

Director TMH

MAGAZINE FOR PARTNERS



KIRILL LIPA:
WE MUST BE PREPARED
FOR ALL CHANGES
AND CHALLENGES

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Production
results

Investment
program

Holding's
development plans



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Alexander Astafiev / RIA Novosti



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Our Anniversary

This year Transmashholding celebrates its 20th anniversary. TMH celebrates its second anniversary in the higher league of railway engineering. Today, the Holding not only provides Russia with the latest technology, but also holds strong positions on foreign markets.

Consolidation of Russia's leading producers of rolling stock and components into a single entity has yielded excellent results. The TMH management not only recovered the entire sector, which after the difficult 1990s was in a deplorable state; it revived the Russian industry, made a major breakthrough and offered the market products based on the best achievements of world science and design thinking.

This required rebuilding the structure, retrofitting the production

areas and training employees, developing new competitive samples of equipment.

Over the years, Transmashholding has been contributing significantly to achieving public objectives of industrial and transport development and expansion of non-resource exports. These objectives were included in the Holding's long-term strategy, and, as it can be seen today, this decision has fully proven itself.

The Holding concentrates on quality, comfort and comprehensive

approach in dealing with its partners. Every day TMH and its employees are learning to look for modern trends and anticipate the desires of consumers.

In this issue, we will recall the history of Transmashholding, tell you about the most outstanding samples of equipment developed over the past 20 years, and share our future plans.

Sincerely,
 Editorial team

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POWER OF BEAUTY!

TMH has won the Good Design industrial and graphic design award for the second year running.

The last year award recognized the DNA brand concept. This year award was given to the concept design of the class TEM23 four-axle twin-engine diesel shunting locomotive. The class TEM23 design was developed in partnership with 2050.LAB – Russia’s National Center for Industrial Design and Innovation. This powerful, cost-efficient and smart vehicle introduces a unified platform of TMH’s new generation shunting locomotives.

The organizers of the contest reviewed design projects from over 55 countries. The TEM23 concept was recognized as one of the best in the Transport category. Other winners in this category included Ferrari, Hyundai, and Mitsubishi.

UNITED ENERGY

Rosatom State Atomic Energy Corporation and TMH have signed an agreement on the implementation of joint energy projects.

The documents were signed by Kirill Lipa, TMH CEO and a member of the Bureau of the Russian Union of Machine Builders, and Evgeny Pakermanov, President of Rusatom Overseas JSC. The parties plan to jointly develop projects related to energy solutions for small-scale generation, transport, and implementation of technologies that involve the use of new fuels. The partners are determined to develop the hydrogen energy infrastructure, expand the product portfolio, and implement projects in distributed and backup power generation.

At the moment, Rusatom Overseas and TMH are successfully cooperating on the project for the creation of hydrogen fuel cell passenger trains, which are expected to be operated in the Sakhalin Region in 2024. To implement joint projects, the parties agreed on the development of two assets. Rusatom Overseas will become a shareholder of TMH-Energy Solutions. In addition, a trading company under control of Rosatom State Corporation will be established to market new joint developments. This decision will significantly expand foreign sales channels and markets



for the enterprises of TMH-Energy Solutions.

NEW ROTATION

Staff reshuffles took place at the Kolomna Plant and Bezhitsa Steel Foundry.

Igor Mochalin, who had been in charge of the Bezhitsa Steel Foundry since 2018, was appointed the General Director of the Kolomna Plant.

He succeeded Dmitry Mirny, who greatly contributed to the digital transformation and retrofitting of the Kolomna Plant and now will be involved in the development of TMH’s engine-building projects in Russia and abroad.



Sergey Filipiev was appointed the General Director of the Bezhitsa Steel Foundry. Until 2019, he worked in the OMK Group. Later, he headed the Interpipe NikoTube (Ukraine). From 2021 and



up to his appointment at TMH, he was a Managing Director at VNIIBT – Drilling Tools (Integra Group). Sergey Filipiev is an expert in the implementation of lean manufacturing tools, quality systems, production planning and business processes optimization.



PREMIUM CONTRACT

TMH won the national 2021 Leasing Deal of the Year Award in the Railway Leasing Deal of the Year category.

The subject of the deal was the financial leasing of twelve EP2D passenger electric trains manufactured by the Demikhovo Engineering Plant, a member of TMH. The contracted rolling stock was added to the fleet of electric trains of the Central Suburban Passenger Company (CSPC) and will carry passengers on the Moscow Central Diameters. The lessor was Sberbank Leasing, the deal was financed by Sberbank, and the contract was insured by AlfaStrakhovanie insurance company.

Since 2016, the CSPC has purchased 126 EP2D trains. The rolling stock is operated on the railroads of the Moscow region.



DIGITAL INTEGRATION

TMH Smart Systems (formerly LokoTech-Signal) and Scientific Research Institute of Precision Mechanics (NII TM) will work together to create traffic control systems for urban rail transport.

The strategic partnership agreement was signed by Andrey Romanchikov, General Director of TMH Smart Systems, Managing Director of TMH for the Development of Intelligent Control Systems, and Oleg Antonov, General Director of NII TM. The partners intend to jointly develop and supply technologies of microprocessor interlocking and traffic control for urban rail transport.

The signed document is a continuation of the successful cooperation which began in 2021. Earlier, a memorandum of cooperation was signed on the development and supply of solutions for traffic and rolling stock management.

NEW PRODUCT FROM TVER

Tver Carriage Works, a member of TMH, presented a new product – a 61-4551 model power station car designed for operation as part of passenger trains.

The acceptance commission positively assessed a prototype. A certificate of conformity was issued, which will allow to launch the production of a pilot batch.

The main task of the new power station car is to provide electric power to passenger trains operated on non-electrified sections of railways with a gauge of 1520 mm. For this purpose,

the car uses a diesel-electric station with a total capacity of 1,350 kW consisting of three diesel-electric installations. The power station car is serviced by one operator whose task is to control the equipment operation. The car is equipped with anti-skid protection and automatic fire extinguishing systems, and a fire alarm indicating the place of the fire.



Kirill Lipa: We must be prepared for all changes and challenges

A milestone anniversary is a great occasion to take stock and speak about plans for the future, especially since in recent years TMH has been adhering to new principles of product creation and has placed a strong emphasis on foreign markets. Kirill Lipa, CEO at Transmashholding, told us about the key accomplishments of the last years, current trends in the industry and priority areas for further development.

TMH FLAGSHIPS

— **Kirill, which of the TMH's achievements in recent years do you consider the most important?**

— We try to regularly update rolling stock in all segments and present new products on the market.

I think the main achievement in the field of electric locomotive engineering is the launch of the 2ES5S and 3ES5S locomotives designed for hauling freight trains of up to 9,000 tonnes. These are the first Russian electric locomotives equipped with an asynchronous traction drive of our own design.

Talking about the metro rolling stock, the Moskva-2020 train deserves special attention. It received positive feedback from all residents of Moscow I interact with. Of course, this inspires a feeling of true pride in what you are doing. The title of real champions in this niche belongs to the designers of Metrowagonmash.

We cannot but mention the suburban rolling stock. Today, we are able to cover all the needs

in this segment. We probably only need to make a double-decker electric train, and then we can say that TMH is able to produce the entire line of rail transport.

KEEPING UP WITH A GLOBAL TREND

— **We live in an environment of ongoing scientific and technological revolution, digitization and implementation of the latest technologies. How is the transport engineering industry transforming under such conditions and is TMH keeping pace with all the changes?**

— Definitely, we are keeping up with a global trend. The innovations that you mentioned affect not only us, but our customers as well. The preferences of our customers are changing, and we are changing along with them.

Of course, new trends affect the processes of any engineering company and the industry as a whole. For example, unmanned driving both on rail transport, in agricultural engineering and other industries is currently under



development. Everyone is now focused on this field, developing new standards for vehicle operation that does not require the intervention by a human driver or requires minimal human involvement. Talking about methods of digital analytics that are used in the rolling stock design, management and operation processes, I can say that they are common for all types of engineering.

Great changes have been taking place and, in my opinion, they should be even more significant in material science. There is great potential here, for rail transport. The first objective is to make the design of our equipment lighter as its weight affects the railway infrastructure, increasing its wear. Considering higher speeds, the weight is essential. Therefore, making vehicles lighter without compromising cargo and passenger safety is a very interesting challenge that we can meet through the development of new materials. They should be as strong as those used today, or even stronger, but much lighter. Traditional materials such as steel and aluminum are, in my opinion, have already become out-of-date and need to be replaced.

Another very important line of business is the transition to electric traction. There are also many different technological projects which will maximize the benefits, including in terms of reducing the environmental impacts and energy consumption.

— **How are customer requirements changing, given all the transformations, and to what extent is TMH prepared to meet them?**
— There is no way for us not to meet the changing requirements. No matter how ready

▽ A field meeting of the Russian Railways Coordination Board at the Bryansk Engineering Plant, 2018



WIDE RECOGNITION

The Holding and its enterprises have won over 100 Russian and international awards over the past 20 years. In particular, more than 15 models in different years have been awarded the diploma of the All-Russian Contest Program "100 Best Goods of Russia". TMH cars were awarded Gold and Platinum Quality Marks of the XXI century of the "All-Russian Brand (III Millennium)" competition. The Holding has repeatedly won competitions in quality, import substitution and industrial design. And the branded model 61-4492 double-decker passenger train consisting of coaches with seats, on the route of Moscow – Voronezh, was listed in the Russian Book of Records as the first "year-round operating regular long-distance train with the largest number of passenger seats". These double-decker coaches also became the winners of the Good Design Awards (Chicago, USA).

we are, we absolutely must be ready for all changes and challenges. And even though these requirements are constantly tightened, I personally consider them only positively. The very fact that we are subject to these requirements already encourages us to move forward, even though the result comes with additional costs. However, compliance with consumer expectations makes us professional market participants with all the perspectives for further growth.

First and foremost are the issues related to safety. The key to the stability of such systems as rail transport is their safe operation and on-time performance.

The second thing is, of course, comfort. This is the most important issue for passengers. The requirements are constantly increasing, and today they include the ability to have access to the Internet, quickly exchange information — all of these are already the norm.

The third area is ecology. This includes efficiency of any fuel or electrical resource, reduction of emissions and negative environmental impacts.

I think that these three aspects have always been and will continue to be crucial in the development of new equipment. And we have to meet them in order to maintain our leadership.

FROM MOSCOW TO THE BORDERS

— **When you became the head of the Holding, there was a lot of discussions about the need to diversify the business geographically. What are the main successes of TMH in the export markets?**

— The achievements are best illustrated by the figures. Last year TMH export revenues amounted to more than 400 million dollars. This indicator is rather high compared to the previous periods.

Over the last three years, the volume of TMH export operations has increased tenfold! This is substantially above the targets recommended by the State. In this sense, we are absolute leaders in the development of Russia's export potential.

Another important point: at Transmashholding, employees realize that they



Alexander Astafiev / POOL / TASS

work in a corporation that is present in the global markets. I think that changes their self-awareness. They realize that they work not only for the Moscow Metro, but for metros all over the world.

— **For several years, Transmashholding has been implementing a DNA Brand, and the new ideology is highly appreciated by the professional community. How satisfied are you with the results?**

— I think, it is very important that we have got such a concept as a DNA brand. I believe it gives all industry participants — from workers and designers to customers — an idea of our products as both technically perfect and beautiful. When you start to think like that, it changes the way you think about everything you do. It is not just a question of color or shape; it is a question of aesthetic experience you get from efforts invested into work.

I think that the feelings experienced by a person who is engaged with the results of their work are crucial. And if those feelings are positive, they charge a person with energy. This means a happy employee who enjoys going



FIGURES

TMH EXPORT REVENUES IN 2021 AMOUNTED

TO MORE THAN

\$400
MLN

TMH EXPORT ACTIVITY HAS INCREASED

TENFOLD

THE LAST 3 YEARS

△ Prime Minister of the Russian Federation Mikhail Mishustin visiting the car assembly process at the Tver Carriage Works, 2021

to work, drawing sketches or manufacturing a particular assembly and who gets pleasant aesthetic experience from this, in addition, of course, to money, incentives and career advancement. If the employee is charged with positive energy, they project it into their work.

There is another side to that story — our customers. Imagine a manager of an abstract metro. If that manager is really happy with the equipment supplied by us, then, first of all, there is a 100 % chance that he would tell everyone about it. Secondly, he will order the next batch. And thirdly, coming to any other city, he will definitely compare the local metro with his own and tell his colleagues, "My metro is better and more beautiful." This is how the human psyche works.

Another aspect is consumers. There is good reason why I mentioned what ordinary residents of Moscow tell me about their aesthetic experience from traveling in our metro cars. They do not know what kind of traction drive



is installed there or what materials are used to make the car body. But they do know that they have positive emotions when they travel in these cars.

That is why I enthusiastically supported the introduction of the DNA Brand. I am not an artist or a designer, and I have no specific desires regarding a particular shape or color of our vehicles. But I definitely want that our designers, customers, and consumers really enjoy the pure pleasure of creating and operating our equipment.

FUTURE TRENDS

— **How do you think the rail transport will change over the next decade? You mentioned that electric traction will develop. What other trends do you consider important?**

— I see a few perspective trends. If we talk about passengers, their choice of transport will be first of all dictated by comfort. The second criterion is the price. Clearly, the cost of one trip will be a determining factor. Hence, the transition from

^ Kirill Lipa, TMH CEO, is guiding a VIP-delegation consisting of Oleg Belozerov, CEO at Russian Railways, Sergey Kobzev, Deputy Managing Director at Russian Railways, and Oleg Valinsky, Deputy Managing Director – Head of the Traction Directorate at Russian Railways, through the Holding's expositions at the International Railway Fair in the area 1520 "PRO // Motion. Expo", 2021

distributed to locomotive traction is driven by the price concept. Passengers get comfort and a lower price for the trip.

Next, certainly, is environmental friendliness. And this will be a public requirement that applies not only to the rolling stock operation, but also to its production.

Every nut will have information written on it on the amount of carbon dioxide released into the atmosphere during its manufacture. It is going to happen, as far as I can see.

Undoubtedly, there will be a growing demand for increasing speeds; so both freight and passenger traffic will become more dynamic.

And, the last aspect, probably, implies a very active development of technologies in the field of information control and information exchange. Business processes will be set up in such a way so that nothing will ever be overlooked.

So that at any given moment, you will be able to answer any question related to

operation of rolling stock: where it is and its technical condition.

Today, consumers enjoy using applications that allow them to obtain the most diverse information online: public transport time table, restaurant menus, the number of calories burned, and so on. Such solutions are increasingly applied on the rail transport as well. And the process of information management will only expand: this includes face control, detection of people in transport, search of criminals, adherence to the face mask regime, and so on.

— **As the head of the company and a businessman, what tasks do you set for Transmashholding for the next five years, what investment projects are yet to be implemented?**

— First off. It is quite obvious that the Holding has to implement the approved development projects. We have a retrofitting program in place, and we must strictly adhere to it.

The second is establishing competence centers. This is a global trend that has been characteristic of the entire mechanical engineering industry over the last 20–30 years. A similar project is being implemented in our company as well.

The third task which we expect to implement is consolidation of competences in manufacturing new rolling stock and repair of the old one. It is not only about organization of the production process,

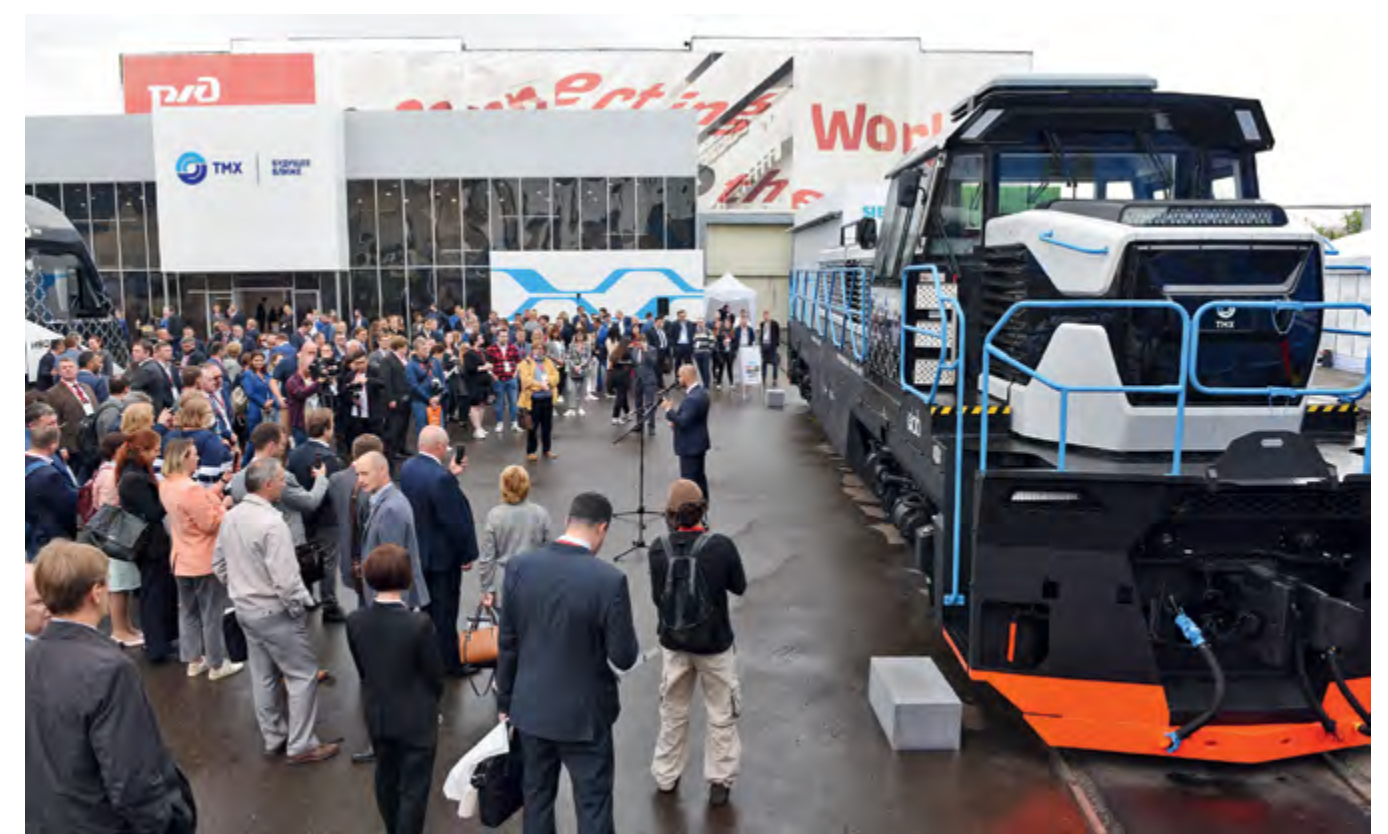


THREE KEY ASPECTS FOR TMH IN THE DEVELOPMENT OF NEW EQUIPMENT: SAFETY, COMFORT AND ENVIRONMENTAL FRIENDLINESS

production culture, technology adoption, this is also a very important psychological aspect. When a new product leaves the plant, we see a perfect vehicle, it is beautiful, and emotionally pleasant. After 10 years of operation it causes quite different feelings. And you think about what you did wrong and why. A new approach, as I see it, should stimulate us to make equipment even better, more reliable and efficient. I believe this project to be very important, and I hope that my colleagues feel the same way about it. That is why the leaders of all our divisions are also in charge of the service companies. After all, simply selling the equipment is one thing. Selling and servicing the equipment for the rest of its life is quite another, in every sense — emotional, financial and manufacturing.

In the future, we will continue to develop our divisional structure. We will work to increase our international activity and global presence. ▽

▽ Presentation of the TEM23 shunting locomotive in the DNA Brand design at the International Railway Fair in the area 1520 "PRO // Motion. Expo", 2021



Through Hardships to Success

Despite the pandemic, TMH has reached a very high level in terms of production output and quality. The great credit goes to designers, process engineers, foremen, and the entire team.

RECOVERY STAGE

Twenty years ago, when Transmashholding was established, there were separate plants producing railway equipment — passenger coaches and locomotives. At that time, all enterprises experienced difficulties in obtaining the premises, equipment and personnel: the shops were not heated, machines needed upgrading, people left in search of better earnings.

All these capacities and resources were about to be consolidated into a Holding company to ensure their functioning. We assessed what needed to be done, identified the means and started investing money: first, from Russian Railways, then private investors appeared who later became our shareholders. That is how Russia's railway engineering industry gradually started to recover.

Every plant had its own engineering department that serviced that particular plant. To consolidate these departments, a special division reporting directly to the technical director was created within the management company. Each plant, while continuing to work for itself, also had to solve issues of intercompany cooperation, for instance, one plant produces wheel sets for all the others, another plant produces traction engines for a number of locomotives, the third one welds bogies, and the fourth one assembles diesel engines. In order to consolidate all these activities in terms of processes, a chief process engineer's department was created. As practice has shown, when a plant focuses on one component, two or three products, the quality of the final product and the production rate



ALEXEY VOROTILKIN
Vice President for Locomotive Cluster Management,
a member of the Managing Board

will significantly increase, and it also allows to expand the functionality of the Holding's assembly plants.

The technological transformation meant that each plant should improve the competences it had historically developed. The practice of better redistribution started: for example, we investigated at which plant welding production was the best, and analyzed the reasons, then we used this experience to develop templates for welders at other plants.

FOLLOWING A PATH OF COOPERATION

One of the main objectives of the Holding's production development was to create a system that would increase output while maintaining high quality and lead times. This system was based on reference production and process lines operating in a certain rhythm, depending on time and output for each item. Today, the rhythm we set earlier allowed us to have a 30 % capacity reserve at all plants, except for Novocherkassk Electric Locomotive Plant and Tver Carriage Works, which are fully loaded.

We have learned how to manage this rhythm in order to achieve the necessary production



TMH ROLLING STOCK PRODUCTION THROUGHOUT 20 YEARS

Vasily Kuzmichenok / TASS



output in any given period with account of the current demand. In addition, we were able to reduce overhead costs by ordering the exact quantities of required components. Thus, more than 3.5 billion rubles were saved in 2021 alone.

The reconstruction of production sites, in particular, at the Kolomna Plant became a big event for TMH. At present, a project for the creation of a new diesel engine assembly line based on the automotive conveyor principle is in its final stage. We can state with absolute confidence that after reconstruction the Kolomna Plant will be able to produce and rebuild up to 1,100 diesel engines per year. This way, we can completely refuse foreign-made diesels, which meets the global task of maximum localization set by the Government.

Intercompany cooperation has progressed significantly. Interaction between all plants and subdivisions of the Holding has been put in place. For example, our own locomotive production is fully supplied with engines. So far, they are purchased from other companies, but soon we will be able to manufacture our own engines.

Another achievement is the consolidation of foundry production at the Bezhitsa Steel Foundry, Promlit, and Petrozavodskmash into a single foundry division. In 2021, Promlit reached

the required capacity for the products needed by TMH, although it started this work from scratch.

Integration of TMH and LokoTech plays a particularly important role as it launched the creation of a locomotive overhaul system at the manufacturing plants. This is a worldwide practice, but it has never been used in Russia before, or at least in the field of rail transport and mechanical engineering. Indeed, when the plant eliminates any defects at its own expense, the manufacturer's responsibility increases.

One of the main tasks for the future is a smooth and easy transition to the divisional management system. This issue is currently under discussion within the Holding. There are plans to optimize production facilities, which will lead to additional reduction of overhead costs. We will also continue integration of the repair and production facilities. All of this should ensure further sustained development of TMH.

The market situation is changing rapidly. However, as practice has shown, Transmashholding is able to survive any turbulence and at the same time strengthen its presence not only in the Russian market, but in foreign markets as well where our products are highly competitive in terms of quality, design and the level of service. ✓

2002

On April 15, Transmashholding was established. Dmitry Komissarov became the company's first CEO.



2003

Bryansk Engineering Plant (BMZ), Novocherkassk Electric Locomotive Plant (NEVZ), and Bezhitsa Steel Foundry were the first to join TMH, followed by Tver Carriage Works (TVZ).

Mikhail Khromov was appointed TMH CEO.



2004

Penzadieselmash and Demikhovo Engineering Plant joined TMH.

2005

Metrowagonmash, Tsentrosvamash, Kolomna Plant and Oktyabrsky Electric Railway Car Building Plant were added to the Holding's assets.

2006

It was agreed that one of the world's transport engineering leaders should be attracted as a strategic investor and a technology partner. The consolidation of assets and optimization of the structure began.

Petr Sinshinov was appointed TMH CEO.



In Sync with the Market

Constant changes in line with the market expectations are the key to successful development of Transmashholding throughout its history.

MECHANICAL ENGINEERING STARTUP

From 2002 to 2005, Transmashholding incorporated the key production assets which are the core of the company's business today. At that time, each plant had a very limited product line. The sales of their products to Russian Railways were decentralized and ad hoc, as the key customer did not have long-term planning and stable financing. Sales to the commercial market and exports were sporadic, as the industry was just beginning to recover from the crisis of the 1990s.

Since 2006, technical and commercial relationships with Russian Railways and other customers have become centralized. The Holding implemented systemic measures to develop production facilities, product portfolio, and management organization within a very tight time frame.

The cornerstone of this structure was a long-term agreement for the supply of locomotives to Russian Railways, which at that time acquired a share in the Holding's capital. There was a greater focus on diversification of markets and search for new customers.

Significant changes in the freight and passenger transportation market have become drivers of the company's transformation.

Between 2006 and 2008, more than 20 suburban passenger companies were established in Russia. In 2010, Federal Passenger Company, First Freight Company, and Federal Freight Company split from Russian Railways. More than a thousand private operators and industrial locomotive owners have emerged. The largest countries with a gauge of 1520 mm also faced an explosive growth of transportation and upgrading of the rolling stock fleet.

Interaction with customers has become centralized under the leadership of TMH Commercial Director based on the sales activity regulations and instructions on interaction between Holding's sales structures and enterprises approved in 2007. The product sale principles have gradually changed as well — from one-time supplies based on the advance payment to long-term contracts with the use of leasing and long-term maintenance.

A key milestone was the long-term contract with Russian Railways for the supply of EP20 electric locomotives (2012) and maintenance of this fleet (2013). In 2014–2016, complete life cycle contracts were signed for the supply of cars to the Moscow Metro and trams to Mosgortrans. This launched TMH's vast service network, which



ALEXANDER CHEBAKOV
Vice President at TMH for Freight Car Building and Casting Cluster Management, a Member of the Management Board

is currently one of the largest in the world.

RESPONDING TO CHALLENGES

The period from 2017 to 2021 was very eventful both for the Russian economy and industry as a whole, and for transport engineering and Transmashholding in particular. We all had to face new challenges — another financial crisis, sanctions and the pandemic. We are successfully overcoming these challenges and trying to make the most of prospective opportunities. The commercial division of TMH is no exception; it is at the forefront of the Holding's interaction with the external environment.

To take up the market challenges, the management system was reorganized in 2018 according to the divisional principle. In the initial phase of development, the divisions performed mainly commercial functions, at present they are points of responsibility for the entire product life cycle — from setting requirements to commissioning and service throughout the entire service life.

The alignment of these processes is still underway due to the emergence of new tools that help organize and control planning, procurement and manufacturing quality control processes as well as the results of product operation with the use of online technologies.

Since 2018, all deliveries of locomotives to Russian Railways and metro cars to the Moscow Metro have been carried out under life cycle contracts. At present, long-term service maintenance is provided by the manufacturer of the supplied electric trains and passenger cars. The implementation of these projects required serious organizational and functional changes in the sales, quality control and service departments of the enterprises.

Another important achievement of the last five years is launching new products that now determine the "face" of Transmashholding. These are Moskva-2020 metro cars, Ivolga electric trains, single- and double-decker passenger cars of the 2019 and 2020 series, 3ES5K, 4ES5K, 2ES5S, 3ES5S and 3TE25K2M locomotives.

The task of the divisions is to ensure that all functional and technical requirements of the operators have been taken into account, as well as compliance with the specified parameters in terms of quality and reliability.

FACTS SPEAK FOR THEMSELVES

The achievement of the tasks assigned to the commercial unit can be assessed

by the revenue dynamics and the share of TMH Group in the target markets, given significant development of the competitive environment in the 1520 area. Over the past five years, the sales volume of TMH products and services has doubled, while export sales have increased even more significantly — 2.4 times (this does not include performance of TMH International). TMH continues to be a market leader in Russia and the CIS countries



FIGURE

70 TO 95%
TMH'S MARKET SHARE IN RUSSIA AND CIS

with a market share of 70 to 95 % in locomotives, passenger cars, MU rolling stock, metro cars, and maintenance services. In my view, the achieved results are positive.

Another important factor is our customer satisfaction. The products of our Holding helped us implement such significant projects as FPC Day Express (EP20 and cars of the new model range), organization of high-speed traffic on the Russian Railways network, launch of Ivolga on the Moscow Central Diameters, development of the traffic capacity on the Eastern Polygon and increasing production at the Elga deposit, organization of passenger traffic on Sakhalin Island. All these projects help address the State objectives to increase mobility of population, ensure transport accessibility, and increase the volume of freight and passenger transportation.

Several projects on upgrading Mongolia's rolling stock were

implemented. Supplies of mainline locomotives to Kazakhstan, Uzbekistan and Turkmenistan, passenger cars to Kazakhstan, metro cars to Uzbekistan started again after a long pause. Work continues on the supply of rolling stock and spare parts to Belarus, Armenia, Azerbaijan and other countries of the broad gauge area. We rely on the future cooperation with our partners, and are aimed at increasing sales and expanding the offer in line with the market needs.

The market has changed greatly in recent years, so it is necessary to grow and change together with it as this is a necessary condition for company's successful development. We are not expecting rapid growth based on past achievements. Today's pace of technical and technology progress, the use of digital technologies accelerate the emergence of new products and components, and therefore increase both expectations of operators and the overall competition level.

The main tasks for the divisions include primarily maintaining stable long-term orders from the Holding's key partners — Russian Railways, Federal Passenger Company, Central Suburban Passenger Company and other suburban companies of the country, Moscow and Saint Petersburg Metros, railroad administrations in the 1520 area. The next cluster of tasks is pertaining to the search for new customers and niches on this dynamic railway equipment and urban transport market. We will continue to create products that maintain TMH's market advantage and ensure their compliance with the internal requirements to economic efficiency and operational reliability, as well as maintain effective work under life cycle and long-term service contracts while meeting the claimed quality and profitability parameters.

We are open to everything new and look forward to the future! **V**

2007

For the first time in the practice of Russian Railways, long-term contracts were signed providing for the development, production and supply by Transmashholding of new samples of equipment.



2008

Transmashholding began implementing the Lean Production program.

Andrey Andreyev was appointed TMH CEO.



2009

Transmashholding and French company Alstom signed an agreement on the strategic cooperation.

Development Institute of Electric Locomotive Engineering (VELNII) became part of Transmashholding.

2010

TMH became the main outsourced locomotive service contractor for Russian Railways.

2011

The first TMH package contracts for the supply and repair of rolling stock for the Moscow Metro came into force.



Epicenter of Engineering

Throughout its history, Transmashholding has been generating new ideas and implementing breakthrough projects. Many solutions implemented by TMH can be rightly considered innovative for Russia.

SINGLE MECHANISM

Establishment of Transmashholding 20 years ago was a major step forward, a chance to revive the Russian transport engineering industry. Although I did not work for the Holding and in the industry at that time, I do understand the main tasks that the company was facing.

Disparate enterprises burdened with economic problems, each with their own technical schools, procurement and sales systems, were to be united into a consolidated effective mechanism that would be able a short while later to provide Russian railway transport with new rolling stock, as well as take a deserved place among the global manufacturers.

We can see that the Holding had successfully met the challenges it faced. During the first years of operation, the product range expanded significantly. A quarter of a century later, Russia resumed production of mainline freight DC electric locomotives that had been manufactured for the USSR railroads in Tbilisi since

the early 1980s. For the first time in the history of domestic transport engineering, serial production of DC electric locomotives for passenger trains was established. The Soviet Union used to import such machines from Czechoslovakia. Mainline freight locomotives of domestic manufacture appeared. Then the Holding began to create vehicles with asynchronous traction drives: diesel locomotives, passenger and freight electric locomotives, and in recent years — electric trains as well.

Remarkable progress was achieved in passenger car building: new series of cars with a stainless steel body were created and later the serial production of double-decker coaches was set up for the first time in the domestic practice.

A great achievement was the creation of Ivolga, the first urban electric train in the Russian transport engineering industry and TMH's first product equipped with an asynchronous traction drive.



ALEXANDER YERMONSKY
Deputy CEO at TMH for Technical Development, a Member of the Management Board

Since 2016, particular attention has been given to import substitution and formation of a single engineering space. I believe that we have even exceeded the tasks set at that time. During this period, we not only created Russia's most powerful engineering center, but also a single testing center and a center for advanced technologies.

RUSHING TROIKA

Over the last years, three new companies have been established at Transmashholding.

TMH Engineering, a single engineering center, has been created. This company is responsible for preparing materials for tenders, preliminary engineering design, and issuing a set of design documentation.

Now TMH Engineering employs about 1,200 engineers. There are seven development centers in Mytishchi, Tver, St. Petersburg, Demikhovo, Bryansk, Novocherkassk and Yaroslavl, near the Holding's production facilities. We have successfully established the largest in Russia and one of the

> 3ES55 is the first three-section asynchronous electric locomotive created by TMH under the import substitution program

most powerful engineering centers in the world that designs a full range of railway equipment.

In the same period, TMH Test Center, a single testing center, was established. It combines several test sites within the Holding and is responsible for testing all new equipment designed by TMH Engineering. We made these organizations independent entities for a purpose. TMH Test Center provides the company management with objective data on the quality of the products designed by TMH Engineering and manufactured at the Holding's enterprises, on their compliance with the technical conditions and requirements of the customers.

The third company that appeared is TMH Center for Advanced Technologies, which carries out research work. While TMH Engineering works according to the approved five-year schedule for the development of new equipment, TMH Center for Advanced Technologies deals with technologies and projects with a planning horizon of 10 years — new types of electric motors, traction systems, new power sources, new control systems.

OUTSTANDING SAMPLES

One of the most significant modern projects is the RA-3 rail bus. It was certified in 2017 and has been in high demand. Now we are developing a RA-3 modification based on hydrogen fuel cells.

The second big project, also very successful, is the 81-775/776/777 series metro train. The Moscow Metro launched this train in 2021. It would be no exaggeration to say that at the moment it is the



FIGURE

MORE THAN
200
PROJECTS

RELATED TO THE CREATION OF NEW PRODUCT SAMPLES HAVE BEEN IMPLEMENTED BY TMH OVER 20 YEARS

2019. These are two TMH's flagship projects intended to ensure a technical breakthrough in railway transportation and stimulate the development of the domestic component base. These are the first Russian freight electric locomotives with Russian-made asynchronous traction drives. And they are now running on the Eastern polygon of Russian Railways.

Another significant project is the 3TE25K2M diesel locomotive, which is also operated on the Eastern polygon.

One of the most landmark projects of TMH Engineering is the TEM23 shunting locomotive. It uses two diesel power units manufactured by KamAZ. The modular design ensures the highest level of reliability: the probability of failure of two diesel engines at the same time is close to zero. If necessary, one diesel unit can be removed and replaced with a battery which is charged from the

best performing metro train in the world. In addition, it won the prestigious award for the best industrial design in the transport industry, surpassing the products of such companies as Siemens, BMW and Mercedes.

In the freight locomotive segment, a notable event in the market was testing of the 2ES5S and 3ES5S electric locomotives in

2012

TMH marked its 10th anniversary

Novocherkassk Electric Locomotive Plant (NEVZ) became the world's largest enterprise ranked by number of employees and successfully completed the IRIS certification procedure.



2013

TMH strengthened its technological leadership in the Russian transport engineering market. At EXPO-1520, the Holding presented 16 exhibits, including the latest achievements.



2014

The most powerful freight AC electric locomotive in the world, the four-section Yermak 4ES5K, was created.



2015

Kirill Lipa was appointed TMH CEO.





< Ivolga electric train on the MCD

rolling stock market and intend to strengthen our leadership in this segment. In the next 5 years, we have to focus on the development of innovative metro trains. There are plans to use supercapacitors and new unique batteries. They will allow the train to move between stations using autonomous electric traction and charge batteries within one or two minutes during stops. There will be no need for conductor rails, which will become a fundamental improvement as it helps reduce electricity costs and infrastructure maintenance costs. In the future, the use of hydrogen energy sources can be quite possible. While diesel fuel has no real competitors, the task of TMH design unit is to maximize efficiency of diesel engines: in terms of the control system, the precision of engine production, the use of the most advanced methods of piping connection, milling, and 3D metal printing.

There are no less ambitious plans for the improvement of electric trains. Mayor of Moscow Sergei Sobyanin said that launching lines 4, 5, 6 after MCD-1, 2 and 3 would be a major project on the development of the Moscow transport system. TMH trains based on the Ivolga platform for such transportation have proven to be effective, and we will continue to work on their traction systems and distributed traction, defining the optimal number of traction units per train, in order to maximize energy savings. We are also committed to reducing the noise emissions and weight of the train, so we are looking into the use of special composite materials.

Thus, TMH remains at the engineering forefront and will continue to put forward the best solutions for its customers. ✓

diesel unit; or a hydrogen power unit or an LPG engine can be installed instead of the battery: in this case the TEM23 becomes a hybrid locomotive. Now two TEM23 samples are undergoing testing. We are very proud of this project. It became possible through combined experience of the engineers who designed electric trains, metro cars and locomotives.

The world's first contact-battery shunting electric locomotive EMKA2 is now put into production at the Novochoerkassk Electric Locomotive Plant. Instead of two diesel units, it uses powerful batteries and at the same time collects electricity from the railway contact network. On electrified sections, the locomotive operates as an ordinary electric locomotive and charges the batteries in the meantime. On non-electrified sections, it can disconnect from the contact network and continue working on the batteries, which is especially important in large depots, at passenger stations where the use of the diesel engine is undesirable.

New electric trains also cannot be overlooked. Ivolga 2.0 trains have been running on MCD-1 and MCD-2 in Moscow since the end of 2019, and we have already introduced a new model — Ivolga 3.0. This development, including the control system, is fully owned by TMH Engineering. Unlike Ivolga 2.0 with installed foreign-made traction systems and engines, Ivolga 3.0 is equipped with Russian-made engines.

We managed to implement advanced solutions on each type of the railway equipment and entered the international market. In particular, our Ivolga platform won a tender in Argentina, we signed a contract with Egypt for the supply of passenger cars produced by the Tver Carriage Works. I am sure that TEM23 and EMKA2 will be equally successful. These unique solutions will definitely find their international customers.

PLANS

Urban rail transport is one of TMH's main lines of business. We expect further growth of the metro

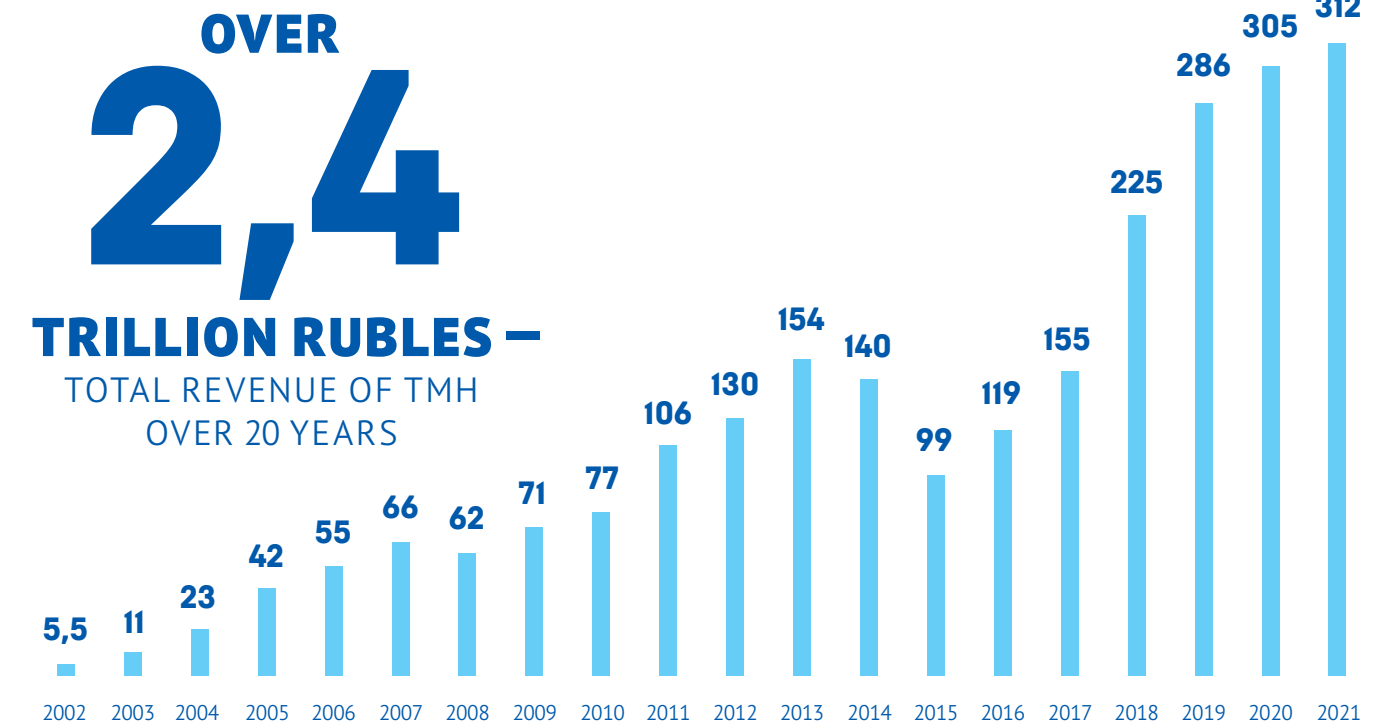
TMH IN RUSSIA AND GLOBALLY

- **Nº 1 among manufacturers in Russia and CIS** in terms of revenues from the sale of new equipment
- **100% share** in the Russian metro train market
- **Nº 1 among maintenance service companies in Europe: 15 000 locomotives** under service maintenance
- **One of the world's largest manufacturers** of rolling stock for rail transport

TMH INTERNATIONAL

- **Established in 2018** to implement international projects of Transmashholding
- **Develops business** in Argentina, Hungary, Germany, Egypt, Israel, Kazakhstan, South Africa
- **TMH largest export contract for the supply of 1300 passenger cars** worth of **\$1 billion** to Egyptian National Railways

SALES VOLUME OF TMH PRODUCTS, BILLION RUBLES



2016

All Holding's plants now operate in accordance with the International Railway Industry Standard (IRIS).



2017

Bryansk Engineering Plant (BMZ) created Russia's first three-section mainline diesel locomotive 3TE25K2M.

All TMH serial products were certified for compliance with the technical regulations of the Customs Union.



2018

TMH signed a contract with Russian Railways for the supply of mainline locomotives with the obligation of their service maintenance thereafter.

A new 2ES5S mainline freight two-section AC electric locomotive with a Russian-made asynchronous traction drive was unveiled.



No Job is Too Tough



VLADIMIR SHNEIDMULLER
Advisor to TMH CEO on Technical Issues

The innovative approach and development of cooperation made it possible for Transmashholding to become a full member of the global traction rolling stock production system.

WITH HARD WORK AND EFFORT

Throughout all these 20 years, Transmashholding has been constantly developing and expanding its product portfolio. TMH created the Yermak series of mainline freight electric locomotives that became the most mass-produced among domestic rail transport. After a 25-year break, the production of mainline freight DC electric locomotives (Donchak) in Russia was resumed at the plants of the Holding. For the first time in the history of Russian transport engineering, serial production of DC electric locomotives for passenger trains (EP2K), high-speed dual system electric locomotives for passenger trains (EP20 Olympus) and mainline freight diesel locomotives (2TE25K Peresvet, 2TE25A Vityaz, 2TE25KM, 2TE25K2M) was established. TMH created the first Russian diesel locomotives and electric locomotives (2TE25A Vityaz, EP20 Olympus, 2ES5 Skif) that use cost-effective and reliable asynchronous traction drives.

We have accumulated tremendous experience in implementing projects

together with our foreign partners. Commissioned by Russian Railways, a batch of EP10 electric locomotives was produced at NEVZ jointly with Bombardier in 2005–2006. This case showed us that European solutions are not always suitable for Russia, as our rolling stock is operated much more intensely.

In 2009, we signed a strategic partnership agreement with Alstom. The French company voiced a willingness to support TMH in modernizing the plants it owns and in developing a new generation of railway equipment for the Russian market. Alstom joined TMH as a shareholder.

During the same period, the Holding began to design more advanced EP20 series electric locomotives, which up till now are considered one of the most reliable on the Russian Railways network. Experts of the All-Russian Research and Development Institute of Electric Locomotive Engineering, which was included in the TMH structure in 2010, contributed to the development of EP20.

At the same time, the design unit of the Tver Carriage Works started to develop a double-decker coach. By the way, colleagues from Alstom did not believe in the success of this idea, but TMH engineers and designers managed to bring it to life.

From the very beginning, we have been upgrading the Holding's production facilities in such a way as to ensure that all plants receive modern and multipurpose machines that allow to produce a wide range of products and respond flexibly to the current demand. For example, in a year and a half, BMZ was able to set up the production of a new 2TE25KM model, which is 90 % assembled from components of domestic manufacture. This demonstrates Holding's high competences and powerful human capacity that is able to meet new challenges. As practice has shown, any crisis also means new opportunities that should be seized appropriately.

MORE THAN EXPECTED

I believe that expanding business to the global markets is the main

achievement of TMH over the last years. Participation in international tenders and monitoring of current trends foster development, including the creation of new products and professional development of the engineering staff.

The second significant event is the creation of the corporate development and training system. Earlier, each plant trained its personnel independently and focused primarily on new employees, while training of middle-level managers, process engineers and designers was set aside. Now we have a single training system in place which positively affects product quality, recognition and promotion in international markets.

TMH also merged the production and service units and completed transition to life cycle contracts. The benefit for consumers is that it saved them time and headaches of where to find spare parts and how to organize maintenance or repair of the equipment. This is the responsibility of the manufacturing plant and the service depot. This system is still being aligned and it might take years. This work would surely have an immediate impact because it is based on global experience and equal relations between the supplier and the customer. I must say that over the last five years these relations have significantly improved, have become more trusting, and the credit for this goes largely to the top management of both parties.

Another important trend is the development of the component base both at TMH and on the suppliers' part. We have come to realize that there are 14 key components that should be produced at domestic plants. Such companies as TMH-Energy Solutions and KSC are focused on producing high-tech components

and improving their reliability and failure-free performance.

In addition, the transition to the divisional management structure that took place at TMH should not be overlooked. When we had everything in one unit, we just had no time for many things. Now we have divisions which understand very well what they have to do and devote sufficient time and attention to their tasks.

All the key targets set by the management and shareholders, in my view, have been fully reached. We have achieved more than we expected, and now we can see the impact of these changes.

ART OF DIPLOMACY

The areas that have to be strengthened include logistics, and assuring the assembly plants are supplied with the necessary components just in time. The next step will be the creation of a single logistics company that will supply TMH enterprises with complete sections-kits and railcar assembly sets, rather than sets of individual components, based on the planned volume of locomotive, car or engine production.

We still have far more work to establish relationships with customers and operating companies. With respect to execution of life cycle contracts, we need to understand the reasons for deviations from the specified parameters of equipment performance. This work should be a joint responsibility and should be based on mutual respect. I can say with absolute certainty that it requires maximum restraint and the ability to negotiate. I believe that both parties will benefit in the end.

We have always been thoroughly studying how the rolling stock affects the track infrastructure, but

no one was particularly interested in how the infrastructure affects the rolling stock. Diagnostics must show not only the current condition of cars and locomotives, but also whether they are operated correctly.

I have been working on the railroad for about 40 years and from my personal experience I can say that correct operation without violations is at least half of success and a guarantee of the long and reliable service life of the rolling stock.

RIGHT OF CHOICE

In May 2021, I was elected Chairman of the newly formed TMH union.

The owners and managers of modern corporations, such as TMH, treat the personnel in a totally different way unlike the State under the Soviet Union. We train our employees at our own expense, provide them with decent social conditions, a favorable working environment, meals, protective clothing, personal protective equipment, and many other things. We do this because we want to avoid staff turnover, as it causes financial losses and costs in public image, takes time to find and train new employees. It is no longer necessary to protect workers in most aspects, which the union used to do before, because it is what the company now does.

We seek to create a new kind of union which is, along with its administrative function, aimed at solving key objectives that ensure occupational stability.

Stability means quality, reliability and dependability of production, it means a strong team and employees' pride in their company. We have a lot of respect for all the unions that exist at our plants, but we want to give our employees the right to choose the best conditions. ✓

2019

Certificates of conformity for Moskva-2019 metro cars and a RA-3 railbus were obtained.



For the first time, TMH presented a perspective shunting locomotive with a hybrid power plant and predictive analytics.

2020

Transmashholding acquired a Hungarian railcar building plant in Dunakeszi, which soon took part in the implementation of the largest contract in TMH's history for the supply of 1,300 passenger cars for the Egyptian National Railways.



2021

Rusatom Overseas and TMH-Energy Solutions signed a memorandum of cooperation and understanding regarding the establishment of a joint venture to combine efforts in the development of hydrogen fuel cell transport.



Together with the Skolkovo Foundation, the first in Russia competition for projects on perspective metro trains and modern urban rail transport was held.

Passengers Deserve the Best



ANDREY VASILIEV
Deputy CEO at TMH for Urban Transport Development,
CEO at Metrowagonmash

TMH metro cars are operated not only in Russia, but also in the metros of Sofia, Budapest, Tashkent, Baku and other cities. Each new generation of trains has something to surprise even the most demanding passenger.

wide recognition in Russia and the CIS countries. For their distinctive appearance they were given different nicknames: for example, “striped” or “canary” (the first trains of this series were painted in three colors: yellow, green and blue). In total, over 7,400 cars of all modifications of the so-called numbered series were produced.

In 2005, Metrowagonmash became a part of Transmashholding. The enterprise was guaranteed increased financial stability, access to the advanced technologies, obtaining additional orders and strengthening presence in the international arena.

Rusich cars of the 81-740/741 series were produced from 2003 to 2013. More than 850 cars were delivered to the Moscow, Kazan and Sofia metros.

∨ Oka series trains have been operating in the Moscow Metro since 2012

PROGRESS DECLARES ITSELF

Metrowagonmash exists since the end of the 19th century. In different years, the plant supplied its products to Germany, Iran, Egypt, India, China, Mongolia, Hungary, Poland, Bulgaria. The 81-717 series cars have gained



In 2012, mass production of the Oka series trains began. The cars were equipped with air conditioners, head cars have a place to accommodate wheelchairs and baby strollers. One of the modifications featured a first open gangway between the cars. In December 2014, the thousandth vehicle of the Oka series was manufactured. This production was finished in 2016 due to the transition to the upgraded model 81-765/766/767 Moskva train.

Since 2014, all cars supplied to the Moscow Metro have been serviced under the life cycle contract (LCC) by Metrowagonmash-Service. At present, there are over 3,600 cars under service maintenance. I must say that TMH is the first company in the industry to implement such form of work. Both parties benefit: the owner and the operator do not have to maintain the fleet, the service company takes care of everything, and the manufacturer represented by the maintenance company, gets a work load for 30 years ahead.

As part of the production base development, Metrowagonmash opened a branch in St. Petersburg in 2019. This division assembles, overhauls and upgrades metro cars.

Speaking about production of metro cars, an interesting transformation of the Oktyabrsky Electric Railway Car Repair Plant cannot be left unmentioned. For many years, it specialized in the repair of all kinds of cars. In 2008, it started to repair metro cars. Soon it ceased to be just a repair enterprise and turned into a full manufacturer of metro rolling stock.

As for Metrowagonmash, its product portfolio also includes rail buses. Their production began back in 2001. This rolling stock is designed for passenger transportation along non-electrified sections of the suburban and interregional railroads.

In 2005, production of the RA-2 began. One of its modifications has smooth non-corrugated sides. DP-S DMU, intended for export, was developed on the basis of the RA-2 rail bus. Since 2012, 39 DP-S DMUs have been delivered to Serbia under three



^ Model 81-765.5/766.5/767.5 metro trains in the Tashkent Metro

contracts. Since 2019, three contracts for DP-S postwarranty technical maintenance have been fulfilled, and a contract valid until January 2023 is currently being implemented.

In 2019, new RA-3 Orlan rail buses were put into operation. The operation of the first trains began on Sakhalin Island. To date, more than 80 RA-3 trains have been manufactured and delivered under the contracts with Russian Railways and the Central Suburban Passenger Company for Russian regions.

Our specialists continuously monitor Russian and international tender platforms for possible deliveries of metro cars and rail buses. We have many successful international projects in our portfolio.

For instance, Metrowagonmash overhauled and upgraded metro cars of the 81-717.4/714.4 series under the contract with Sofia Metro. In 2020, eight metro cars were delivered to Bulgaria, and later the companies signed an option to overhaul and upgrade another 40 metro cars of the same series.

Another export contract with the Budapest Metro provided for the overhaul and extension of lifetime of 222 metro cars of the 81-717/714 and Ev3 series.

“RUSSIAN QUALITY”

Global upgrading of the line of cars manufactured by TMH for metros in Moscow, St. Petersburg and other cities has recently

WE DREAM ABOUT NEW TYPES OF ENERGY, ABOUT LAUNCHING TRAINS THAT “CARRY” ENERGY ON BOARD: IT COULD BE HYDROGEN OR VARIOUS BATTERIES

become a key milestone in the development of the urban rail transport.

New generation metro cars have undergone radical change both technically and visually compared to their predecessors.

Cars of the Moskva-2020 series should be noted separately. Passengers immediately appreciated the spacious inter-car passageway, the width of which increased from 1 to 1.6 m. By the way, the total length of the open gangway is a record for metro trains and is more than 1,5 football field. The doorways have also been widened from 1.4 to 1.6 meters, which made it more comfortable to board or get off the car. The trains are equipped with modern media devices — screens and touch panels that allow to get information on the trip or plan a route and above-the-door information boards display the latest traffic details.

The striking design draws attention. The appearance is extremely important. We think that our passengers deserve the best. The Moskva-2020 train won the prestigious Red Dot award — a kind of an Oscar award in the field of industrial design. So the most beautiful

▼ Moskva-2020 train, the winner of the prestigious international Red Dot award

transport on the planet of 2021 is running in the Moscow Metro.

In five years, significant work has been done to improve quality. Our greatest wish is that the term “Russian quality” would mean “outstanding, excellent quality” all over the world, and for our part we will do everything possible to achieve this. Our efforts have been acknowledged. For example, in 2020 TMH received the Russian Government Quality Award for implementation of highly effective methods of quality management. Our engineers are constantly improving the reliability of our equipment.

DREAMS COME TRUE

In the past, we dreamed of taking a leading position in the market, joining the galaxy of the world’s largest metro equipment manufacturers — and it has come true. In the future, we intend to remain on top of the list of metro car suppliers.

We plan to continue to expand into international markets — Africa, Egypt, Chile, Israel, India, and other countries, and that is



▲ RA-3 Orlan rail bus



what we are already actively working on.

We dream about new types of energy, about launching trains that “carry” energy on board: it could be hydrogen or various batteries. A train able to run with non-contact energy transfer would very soon become a reality.

Of course, design will not be ignored. New trains will be even better, more beautiful, and more comfortable. We hope that passengers will commend our endeavor.

In addition, TMH is working extensively to apply new materials for the body and interior. This reduces the weight of the structure, improves efficiency, comfort and helps gain many other benefits and advantages. Talking about comfort, we do care deeply about reducing the noise level. We intend to implement active electronic noise cancellation devices.

In relation to the current trends in digitization, automatic driverless operation and artificial intelligence on transport, I would like to note that some application solutions will soon be seen onboard TMH cars. An unmanned technology in the metro is not just a train, but rather a whole system that includes the entire structure of the tunnels and stations. Can we make unmanned transport within five years? Technically, yes. Let’s hope that the legislation and infrastructure will change by that time.

Rolling stock starts with safety. Today, the metro and urban public transport in

general are among the safest ways to travel in the world. And we will continue to strengthen this competitive advantage.

Among the objectives for the next few years, I would also like to mention the development of TMH’s maintenance services. We have been selling most of our rolling

stock under life cycle contracts for quite a long time. In other words, every day the customer has functioning rolling stock that was properly serviced, clean, and fully available for operation. The driver only needs to enter his workplace and start the train. If he suddenly notices a malfunction or the train itself informs about it, we will replace it with another one and take the defective train for repairs.

Life cycle contracts call for greater efforts, not only provision of services. They have changed the very paradigm of rolling stock design and manufacturing.

Today, while thinking over the next innovation, we must remember that we have to live with this rolling stock not only during the warranty period, but during its entire service life. Therefore, it must be comfortable and convenient both for passengers, drivers and maintenance personnel at the depot.

I believe that today’s trains are so sophisticated that giving them to the manufacturer for service was absolutely the right decision. I assume that this trend will only increase in the future, and we are ready for it. ▼

TO SUIT ALL TASTES

On the occasion of TMH's anniversary, we collected interesting facts about products for 20 years of Holding's operation.

ELECTRIC LOCOMOTIVES



E5K, 2ES5K, 3ES5K, YERMAK 4ES5K

- One of the first products developed at TMH, first unveiled in 2004, put into production in 2007
- Modifications differ in the number of sections, according to the prefix
- Widely represented on the network electrified with AC voltage, in difficult climatic and terrain conditions of Siberia and Far East, as well as in Ukraine and Uzbekistan
- Yermak is the most mass-produced modern electric locomotive in Russia: more than 5,000 sections have been built over these years



EP2K

- The first batch-produced DC electric locomotive for passenger trains in the new history of Russian electric locomotive engineering, unveiled in 2006, in serial production since 2008
- Equipped with a power supply system for train cars
- A modular design allows to replace an outdated component with a new one during maintenance



DONCHAK 2ES4K, 3ES4K

- A prototype was built in 2006, serial production began 2 years later. This event marked the recovery of freight DC electric locomotive production in Russia after a break of a quarter of a century
- They differ in the number of sections, according to the prefix
- A freight and passenger version is different in that it uses an electropneumatic braking system for faster braking when hauling a passenger train at high speeds and an electric heating system for the passenger train

EP1M, EP1P

- The EP1M is an AC electric locomotive for passenger trains, in serial production since 2007
- Locomotives operate in all Russian climatic zones: from the Arctic Circle and north-western borders of the country to Eastern Siberia and North Caucasus
- The railroad workers gave the locomotive an affectionate nickname Marusya.
- EP1P is a modification for Primorye, with the tractive power increased by 16.5 %. It is operated in complicated landscape conditions



EP20 OLYMPUS

- Russia's first high-speed dual system electric locomotives for passenger trains, in production since 2011
- Created jointly with Alstom
- Drives passenger trains on polygons electrified with different types of current, without changing the locomotive, which reduces travel time
- Can drive trains consisting of up to 20–24 cars on the railroad sections with difficult terrain conditions, with minimum impact on the track

NPM2M

- Commissioned by the Magnitogorsk Iron and Steel Works, it was created in 2013 on the basis of the NPM2 electric locomotive
- Designed for operation on the railway tracks of metallurgical enterprises and open-pit mines, can operate under the MU system
- It features improved onboard electronics



2ES5S, 3ES5S

- Certified in 2020, designed for operation on the hardest sections of the Baikal-Amur and the Trans-Siberian railway lines
- Freight electric locomotives, first in domestic transport engineering, with asynchronous traction motors made on the domestic element base

DIESEL LOCOMOTIVES

PERESVET 2TE25K

- The first Russian two-section mainline freight diesel locomotive with six-axle sections, AC/DC electric transmission and commutator traction motors
- Produced from 2005 to 2009
- Runs in Russia, Mongolia, Kazakhstan, Turkmenistan and Uzbekistan



TEP70BS

- Diesel locomotive, designed for driving luxury passenger trains on non-electrified sections of railways
- Modern modification, serial production since 2006, features a two-wire system of car power supply
- Runs in Russia, Lithuania, Belarus, Uzbekistan and Turkmenistan
- The series is named after the famous Soviet railroad worker Boris Salambekov



2TE25KM, 3TE25KM2M

- 2TE25KM is Russia's first mainline freight locomotive to be mass-produced
- It was developed in 2015 within narrow time constraints under the Russian Government program to boost freight traffic on the Trans-Siberian and Baikal-Amur Mainline railways
- A new production facility with a capacity of 300 sections per year was established in Bryansk to manufacture these locomotives
- A three-section version is the most powerful on the railways with a gauge of 1520 mm, designed to drive freight trains weighing up to 7,100 tonnes



TEM28

- A shunting locomotive with an AC/DC electric transmission
- Its traction characteristics are similar to powerful mainline locomotives
- Reduces fuel consumption by more than 25 % compared to its counterparts
- Produced in 2016



VITYAZ 2TE25A

- The first Russian mainline freight diesel locomotive with an asynchronous traction drive
- Asynchronous traction motors of the locomotive are more powerful and easy to use compared to commutator motors
- Produced from 2006 to 2016



TEM-TMH

- Russia's first modular shunting locomotive with a DC electric transmission
- Created jointly with ČZ LOKO and Vilnius Locomotive Repair Depot
- Produced from 2009 to 2015

TEM23

- The first TMH diesel locomotive in the DNA Brand design, unveiled in 2021
- Can operate with either one or two diesel modules according to the required capacity
- A remote control system and an "Auto Driver" system that does not require the intervention by a human driver can be installed



METRO CARS

OKA 81-760/761

- Produced from 2010 to 2016
- Features ventilation, air conditioning and heating systems in the passenger car, a video surveillance system that broadcasts to the situation room, an asynchronous traction drive, air disinfection systems and an evacuation ladder in the head cars were used for the first time
- Russia's first train with a through passageway was created based on the Oka
- The Oka was the first metro train that was supplied under the life cycle contracts



YUBILEYNY 81-722/723/724

- The first batch was manufactured in 2014, for the 60th anniversary of the Saint Petersburg Metro, then two more modifications were developed
- Features an asynchronous traction drive, a forced ventilation system, electronic route indicators, safeguards preventing passengers from falling onto the tracks
- Additional cameras and light devices are used in the design to control train doors alignment with the sliding doors in the closed type stations ("horizontal lifts")
- In the newest, third modification the weight of the structure was reduced to 6 tonnes per car



81-765/766/767

- Produced since 2016
- Runs in Moscow, Kazan, Baku and Tashkent metros
- Features a brand new design, a light warning system signalling door opening and closing, air conditioning and ventilation systems, USB-sockets for charging electronic gadgets of passengers
- Cars of the 4th modification called Moskva-2019 features an improved electrodynamic braking system which allows to brake until full stop without applying pneumatic friction brakes resulting in smoother and quieter stop



MOSKVA-2020 81-775/776/777

- Produced since 2020
- New "rose gold" interior design
- Features the widest doorways and inter-car passageways in the history of railcar building – 160 cm, the area of visible glazing of doors has been doubled, console LCD monitors located under the ceiling, USB-sockets between the passenger seats, handrails with warm coating, etc.
- A new control panel and an automated driver assistance system



RAIL BUSES AND DIESEL TRAINS

RA-2 RAIL BUS

- Produced from 2005 to 2015
- Designed for suburban communication on the railroads of Russia, Ukraine, Lithuania and Mongolia
- Features sliding plug vestibule doors with individual control from buttons, air-tight inter-car passageways and doors; double-glazed windows with shutters; passenger seats with headrests and soft inserts; heating and forced ventilation systems
- A retractable footstep allows to board passengers from low level platforms



DP-S DMU

- An export model for Serbia. Supplies were carried out from 2011 to 2016
- Developed on the basis of the RA-2 rail bus, but for the European dimensions, with a 1435 mm gauge bogie
- Features a modernized body, a new control cabin unit, only head-car configuration, no intermediate cars
- It differs from the RA-2 by a longer car due to the absence of the service vestibule of the driver's cabin and a wider inter-car passageway without doors



RA-3 ORLAN RAIL BUS

- Produced since 2019
- Runs on more than 40 routes in many regions of Russia
- An increased width of the aisle between the seats, a more spacious vestibule and functional luggage racks; USB-sockets built into the seat units; Wi-Fi; passenger cars and driver's cabins are equipped with climate control with an air disinfection system
- Wheelchair lifts and separate seats for low mobility passengers, universal toilet facilities

ELECTRIC TRAINS



ED4MKM-AERO

- A modernized version of the ED4MKM electric train designed to transport passengers between stations and airports
- Produced from 2007 to 2011
- A car layout of special design with luggage areas, a separate luggage car was created for an electric train for the first time in Russia
- The train includes a VIP class car



ED9E

- Produced from 2006 to 2016
- Equipped with a set of energy-efficient electrical equipment which helps save up to 20 % of electric power
- Unlike its predecessors, ED9E fitted with regenerative braking with a possibility to return electric power to the contact network remains in motion until full stopping, barely readable, which reduces operating costs by a quarter
- Features exterior sliding plug doors, tight couplings



ED4M-500, ED9E-500

- The 500 series trains were produced since 2011
- The series was different from a base model by a new exterior design, including a fiberglass driver's cabin module and smooth side walls with new windows
- New solutions increasing comfort of the trip have been implemented: Wi-Fi, advanced microclimate systems, bicycle racks, biotoilet



EP2D, EP3D

- EP2D trains have been produced since 2015 for DC networks, EP3D trains have been produced since 2016 for AC networks
- The first electric trains certified in accordance with the requirements of the Customs Union
- Cars of three classes equipped with two- and three-seater sofas with built-in USB ports for charging mobile devices, emergency crash systems on head cars and inter-car couplers, sealed inter-car passageways without doors
- Adapted for low-mobility passengers, equipped with folding ramps, racks for wheelchairs, spacious toilet facilities, information boards in Braille



IVOLGA

- The base model was created in 2014, Ivolga 2.0 was unveiled in 2019 and Ivolga 3.0 – in 2021
- More than 90 % of components are Russian-made, including all major systems and units
- An asynchronous traction drive significantly increases power and considerably reduces operating costs; wide doorways and absence of vestibules make boarding and deboarding easy; cars are equipped with a lot of information screens, handrails, USB ports for charging electronic devices; head cars are equipped for low-mobility passengers
- Ivolga 3.0 is the latest development. The use of advanced technical solutions allows the train to change direction of movement within 1–2 minutes



Yury Bartenev / Shutterstock.com, Dmitry Shchukin / Shutterstock.com, Valery Sharifulin / TASS

PASSENGER COACHES

RIC TYPE PASSENGER COACH

- The model 61-4476 sleeping coach was certified in 2012 for the use on international routes
- Developed together with Siemens, it can be operated both on the wide- and narrow-gauge railways
- The compartment doors are swinging, not sliding like on Russian trains, there is temperature control in the sleeping compartment
- Each table has a built-in sink and a small trash can



2020 DOUBLE-DECKER COUPLED PAIRS

- The first double-decker coaches in the Russian transport engineering practice that can be operated as coupled pairs
- The series includes a compartment coach (61-4523), a staff coach (61-4524) and a restaurant car (61-4525)
- For the first time in Russian passenger car tradition, a bogie was equipped with air suspension to increase the ride quality, reduce the noise level and impact on the track
- Enlarged space for passengers of the upper level



2019 SINGLE-DECKER COUPLED PAIRS

- The model 61-4517 compartment coach was made as a coupled pair for the first time in the history of Russian transport
- A new approach to the organization of internal space: shower cabins in every coach, service area with vending and coffee machines in every coupled pair, including in non-compartment model 61-4516 cars.
- Among routes of single-decker coaches made as coupled pairs, the longest one is from Moscow to Vladivostok



SINGLE-DECKER COACHES OF THE "FORTY-FOUR FORTY" SERIES

- Certified in 2008
- First in the series were the 61-4440 compartment coaches and the 61-4447 couchette coaches, later followed by a staff coach (61-4445), a coach with seats (61-4458) and a restaurant car (61-4460)
- For the first time in domestic practice the flat corrugated cladding was applied to the body side walls, thus combining aesthetic benefits and wear resistance with the required rigidity. Stainless steel bodies increase the service life of coaches from 28 to 40 years.
- Unlike its predecessors, this series features enhanced sound insulation, improved ergonomics and interior design, biotoilets, heating and air conditioning systems



DOUBLE-DECKER COACHES

- Serial production began in 2012
- The series includes a compartment coach (61-4465), a compartment staff coach (61-4472), an SV coach (61-4465.01), a restaurant car (61-4473), a coach with seats (61-4492) and a staff coach (61-4503)
- The number of places has been increased without compromising the usual level of comfort,

convenient storage of personal belongings, individually adjustable lighting, climate control have been well designed

- Trains consisting of double-decker coaches connect Moscow and St. Petersburg with the largest cities of the European part of Russia: Kazan, Voronezh, Samara, Adler, Kislovodsk, Izhevsk, Petrozavodsk, Murmansk and others

SPECIAL CARS

61-504, 61-4505 BAGGAGE AND MAIL CARS

- Unveiled at the end of 2014
- The model 61-4505 car is equipped with a unique integrated monitoring system which provides for simultaneous control of several 61-4504 model baggage cars included in the train
- Carrying capacity of cars is increased by more than 3 tonnes thanks to the body extension by 1 meter
- The model 61-4505 car body is divided into cargo and service areas



61-4483, 61-4484 MAINTENANCE CARS

- The model 61-4483 car is designed for dosing hopper trains, and the model 61-4484 car is included in the maintenance and repair train and is used for accommodating repair crews and providing conditions for their work
- Produced since 2011
- Conditions for work and rest of railroad workers have been considerably improved: comfortable compartments for two people, shower cabins, a kitchen-dining room equipped with appliances, a storeroom with a clothes drier, air conditioner and heating

FREIGHT CARS

19-3116 HOPPER CAR

- An improved modification commissioned by Uralkali was put into production in 2005
- A drop-shaped car provides for almost 100 % volume of bulk materials filling, and the modified angle of slope of end walls provides for unobstructed sliding of bulk cargo during unloading without getting stuck
- The car frame is designed without a load-bearing center still which allowed to increase the capacity of the lower part of the body, lower the center of gravity and carry out unloading in the space between rails



13-9751-01 FLAT CAR

- Designed for transportation of heavy-tonnage containers
- Produced since 2008
- Features a dual circuit braking system
- Boasts improved robustness of strength members



13-6726 FLAT CAR

- Designed for transportation of heavy-tonnage containers and tank-containers, including those with hazardous cargoes, which became possible through the use of elastomeric class T3 shock absorbers
- The launch of serial production is planned in 2022
- Two patents for unique technical solutions were obtained during the model design process



13-9744-06 FLAT CAR

- Designed for transportation of tank-containers and heavy-tonnage containers
- Produced since 2003
- The frame is equipped with tie-down brackets and additional fitting stoppers to transport a tank-container in the center of the flat car
- At the customer's request, the brake equipment can be fitted with threaded or slip pipe joints



12-3090 GONDOLA CARS

- Certified in 2011
- Features reinforced design of upper strapping which prevents deformation of the body during loading and unloading operations
- Lining of the side walls reduces friction of the cargo against the walls during unloading

13-6987 FLAT CAR

- The first mass-produced Russian contrailer flat car for transportation of semi-trailers and heavy-tonnage containers was unveiled in 2021
- Features a special basket – a removable reusable cargo attachment device for transportation of semi-trailers
- Over 70 cars have been produced which are operated by the First Federal Contrailer Operator



Transport is Getting Smarter in No Time

The main focus of the Information Control Systems Division for the next years is on the development of integrated solutions for mainline and industrial transport in Russia and CIS.



ANDREY ROMANCHIKOV
Managing Director for Development of Intelligent Control Systems

KEEPING UP WITH A GLOBAL TREND

The transition from relay-based train control systems to intelligent control systems around the world has been driven by technological advancement. Communication capabilities have changed, and there has been a breakthrough progress in terms of information exchange via radio channels. Any object, whether rolling stock or infrastructure, can now be easily incorporated into a single control system due to the data transfer rate. The development of computing technology

allows to process large volumes of information and solve management tasks more efficiently than humans do. Transparency is also important: digital control systems, unlike analog counterparts, provide historical information of what happened to the equipment, what caused a particular event, so it is possible to predict what will happen next. Thus, the rolling stock maintenance process can be improved.

TMH could not stay away from the global trend. In rail transport, like in all other areas of life, digital technology is the fastest growing segment. Our customers are planning considerable investments into digital technologies, and we must offer them our products in this segment. For example, we are developing intelligent control, safety and diagnostic systems for rolling stock together with specialists from TMH Engineering. Infrastructure solutions for the automation of rail transport and metros are important as well.

In 2017, LokoTech-Signal (recently renamed to TMH Smart Systems) was established for the purpose of preparing a complete portfolio for rail transport that would allow TMH to be competitive and provide customers with the products and services they need. In addition to the purchase of assets and in-house development, it also cooperated with other companies engaged in creation of unified technical solutions.



the system has been accepted to regular operation.

Dissemination of the Virtual Coupling intelligent system continues on the Eastern polygon of Russian Railways. This technology is developed and implemented jointly with R&D Institute of automation, informatization and communication (NIAS). The proven increase in the capacity on the existing infrastructure is 15 %, which results in significant investment cost savings for the customer. All new Yermak locomotives produced at the Novocherkassk Electric Locomotive Plant (NEVZ) are equipped with this system directly at the plant.

For metros, CTRL@LOCK 100 traffic control system was designed. It was the first system to pass the entire inspection cycle and was approved for implementation in the Moscow Metro. At the beginning of 2022, the division approved the strategy of intelligent systems development up to 2026 which is fully focused on comprehensive solutions for mainline and industrial transport. Projects of the high priority include:

- development of a comprehensive integrated system that combines machine vision and automatic driving for mainline transport;
- development of a comprehensive diagnostic system to detect the pre-failure condition of the vehicle, automatically analyze it online and give maintenance recommendations (such system is already being incorporated into all perspective rolling stock projects);
- implementation of comprehensive projects for unmanned driving. **V**

NEW OPPORTUNITIES

Today, TMH customers are placing more complex requirements on our products.

It is not enough for them to get rolling stock, they want comprehensive systems that ensure safe and efficient interaction of the railway infrastructure and rolling stock and create additional benefits for the business such as increased capacity and energy efficiency.

A new division that was formed within the Holding's structure in 2020 is focused on the development of such systems. It combines competences of several companies engaged in the development, production and service of digital solutions and traffic control technologies — LokoTech-Signal, AVP Technologies, Transtelesoft and some others. The division includes six research laboratories on the adaptation and testing of traffic control systems, and a machine vision laboratory to test obstacle detection, rolling stock remote control, and unmanned driving.

Today, the division has developed a full product portfolio that meets modern customer requirements. Industrial enterprises, metros and mainline carriers in Russia and CIS have already shown interest in the division's products.

At the beginning of 2022, Kazakhstan Temir Zholy (KTZ, Kazakhstan Railways) tested the CTRL@LOCK 400 interlocking system designed for contactless control of switches and traffic lights. The system will considerably increase traffic safety and contribute to the development of the transit potential. CTRL@LOCK 400 has already shown its reliability and received positive feedback from the service companies related to KTZ. The implementation of this system is economically viable compared to its analog counterparts. At the moment,



BENEFITS FROM IMPLEMENTATION OF DIGITAL TRAFFIC CONTROL SYSTEMS



CTRL@VISION — MACHINE VISION SYSTEM

0.05 SECONDS IS THE RESPONSE TIME OF THE OBSTACLE DETECTION SYSTEM WHEN THE LOCOMOTIVE MOVES



CTRL@CONNECT — VIRTUAL COUPLING

UP TO 20% GROWTH OF RAIL NETWORK TRAFFIC CAPACITY ON THE EXISTING INFRASTRUCTURE



CTRL@TRAFFIC — UNMANNED DRIVING SYSTEM

GOA-4 IS A COMPREHENSIVE ON-BOARD + INFRASTRUCTURE SOLUTION FOR MAXIMUM AUTOMATION



CTRL@LOCK — MICROPROCESSOR INTERLOCKING SYSTEM (MPC)

UP TO 65% REDUCTION OF THE SYSTEM'S LIFE CYCLE COST



CTRL@TRACK — TRACK CIRCUIT SYSTEM

UP TO 90% REDUCTION OF SYSTEM'S MAINTENANCE COSTS



VALOGI ALEKS SUHININ
TMH Managing Director for Quality and Reliability

First-Rate

In 20 years, we have achieved remarkable success in many areas regarding quality. However, we still have to address many new tasks.

NOTHING IS IMPOSSIBLE

In the Holding's early years, the product quality control system was rather weak. Even in 2010, the customer acceptance rate for locomotives was only 63 %.

We have committed ourselves to increase it by 30 % and have done a great job to achieve this goal. By the end of 2021, it reached 90–95%.

At the same time, we aimed at reducing the time spent on solving problems related directly to the quality of production by 30 %. Now we are using sophisticated software, special computerized platforms which help us solve quality issues in production within 8 to 30 days, depending on the nature of the issue.

After Transmashholding and Alstom agreed on a strategic partnership in 2008, development of the efficient production system has become one of the priority tasks. We followed the French experience, adopted it to the Russian soil and created our own production system. It involved work in many areas, including the management system, quality, launching into manufacture, supply chains, operations management. In this way we intended to reduce labor costs, improve inventories control, optimize indirect costs, reduce costs related to quality discrepancies, improve the overall quality of products and processes.

Over the past few years, much effort has been put into developing and establishing reference lines at TMH facilities which resulted in the alignment of production processes enabling to manufacture

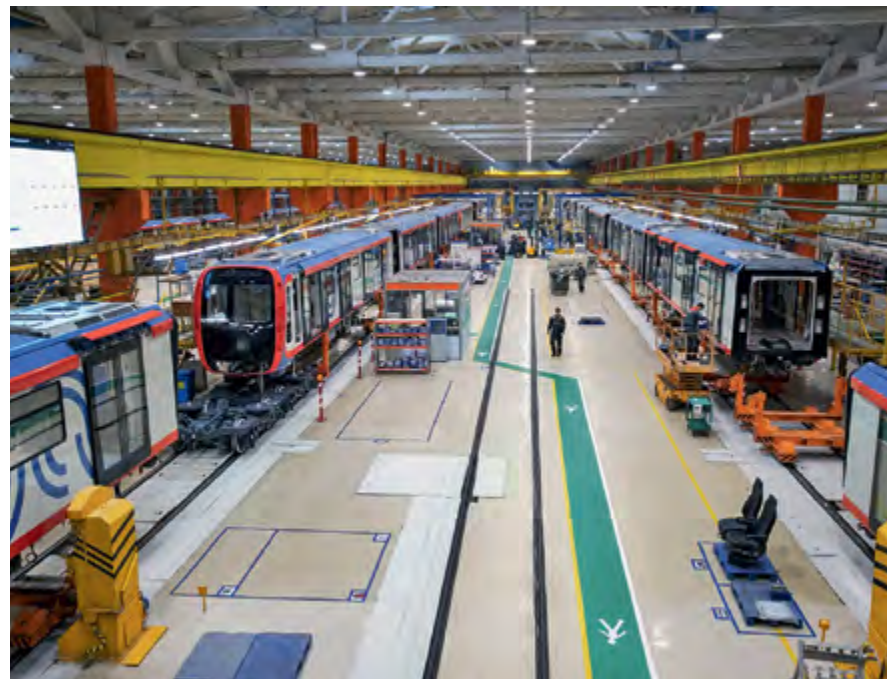
quality products with account of the production takt time. Looking forward, we will continue to work on the reference lines and adopt this concept for the reference cells. In addition, we will focus on improving the production culture among operators, improving supply chain efficiency, creating a more responsible and modern attitude to labor among employees, and implementing the Leader's standard work. My task now is to breathe new life into the Holding's production system and ensure its regular and full functioning with account of all the areas we have initially defined.

A NEW PHILOSOPHY

Two years ago, a working group was formed with the purpose of developing unified standards and regulations on quality assurance and reliability to be adopted in all TMH Group companies. This group under my leadership and in close cooperation with all functional units is currently developing new standards and procedures as well as consolidating and optimizing the existing ones.

Considerable success has been achieved in the implementation of production reference lines which help achieve key performance indicators

▼ Reference line at Metrowagonmash



> Assembly of locomotives at Bryansk Engineering Plant

using such criteria as quality, cost, and delivery.

In January 2022, product quality and process planning was begun with the support of TMH Engineering and the Holding's technical directorate.

It includes implementation of principles and practices of Advanced Product Quality Planning (APQP) in design, and implementation of the ISO/TS22163 business and quality management standard, known as the International Railway Industry Standard (IRIS).

APQP has been successfully implemented in the automotive and aerospace industries. It has much in common with IRIS. We have combined the best things these practices offer, and implemented and used them within TMH. As a result, our engineering centers will operate under unified quality principles.

Refresher training in quality and lean production tools was given at 11 key TMH plants. Managers and plant managers had to be retrained, with particular emphasis on the benefits that come from the continuous use of these tools. 250 people were trained. The training course included both theory and application of lean production in the shops with the purpose of implementing improvement ideas.

TMH's priority task is to continuously improve the quality of processes and products. A comprehensive approach to quality management and a new philosophy are used to address this task. The quality of processes is essential to the product quality.

We have big plans for the next five years. We intend to implement and ensure application of the APQP principles and practices in engineering departments, focusing on systematic failure mode and effects analysis (FMEA). There are also plans to implement business and quality management standards in engineering according to ISO/TS22163. This work includes the creation of a corporate user experience database (REX) which will allow TMH engineers share practical experience and learn from their own mistakes. Such database is already being compiled, but it



FIGURE

90-95%

THE RATE OF LOCOMOTIVE ACCEPTANCE BY CUSTOMERS IN 2021

needs to be improved and expanded. We also have to create a database of quality indicators, including systematic reporting.

We will continue to develop personnel skills using the Transmashholding Education System (TES) with the emphasis on practical training.

In my opinion, special attention should be paid to identifying the root causes of difficulties that arise, analyzing the tools to address them and the effectiveness of the measures taken. All TMH employees, without exception, should be involved in this process.

As part of the Transmashholding Operating System (TOS), we

must develop a Leader's standard work system along three vectors: vision of the target and a strategy of its achievement; continuous improvement of product quality and improvement of the product creation process (kaizen); management of daily organizational and operational activities.

Leaders, in the terms of lean production, can be employees of different levels — general director, quality director, shop foreman. Each of them should work in these three areas, but the percentage between them depends on the level which this leader occupies in the structure of the organization. Regardless of their level, all leaders should regularly "go to gemba", a place where production happens, in order to understand the current situation, provide support to employees, make suggestions for improvements, and act as a mentor.

Another group of tasks is related to the development and use of a supplier's quality management system. Some elements of such system are already in place, but they need to be improved. ▼

Energy of the Future



DENIS TARLO
First Deputy CEO at TMH-Energy Solutions

Transmashholding continues to develop diesel engine engineering and create custom solutions in the field of electrical engineering, including under programs of import substitution. I would like to speak about the most perspective projects in this area.

TURNKEY SOLUTIONS

Established in 2020 by merging TMH energy assets, TMH-Energy Solutions became the competence center for the development and promotion of turnkey integrated energy solutions. In order to achieve these objectives, the shares in the Kolomna Plant, Penzadieselmash, TMH-Electrotech and Zavod AIT were contributed to TMH-Energy Solutions. In addition, Petrozavodskmash and the diesel and electromechanical division of LokoTech were placed under the operational control of TMH-Energy Solutions.

One of our main objectives today is to ensure production of a full line of engines with a wide power range to cover the existing demand of Russia's key industries, and to guarantee the spare parts supply and technical support throughout the entire life cycle. Highly qualified, skilled professionals regularly join the TMH-Energy Solutions team, and new promising projects are added to the company's portfolio.

In 2020, to improve quality and cost control, TMH shareholders decided to localize repairs of manufactured products directly at the manufacturing plants. Soon, a project was launched at the Kolomna plant to develop repair facilities for the D49 engine. We are responsible for the implementation of this project. 75% of all the necessary equipment has been already purchased, and installation works in the shops are underway.

Another important project aims at setting up a Science and Technology Center (STC) for marine diesel engine engineering with the support from the Ministry of Industry and Trade. The domestic market of marine power plants is highly competitive and is strongly dominated by foreign production. The STC will help create a line of Russian-made propulsion systems of various capacity intended primarily for civil shipbuilding. The new company is expected to

∨ The 9GMG gas diesel generator was developed by designers of the TMH Engine Engineering Center for the shunting locomotive manufactured at the Bryansk Engineering Plant under the state program on the introduction of gas powered vehicles

design and create power plants and provide a full suite of services. Preparation work is underway, the launch of production is scheduled for 2023.

An important event was contribution of Rusatom Overseas (controlled by Rosatom State Corporation) to the charter capital of TMH-Energy Solutions with a share of 25.01 %. Together with Rusatom Overseas, we intend to develop energy solutions for small-scale generation and transport, carry out transition to new types of fuel, expand the product portfolio and import substitution in diesel engine engineering, and implement backup power generation projects.



Strategic partnership with Rosatom State Corporation will give us an opportunity to use technology, productive and commercial resources of the nuclear industry for further development.

In addition, together with Rosatom, Russian Railways and the Government of the Sakhalin Region, we are engaged in a project to create a hydrogen fuel cell train ("H-train"). Rosatom will supply hydrogen fuel and organize the refueling infrastructure, the Government of the Sakhalin Region and Russian Railways are responsible for train operation, and we will supply propulsion systems. The launch of the first train is scheduled for 2024.

THREE PILLARS

In its first year, TMH-Energy Solutions managed to test the 16SDG500 marine engine and the DTA-200T asynchronous electric motor, complete production of prototypes of seven more new engines, and improve the quality and reliability of all major products. Of course, we are still at an early stage of the journey and there is still a lot of work to be done. We plan to continue to develop three main areas in

^ Production site at the Kolomna Plant

the next five years: diesel engine engineering, electric machine engineering, and alternative energy.

We will continue our work on import substitution in diesel engine engineering. First of all, we are going to replace GEVO engines used on 3TE25K2M diesel locomotives with in-house diesel generators. Another priorities high on the agenda are an increase in the supply of the D500 family engines and development of turbochargers production.

In electric machine engineering, the main focus will be on developing production of asynchronous traction motors, alkaline batteries and high-power energy storage systems. In the future, we also plan to enter the lithium batteries and charging infrastructure market.

As for alternative energy, the development of 9GMG and 16GDG gas-fueled engines will be completed shortly. We will continue work on the creation of a hydrogen fuel cell train.

We also plan to develop the relevant competences and substantially expand the range of products for further scaling up both existing and new energy generation solutions in other regions and countries. ∨



FIGURE

MORE THAN
10,000

DIESEL ENGINES OF VARIOUS CLASSES HAVE BEEN CREATED BY TMH OVER 20 YEARS



Like Clockwork

At present, all Holding's enterprises work according to the uniform procurement principles. Many processes have been automated.



ANDREY SHEREMETEV

Deputy CEO for Equipment and Material Procurement at Transmashholding

PRIORITIZATION

In the early 2000s, the enterprises that made the backbone of Soviet transport engineering began to join Transmashholding. Of course, they were completely independent, each had their own procurement systems with a pool of suppliers, and applied local production standards. However, the domestic industry was in decline during those years, so the choice of suppliers was limited and it was not always possible to purchase goods of decent quality. It was under such conditions that the Holding began to build its own procurement system.

A special structure, RusTransComplekt, was set up within TMH to organize a centralized procurement system. For many years, it thoroughly cooperated with major suppliers, consolidated supply volumes and provided TMH enterprises with optimal solutions for the supply of raw materials and inventories in terms of prices, quality, logistics, and delivery time. As a result of restructuring that followed, the procurement management functions were localized at the Holding's Directorate for Equipment and Material Procurement.

At the initial stage, significant attention was paid to the distribution of authority between the centralized procurement system and the enterprises which continued purchasing for their own needs, as well as to the formation of input control systems for purchased items. An inspections system was established in the supplier companies.

The Holding conveyed the idea to both current and potential suppliers

that TMH was a reliable customer ready for long-term cooperation with those suppliers who would provide the required high-end products of stable quality and could guarantee contracted supply volumes. The Holding provided assistance in the development of such suppliers — organizational, technical, and even financial.

Strong emphasis was put on the creation of a system of alternative suppliers. The Holding has always sought and still seeks to avoid situations where the supplier of key components is a monopoly, and prefers to work with two or three partners simultaneously. Competing for the TMH market, they are constantly working to improve the quality and technical level of their own products.

From the very beginning of its business activity, the Holding has had a preference for working with domestic suppliers, although there were a lot of contacts with foreign manufacturers because much of what we needed for our work was not produced in Russia in the 2000s. Accordingly, Russian manufacturers were first on the list regarding the priority followed by foreign suppliers who were ready for localization in Russia, and if such options were not available, the Holding worked directly with imported products. This system of priorities still exists today but has acquired new relevance. Opportunities for Russian suppliers are especially high.

DIVING INTO DIGITAL WORLD

Over the last years, Transmashholding has been actively implementing processes

of automation, digitization and optimization of the procurement activity at all of its stages — from planning to warranty obligations during the life cycle of units and components.

TMH enterprises were transferred to a modern digital management platform; the supply and warehousing logistics software was fully upgraded to meet current needs of the plants. A special tool based on 1C: ERP — manager's personal desktop for procurement plan management — was introduced. An electronic exchange procedure for procurement plans and their adjustment with the Holding's key suppliers was established.

Automated calculations of procurement requirements in accordance with the current production demand and warehouse balances were introduced. Logistic parameters of products (manufacturing and transportation time of inventories, factory order, weight, type of packaging, etc., a total of 23 parameters) are integrated into the planning processes, which allows to provide enterprises with everything they need just in time. Approval of the replacement of inventories with their counterparts or substitutes in production has been digitized. A unified approach to transfer of in-house products to outsourcing was developed and approved.

A digitized approval of the procurement procedures with distinguishing time and role areas of responsibility reduced the procurement period and improved economic efficiency and the quality of the product range purchased.

During the same period, an electronic document management system regarding suppliers was implemented, and the product certificate tracking process was automated.

Supplier and purchased products quality assessment procedures have been implemented. The warehouse logistics system was automated, the processes of inventory supplies to the reference assembly lines were digitized, QR-labels and sensors on the units, recyclable containers and transport were installed.

Thus, all procurement operations were digitized. This helped ensure uninterrupted supplies to Holding's enterprises even during the pandemic, when the supply chain was disrupted and the prices for raw materials and supplies rose. We overcame a difficult period in the market as comfortably as possible for all participants in the procurement and production processes, managed to achieve cost optimization targets, while maintaining a high level of quality of the supplied components.

In general, we can talk about improving the quality of planning on the part of the demand initiators and the entire work of the procurement services, as well as improving the process of interaction with suppliers. However, there is still room for improvement and development.

First of all, we have to achieve all the annual performance targets regarding the Holding's logistical support. We have also set ourselves

to focus on the participation of the procurement department in the development and optimization of the cost of new products, on the maximum expansion of the alternative suppliers network, on enhancing the reliability of purchased components, on the development of beneficial partnerships with suppliers, which is particularly important in the current market conditions. Of course, we will continue to improve the quality of planning with a view to increasing its horizon, reducing the level of inventories and releasing working capital.

Another important objective is a better development of Holding's warehousing facilities to the level achieved on the reference lines. This will require the modernization of storage areas to the European level, as well as the automation of all warehousing processes.

Now we are in the process of setting up a procurement center which will essentially become a procurement division. It will combine and concentrate functional competences and areas of responsibility in terms of logistics support of TMH and LokoTech enterprises.

NEW CHALLENGES

The current year was marked by unprecedented challenges that we have not seen in the pandemic or in the past 30 years, which certainly created the need to mobilize all

procurement departments, change the previously established and aligned business processes. Without exaggeration, the role of the procurement function has become crucial in the Holding's business. The most important thing now is to ensure uninterrupted operation of our plants, which are a backbone of Russia's economy and create tremendous numbers of jobs.

Despite all the difficulties, we managed to rebuild relationships with our suppliers in just one month. Financial mechanisms of mutual settlements with foreign partners under current sanctions were set up promptly; logistics and customs issues are successfully resolved. Together with TMH Engineering, we work continuously on import substitution and development of new markets, and here we have achieved significant results, which allowed to make Holding more sustainable.

While understanding the importance of the mission entrusted to procurement, our priority targets, first of all, include operational establishment of new logistic routes, assisting our suppliers in import substitution of key systems, in-depth study of the Asian markets and developing markets of friendly countries. Another important task is accurate procurement planning in accordance with the production plans of enterprises, which, in turn, allows the rational use of the Holding's funds. **V**



The most important thing of the procurement block is to ensure uninterrupted operation of TMH plants, which are a backbone of Russia's economy and create tremendous numbers of jobs

Focus on Development

Modern technology develops very quickly, forming a new ecosystem of human capital. Business processes are transformed, digital culture is developed, shared information space is created, and service platforms for external and internal clients are introduced. Heavy engineering is based on the unique engineering competences and technology development, and our employees are the main ambassadors of the changes.



NATALIA SHISHLAKOVA

Deputy CEO at TMH for Transformation and Project Activities, a Member of the Management Board

4C MODEL

We have come a long and successful way since the establishment of TMH. The expertise accumulated over 20 years is invaluable. We can now safely say that TMH occupies its niche in the heavy engineering segment and has become a global manufacturer of modern transport solutions. The Holding's management improves the employee recruitment, training and professional development systems. We cooperate with Russia's leading universities, develop training programs, and form a talent pool.

The professions of the future help us to scale up projects and implement them everywhere. The 4C model is gaining popularity in the scientific community: creativity, communication, critical thinking and collaboration. These are the key skills of a TMH specialist.

Today, the relevant competences form new training models. New age education must change to meet the requirements of modern professions.

Training centers are the Holding's pride. One of the oldest is the Tenischeva Training Center of the Bryansk Engineering Plant. The largest training center is the NEVZ Corporate Training Center at the Novochoerkassk Electric Locomotive Plant. Most enterprises have specialized licensed training centers of regional importance. Seven of them are certified and can train Holding's employees and arrange external

training, including for our partners who are engaged in the rolling stock maintenance. In addition, TMH concluded strategic agreements on mutual partnership with universities in all regions of TMH presence: Bauman Moscow State Technical University, Russian University of Transport (MIIT), Bryansk State Technical University, Moscow Institute of Steel and Alloys, Platov South Russian State Polytechnic University.

The latter is located in Novochoerkassk, where our largest electric locomotive plant is situated, and a large number of students have their practical training at this enterprise.

The students who show the best results join our company. Over the 20 years past, mechanical engineering has significantly raised its professional prestige.

DIGITAL TRANSFORMATION

Providing the Holding with competences of the future is a major challenge that we all want to accept and respond to with dignity. Digital transformation which implies introduction of new decision-making principles, digital culture development, and changes in the business environment, is impossible without the involvement of every person in this process.

Many professions of the future in mechanical engineering have digital

tools that offer unique and diverse non-standard services. Therefore, digital competences of younger generations are important to us. Together with the Higher School of Economics, Skolkovo Moscow School of Management, and Innopolis University 2035, we are developing digital transformation programs.

Skolkovo held a Leadership in Digital Transformation Program. More than 70 employees were trained. Together with Innopolis University 2035 under the Leaders in Digital Transformation Program, we organized training for more than 300 key employees: they were awarded CDO (Chief Data Officer) and CDTO (Chief Digital Transformation Officer) diplomas. At the moment, 22 best engineers of our Holding are trained at the Higher School of Economics under the School of Innovation program.

Our priorities are performance-based work and unlimited growth prospects. The Holding, therefore, creates an environment and expert community to implement a vacant posts operational filling program. The Talent Pool Development School is a very effective project of TMH talent management.

Since its creation, more than 1,200 people have joined the talent pool,



^ In 2017, TMH implemented a KPI system which means that each employee influences the overall result

and more than 200 of them have already fulfilled their individual career plans and occupied the target positions. Personal achievements of each employee are important for successful development of the Holding in the competitive environment. That is why one of the Holding's strategic objectives is to create and develop a highly professional talent pool. We strive to preserve more than a century-old traditions of the Russian transport engineering industry and ensure its dynamic development and compliance of the quality of our products with the modern world.

FOLLOWING UNIFICATION

Today, TMH is at the stage of extensive changes: business processes are transformed and new business are developed. We accept the current market challenges and consumer expectations, and this makes us the pioneers of digitization in the Russian engineering industry.

Digital Depot, Digital Factory, and Digital Locomotive programs have already established themselves in the industry. A number of projects have been recently successfully completed, and the solutions created have been

production and service. The digital transformation program includes more than 100 different projects and initiatives. We are switching to paper-free office for new types of products, organizing design of locomotives, cars and parts in the virtual environment.

Based on 2021 results, Transmashholding had all the necessary conditions in place for the functioning of the project office model: a project typology with approved criteria was developed, the necessary project management methodology was elaborated: top-level methodology for all project types and a detailed methodology with descriptions and detailed check lists for projects of the highest priority related to product and digitization. The next stage is to develop a project ranking model which will include a list of criteria that the company considers important. Business process unification has become a natural continuation of the digitization development. TMH plants have already made significant achievements in the QMS and lean production practices which are based on the process approach. Our perspective task for the future is the formation of a comprehensive architecture of the Holding's business processes, unified models for standard processes and functions at the sites, and general rules for setting up organizational structures.

Since 2017, TMH has implemented a KPI system. At the beginning of each year, the Holding's management sets corporate key objectives for the company, which are further broken down to functional units. Each of our employees affects the result! In the future, we plan to create an end-to-end performance indicator system for the entire TMH Group, compare KPI against a specific process or project, and analyze best practices.

TMH is the Industry Leader. Our vibrant team are united in the common purpose. We believe that being professional means working with dedication, producing quality and safe products, being the first to learn about the latest market trends, applying the latest digital technologies, i.e. continuously moving forward.

Future is Better with Us! All global achievements still lay ahead! **V**



FIGURE

TODAY, TMH ENTERPRISES EMPLOY

ABOUT
39,000
PEOPLE



2022
YEARS

