

Transport and urban smart mobility trends

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Технологии
Доверия

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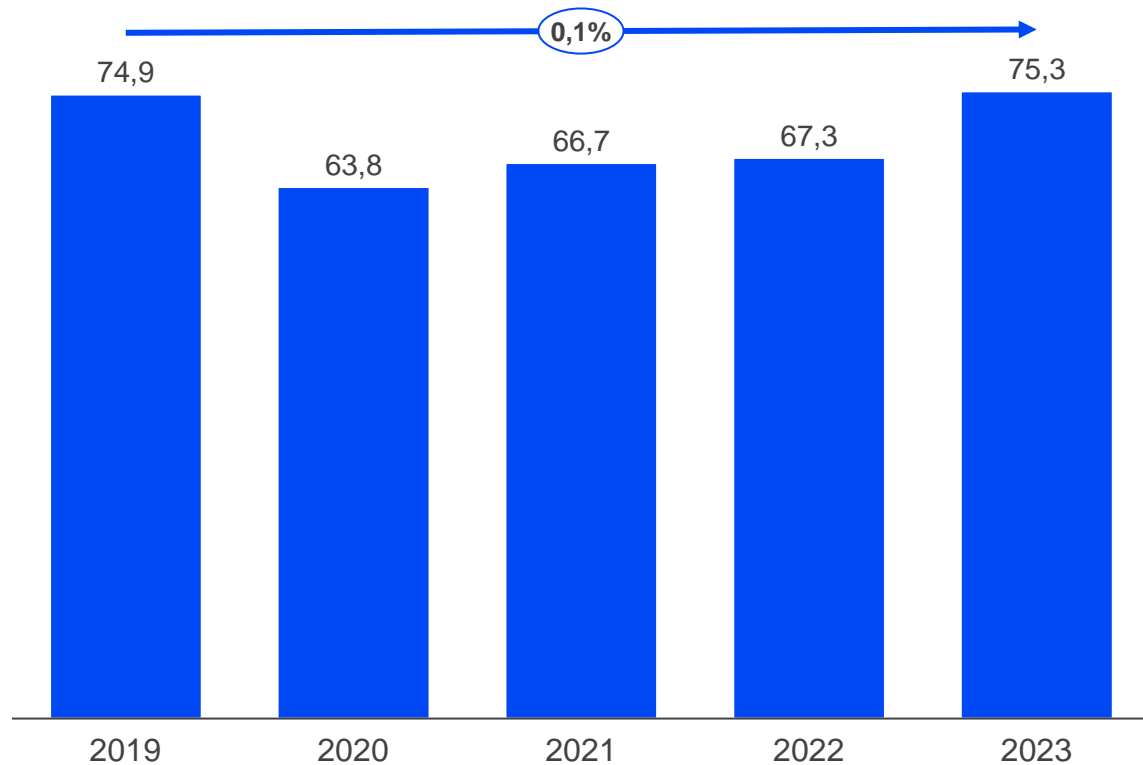
Global car market – Volume, country structure and current trends

01



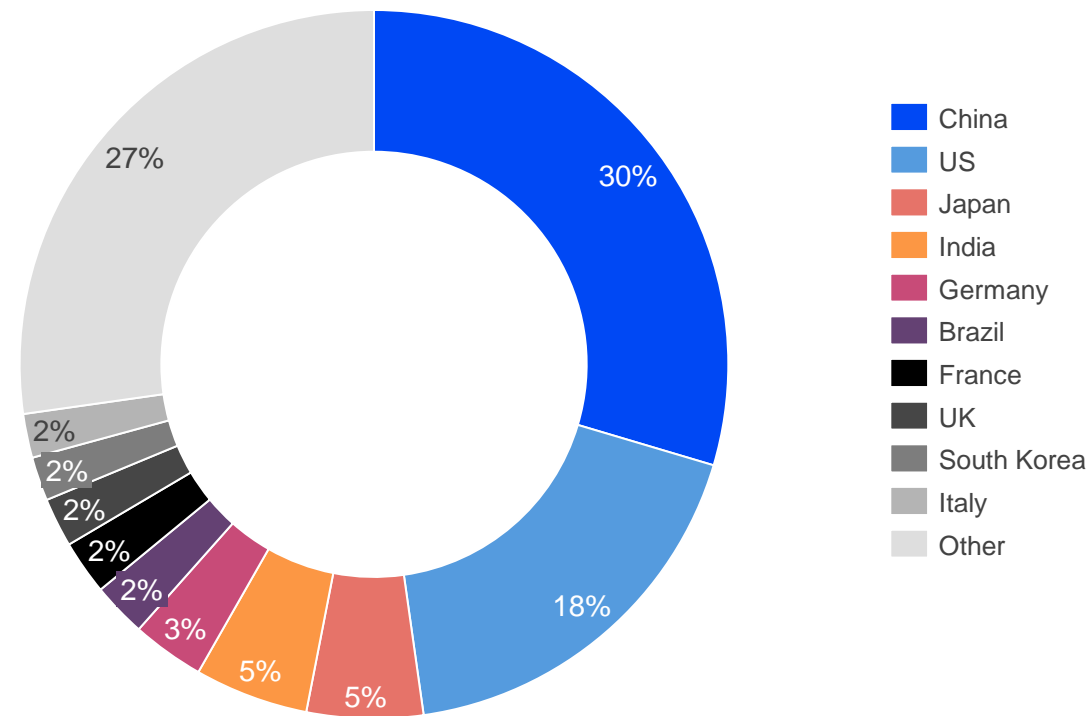
In 2023, the global car market saw a post-pandemic rebound. China keeps the lead in car sales, accounting for 30% of the market

Global car sales, 2019–2023, million cars



Source: Statista, TeDo analysis

Global car sales by country in 2023, %



Source: Autostat, PwC analysis

The pace of smart mobility development is accelerating, producing an increasing impact on the global car market



Global car market recovery drivers

- 1 Innovation**
Adoption of innovations and new technologies, such as autonomous driving, connected cars and transport telematics, heightens consumers' interest and opens up new market growth opportunities
- 2 Developing infrastructure**
Building and upgrading of infrastructure required for innovation and new technology adoption facilitates the spread of such vehicles
- 3 Vehicle electrification**
Steady interest in green vehicles and e-mobility technology reflects changes in consumer preferences
- 4 Safety and environmental standards**
Toughening car safety and environmental requirements can result in innovations and enhanced safety, fuelling the market growth



Global car market recovery constraints

- 1 Increasing cost of car ownership**
The cost of car ownership (fuel, insurance, maintenance and repairs) can grow too high, making people less willing to purchase a car
- 2 Environmental and regulatory measures**
Strict environmental standards and regulations aimed at reducing CO2 emissions and air pollution can force car manufacturers to increase the cost of their cars to ensure compliance with these requirements
- 3 Sharing economy**
Giving preference to car sharing, public transport and e-scooters over car ownership can push down demand for new cars
- 4 Macroeconomic factors**
The global economic downturn or recession in key global regions can lead to reduced household incomes and lower demand for cars

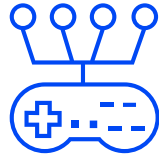
Source: public sources, TeDo analysis

There are five key areas of smart mobility development worldwide



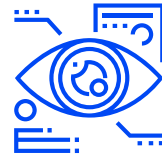
Mobility as a service (MaaS)

- Mobility as a Service is a concept switching from car ownership to sharing services (e.g. car sharing, kicksharing, etc.).



Connected cars

- Connected vehicles can share data with other cars, devices, services and networks, including your home and office).



Transport telematics

- Technology of fast data sharing between connected vehicles.
- With telematics, traffic can be optimised and vehicles can connect to infrastructure, etc.



Vehicle electrification

- Transition from the traditional internal combustion engines to electric (and hydrogen) engines.



Autonomous driving

- Complex hi-tech solution for autonomous driving with or without partial human involvement.
- Specifically, it includes ADAS¹.
- There are five levels of autonomy, where 5 means that a car is completely autonomous.

¹ Advanced driver-assistance systems
Source: public sources, TeDo analysis

Impact on the car market

Connected vehicles outlook

02



The growing popularity of connected vehicles is driven by their key advantages, such as improved safety and efficiency, as well as comfort for users

Connected cars – operating principle

A connected car is a vehicle with internet access. Connected vehicles can share data with other cars, devices, services and networks, including your home and office.



Source: Ingosstrakh, Vestnik Glonass (The GLONASS Herald journal) and other public sources, TeDo analysis

Technologies of trust

Connected services

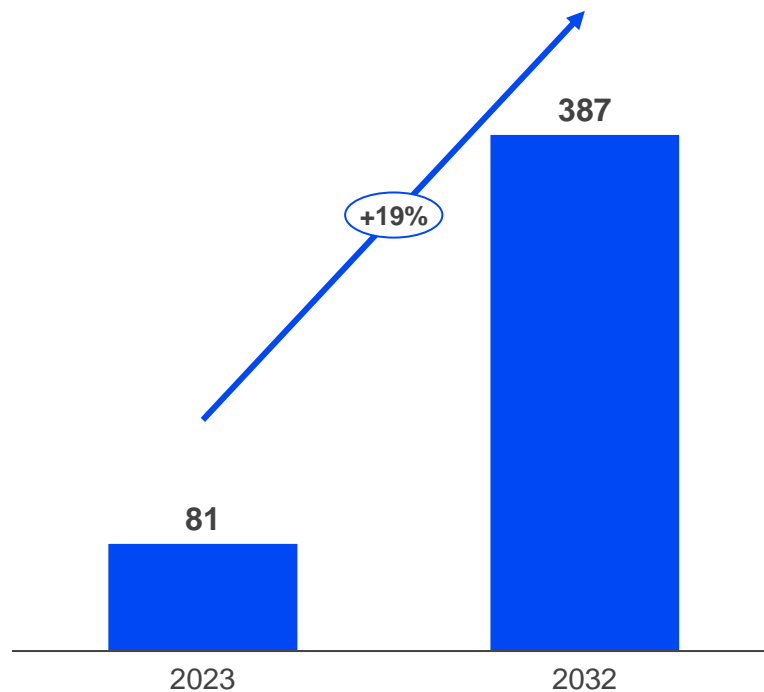
1. Navigation
2. Security
3. Diagnostics
4. Payments
5. Customisation

A connected car relies on the following key communication technologies:

1. V2V (vehicle-to-vehicle) is a communication technology embedded in a connected car that can physically register what is happening around the car, share details about traffic and distance and communicate with other vehicles.
2. V2I (vehicle-to-infrastructure) enables data sharing between a car and various road network devices (RFID readers, signs, cameras, lane markers, street lamps, parking marks).
3. V2X (vehicle-to-everything) includes all types of connections.

The global market of connected cars will grow by 19% annually until 2032. Key growth drivers include implementation of ADAS and increasing number of autonomous and electric vehicles

Growth of the global connected cars market in 2023–2032, USD billion

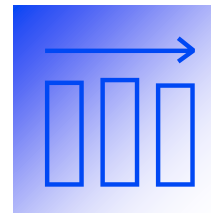


Source: Fortune Business Insights and other public sources, TeDo analysis



Market growth drivers

1. Growing popularity of Advanced Driver Assistance Systems (ADAS)
2. Growing market of electric cars and increasing number of autonomous vehicles
3. Increasing demand for anti-theft systems related to more sophisticated and complex car design
4. Closer collaboration between technology companies and car manufacturers

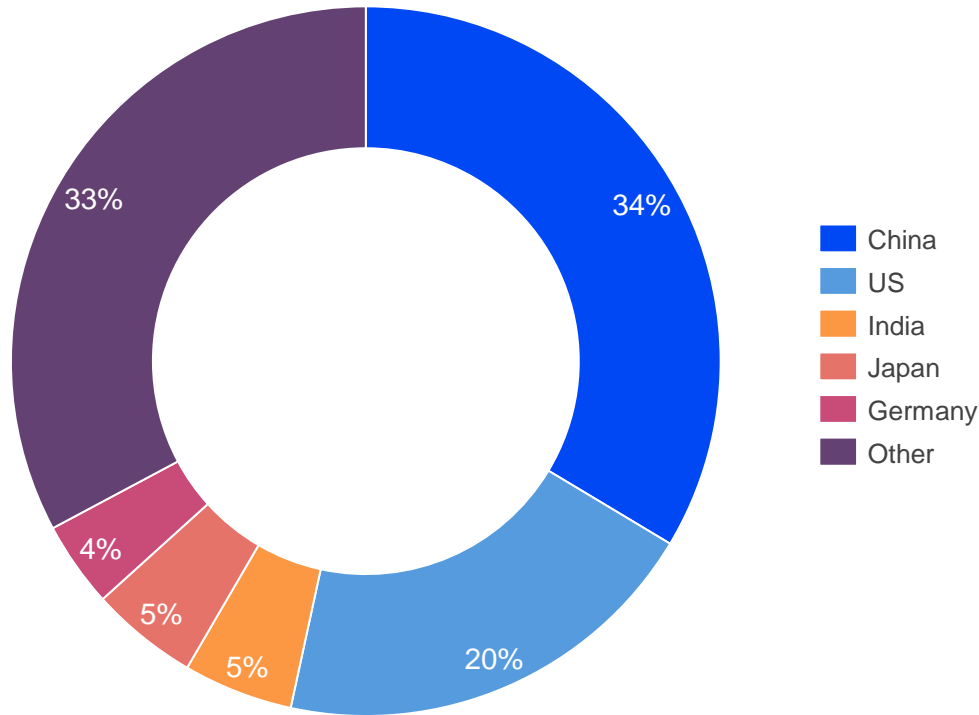


Market growth constraints

1. Slow development of the infrastructure required for connections (5G), low throughput capacity of networks
2. Increasing cost of cars
3. Cyber risks inherent to application of connected car technologies
4. Increasing interface sophistication
5. Technical flaws and unstable systems (unstable network, compatibility issues, poor quality of internet connection)

By 2023, China will see the biggest sales of connected passenger cars, followed by the US, India, Japan and Germany

Segmentation of connected passenger car market in 2030 by country, %

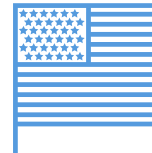


Source: Counterpoint, TeDo analysis



Chinese market highlights:

Adoption of EV, C-V2X and other connected information and entertainment features. Chinese EV manufacturers, such as BYD, NIO, Xpeng and Li Auto focus on standing out against traditional players and seek to enter the global market.

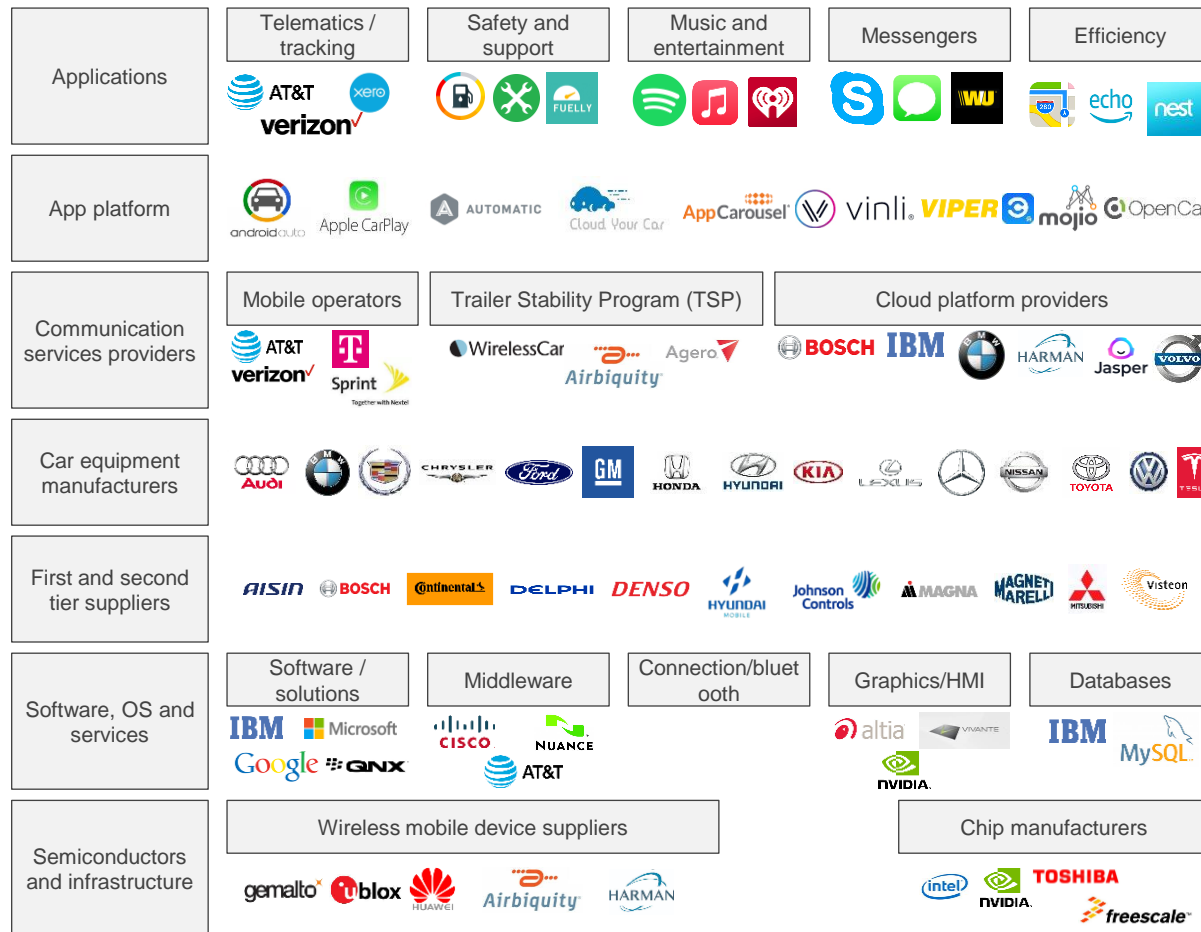


US market highlights:

Growth will be driven by adoption of advanced safety features, such as V2X and 2+ autonomy. AT&T is at the cutting edge of the connected car market, while its competitors, such as Verizon and T-Mobile, are pushing for benefits from predictive maintenance, maintenance planning, remote diagnostics, live maps and content platforms.

Full-fledged development of connected car technologies requires consideration of the entire technology ecosystem and partnerships with telecom companies

Connected car ecosystem



Source: MNT Consulting, TeDo analysis

Technologies of trust

Partnership cases:

1. For **AT&T**, connected vehicles is a key growth area. Its network provides services to over 30 million connected cars. In the US, AT&T collaborates with 31 car brands. The company provides cellular services to just about the entire industry. While the main connection technology is LTE, AT&T is also exploring 5G to connect next-generation cars in the future.
2. **Vodafone** is taking it a step further by providing software and hardware to be installed in connected cars and a network to connect all devices. Vodafone also provides managed services to car drivers and delivers telematic systems to such major part manufacturers as Audi, BMW, Porsche, etc.
3. **Orange** provides infrastructure services for the connected car ecosystem, including mobile and information technologies. The company delivers M2M SIM cards to all Renault vehicles equipped with proprietary tablets with R-Link installed.

Network coverage is a crucial driver of the connected car market and requires partnerships with public institutions, industry associations and smart road system developers

Partnership cases:

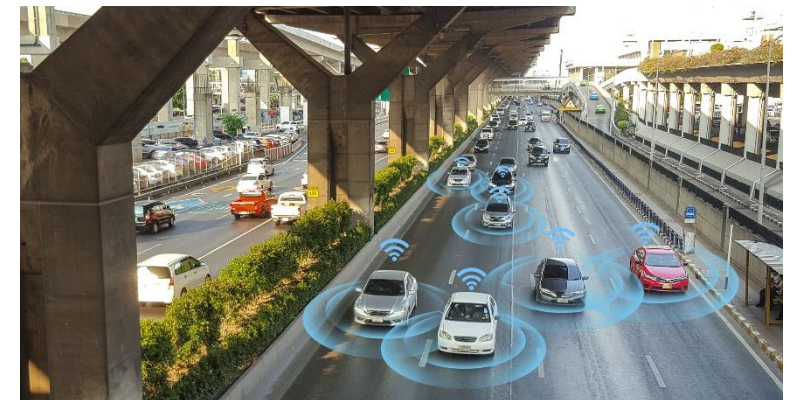
1. Industry associations and technology and V2X standards

The GSM Association of mobile network operators believes that the worldwide availability of V2X enabled by 4G and 5G, as well as the support provided by 130+ major mobile operators, vendors, car manufacturers and suppliers provide good incentives for the public regulators to set out a regulatory framework for faster V2X development.

Accordingly, the Association collaborates with the ecosystem of operators, OEM manufacturers and regulatory bodies to come up with a common approach to safety and regulatory infrastructure solutions.



- ### 2. The 5G Automotive Association (5GAA), a global cross-industry organisation of companies working together to develop solutions for future mobility, highlights regional developments that promote V2X adoption, including launch of C-V2X cars with many Chinese OEM manufacturers. China was the first to introduce a national Internet of Vehicles policy by adopting C-V2X as the standard and encouraging further cooperation. These measures facilitate further collaboration between automotive, transport and communication industries and promote joint efforts in public safety and security.



Source: IBM, TeDo analysis

Car fleets are becoming a part of the global smart city trends, with car fleet owners showing growing interest in new technologies

Key development areas for car fleets:

- 1 **Autonomous vehicles**
Autonomous cars can significantly change the parking landscape as such vehicles will be able to look for free places on their own, reducing the demand for large parking spaces
- 2 **Smart parking and spot booking**
With smart technologies, drivers can book parking spots in advance from a mobile app or website, enabling car fleets to improve space management and streamline spot utilisation
- 3 **Integration with urban infrastructure**
Car fleets can become a part of wider urban infrastructure integrated with traffic control systems, lighting, safety and even entertainment
- 4 **Safety and control**
Safety and control can be improved by using data and AI to prevent crime and ensure uninterrupted operation of car fleets

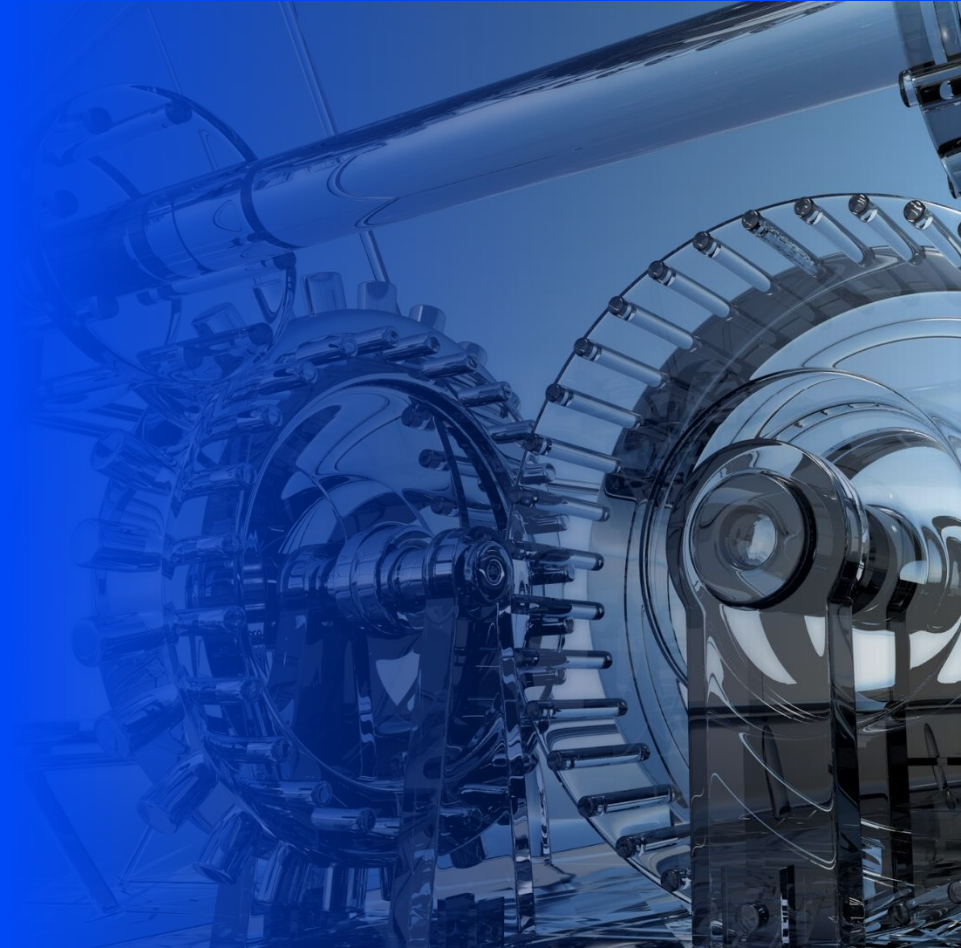
Technologies to be adopted by car fleets:

- 1 **Automated parking lots**
Automated systems can considerably improve the parking index, making the parking process faster and more convenient
- 2 **Internet of Things (IoT)**
Sensors can monitor spot availability, automatically control lighting and signals, and ensure safety and security at a parking lot
- 3 **Autonomous vehicles**
Autonomous vehicles can find a spot at a parking lot, increasing the parking space utilisation
- 4 **E-services and charging stations**
Installation of chargers at parking lots is becoming mandatory for e-vehicle demand satisfaction
- 5 **Mobile and contactless payments**
These payment systems simplify payments for users and improve parking space management for operators. Contactless technologies also enhance transaction security
- 6 **Data analytics and business intelligence**
With data mining and analysis focused on user behaviours at parking lots, operators can take informed decisions about parking space management. It includes rate optimisation, utilisation management and service quality improvement

Source: public sources, PwC analysis

Transport telematics trends. V2X

03



Transport telematics offers a comprehensive solution for better road safety. Other benefits include cost reduction in car fleet management

Technology advantages

Monitoring and safety

Monitoring systems and sensors ensure transport and load safety

Real-time accuracy

Accurate real-time monitoring

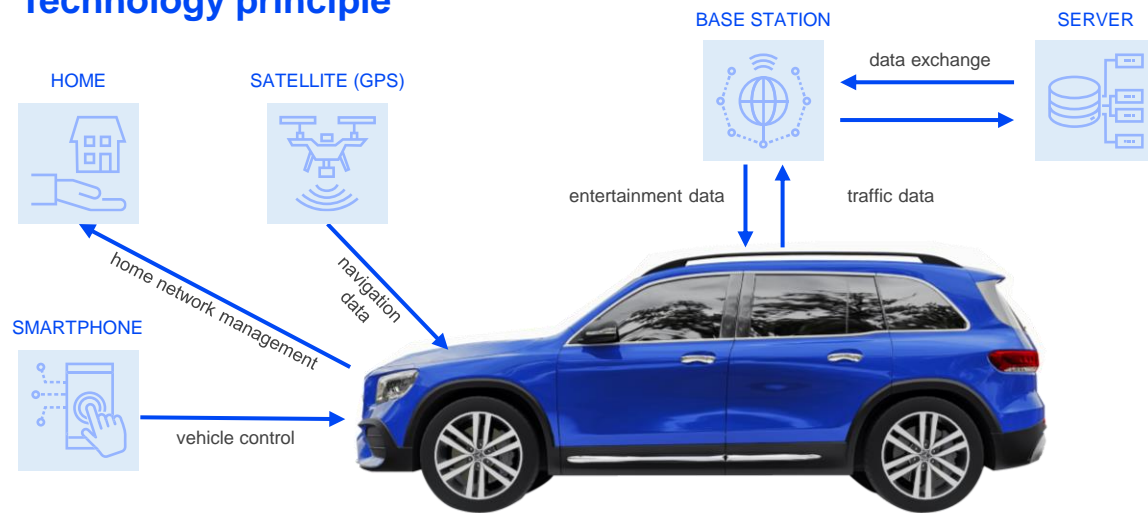
Route optimisation

Movements analysis optimises routes and reduces time en-route

Resource saving

Driving style and fuel consumption analysis reduces costs

Technology principle



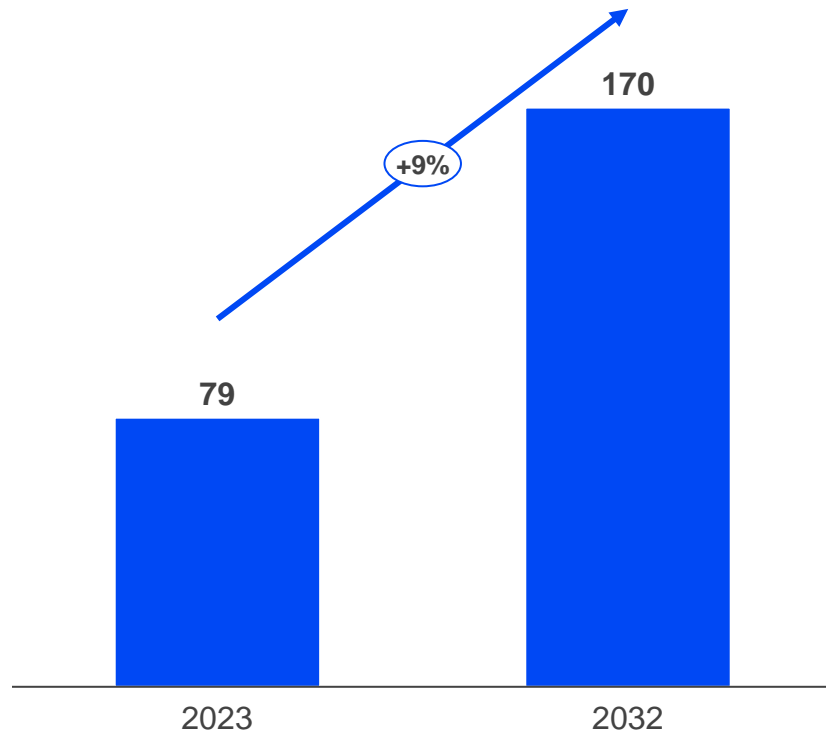
Source: public sources, TeDo analysis

Difference from a connected vehicle

- 1. Application:** Connected cars focus on end users and offer convenience and additional features to improve personal driving experience. Telematics is primarily used by professionals and businesses to improve car fleet management and streamline transport operations, as well as by insurance companies.
- 2. Function:** Telematics focuses on collecting and transferring data from vehicles, while connected cars offer wider functions with real-time interaction and connection with external objects.
- 3. Integration potential:** Telematic systems rely on external connection methods for data transmission, while connected cars use in-built internet connection for direct interaction and data exchange.

The global transport telematics market will grow annually by 9% until 2032. A key growth driver is the increasing demand from car owners and car fleets

Global transport telematics market in 2023–2032, USD billion

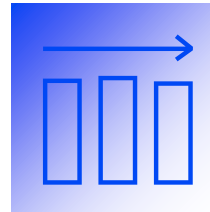


Source: Fortune Business Insights and other public sources, TeDo analysis



Market growth drivers

1. Growing demand for safety, security and navigation apps
2. Increasing demand for car fleet assessment and management apps



Market growth constraints

1. Increasing data leaks, cybersecurity issues
2. No regulatory framework

V2X – a technology for communication between a car and other vehicles or elements in its environment. It is widely used in the automotive industry



Inform about potential traffic issues

Potential traffic issues include:

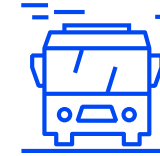
- 1) collision risks,
- 2) traffic jams,
- 3) accidents,
- 4) roadwork,
- 5) other obstacles en-route (pedestrians and objects on the road).



Control road traffic

Traffic control can be performed for:

- 1) mixed traffic including cars with or without V2X equipment,
- 2) columns of vehicles (e.g. trucks or sweepers),
- 3) self-driving vehicles (as a command to manoeuvre or stop).



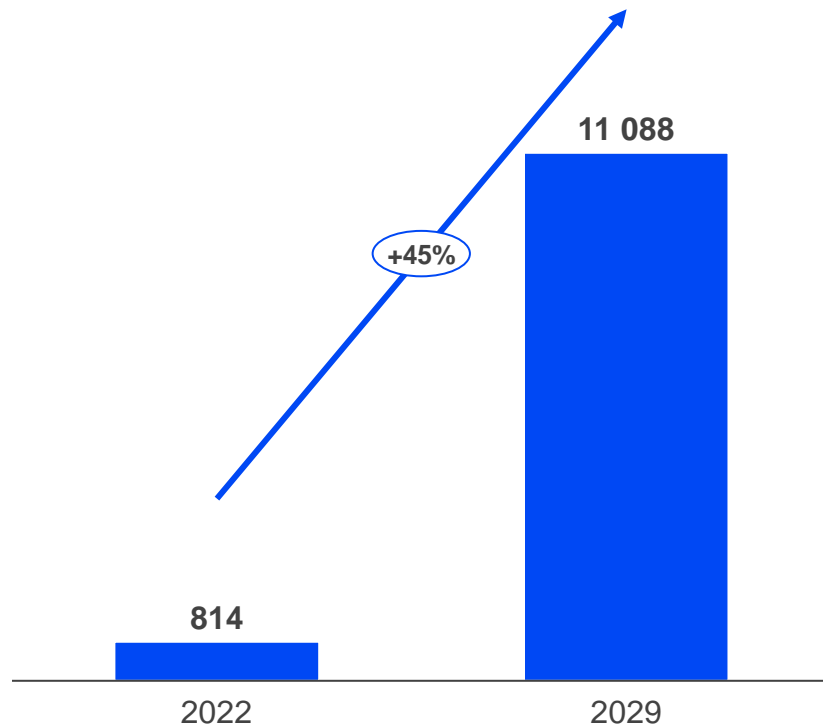
Ensure the passage of emergency services and public transport

V2X addresses the following tasks:

- 1) ensure priority passage of emergency services and public transport,
- 2) select an optimal route and reduce time en-route.

The global V2X market will grow annually by 45% until 2029. The increasing demand for safety and improved traffic efficiency is a key growth driver

Global V2X market in 2022–2029, USD million

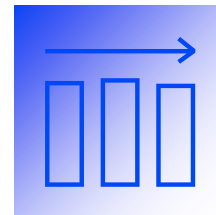


Source: Fortune Business Insights and other public sources, TeDo analysis



Market growth drivers

1. Enhanced safety
2. Improved traffic efficiency (V2X enables early identification of traffic jam factors to be considered by drivers)



Market growth constraints

1. High technology testing costs
2. No testing infrastructure

Difference between transport telematics and V2X markets

Transport telematics is an IT-enabled system for vehicle and route monitoring, control and optimisation. Transport telematics is mainly used by businesses to manage their car fleets or by government agencies to monitor road traffic.

V2X is a broader concept including communication between vehicles (V2V), vehicles and pedestrians (V2P), vehicles and infrastructure (V2I), and other communications. The main purpose of V2X is to improve road safety through real-time information exchange between road users.

Technological sovereignty in Russia – Development of advanced services and services based on intelligent systems, platforms and networks for logistics of people and things

04



Russia sees intensive development in almost every dimension of smart mobility

Selected

Mobility as a service (MaaS)

- **Intelligent transport system (ITS)** is a solution developed by Moscow Transport which is in line with the international experience, except for seamless fare collection system.

Connected cars

- Testing-stage projects

Transport telematics

- **Vehicle-to-everything (V2X)** – In Summer 2022, St Petersburg launched implementation of V2X equipment for public transport. The city is looking to develop the project.
- **MosObiTelematika** (part of Telematika Corporation) developed a world-class device based on Russian stack. The device complies with international standards and meets the import substitution objectives.
- **CKAD** (Central Ring Motorway) has required infrastructure. Autonomous cargo transportation will be launched for Highway M-11 between Moscow and St Petersburg as part of the Unmanned Logistics Corridor Project.

Vehicle electrification

- E-vehicle **Evolute**. Available in the market since October 2022.
- E-vehicle **Moskvich**. Sales started in early 2023.
- E-vehicle **ATOM** – a prototype; mass production is expected by 2025.
- **SberAutoTech FLIP** – a prototype of self-driving public e-transport.

Autonomous driving

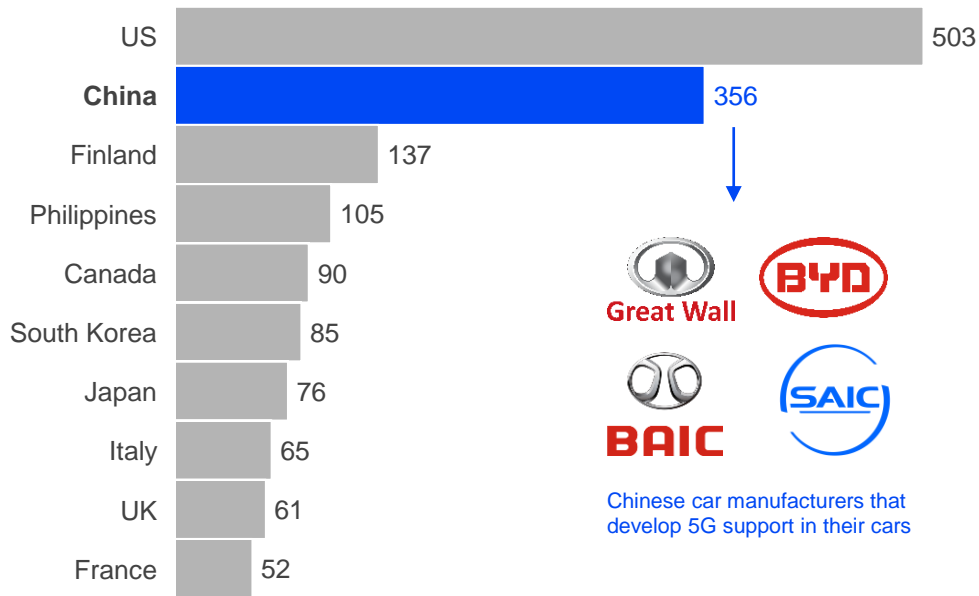
- **Yandex** – Self-Driving Car.
- **SberAutoTech** – self-driving cars.
- **KAMAZ** – self-driving special-purpose machinery.
- **Starline** – self-driving cars RICAR & OSCAR.
- **NTI Competence Centre** – testing of a navigation system for self-driving special-purpose machinery.
- **Advanced Driver Assistance System (ADAS)** – equipment suppliers in the Russian market include Central Scientific Research Automobile and Engine Institute (NAMI) involved in development of a national ADAS solution.

Next-generation 5G is critical for smart mobility development. The global 5G market shows a rapid growth



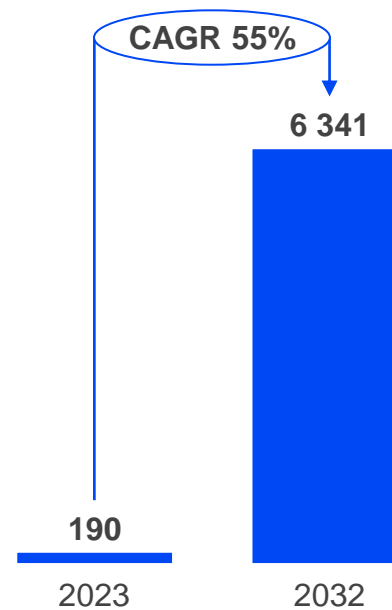
Full-fledged smart mobility development requires high-speed Internet. 5G coverage is a pre-requisite for faster data transmission and processing, as well as for self-driving vehicle operation, V2X, IoT and ITS operation, etc.

Number of cities with 5G by country, 2023



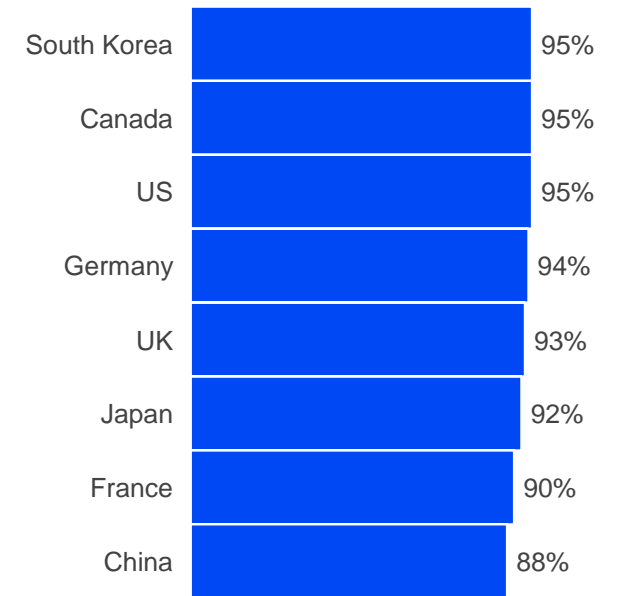
Source: Statista, TeDo analysis

Global 5G services market in 2032, USD billion



Source: Market Research Future, TeDo analysis

Projected 5G adoption by 2030, % of the total connections



Source: GSMA, TeDo analysis

Russia is expected to have the required 5G infrastructures no earlier than in 2030, with mass availability of 5G projected for 2035

Key LTE and 5G development stages in Russia. Projections by the Russian Ministry of Digital Development

| | 2026 | 2028 | 2030 | 2031 |
|---|---------------------------------|---|---|-------------------------|
| Building LTE ¹ infrastructure | In settlements of 1,000+ people | | In smaller settlements with 100+ people | Along national highways |
| Building 5G infrastructure | | In cities of more than one million people | In smaller cities of more than 500,000 people | |
| Developing broadband access infrastructure | | Building optic channels in remote areas | Providing high speed access (1Gbps) for apartment block in cities with more than one million people | |

Communication industry development strategy by the Russian Ministry of Digital Development. Key highlights



Main frequency range for 5G networks is 4.8-4.9 GHz, with potential expansion to 4.4-4.9 GHz



Ban on using frequencies in the most suitable range (3.4-3.8 GHz) by commercial networks as these frequencies have been assigned to defence and law enforcement services

2030

5G available in the area where 20-25% of Russian population live

2035

5G available in the area where 50-60% of Russian population live

¹ High-speed wireless data transmission standard for mobile phones and other data terminals

Source: meeting materials of the Digital Economy Working Group of the State Council, Communication Industry Development Strategy, TeDo analysis

Key takeaways

05



Takeaways



In 2023, the global car market saw a post-pandemic rebound
China keeps the lead in car sales, accounting for 30% of the market



The pace of smart mobility development is accelerating, producing an increasing impact on the global car market



There are five key areas of smart mobility development in the world



The growing popularity of connected vehicles is driven by their key advantages, such as improved safety and efficiency, as well as comfort for users



The global market of connected cars will grow by 19% annually until 2032
Key growth drivers include implementation of ADAS and increasing number of autonomous and electric vehicles.



By 2023, China will have the biggest sales of connected passenger cars, followed by the US, India, Japan and Germany



Full-fledged development of connected car technologies requires consideration of the entire technology ecosystem and partnerships with telecom companies



Network coverage is a crucial driver of the connected car market and requires partnerships with public institutions, industry associations and smart road system developers

Takeaways



Russia is expected to have the required 5G infrastructures no earlier than in 2030, with mass availability of 5G projected for 2035



Transport telematics offers a comprehensive solution for better road safety Other benefits include cost reduction in car fleet management



The global transport telematics market will grow annually by 9% until 2032
A key growth driver is the increasing demand from car owners and car fleets



V2X – a technology for communication between a car and other vehicles or elements in its environment
It is widely used in the automotive industry



The global V2X market will grow annually by 45% until 2029
The increasing demand for safety and improved traffic efficiency is a key growth driver



Russia sees intensive development in almost every smart mobility area



Next-generation 5G is critical for smart mobility development
The global 5G market shows a rapid growth



Russia is expected to have the required 5G infrastructures no earlier than in 2030, with mass availability of 5G projected for 2035

About Technologies of Trust

06



Technologies of Trust

“Technologies of Trust” (www.tedo.ru) provides industry-focused audit and business consulting services. Over 3 professional working in our offices in Moscow, St Petersburg, Ekaterinburg, Kazan, Novosibirsk, Rostov-on-Don, Krasnodar, Voronezh and Nizhny Novgorod use their wealth of experience and deliver quality services to help our clients build trust in business.

Around **3,000** employees, including:

around 1,000 auditors;

> **440** consultants on strategy, operations and digital technology

> 340 tax and legal consultants

> 330 corporate governance and deals specialists

Our audit and consulting clients include:

↗ 9 of the top 10 financial companies and banks

↗ 10 of the top 10 oil and gas companies

↗ 9 of the top 10 metals and mining companies

↗ 9 of the top 10 wholesale and retail companies

↗ 6 of the top 10 transport and logistics companies

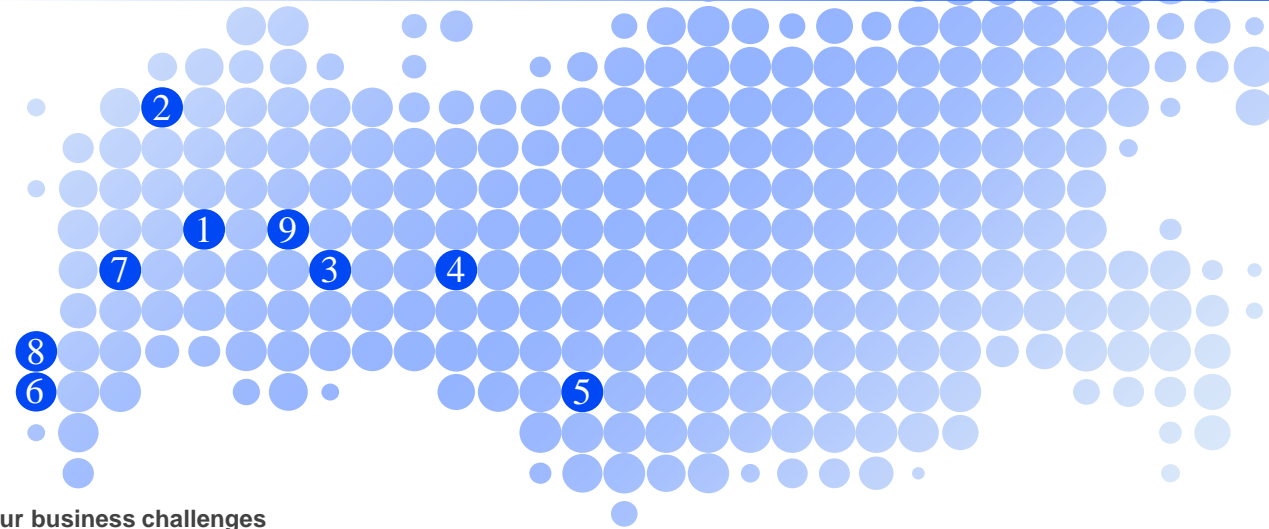
↗ 7 of the 10 largest power industry companies

9 offices across Russia

- 1 – **Moscow** since 1989
- 2 – **St Petersburg** since 1993
- 3 – **Kazan** since 2007
- 4 – **Ekaterinburg** since 2008
- 5 – **Novosibirsk** since 2011
- 6 – **Krasnodar** since 2011
- 7 – **Voronezh** since 2012
- 8 – **Rostov-on-Don** since 2014
- 9 – **Nizhny Novgorod** since 2018

> **4,000** clients

including 224 from 2022 RAEX-600 (based on 2021 results)



Your partner in finding solutions to your business challenges

| | | | |
|-------------------|-----------------------|----------------------|--------------------|
| Risk Assurance | Deals | Corporate Governance | FS Sector Services |
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Digital products



Share reliable insights



Comment on latest news, share analytics and overviews of developments in laws and regulations, and announcements of upcoming events



Sign up for our newsletter!

We are Russia's leading automotive practice

How we can help automotive companies



What should my company's strategy look like to ensure success in the market? How can I achieve my shareholders' objectives? What is my business worth?



Market analysis: how the market is expected to evolve, what will be the demand for cars, car sharing, shared mobility, buses and special vehicles?



Searching for sources of financing and partners: how do I negotiate the best terms for my deal?



Driving business efficiency: what is the best organisational structure and headcount for my company? Which business processes are most feasible to automate?



Impact analysis of the latest and anticipated amendments in tax and customs legislation



Legal issues arising from business incorporation, restructuring and value protection



Ensuring the transparency of financial reporting and improving trust among creditors, investors, shareholders and business partners in the information provided to them

Our competitive edge

1

With our industry-based capabilities, we can focus our resources, knowledge and experience on particular activities and lines of service. Our team has gained profound expertise in the specifics of the automotive industry.

2

We are well-versed in industry best practice and can bring in leading subject-matter experts to assist us, all of which helps us find the most efficient and innovative ways of resolving our clients' issues.

3

The automotive industry is one of priorities for TeDo. We work with various industry players: Russian and multinational companies, vehicle and component manufacturers, importers and distributors.

4

Our activities in the automotive sector go beyond providing advisory services to our clients. We also engage extensively in professional conferences, network with industry associations and publish our expert opinions and research findings in the mass media.

5

We have comprehensive knowledge of our clients, as TeDo Russia provides auditing and advisory services to 63% of the country's automotive leaders.

We are Russia's leading automotive practice



TeDo strives to be at the forefront of latest developments in the automotive industry and share the most relevant ideas and insights with our clients.

Keeping this in mind, TeDo:

- Conducts **detailed research devoted to the current state of the automotive industry and to its development issues**
- **Holds specialised workshops and seminars** for of the automotive industry clients on industry and business development issues
- **Participates in key industry events;**
- **Sponsors** key industry events and research



TeDo collaborates with NTI Autonet and participates in annual conferences.

Russian automotive market 2023 results and outlook

Russian automotive market development areas in the innovations segment

Driving the future: understanding the new automotive consumer

Transport and urban smart mobility trends

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