FINNISH GOVERNMENT'S RESOLUTION ON PROMOTING AUTOMATION IN THE TRANSPORT SECTOR

Contents

1 Introduction

Automation is currently developing in all modes of transport. Transport automation is a central part of a well-functioning transport system of the future. Automation will help to achieve many societal benefits, such as improved transport safety, reduced emissions and better services. However, positive development will not happen by itself, but requires the support of advanced regulation and opportunities for experimentation, among other things.

One of the objectives recorded in Prime Minister Sanna Marin's Government Programme is that Finland will be known as a front runner in technological advances, innovative procurement and the culture of experimentation. The measures presented in the government resolution on promoting automation in the transport sector implement especially the following points of the Government Programme:

- The Government will promote the digitalisation and automation of transport and logistics by allocating funding for experiments and by influencing international and EU regulations in the sector.
- Instructions will be issued for Finland on the ethical use of artificial intelligence.
- Attention will be focused on accelerating growth-oriented initiatives in different industries, along with bold renewal projects to meet the challenges of the future, for example, by taking into account the scope for SMEs to seize new opportunities via open interfaces information policy and efforts to further the use of digital services and technologies.
- Finland will modify its legislative environment and administration to facilitate advances in digitalisation, sustainable development and a large-scale culture of experimentation.
- In order to develop the system, reduce emissions and improve accessibility, opportunities provided by transport digitalisation, broader and more diverse offering of services and shared use will be taken into full use.
- In cooperation with industry operators, we will create sector-specific low-carbon roadmaps that will be brought in line with our new climate actions
- Consideration will be given to the special characteristics of urban environments and rural areas, to different transport modes and to opportunities for intelligent solutions for transport infrastructure on land, the sea, and in inland waterways and air.

The government resolution on promoting automation in the transport sector applies to all modes of transport. It lays down the policies and measures common to them all as well as the most important transport mode-specific actions. The cross-cutting policies applying to all modes of transport are human-centred development and utilisation of automation, more efficient exchange of information and comprehensive development of regulation. They have been processed into the following sets of measures to promote the development of automation in the transport sector in Finland: development of 1) regulation and 2) physical and 3) digital infrastructure, 4) utilisation of data, and 5) increase in experimentation and testing. In addition, attention will be paid to the development of assessing the key 6) competence and 7) impacts from the point of view of the development stages that follow.

The resolution is based on a comprehensive plan for legislation and key measures in transport automation prepared by the Ministry of Transport and Communications in broad-based stakeholder cooperation. The plan addresses all modes of transport and focuses on the current situation in automation development, the technical development of means of transport, legal issues and the needs to develop the regulation framework. In addition, it focuses on the development

of control and management services, the infrastructure needs in transport automation, the utilisation of information and data, and the implementation of and support for experiments and pilots.

In both the plan and the resolution, automation is understood broadly to cover the already existing technologies that assist people in different ways. The resolution and the plan are a continuation of earlier examinations of the automation framework and roadmaps at the strategy level. Transport automation is an international development trend that strongly shapes societies. Its progress needs to be reviewed and the plan updated approximately every couple of years.

Resources and links to other national programmes, plans and strategies

The measures of the resolution will be implemented within the limits of the budget and the existing appropriations. Decisions on additional appropriations or other measures affecting the budget will be made separately within the central government spending limits and in the annual budgets.

The measures concerning experiments and pilots are part of a set of measures for which a total of EUR 76.5 million has been reserved in the National Transport System Plan (Transport 12). In addition, the funding reserved for waterway repairs, information utilisation and the railways Digirail project in the Transport 12 plan support the implementation of the measures proposed in the automation plan. Funding for the Digirail project has also been applied to the EU's Recovery and Resilience Facility RRF. The automation development is currently supported by several ongoing transport mode-specific projects whose funding is received from other sources, such as the funding instruments of Business Finland.

The transport automation plan has been prepared simultaneously with the National Transport System Plan (Transport 12), in which especially the funding needs of pilot projects and points of view related to the utilisation of information and data have been taken into account. During this government term, transport digitalisation and the utilisation of automation in transport have been discussed in several different strategy documents and their preparation, such as the Logistics Digitalisation Strategy, the Roadmap to fossil-free transport and the resolutions based on it, Transport Safety Strategy, the Maritime Policy Action Plan, the Digirail project and the Sustainable Growth Programme for the Transport Sector. In this resolution, the examination is conducted merely form the point of view of transport automation and the measures required to promote it.

2 The vision, opportunities and risks in transport automation

The vision for the development of automation in the transport sector is that transport of the future will be safer, more efficient and more sustainable. However, the vision will not be realised by itself. It requires active measures in decision-making and broad-based cooperation between actors. The different areas of automation development also have opportunities and risks of their own.

Transport automation can be used to accelerate the achievement of wider societal objectives. At the level of the transport system, automation can also contribute to what kind of environments city centres will develop into in future as a result of changes in the volumes of traffic and to how the logistics chains will function.

Safety and security

Safety is a central value guiding the development and utilisation of transport automation. Maritime transport, rail transport and aviation are the modes of transport in which safety is already at a high level, especially in the Western countries. In road transport, however, a large number of people die and are injured worldwide every year. Automation can significantly promote the achievement of the so-called Vision Zero in road transport. Automation must be developed in a way that will also improve the safety and smoothness of cycling and walking.

Ensuring cybersecurity and data protection must be taken into account in the development and use of transport automation systems and services and in the utilisation of information and data. In addition, it is essential from the point of view of the safety of automation that the competence level and ability of people to understand the limits of automation will be taken into account in automation development.

The security of supply and the requirements of contingency and preparedness must be taken into account in automation development in such a manner that it is possible for people in Finland to trust the functioning and resilience of the transport system in all conditions throughout the year. The transport automation systems must also be able to safely manage situations in which there are disruptions or outages in communications.

Efficiency

Efficient automated transport is smooth and optimised. Efficient transport is promoted by the networking of transport, which enables the utilisation of data. Highly automated means of transport must be linked with each other and with the transport infrastructure, such as traffic control and management functionalities, through communications. With real-time data, it is possible to enhance the provision of traffic control and management services and the operation of providers of such services. The exchange of information significantly improves safety, especially in transport environments with heavy traffic.

Sustainability:

Automation development also supports the achievement of the sustainability goals. Along with the utilisation of information and data, traffic fluidity, the optimisation of routes and logistics chains, and real-time traffic control will be more efficient, which supports the achievement of the emissions reduction targets. Automation can also extend the selection of sustainable mobility services.

From the point of view of social sustainability, automation can enable safe and independent mobility also for persons with reduced physical abilities to cope in ordinary transport.

On the other hand, it has been estimated that, at worst, automation may increase the number or vehicles and vehicle kilometres as a result of increasing convenience. When developing automation, attention must also be paid to the possible negative development trends at the level of the transport system, and the attractiveness and safety of walking and cycling must be ensured to prevent its impacts on matters such as the emissions of transport and public health from becoming negative.

Finland's opportunities to benefit from the automation development

The developing transport automation is part of the digitalisation development in the transport sector. It is a global megatrend, which in itself is independent of the measures taken in Finland.

However, Finland has better-than-average capacities to benefit from digitalisation and use it to generate innovations, competitiveness and wellbeing in society. Digitalisation typically brings its pioneers great benefits, particularly as a result of innovations, among other things. This is why Finland has for a long time aimed to be one of the top countries in digitalisation. However, it is important to also take full advantage of the innovations and technologies developed elsewhere in the world.

By investing in automation development, it is possible to create preconditions for the innovations of Finnish actors and increase the export opportunities of companies. Through the development of the operating and the regulatory environment and with other support measures, a basis can be laid for growth and international competitiveness. Finland has special expertise in the development of technologies and operating in arctic conditions. Also, the level of the existing digital infrastructure, the current advanced regulatory environment and the exceptionally close cooperation of the public and the private sector are our strengths.

A very large number of uncertainties are still associated with the progress of automation in the transport sector. Like in the development of digitalisation in general, we cannot see far into the future. However, preparations must already be made for the progress of automation. To achieve significant societal benefits, preparations must be made with regard to regulation, resources and societal planning. For the automation of transport to be possible, the physical basic infrastructure of all modes of transport must be in a good condition. Close cooperation between private and public actors plays a central role in the preparation, and the cooperation mechanisms need to be further developed.

The desired development trends will not happen by themselves but require determined development. We must define what kind of impacts we want automation to have and how they can be achieved.

3 Policies for the development and utilisation of automation in the transport sector

Three guiding policies applicable to all modes of transport can be set for the development and utilisation of transport automation. The policies emphasise the importance of a human-centred approach, the effectiveness of the exchange of information and comprehensive regulation in the development of automation.

Policy 1: Transport automation will be developed in a human-centred manner

When transport automation is developed and used, the focus must be on the wellbeing of individuals and societies. For example, respect for fundamental and human rights must be built in the development and use of automation systems (by design). People's trust in automation is a precondition for achieving public approval. With trust and approval, the societal benefits of automation can also be achieved better.

Transparency is a key factor from the point of view of creating trust. The transparency of algorithms means that independent third parties such as the authorities or inspection bodies can assess the security of systems (including cybersecurity) and the grounds of decision-making and, if necessary, determine what the course of events was and how the decision-making progressed. The required transparency related to the interaction between people and machines makes it possible to ensure that people understand when they are dealing with a system based on artificial intelligence and what it means for them from the point of view of their actions in the situation concerned.

Policy 2: The exchange of information related to transport will be enhanced significantly

To promote networking and automation in transport, it must be possible to use public communications networks to exchange information. Currently, the networks are still 4G/LTE networks and in the future, there will also be 5G networks and satellite positioning.

The digital competitiveness of Europe and Finland requires fast and reliable 5G networks serving all sectors of society to be built as quickly as possible. These networks are often built on market-based terms by private companies. The developing transport services may play an important role as an accelerator of the construction of 5G networks. However, the construction of 5G networks along transport routes requires joint measures by a wide field of actors.

Finland aims to be in the forefront in the development of services utilising 5G technology and based on transport automation. Reliable and up-to-date data on the route network is a necessary basis both for route maintenance and for smooth, safe and environmentally friendly transport. Increasingly automated transport will place even greater demands on data than currently, and real-time data will be a central requirement.

Policy 3: The regulation framework in transport automation will be developed comprehensively

Over the decades, transport regulation has become very technical and specific. However, with digitalisation, the technical development of the systems has been so rapid that the current regulation model has run its course. Transport automation needs to be supported with both internationally drawn up regulation and agreed procedures and standards. The regulation must be based on objectives, performance and risks, and not on technical regulation focusing on details. The regulation must also enable pioneering and new operating models.

The challenges brought by transport automation require new kinds of solution models and concepts. When regulating the use of automated means of transport, we should focus on ensuring that the means of transport in question observes the traffic rules or international agreements regardless of whether it is controlled by a person or a machine. If necessary, traffic rules or agreements must be renewed to make their application possible, consistent and clear in the increasingly automated operating environment.

Transport automation must be technology neutral. The statutes must also take into account future needs and technologies. For example, regulation must make it possible to choose the technology on the basis of how the best services can be implemented in a cost-effective and sustainable manner.

The development of automated transport must be business-driven and comply with the principles of sustainable development. As a rule, the role of the authorities is to be an enabler and supervisor. Especially when new business models and operating practices and a decentralised data dissemination infrastructure is being built, public actors may also have a new kind of role as a promoter of ecosystems and interoperability.

When preparing individual regulatory projects, the impacts of the projects must be assessed in relation to whether or not they promote the achievement of important societal objectives and visions. Regulatory projects should be increasingly examined from “top to bottom”. More attention must be paid to the matter especially in important international regulatory projects that are pending.

4 Transport mode-specific examination and objectives

The benefits of the automation development of the different modes of transport can be realised fully only if they have also been taken into account at the level of the transport system. This requires better exchange of information, a situation picture and attention to the properties of automation when the transport system is planned and designed. Applications enabled by the system level include coordinated travel and transport chains in logistics and more efficient traffic control.

4.1 Road transport

The objective in the automation of road transport is to enable people to move from the place of origin to the destination using automated functionalities. The automation of road transport towards self-driven vehicles has been slower than estimated a few years ago. However, the development is inevitable and newer vehicles already have a considerable amount of automation assisting the driver, such as lane control and dynamic cruise control. It must be possible to deploy similar automation solutions and benefits as soon as the techniques develop and enter the market.

The utilisation of automation must be promoted so that an automated driving system can manage a dynamic driving task as widely as possible in Finland, almost regardless of the weather conditions. Outside the operating area of automation, it must be possible to continue the journey smoothly when a person takes over the driving. In the short term, independent driving by the automated driving system will be possible in motorway conditions. It must be supported by advanced regulation, classifications of the physical infrastructure from the perspective of intelligent transport, and development of the digital infrastructure along waterways.

Automated and remotely controlled vehicles, small buses and other automated means of public transport may offer a competitive alternative for cars when linked seamlessly with the rest of public transport and travel chains. Remotely controlled small buses can be used to offer services for the first and last kilometre of travel routes in urban areas and to improve transport connections in sparsely populated areas. Transport robots used for small logistics are also an interesting development trend. The development and use of services based on them must be supported so that it will be possible to pioneer in creating a market for such services.

4.2 Water transport

The aim is to create preconditions for automation in water transport and to promote the implementation of Finnish automation solutions. From Finland's point of view, the main challenges in the utilisation of automation in water transport include the archipelago, which is difficult to navigate, and the winter conditions. The term water transport refers to both maritime transport and inland water transport.

The utilisation of automation is currently progressing in the different systems of vessels. Vessel and sensor technologies and applications of artificial intelligence are already advanced and vessels should be seen as entities in which the different systems must be interoperable. In future, the crew are likely to be needed, for example, to take care of passenger safety.

As the regulation in water transport and especially in maritime transport is largely international, it is important that the framework for international legislation support the implementation of high-level automation and autonomous shipping, for example, with regard to the maritime situation picture and navigation.

Efforts are made to create preconditions for automation by increasing the intelligence of waterways and transport chains. The key is to implement the physical and digital infrastructure, the data services and the administration model required by an intelligent waterway. The introduction of remote pilotage in selected areas would also support the automation development. A digital, up-to-date situation picture that can be disseminated to different user groups and consists of several different sources should be used in water traffic control. At the national level, the aim is to utilise advanced automation in ports and limited areas in national freight transport and navigation. The first possible implementations can be carried out through automation trials at ports and in archipelago traffic.

4.3 Rail transport

The aim in rail transport is to introduce new technologies especially in automatic train protection and railway traffic control. The most important entities in promoting this include influencing EU regulation in order to enable rail transport automation and to increase information and competence that promote automation in rail transport by means of the Digirail project.

Rail transport means railway traffic and urban rail transport, which in turn is divided into trams and underground trains. Railway traffic operates in a closed environment, as it is not possible to operate on the rail network without appropriate permits, and the number of operators is limited. It is estimated that the greatest benefits of automation and data utilisation will be achieved in automated train protection and railway traffic control. As for urban rail transport, the automation of underground trains will help to achieve significant benefits, for example, in safety and efficiency. As for trams, automation requires the definition and planning of objectives as part of urban transport as a whole.

The best solution for automated train protection and railway traffic control is currently being identified in the Digirail project, which also plays a central role in enabling railway traffic automation in Finland. The Digirail project will implement a test track that makes it possible to test the utilisation of automation and data in rail transport. In the pilot stage of the project, the compliance of the radio network solutions with the requirements of the EU's technical specifications will also be tested, and the interoperability of the rail network and rolling stock in commercial transport will be verified.

In rail transport, the aim is to generate Finnish export expertise in digital rail transport with a focus on automation, data utilisation and development of cybersecurity. Creating a cooperation package for the public and the private sector to develop new technologies for railway traffic is central to this work.

4.4 Unmanned aviation

The aim is to be an attractive environment for conducting experiments and tests and that way be one of the pioneering countries introducing unmanned aviation services. Enabling the technological development must be at the centre of activities in the public sector. Especially unmanned aircraft are examined from the point of view of automation development because their development is, as a rule, already advanced and the related structures and regulation already exist.

In future, unmanned aviation will have significantly wider commercial potential. Most of the market potential of the activities focuses on flights taking place out of sight of the person controlling the flight remotely or the operator monitoring it. Extensive operation requires more comprehensive and reliable digital real-time data on the airspace and its users, and knowledge

of obstacles to flying at low altitudes and in urban areas. The EU has prepared the U-space regulation framework applying to unmanned aviation. The framework concerns the creation of a safe operating environment for automated unmanned aviation.

The aim must be to enhance the use of the airspace safely to meet the needs of unmanned aviation. For the implementation of dynamic airspace management, it is necessary for the aircraft to be able to share data on their locations and observations in a decentralised manner. U-space regulation aims at dynamic and flexible use of the airspace in which unmanned and manned aviation can be coordinated safely.

5 Measures

Automation in all modes of transport can be promoted with similar measures. At the same time, the measures will support the utilisation of automation at the level of the transport system. The measures are related to the development of 1) regulation and 2) the digital infrastructure, 3) promotion of information utilisation, 4) the development of the physical infrastructure and 5) increasing experimentation and testing. In addition, attention will be paid to the development of assessing the key 6) competence and 7) impacts from the point of view of the development stages that follow.

The measures presented in the resolution will already be topical in the near future and their implementation should be started immediately. With several measures, progress will be made stage by stage so that the first stages can be completed in two or three years. As a rule, however, the implementation will take longer. Measures such as close cooperation are continuous by nature.

Preparations for the future must be made by means of planning, research, experiments and pilots. For example, large investments in the development of the physical infrastructure are not topical as yet. The preparation of enabling regulation has already been partly launched and influence is exerted actively at the international level. National cooperation in its current form already works fairly well, but its structures still need to be improved. It is essential to constantly maintain a situation picture of automation development as part of the analysing conducted on the whole transport system.

The key measures have been coordinated and some of the actions are consistent with the Transport 12 plan, the Sustainable Growth Programme for the Transport Sector, and the measures in resolutions on the digitalisation and cybersecurity of logistics.

5.1 Regulation

Issues related to regulation are central to the development of the operating environment required by transport automation. As a general rule, transport automation is based on data utilisation and use of artificial intelligence systems. Regulating artificial intelligence in a way that ensures its ethical development and use is something new and challenging from the point of view of the fairly detailed traditional technical regulation of transport. It is essential in the regulation of artificial intelligence systems to define the actors' new roles and the obligations, responsibilities and rights associated with these roles.

Another essential point is transparency. Regulation must ensure algorithmic transparency, which makes it possible to assess the security of the systems, including cybersecurity. In addition, transparency towards people who are the end users and other actors using the same route

is required. In all modes of transport, influencing the regulatory work taking place in the EU and international organisations, and drawing up the required standards play a central role.

As for regulation, the aim is to create the most progressive regulatory environment in the world also in the field of transport automation. Finland has good capacities for achieving this goal as the country is already known internationally for its enabling regulatory environment. A progressive regulatory environment and the commitment of the political leadership to promoting digitalisation are important competitive factors.

The field of automation in the transport sector is broad and our ability to foresee the future is limited. It is therefore important to maintain a comprehensive situation picture of the current state in transport automation and of the needs and measures that may guide the development in the desired direction.

Key measures:

1. The required national regulatory projects will be prepared to promote experiments and the implementation of automation.

2. Influence will be exerted actively and strongly in the preparation of statutes and standards in the EU and in international transport organisations, and the resources used for this will be strengthened with broad-based cooperation of the private and the public sector.

   Principal organisations responsible for the measures: Ministry of Transport and Communications, Finnish Transport and Communications Agency, Finnish Transport Infrastructure Agency and municipalities. The agencies implement the measures as part of their duties. They draw up annual more specific plans for promoting the measures.

   Other key actors: Other ministries, municipalities, universities and higher education institutions, companies and organisations.

   Impacts on resources: Possible to implement with current resources.

Transport mode-specific priorities include especially the following:

- In road transport, a project examining and preparing the regulation affecting automation has been launched to prepare for the changes due in international agreements. The changes will enable the use of an automated driving system instead of a (human) driver. In addition, a legislative drafting project has also been launched to develop the regulation on testing automation in road transport within Finland.

- In water transport, efforts will be made to promote the creation of a uniform reference framework for statutes in international and EU cooperation. In addition, the need to amend national legislation with regard to the national water areas will be determined in order to enable the first services and pilots.

- In rail transport, the content of the Rail Tracks Act, the Rail Transport Act and the Act on Transport Services will be assessed from the point of view of enabling automation and digitalisation. In addition, the functioning of legislation concerning urban rail transport will be assessed from the point of view of enabling automation especially in mixed traffic.

- With regard to unmanned aviation, a risk-based regulatory approach compatible with the needs of all airspace users will be promoted, the effectiveness of national aviation regulation will be improved, in particular with regard to flight activities at low altitudes, and the U-space operating environments comparable to air navigation services for unmanned aviation referred to in the EU's proposal concerning U-space.

5.2 Digital infrastructure

The development of the digital infrastructure is aimed at promoting the construction of the communications networks required for automation and the supply of electricity serving the networks along the routes. In principle, the development work will progress on market-based terms, while taking into account the needs of piloting and business operations. Whenever possible, the basic solution must be the use of general-purpose technologies, such as the 4G/5G networks as the solution for communications.

The present development stage of the digital infrastructure (4G/LTE networks) seems to be sufficient for the current needs of the increasingly digitalised transport, but the needs focusing on capacity and operational reliability are increasing rapidly as automation and networking increase. There is already a fairly comprehensive 4G network on the main routes in road and rail transport. There are shadow regions especially on low-volume routes in northern Finland, but insufficient communications connections are also found to some extent on the main routes between population centres in different parts of Finland. The communications connections required along shipping routes and those required separately on the open sea pose a challenge. With regard to aviation, a special issue that must be solved is the possibilities to use networks while in the air.

By using the base station locations of the 4G network and lower mobile frequencies, it is possible to build so-called 5G basic coverage, which will also serve the increasingly automated transport. A 5G network, which uses mid and high frequencies and provides higher capacity, is likely to be required on congested sections of routes (3.5 GHz) or even at specific spots (26 GHz). Because communications networks in Finland are built on market-based terms mainly to serve population centres, the development would need funding even in road and rail transport. Therefore, it should be assessed separately at a later stage how the construction of fast communications along routes could be accelerated. At the European level, funding is directed to the construction of 5G networks through systems such as the CEF funding system, and the opportunity to take advantage of these sources of funding should be examined in cooperation between the parties.

Mobile base stations require a constant supply of electricity and use local and nationwide electricity networks. The construction of new small cell base stations would probably require the construction of new connections and switchboards. Therefore, ensuring the power supply needed for the developing communications infrastructure may also require measures to be taken.

Key measures:

3. The quality and coverage of the information on the digital infrastructure will be developed in cooperation with the actors in the sector in such a manner that it will also serve transport automation. It is essential to develop the data collection carried out by the Finnish Transport and Communications Agency.

4. The current state of the digital infrastructure will be mapped in more detail, and the required level of services and the minimum requirements for promoting automation on the

main routes and in the central transport nodes will be determined in cooperation with the actors in the sector.

5. The situation picture, collaboration models and competence in cybersecurity required for automation are determined and improved and the protection of safety and security-critical data is ensured in the required manner.

   Principal organisations responsible for the measures: Finnish Transport and Communications Agency, Finnish Transport Infrastructure Agency and Ministry of Transport and Communications. The agencies implement the measures as part of their duties. Agencies draw up annual more specific plans to promote the measures.

   Other key actors: Other ministries, telecommunications operators, municipalities, research institutes, companies and organisations.

   Impacts on resources: Mainly possible to implement with current resources. Comprehensive development of data collection at the Finnish Transport and Communications Agency and the improvement of the situation picture in cybersecurity require additional funding.

Transport mode-specific priorities include especially the following:

- In road transport, the development of communications is followed by conducting regular measurements. Initially, motorways and possibly the ring roads of cities or some of the main routes will be the focus of development and piloting.

- In water transport, a definition will be drawn up for a smart waterway, which comprises especially communications (plan for the digital infrastructure), a model for the utilisation and exchange of dynamic data (data collected by different actors, importance of vessel technology and artificial intelligence) and the physical infrastructure (such as safety equipment).

- The development and verification phases of the Digirail project will be implemented in rail transport (2021–2027). They include a test track, a testing laboratory, development of the 5G network for railways (FRMCS) and a positioning system for railways. In the procurement and implementation stages of the project (2028–2040), the aim is to equip the entire rail network with the European Rail Traffic Management System (ERTMS).

- With regard to unmanned aviation, solving matters such as special challenges related to directing the networks will be explored so that aircraft will be able to send and receive data during the flight.

5.3 Utilisation of information and data

In Finland, work to develop a data-based operating environment has already been carried out for a long time and this work needs to be continued and enhanced with regard to the data required for automation. Finland aims to promote the development of a European data economy and the creation of a data management model in which the processing of data is entirely decentralised. To support the development, the need for coordination roles that promote interoperability and the actors in those roles must be identified and enabled.

Transport automation needs to be supported by static data (changes only rarely or not at all) and dynamic data (changes constantly) that is digital and as real-time as possible, reliable and as a rule moves between actors through open programming interfaces. A digital model in which the

data corresponds to reality as closely as possible needs to be created for the physical transport infrastructure. At a later stage, an entity comprising the digital model of the built environment and the physical transport infrastructure should be formed.

Dynamic transport data has often been collected by vehicles. It is data that may provide detailed information on local conditions or possible disruptions related to transport. In principle, making it available in automated transport especially through traffic control and management services is possible in Finland, as the operation of Fintraffic Oy, a company offering these services, as a node for information has been taken into account in regulation. The role of Fintraffic Oy in accelerating the development of a data-based operating environment in the transport sector needs to be further enhanced. However, obtaining and utilising especially the data collected by vehicles poses challenges from the data security point of view, in particular. Efforts to solve them can mainly be made at the level of the EU.

With regard to the utilisation of information, there are still questions related to the competition law, protection of business secrets, privacy and data protection, and data security and cybersecurity. They must be taken into account in the implementation of all measures.

Key measures:

6. The digital model describing the physical transport infrastructure will be developed to include the required and sufficiently high-quality information from the point of view of increasingly automated transport.

7. The services of the traffic control and management service provider Fintraffic Oy acting as a node for dissemination of dynamic information will be developed to enable the company to act as a supply platform for transport-related data and also as a promoter of the data dissemination ecosystem. The ecosystem forming around it will be developed simultaneously.

8. Access to the information required by the authorities to perform their statutory duties and the information required to meet the needs of traffic control and management will be ensured.

   Principal organisations responsible for the measures: Finnish Transport Infrastructure Agency, Finnish Transport and Communications Agency and Ministry of Transport and Communications. The agencies implement the measures as part of their duties. Agencies draw up annual more specific plans to promote the measures.

   Other key actors: Fintraffic Oy, municipalities, other public-sector actors, other companies and organisations.

   Impacts on resources: The development of the services of Fintraffic Oy requires additional funding in accordance with the Transport 12 plan, approximately EUR 25 million. In addition, with regard to the transport mode-specific measures, the development of data on the street network requires additional funding in accordance with the Transport 12 plan.

Transport mode-specific priorities include especially the following:

- In road transport, the coverage, quality and availability of the data on municipal street networks are improved to meet the needs of transport automation in the same way as the state develops the data on its own route network, as stated in the National Transport System Plan.

- In water transport, the needs of automation are taken into account, for example, as part of the architecture development in the new project on the maritime transport notification service (European Maritime Single Window, EMSW) by unifying and harmonising the exchange of information and by creating preconditions for developing the value added services offered by third parties.

- In rail transport, the availability and sharing of data related to urban rail transport will be improved.

- With regard to unmanned aviation, the availability and sharing of data on weather conditions, flight barriers and the location of other unmanned aircraft will be improved.

5.4 Physical infrastructure

It is still uncertain how the physical infrastructure should be developed to meet the needs of transport automation. More information is also needed on whether the physical infrastructure can support the automation activities and how the required development could be carried out with reasonable costs. However, it is clear that the good condition of the basic infrastructure will also support automation. For the time being, significant investments in the infrastructure to support automation are not topical. At least in the near future, investments should be made in measures that benefit both the traditional and the increasingly automated transport. Progressing through experiments and pilots is necessary to form an understanding of the required measures.

Key measures:

9. An estimate of the desired level of automation in different parts of the route network will be drawn up as well as a view on the measures promoting automation in line with the estimate, especially on possible problem points. If necessary, the estimate will be drawn up in cooperation with municipalities (e.g., the street network).

10. Influence is exerted in international cooperation to promote the creation of a smart classification of routes and definitions for the preconditions for automation.

11. Preparations for the measures required by transport automation are made actively in urban planning. Cooperation between government and municipal authorities and private actors will be intensified so that it will be possible to prepare for automation at all levels of planning.

Principal responsible organisations: Finnish Transport Infrastructure Agency, Finnish Meteorological Institute, Ministry of Transport and Communications and Finnish Transport and Communications Agency. The agencies implement the measures as part of their duties. Agencies draw up annual more specific plans to promote the measures.

Other key actors: Ministry of the Environment, centres for economic development, transport and the environment, municipalities, research institutes, companies and organisations.

Impacts on resources: Possible to implement partly with current resources. Of the transport mode-specific priorities, especially the development of the smart waterway requires additional funding in accordance with the Transport 12 plan, and the Digirail project requires additional funding in accordance with the Transport 12 plan and what has been proposed for the EU's Recovery and Resilience Facility (RRF).

Transport mode-specific priorities include especially the following:

- In road transport, the development measures initially focusing on motorways will be determined and piloted on an actual road section approximately 150 kilometres in length. In the following phase, the development measures deemed necessary will be launched on all stretches of motorway longer than 100 kilometres. Later, development measures will be determined and implemented on the rest of the higher-grade road network in the service level classification for automated transport.

- In water transport, the physical infrastructure of the smart waterway and its shared use is being developed, such as weather stations, intelligent fixed and floating safety equipment and sensors.

- To advance automation in rail transport, a test track equipped with the most advanced data transmission and railway infrastructure will be built in accordance with the Digirail project. This environment will make it possible to trial automation levels 1 and 2 in rail transport.

- With regard to unmanned aviation, the regulation of airfields and the coordination of places for taking off and landing in land use planning will be developed.

5.5 Experiments and testing

The development and introduction into use of automated means of transport will require diverse testing in different environments. International regulation will also change in a way that emphasises the importance of testing. It must be possible to create criteria based on objectives, performance and risks to ensure transport safety, data protection and cybersecurity and generate ways to demonstrate and assess how these objectives have been achieved. As for cybersecurity, it is possible to take advantage of already existing criteria to implement the assessments.

Because there are many uncertainties associated with the development of automation, the importance of different experiments and piloting will increase. The experiences gained in the experiments can be used in the following stages of the development of automation by scaling the obtained results. Public procurements play an important role in the use of experiments to develop services and in implementing the developed service concepts.

Finland has the opportunity to develop testing to improve the cybersecurity of automated means of transport and capacities to offer test environments and conditions that enhance the ability of automated systems to also cope with challenging conditions and situations in future. In addition, Finland needs research, experimentation and piloting of its own to gain an understanding of the interaction between the automation technology of a means of transport and the infrastructure as well as an understanding of the needs in infrastructure development. Experiments and testing are also used to improve companies' expertise and competitiveness in international markets.

Key measures:

12. The research, development and innovation funding will be directed to automation experiments and pilots and to conducting research that supports development work.

13. The utilisation of national funding and funding from the EU to promote automation will be enhanced. Finland exerts influence internationally and in the EU, contributing to what research, innovation and pilots are focused on.

    Principal organisations responsible for the measures: Finnish Transport and Communications Agency, Finnish Transport Infrastructure Agency, Business Finland, Academy of Finland and the Ministry of Transport and Communications. The agencies implement the measures as part of their duties. Agencies draw up annual more specific plans to promote the measures.

    Other key actors: Municipalities, universities and higher education institutions, companies and organisations.

    Impacts on resources: Requires additional funding, for example, in accordance with the allocation of EUR 76.5 million for experimentation proposed in the Transport 12 plan.

Transport mode-specific priorities include especially the following:

- In road transport, the use of automation will be experimented with and piloted in city and urban environments in person and/or goods transports.

- In water transport, trial platforms and their cooperation are developed as a regulatory sandbox and an enabler of market access. In addition, experiments and pilots are implemented nationally, in the neighbouring areas and with pioneering countries.

- In accordance with the Digirail project, a test track will be built to promote automation in rail transport.

- In unmanned aviation, experiments will be enabled with the help of UAS geographic zones (Unmanned Aircraft Systems).

5.6 Development of expertise

Transport automation will require new kind of competence from the people who use it. For automation systems to be able to promote the realisation of the vision of safety, efficiency and sustainability, they must be used correctly. Automation will also change the ways of working. The topic requires a study focusing on several administrative branches. At the initial stage of competence development, driver training and the need to develop professional qualifications in different transport modes must be examined. In addition, new competence needs of consumers as end users of automatic systems especially in road transport should be determined.

14. Competence needs and methods for the development competence will be determined.

    Principal organisations responsible for the measures: Ministry of Transport and Communications, Ministry of Education and Culture and Ministry of Economic Affairs and Employment.

Other actors: Finnish Transport and Communications Agency, Finnish National Agency for Education, Service Centre for Continuous Learning and Employment, organisations representing private-sector actors, universities and higher education institutions, vocational education and training providers, and other providers of competence services.

5.7 Development of impact assessment and the indicators supporting it

In connection with the preparation of the plan for legislation and key measures in transport automation, work to develop the assessment of the impacts of automation was also launched. It is a reasonably challenging task, which even internationally is only at the initial stage. The impact assessment should also support efforts to increase the understanding of the wider impacts of automation, such as its impacts on individuals and society and on the transport system as a whole. It should also be possible to assess the impacts on other road users and modes of transport, such as walking and cycling.

The development of the assessment criteria is challenging, especially when it comes to quantitative assessment criteria. It must also be noted that the impacts specifically caused by automation may be difficult to separate from the total impact, which is a result of all of the different measures with a similar effect. Therefore, it was possible to only outline the framework for impact assessment in the plan. The assessment of the impacts of automation will be integrated into the impact assessment carried out in the planning of the transport system.

15. A framework for assessing the impacts of automation development in transport and the indicators supporting it will be created.

    Organisation responsible: Ministry of Transport and Communications.

    Other actors: Finnish Transport and Communications Agency, Finnish Transport Infrastructure Agency, Finnish Meteorological Institute, research institutes, universities and higher education institutions.

5.8 Implementation and monitoring of the resolution

The implementation of the resolution on automation in the transport sector requires more specific plans at an annual level. The effectiveness of the resolution will be measured and the implementation of the measures will be reported. The plan for legislation and key measures in transport automation includes a measure regarding the development of the impact assessment of automation in transport and the indicators supporting it as part of the development of impact assessments for the Transport 12 plan.