register of Certification of the Federal Railway Transport. The certification is conducted for compliance with the safety standards approved by the Ministry of Railways of Russia. Since these standards were elaborated in the period of 1998–2002, they no more respond to the requirements for modern rolling stock in many parameters. For example, they do not cover the parameters for high-speed rolling stock, cars with an axle load over 25 tonnes and so on.

The Federal Law 'On Technical Regulation' from December 27, 2002, did not allow the introduction of amendments to existing safety regulations or the adding of certification requirements. The situation changed with the adoption on May 1, 2007, of amendments to this law, that allowed to start work on making amendments to existing safety regulations. This moment heralded the beginning of the process of formation of a fundamentally new wording of safety regulations, providing for the removal of bureaucratic and innovation development obstacles, reducing the price and the content of the obligatory certification procedures, expanding the declaration and volunteer conformity acknowledgement.

The efforts of UIRE and its committees and members are important in this process.

THE CENTRE OF TECHNICAL COMPETENCE

Enhancing product quality is now an objective of the highest priority and importance in Russia. This applies fully to the railway equipment manufacturers. The quality and reliability of equipment do not comply with modern requirements and the level reached by the railways of the European countries. This reduces their competitiveness and causes unjustified operating costs.

This is why UIRE has undertaken to organise the development of the voluntary certification system and quality control systems, a highly efficient mechanism in practice abroad.

An important peculiarity of UIRE in organisation of the voluntary certification lies in participation of both the end users and manufacturers. Note that the suppliers of sophisticated equipment are, at the same time, consumers of the purchased completing assembly units and parts, on the quality of which depends, in many respects, the reliability of operation of their products. This clarifies the independence of partnership in technical matters and a striving towards objectiveness in upholding common interests.

The first stage of this work has been overcome by registering the system of volunteer certification in rail transport on March 6, 2008 by the Russian Federal Agency on Technical Regulation. The Centre of Technical Competence, a subsidiary undertaking, has been created to deal with the problems of the partnership members and the orders they place. The primary objectives of the Centre's operation include:

- Certification of the products, the quality and ecology management systems, personnel and services in the rail transport field;
- Testing the products, involving accredited certification centres;
- Carrying out operating tests to control the reliability and efficiency parameters of the rail transport equipment;
- Elaborating the standards (national, international, corporate) and other regulatory-technical documents and standard testing procedures. Participation in elaborating the international standards or in harmonising the standards;
- Carrying out the engineering appraisal of the projects and engineering designs of railway equipment and systems, draft regulatory-technical documents, engineering processes and equipment for production and repair of the railway equipment, technical diagnostics, the programs and procedures for testing the railway equipment and its components, the programs and means of metrological support of the enterprises, and the results of various tests.

Technical Competence Centre activity will result in an increase in the quality and efficiency of rail transport operations.

QUALITY POLICIES

To ensure high operating performance of the new rolling stock, it is necessary to change in sequence, in a short space of time, over to new principles of cooperation with rail transport equipment manufacturers in terms of quality. In cooperation with RZD, UIRE has elaborated a programme for the sequential intensification of the requirements for engineering systems of quality provision. Thus, at the first stage, RZD does not accept products from enterprises that have no product certificates or which have not had the stability of their engineering process confirmed.

At the second stage, covering the period from 2009 to 2010, UIRE plans to introduce an intermediate standard of requirements to supersede the existing one and actually approximate to the IRIS standard.

During this period, the products supplied by manufacturers without the certified quality management systems and certified production lines will not be accepted. An estimation of the engineering systems should form the basis for making contracts on the supply of rolling stock.

At the third stage, covering the period from 2011 to 2015, a full-scale transition to international standards is envisaged, particularly with regard to reliability and life cycle costs.

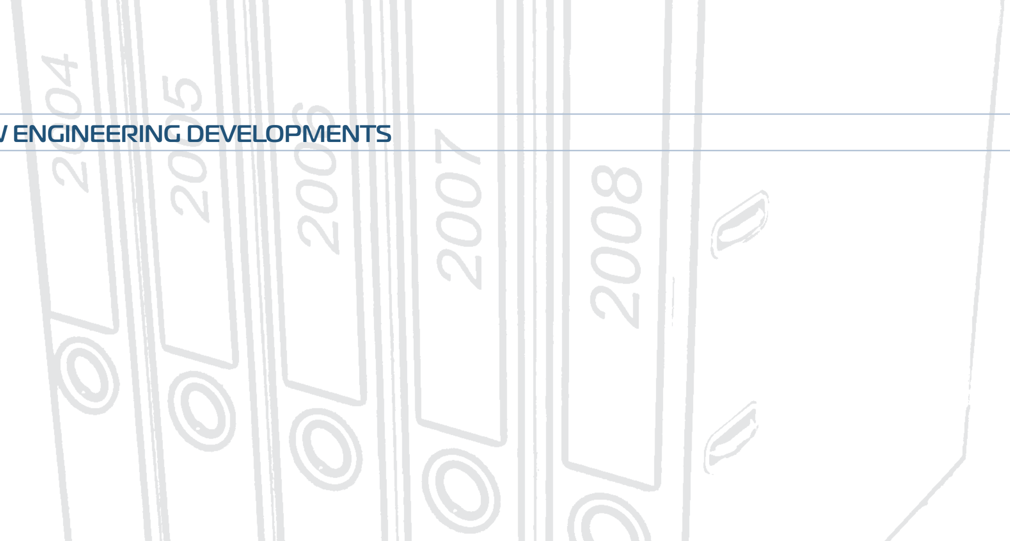
The above approaches have been discussed with the equipment manufacturers at the meeting of UIRE and have been endorsed by them.

At present, preliminary work is being done to realise the proposals of the manufacturers' chief designers to expand the audit sphere to cover the development, design and production launch of new rolling stock. There is an objective to initiate, from 2009, the full-scale auditing of all stages of the new rolling stock life cycle.

To implement the above mentioned objective, UIRE has decided to establish a subsidiary undertaking, 'Tekhnotest' Quality Bureau to take on a part of outside auditing activities.

The primary objectives of this Bureau will be as follows:

- Implementation of UIRE policy in ensuring the quality of supplied products by realising a complex of systemic measures on strategic cooperation between the railway engineering enterprises and organisations.
- The organisation of an audit of the enterprises' quality management systems, to perfect the quality control methods, to improve the degree of conformity to the specified standards, and introduce advanced quality provision methods and tools.



A NEW MODEL LINEUP OF LOCOMOTIVES

David Kirzhner
Deputy Head of Locomotive Department
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In the USSR, there were nine enterprises which produced together about 2000 locomotives a year. In 1990s, the output dropped drastically. Moreover, with the collapse of the USSR and Comecon, there were no supplies in Russia of the DC freight and passenger electric locomotives, diesel shunters produced mainly in Ukraine, Georgia and Czechoslovakia.

The modern stage of Russia's development required an updating of the locomotive lineup. This is why the Programme for development and commercial production of new locomotives was developed. It is divided into three stages:

1st stage

- upgrading the serial production of rolling stock (2004–2005);
- development and production of prototypes, testing of new transition rolling stock, including locomotives with commutator traction motors (2004–2005).

2nd stage

- development of new production facilities, reconstruction of existing facilities, and organisation of serial production of new-generation rolling stock (2004–2006),
- development and production of pilot locomotives and their testing, including those equipped with commutatorless traction motors (2005–2008).

3rd stage

- development of the serial production of new-generation rolling stock, introducing new processes of servicing and repair and creating a market for enterprises in the production of rolling stock and their components (2009–2010).

Today, it can be stated with confidence that the first two stages of the aforesaid program, started in 2004, have already been successfully completed. The primary objective – the revival of national locomotive engineering – has been reached. In 2007, engineering enterprises producing locomotives succeeded in exceeding an annual output of 300 units and in 2008 RZD intends to buy 500 locomotives.

2ES5K, EP1M and 2TE70 series locomotives of the transition period have now appeared on the railway network.

The 'Ermak' series freight DC electric locomotives in one-, two- and three-section versions, built on a practically unified undercarriage, are now operating on the RZD's network.

Certification tests of the new 2ES4K freight DC electric locomotive produced by Novocherkassk Electric Locomotive Plant have already been completed. The first locomotives are now operated by Western-Siberian Railway.

Now, for the first time in the history of Russia, Sinara – Transport Machines has initiated the production of 2ES6 series freight electric locomotives, incorporating an entire range of fundamentally new assembly units and parts:

- traction motors with motor-axial frictionless bearings;
- radial wheel pair trucks;
- distributed microprocessor-based control, safety and diagnostics system, modular compressor units, and others.

The supply of EP1M series passenger AC electric locomotives continues the range of the EP1 series electric locomotive.

EP2K series passenger DC electrics locomotive produced by Kolomna Plant figures specially in the plans of RZD.

2TE25-series electric freight locomotive, incorporating an induction traction motor, represents a new generation in the range. This locomotive, based upon Russian designs, has already demonstrated excellent power-hauling results in trial runs.

At present, alternative fuel types are under analysis for locomotive traction purposes. The prominent example in this respect is a GT1 gas turbine locomotive.

All newly produced locomotives show traction and economic parameters differing insignificantly from those made in the 1970-80s and leave much to be desired. The quality of the produced traction rolling stock makes a separate problem. Not infrequently some parameters fall beyond the values set in the specifications.

In many aspects, the above misfit is caused by particular designs and directly depends upon the locomotive production methods.

Meanwhile, it should be pointed out that the products cost is approximately the same as of the world's best specimens, and the costs are continuously increasing. For example, the price for an air-conditioning system for EP1M electric locomotive has exceeded €14,000, the fire extinguishing system price is also high with the systems safety leaving much to be desired.

Thus, the main problem now consists in a real locomotive cost-to-quality ratio. One should understand, when, in terms of the current price increase, it is profitable to buy new locomotives and when a declarable decrease in operating costs becomes real. Anyway, the designs' costs should be correlated with the life cycle cost.

It is vital to distinguish the directions for the locomotive designers to concentrate at. First of all, it relates to the development of commutatorless induction traction engines.

It is necessary to develop and put into production in the nearest future the locomotives adapted for a one-driver maintenance. It means absolutely different concept of applying the control and diagnostics systems and provision of traffic security. A driver at such a locomotive must, without leaving the cabin, be sure that traction transformer does not overheat, there is no smoke screening in the engine room and that he is capable to recover the locomotive operation in normal mode.

An enormous potential of improving the locomotive operation quality indices consists in increasing the axial load to 27–30 tonnes. The major railway main lines can transmit the rolling stock with such loads. This is why the possibilities of widening the heavy-load motion get opened.

One of the primary requirements is to provide unification and modular concept of locomotive production.

To produce a new generation of com-

2TE25A Diesel locomotive

petitive rolling stock national manufacturers need to use the world class modern production technologies and to establish a close cooperation with the major customer (RZD), on the one hand, and with development contractors (specialized R&D institutes and engineering centres), on the other hand. RZD is ready, in the framework of this cooperation, to provide manufacturers with engineering solutions for the main assembly units and parts and the entire set of required documentation. ■

Realisation of the Russian locomotive production programme

OPERATING NOW | TRANSITIONAL | PROSPECTIVE

FREIGHT AC ELECTRIC LOCOMOTIVES

VL80

2ES5K

2ES5

FREIGHT DC ELECTRIC LOCOMOTIVES

VL11

2ES4K

2ES6

PASSANGER DC ELECTRIC LOCOMOTIVES

ČS2

EP2K

EP20

FREIGHT DIESEL LOCOMOTIVES

2TE116

2TE25K

2TE25

2004 2008 2010

DEVELOPMENT AND PRODUCTION OF THE WORLD'S FIRST MAIN LINE FREIGHT GAS TURBINE LOCOMOTIVE RUNNING ON LIQUIFIED NATURAL GAS

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The Rail Transport Development Strategy envisages an increase in weight and speed of trains, especially on the principal rail routes. The objective of reducing rail transport operating costs places the question of development of high-power self-contained locomotives. The RZD's Power Strategy sets the objective of substituting 30% of the diesel fuel consumed by self-contained locomotives with natural gas. This level is planned to be reached by 2030.

The primary objective of the development of a gas turbine locomotive running on liquefied natural gas is to create in the shortest possible time a high-power, self-contained locomotive running on an alternative fuel, which allows carrying on non-electrified lines the same train's weight as electric locomotives.

The weight and size constraints do not allow development of a locomotive diesel generator rated at above 4,400 kW with the required fuel load. This is why when changing electric traction to diesel a train driven by a single electric locomotive is divided into parts further driven by several diesel locomotives. RZD needs a locomotive capable of carrying a train with over 6,000 tonnes weight which was driven by one electric locomotive and, without breaking it up, of delivering it to its destination. A gas turbine locomotive, incorporating a gas turbine engine rated at 8,000–9,000 kW, a level of three modern diesel engines, can meet the above requirements.

Gas turbine locomotives were developed and tested between 1941 and 1973 in Switzerland, France, the USA and the USSR and ran on petroleum fuels.

Experience in operating gas turbine locomotives demonstrated that gas turbine engines has repair and operating costs lower by 30–50% and a lubricant consumption from five to six times lower than diesel engines. Moreover, unlike diesel locomotives, they require no warming up in winter, which is especially important in Russia.

The problem of switching to alternative fuels, including natural gas instead of petroleum fuels is becoming particularly important in connection with the increase of liquid fuel price throughout the world and depletion of oil reserves alongside with the problems of environment pollution.

The relatively low cost of natural gas allows the effective use of expensive equipment when developing state-of-the-art power installations for self-

A GAS TURBINE LOCOMOTIVE IS A LOCOMOTIVE WITH A GAS TURBINE OR A COMBINED ENGINE. ALMOST ALL EXISTING GAS TURBINE LOCOMOTIVES INCORPORATE A SINGLE-SHAFT OPEN-CYCLE GAS TURBINE UNIT WITH ELECTRICAL TRANSMISSION.

THE FIRST PATENT ON THE GAS TURBINE LOCOMOTIVE WAS ISSUED TO A RUSSIAN ENGINEER A. SHELEST IN 1922. THE FIRST GAS TURBINE LOCOMOTIVE WAS MANUFACTURED IN SWITZERLAND IN 1941. THIS TYPE OF LOCOMOTIVES APPEARED FOR THE FIRST TIME IN REGULAR RAIL SERVICES IN THE USA IN 1948 AND, IN 1969, UP TO 50 SUCH LOCOMOTIVES RUNNING ON PETROLEUM FUELS WERE OPERATED ON THE UNION PACIFIC RAILROAD. SOME GAS TURBINE LOCOMOTIVES WERE ALSO PRODUCED IN GREAT BRITAIN, SWEDEN, CZECHOSLOVAKIA AND THE USSR.

contained transport facilities, such as gas turbines, gas and fire safety systems and cryogenic equipment. The world's first pre-production model of the a freight main line gas turbine locomotive running on liquefied natural gas was produced in Russia under the order of RZD, with a 8.3 MW gas turbine engine on board. Since 1998 experience has been gained in operation of TEM19G 882 kW gas turbine shunters, running on liquefied natural gas.

The idea of using cryogenic fuel, liquefied natural gas (LNG) on high-power main-line locomotives was expressed by RZD.

The advantages of LNG as a motor fuel lie in its higher density (3 times higher) and lower pressure compared to compressed gas. This allows to make a 2.5–3-fold reduction of overall dimensions and a 15-fold reduction of locomotive fuel stock system weight (17,000 tons of gas). It also provides a cruising range of at least 1,000 km before refuelling. In this respect, total weight of a 8–9 MW main line gas turbine locomotive running on compressed gas would come up to 750–800 tonnes, while usage of liquefied gas made possible construction of a GT1 gas turbine locomotive with a weight not exceeding 300 tons.

Annual operating cost savings if gas turbine locomotives running on liquefied natural gas are used instead of freight diesel locomotives will comprise:

- €230,000 a year per one gas turbine locomotive carrying 6,500 tonnes trains;
- €320,000 a year per one gas turbine locomotive carrying 8,000 tonnes trains.

Development of the main line gas turbine locomotive was initiated in March 2005.

In selecting a proper gas turbine engine for a gas turbine locomotive, a number of gas turbine units has been analysed among those produced by Russian manufacturers including 'Salyut', 'Soyuz' Air Engine Scientific and Technological Centre (Moscow), Aviadvigatel (Perm), Kuznetsov Samara Scientific and Technological Centre and their production and experimental capabilities have been studied.

Kuznetsov Samara Scientific and Technological Centre came up with a NK-361 series 8,300 kW gas turbine engine, which has the most efficient regasification circuit, where the liquefied natural gas changes into gaseous state in a heat transfer device installed directly in the turbine exhaust pipe without use of any intermediate heat carriers. A similar scheme was formerly developed by Kuznetsov Centre and used on a Tu-155 prototype aircraft. During the development of this engine the experimental capabilities to test cryogenic equipment were formed and a team of highly-qualified specialists in aircraft cryogenic engines was built. Both these factors determined the selection of a manufacturer of a gas turbine locomotive engine.

All-Russian Rolling Stock Design and Technology Research Institute (VNIKTI, Kolomna, Moscow Region) played a role of a central development centre of a gas turbine locomotive. To save necessary time for the locomotive development and production, it has been decided to design it on the base of a serial VL15 electric locomotive undercarriage.

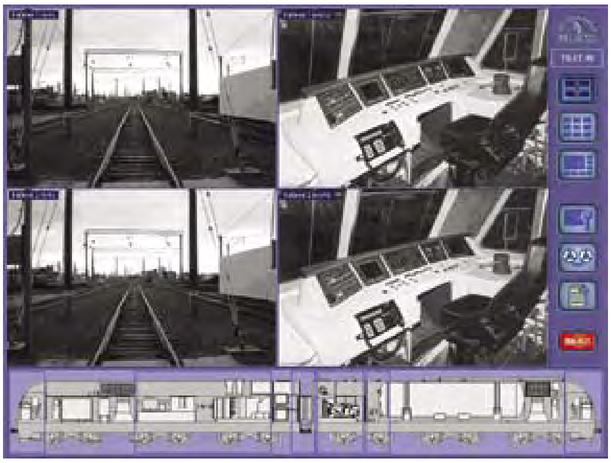
Test of a gas turbine engine

In the period of 2005–2006 VNIKTI developed engineering requirements, gas turbine locomotive terms of requirements, made the sketch and preliminary design, worked out the design specifications on the locomotive traction and booster sections, produced and tested a part of the component units, including a locomotive microprocessor control system, control panels, traction and auxiliary converters. VNIKTI specialists provided continuous engineering support throughout the manufacturing and testing of the locomotive and its major equipment at Voronezh Diesel Locomotive Repair Plant, Kuznetsov Samara Scientific and Technological Centre, Uralcryomash, Samara Rolling Stock Repair Plant and some other associate executors.

The locomotive consists of two sections, one holding the power unit (traction and auxiliary generators and gas turbine engine) and the compressor unit, and the other holding the cryogenic tank units (for storing and feeding liquefied natural gas) and a 400 kW generator for shunting movements. The sections also include driver's cabins, ventilation units and high-voltage cabinets. To ensure gas and explosion safety, the locomotive has modern gas detection and automatic ventilation systems.

The modular driver's cabin is mounted on the locomotive independently of the body to that makes repair work easier. The cabin has a steel bearing frame and a plastic outer skin. The inner skin is also made of plastic panels and meets all the requirements specified for it. The cabin is furnished with a modern control panel, ergonomic seats and air-conditioning.

The locomotive is equipped with a video system controlling status of the main equipment (the traction unit, cryogenic tank system, inter-section spaces) and control cabins. Video cameras, aimed ahead, also record a situation on a locomotive's route. Now the image recorded is transmitted to a driver's cabin



GT1 gas turbine locomotive video system

only, but in prospect data could also be transmitted to the dispatching centre, where specialists controlling the train's motion parameters could instruct a locomotive crew or even stop the train by remote controls activating the emergency braking system.

In December 2006 resistor tests of the locomotive power unit at Kuznetsov Centre test grounds with the gas turbine engine maximum output power take-off resulted successfully. In April 2007 Voronezh Diesel Locomotive Repair Plant completed the locomotive assembly. VNIKTI and Kuznetsov Centre specialists succeeded in producing and testing a fundamentally new gas turbine and cryogenic equipment control system (MPSU-GT) in a tight schedule (from October till December 2007).

Since May 2008, Kuybyshev Railway and its Samara Rolling Stock Repair Plant have been performing the commissioning and testing of the locomotive.

On July 4, 2008 the world's first gas turbine locomotive running on liquefied natural gas completed a trial run with a 3,200 tonnes freight stock on Kuibyshev Railway.

The teams of enterprises that have developed this locomotive continue to improve the locomotive's sophisticated systems with participation of specialists in cryogenic equipment and fundamental science.

GT1 locomotive trial run

SATELLITE TECHNOLOGIES FOR INNOVATIVE DEVELOPMENT IN TRANSPORTATION MANAGEMENT

Professor **Sergey Adadurov**
Doctor of Engineering
Managing Director
NIIAS institute

The railway industry implements programmes of great national importance, the aims and objectives of which are stated in the Rail Transport Development Strategy up to 2030.

This is the main document, in which strategic priorities of the industry development are laid down systematically. Moreover, they are stated not in a corporate, but in an inter-sector sense, embracing not only rail transport, but also railway engineering industry and allied sciences and arts.

Priority orientations of the most active innovative use in the railway industry are clearly defined in the programme.

Implementation of traffic integrated management systems and dynamic monitoring of infrastructure and rolling stock conditions using satellite technologies are stated as breakthrough innovative tendencies in the the Rail Transport Development Strategy.

So what has been done by Russian Railways OJSC in the field of innovative development over the past year?

First of all, priority directions in development and introduction of satellite technologies, combined in the integrated scientific and technological plan named 'Creation of modern systems of traffic control and train safety' for 2007–2009, were formulated.

As a priority direction to be implemented in 2007–2008 dislocation definition and rolling stock traffic control have been selected, in particular, a special self-powered rolling stock (SSRS), heavy repair equipment, repair and wreck vehicles with the use of coordinate- and time-based information from GLONASS/GPS global satellite navigation systems.

At present, the definition of dislocation and condition of railway mobile objects is performed using existing systems of dispatching control and gathering information by manual means (telegrams, telephone messages and verbal reports). The actual conditions of a real object, including the effectiveness of its operation, are not controlled by automatic means and are unreliable. The 'human factor' plays a considerable role in the reliability of the obtained information.

The task was set to make the above mentioned process automatic and ensure the target level of reliability, basing on satellite navigation technologies, mobile digital communication and geoinformation systems (GIS RZD), tied within the targeted system-wide solution.

A target condition for 2007–2008 was defined as obtaining the basic process solution for the indicated questions, optimised by cost-effective criteria, its approbation and implementation at the Chelyabinsk – Rybnoye route.

The proposed technical solution is based on the use of GLONASS/GPS satellite on-board navigation-communication terminal sets, installed in locomotives and SSRS and integrated into the data transmission network of RZD with the help of the mobile digital communication system. The obtained information about location and object-motion parameters is then processed by GIS RZD software tools and fixed to a flow chart of spatial representation of RZD tracks.

The most accessible open system in the GSM/GPRS format is used as a telecommunication system. At chosen sections of railways guarantee possible connection and message delivery. Such possibilities are already introduced in Moscow, Kuybyshev and South-Ural railways.

Within the structure of traffic dispatch centres and transport control centres, special hardware and software complexes for satellite data collection and processing are being formed, the telematic servers of which facilitate collecting, processing, storage and delivery of coordinate-, time-based and telemetric data from locomotives and SSRS at computer work stations.

The special software tools deployed on these servers, allow a location to be determined by three-dimensional geographic coordinates, tying them into special electronic charts and digital route model, working within the framework of GIS RZD.

The suggested installation of on-board GLONASS/GPS navigation-communication terminal sets on locomotives and SSRS ensures a high level of protectability from mechanical and climatic interference, for example from contact wire fall, lightning discharge and so on. Moreover, they are adapted to the requirements of equipment setup on the rolling stock of RZD's and the corresponding safety regulations are also satisfied.

Transmission devices of on-board sets allow operation both off-line and together with complex CLUB-U locomotive safety devices on locomotives and CLUB-UP devices on special self-propelled rolling stock.

This allows not only to meet the requirements in terms of prospective development and mandatory application at rail transport objects of GLONASS system; it also ensures the requirements during information transmission over open communication channels from mobile objects.

IN ACCORDANCE WITH THE RUSSIAN REGULATORY AND LEGAL FRAMEWORK, THE APPLICATION OF THE GLONASS SYSTEM IS OBLIGATORY.

The latter requirement is realised by means of special software tools, built into the on-board sets, which provide for conversion from satellite navigation data in the geocentric system of coordinates to kilometres and pickets in the railway coordinate system. Such a technical solution helps to satisfy the requirements of current secure limitations and considerably decreases expenses on encryption, information protection in communication channels and cryptography system support.

Simultaneously, work continued in 2007–2008 on standard fitting out of locomotives and SSRS of RZD with CLUB-U and CLUB-UP integrated locomotive safety devices, which are serially produced by Izhevsk Radio Plant and, since 2006, with GLONASS/GPS receivers.

At present RZD has about 2,800 main line locomotives, 910 EMUs and 2,000 SSRS units in operation, including heavy track machines, with satellite equipment fitted on board. Except the equipment of this rolling stock, satellite equipment continues to be installed on special track recording cars and rail spotter cars, and also on other rolling track measuring devices (such as track measuring trucks). These sites are currently fitted with about 200 kits of satellite equipment. Work continues on fitting passenger trains with satellite security systems and INMARSAT systems for mobile satellite communication. 101 passenger trains have already been equipped and taken under operational control. In 2008–2009 their number will increase up to 600.

In 2008 RZD has completed work on the creation of satellite monitoring technologies for the operation of heavy repair equipment. The developed technical solutions facilitate operative and objective control over the supply of necessary machinery to repair work areas and, most importantly, control over observance of repair works procedures in real time. Such monitoring means that dispatch operators can be warned in time about deviations from the planned schedule and possible 'overexposure' of a gap, and take the necessary steps to organise train operations.

Technology has been developed to control wreck trains dislocation and movement of these trains to emergency situations locations. Here, using satellite technologies through a space communications channel, the transmission of express video filming is provided from the site of such emergency situations. This all allows the RZD's management to get an objective picture of the current situation and to make reasonable management decisions on the rapid liquidation of the problem.

A beneficial contribution to the RZD's resource-saving programme is made by satellite technologies in the matter of rail lubricating system improvement. In 2008 technology should be developed and on-board hardware and software complexes created, to be installed on mobile rail lubricators, which provide automated control of the rail lubrication process, and thereby contributing to the reduction of above-standard wear-out in the 'wheel-rail' system.

In the years coming, work on the application of satellite technologies by RZD will enjoy further development. This work is tied in with the RZD White Book and arrangements of the Federal special-purpose programme 'Global Navigation System' up to 2011. Among these works much emphasis is put on the development of coordinate management systems and interval railway traffic control with flexible block-sections. In such systems, GLONASS/GPS satellite navigation data on location, speed and train length, combined with mathematical models of train situation make possible train movement without use of signalling lights. This is the way to creation of 'intellectual' trains with a built-in auto-directing and self-diagnostics system.

Work will be further developed on concurrence of satellite data on location and rolling stock movement parameters with automated systems of train service management, applied by RZD, such as GID-URAL, DC-YUG and ASOUP.

Intensive progress is made in the development of satellite monitoring system of hazardous and valuable goods transportation and also container traffic using GLONASS/GPS equipment and mobile digital communication systems, including mobile communication systems of GSM/GPRS format and satellite communication, such as INMARSAT, or low-orbiting satellites, such as Gonets/OrbComm.

Taking into account high requirements for the precision of rolling stock location determination at railway hauls and stations' layouts (positioning errors should not exceed 1 m), special emphasis is put on the development of technology for high-accuracy definition of rolling stock location in international travel corridors on the basis of the complex use of system data provided by the Russian Differential Correction and Monitoring System and the European EGNOS system of differential corrections.

The key problem for the succesful application of satellite technologies on Russian railways lies in the creation of an integrated system for a digital coordinate description of railways and infrastructure objects of railway transport.

Such a system is needed for almost all functional spheres of application of GLONASS/GPS coordinate- and time-based data, beginning from design, construction and operation of railways up to the creation of special systems for monitoring and display of rolling stock dislocation in real time.

Work in this direction is performed by RZD in cooperation with Roskartografia and the Russian Ministry of Defence. The task is to create technologies and regulatory legal acts, which specify procedure for updating open digital navigation charts of 1:25,000, 1:50,000, 1:100,000 scales, and also to use open state-run coordinate systems SK-95, PZ-90 and the international coordinate system WGS-84 for railway transport tasks.

It should be noted that development of the statutory and legal framework and regulatory-technical documentation, regulating the operating procedures of GLONASS/GPS global satellite navigation systems on rail transport, in respect to safety requirements, is a priority direction of RZD activities in this field.

We should define precisely a list of goods and services for provision of navigation for rail transport (and the entire transport complex in general) which are subject to certification and licensing.

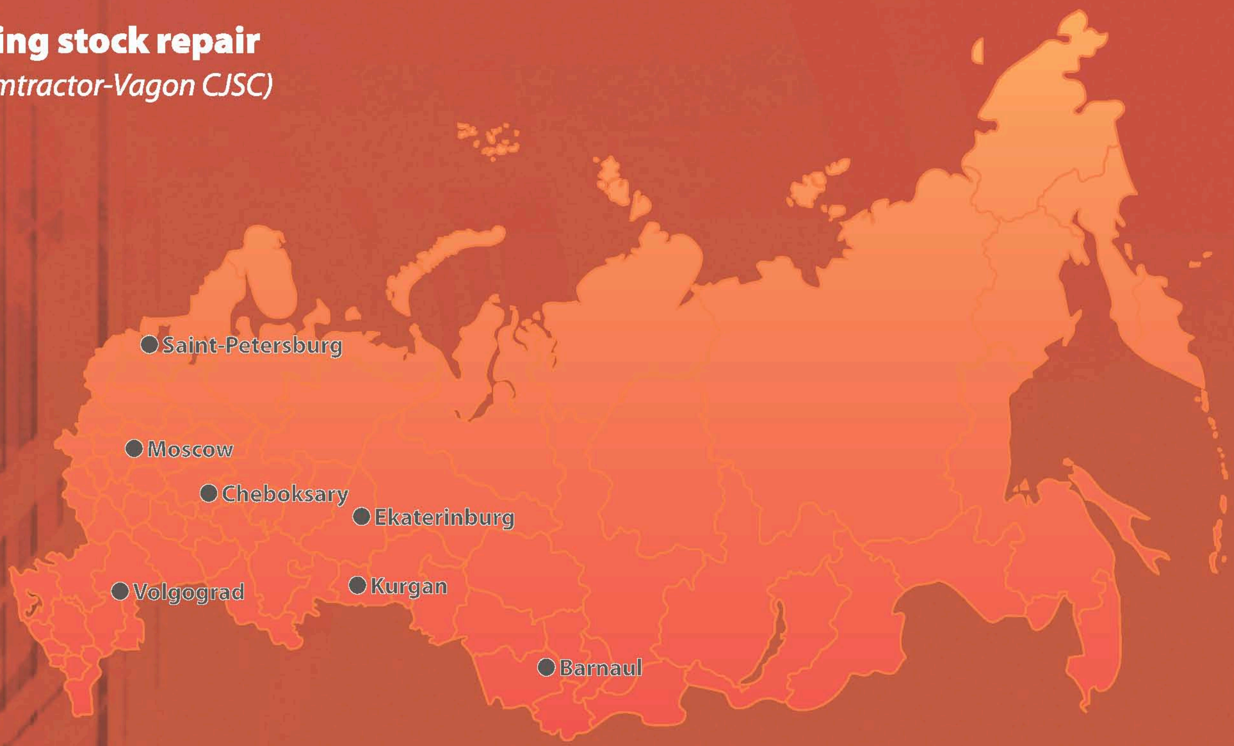
On the agenda appears the development of industry standards and regulations on the application of satellite navigation technologies, hardware and software devices and systems on their basis by RZD. Work in these fields is being carried out in close cooperation with the Russian Space Agency, the Ministry of Transport and the Ministry of Defence.

On the whole, the RZD White Book envisages mass implementation of satellite technologies by 2015.

According to preliminary evaluations, the total demand of RZD for satellite navigation devices and systems on their basis in this period will amount to not less than 28–30 thousand units.

Furthermore, it is planned to use at least 50,000 portable satellite positioning devices (in a form of industrial Pocket PCs) to equip railway track gangs to ensure higher security and to increase labour productivity in the services of RZD.

All the above directions of GLONASS/GPS satellite technologies and digital communications systems implementation should provide RZD with an opportunity to implement a multilevel system of complex security, to obtain a synchronisation mechanism for large-scale business processes, realised across the immense network of railways in Russia and in neighbouring countries. These business processes may include logistics operations management, organisation of multimodal transportation and transport of hazardous and valuable goods.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