



TRAFIKVERKET

Roadmap

– Digitalisation of the Road Transport System
(short version)

This is a short version of “Roadmap – Digitalisation of the Road Transport System for the Years 2022–2030”¹. Read the complete roadmap, in Swedish, for more information on the development towards the digitalisation of the road transport system, as well as on concrete steps that can be taken to help advance development.

In 2019, the Swedish Transport Administration launched a roadmap towards a connected and automated road transport system². The transport system is undergoing comprehensive digitalisation globally, and the roadmap was an important step in the long-term work to utilise the many opportunities that digitalisation may offer to modernise the road transport system. Due to the steady advancement of both society and technology, the roadmap has now been updated to better reflect new conditions, development needs and proposed measures.

The roadmap is based on the current transport policy objectives, as well as on national and international development. In light of the Swedish Transport Administration’s mission, the purpose of the roadmap is to identify important steps and apply measures to more readily benefit from the opportunities that digitalisation offers. The roadmap indicates proposed measures and areas where the Swedish Transport Administration either leads or participates in the development, or considers there to be development potential in order to meet the transport policy objectives and Goals 2030 – Accessibility in a Sustainable Society³.

By fostering new knowledge in early stages, the Swedish Transport Administration both contributes to and accelerates the possibility of benefiting from digitalisation within road transport. Through a structured methodology and by discussing and collaborating with other actors within the transport system, the Swedish Transport Administration will build knowledge and continuously increase the ability to utilise the potential of digital solutions in the road transport system.

The overall transport policy objective is to

ensure economically efficient and sustainable provision of transport services for the general public and businesses throughout the country. In addition, the Swedish parliament (riksdag) has determined a functional objective – accessibility – and an objective for considerations – safety, environment and health.

Digitalisation and the development of the transport system

The future development of the transport system will be, to a large extent, impacted by digitalisation. Connectivity, automation, electrification, the sharing economy and platform solutions are all examples of trends that are gradually being introduced into the transport system. The trends are inter-related, and implementing new services and features in the transport system is challenging from a system perspective, while also avoiding significantly negative side effects. Appropriate instruments, such as policy instruments, may be needed to achieve the desired changes.

The sharing economy and servicification

have profound impacts on how we consume and use services. Instead of buying and owning physical goods, increased consumption has been made both possible and accessible through digital channels and services. The development of combined mobility as a service has created coordinated packages of mobility services. Similar developments can also be seen in the freight transport industry. Mobility services have the best chance of success wherever there are large numbers of users, for example in bigger cities and densely populated regions. Citizens' demand for accessibility and society's goals of providing an accessible, sustainable and efficient transport system is what drives the growth of these new services.

Connected and automated vehicles

mean that the interplay between vehicles and infrastructure increases. This is due to the increased connectivity of both vehicles and infrastructure in combination with the increased number of vehicles with advanced driver-assistance systems. The vehicles are capable of autonomously sensing their surroundings and managing digital information about the infrastructure and traffic to then be able to automatically react in different traffic environments or under different circumstances. All vehicles, save a few possible exceptions, will be connected by 2050. Until then, the physical and digital road infrastructure needs to be compatible with several types of road-users and vehicles to ensure that the transport system is safe and efficient.



Increased access to data.

In conjunction with the increased connectivity of the transport system and new vehicles and devices being equipped with advanced sensors, large amounts of data are being generated about both the use of the transport system and the state of road structures. This data can be aggregated and provide useful information to improve accessibility, conditions and traffic safety, as well as reduce environmental impact. Data has become a strategic resource for development and digital innovation, and according to the EU data strategy, Swedish companies, agencies, regions and municipalities need to be able to share and use data on a national and European level.

The user in the system.

One of the most important and essential aspects of the shift towards a modern road transport system is understanding humans' role from a user and system perspective. In general, there is limited knowledge when it comes to new technology, like automated vehicles and sharing services. People's and organisations' lack of knowledge can prevent adoption. Additionally, the digitalisation of the road transport system also includes significant ethical and moral questions that need to be considered in terms of infrastructure and regulations.

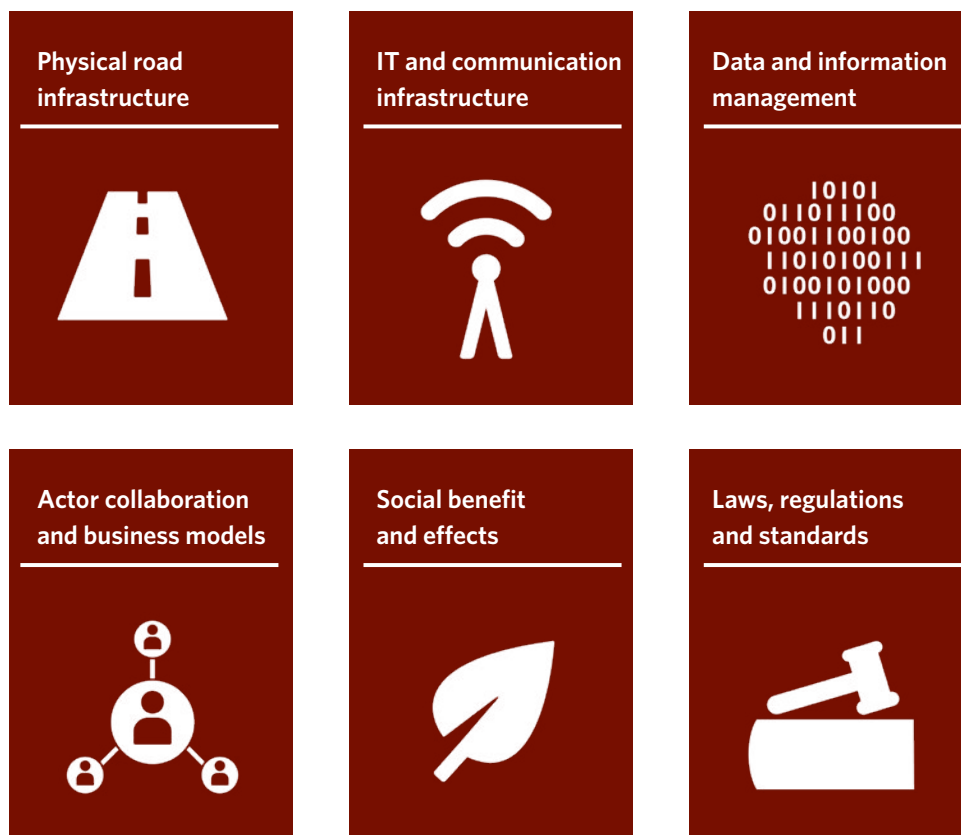
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Focus areas

The roadmap identifies six prerequisite focus areas that need to be developed in order to enable the implementation of the proposed measures at a larger scale. Within these focus areas is the need for the Swedish Transport Administration to strengthen their ability to utilise the opportunities that digitalisation offers.

In 2021, the Swedish Transport Administration decided on a number of central positions that can be found in the roadmap. The focus areas that each respective position applies to are: physical road infrastructure, IT and communication infrastructure, as well as data and information management. The purpose of the positions is to reflect the current level of knowledge and the Swedish Transport Administration's stance on the continued development towards connected and automated road transports.



Figur 1: The roadmap's focus areas



Physical road infrastructure

has a very long lifespan and is now dealing with several new technological solutions with significantly shorter lifespans. How and if the physical infrastructure should be adapted to new technology is important knowledge given that the management, maintenance and investment in road infrastructure are all cost drivers.

The Swedish Transport Administration's position on physical road infrastructure:

- The administration's position is based on intelligent technology being included predominantly in the vehicles and not in the road infrastructure. The Swedish Transport Administration therefore has a restrictive stance on adapting road infrastructure to support vehicles with advanced driver-assistance systems, connectivity and automation.
- The Swedish Transport Administration strives for a standard in physical road markings that takes into account the traffic safety benefits of vehicles with advanced driver-assistance systems.



IT and communication infrastructure

will play a new role, which will also change actors' roles. This infrastructure has the possibility of supporting the implementation of new technological solutions and digital services, which could lead to advantages similar to those that an adapted physical infrastructure would eventually bring about.

The Swedish Transport Administration's positions on IT and communication infrastructure:

- The Swedish Transport Administration considers commercial communications solutions from external actors to be the primary means of exchanging data to and from vehicles.
- At present, the Swedish Transport Administration has no plans to install roadside equipment for direct communication with vehicles. However, if those kinds of solutions prove to be cost-effective on specific roads in the future, this kind of infrastructure may become relevant later on.
- The Swedish Transport Administration will, within the framework of our mission, promote and enable the development of IT and communication infrastructure along state road networks, which preferably are managed by different market actors.



Data and information management

plays an essential role in digital innovation. Providing correct and quality data paves the way for new services throughout the road transport system. To ensure efficient processes and management of data, there is an ongoing need for the development of new functionality, both for providing data and using external data. The Swedish Transport Administration's ability to manage data and information should be continually reviewed and developed to meet the expectations regarding the digitalisation of the road transport system.

The Swedish Transport Administration's strategic positions on data and information management:

- The Swedish Transport Administration will provide machine-readable data regarding traffic regulations, properties of the state infrastructure and up-to-date information on places or roads within the infrastructure that we are responsible for.
- The Swedish Transport Administration will strive to provide data in ways and through channels that will lead to the most social benefits.



Actor collaboration and business models

are being developed as a result of the aforementioned development trends. One particular challenge is using existing business models or establishing new ones that offer both social and business benefits. Digitalisation also increases the need to, in collaboration with other actors, clarify roles in the road transport system.



Social benefit and effects

The development of systems and services places new demands on how social benefits and effects are calculated, given that it's often difficult to compare them to conventional investment measures. The potential benefits of digitalisation in the road transport system include a safer road transport system where vehicles and infrastructure are used in a more effective way, which in turn benefits the environment, accessibility, conditions and traffic safety.



Laws, regulations and standards

often need to be adapted to support a broader implementation of new technology and innovations that challenge existing regulations due to the fact that they work differently than traditional solutions. Actors are also able to play an active role in updating legislation, regulations and standards, which is a necessary step in the digitalisation of the road transport system. Development can be accelerated through increased knowledge, dialogue and understanding on the part of both agencies and suppliers.

Proposed measures

One step on the road

towards taking full advantage of digitalisation's many opportunities is planning and implementing measures that are deemed as having a positive impact on the transport policy objectives and goals 2030 – accessibility in a sustainable society. This includes creating new support systems that both use digitalisation to improve the current transport system and that prepare us for future demands. The Swedish Transport Administration has therefore identified and proposed measures where digitalisation has the potential to improve operations and lead to benefits in the transport system. In the roadmap, 34 different proposed measures are presented on how digitalisation and new technology can be applied to the road transport system. The proposed measures are grouped together and presented in seven categories, based on the type of technology or application area that the proposed measure is most connected to.

The measure categories are presented on a general level to illustrate the current situation, potential and long-term objectives of the area, as well as the estimated effect on the goals. The proposed measures consist of a short description and propose steps that can or should be taken. The maturity of the proposed measures varies, which means that certain steps have already been initiated or decided upon, while others are in the planning stage or simply ideas. The proposed measures that are in the idea stage have the potential to utilise the opportunities that digitalisation offers in order to create a more sustainable, safe and efficient road transport system. Due to the gradual nature of development, measures begin with research and investigations, and those that are deemed to have potential then move on to testing in either demonstration or pilot projects. If the tests are successful, large-scale implementation will be the relevant next step.

To enable the process and larger-scale implementation of the proposed measures, all of the focus areas need to be developed. Certain prerequisites are more relevant for certain proposed measure than for others. The proposed measures can help to further develop and provide a clearer picture of the development needs and strategic issues that are presented in the focus areas. Effective data and information management is a common prerequisite that needs to be further developed to be able to take advantage of the opportunities of digitalisation within the road transport system. How data is managed and who creates and owns that data are factors that have a large impact on how the proposed measures are implemented in the future.

1. Measure category road traffic management

The purpose of road traffic management is to monitor, direct and guide traffic in order to maintain clear roads. This becomes even more important when considering the optimal use of the existing road network, as opposed to the expansion of the road network. Development towards connected vehicles and increasingly advanced driver-assistance systems makes it possible for vehicles to process and act automatically based on static and more dynamic data and information, which further increases the possibility of more active traffic management and control.

Proposed measures:

- Providing data on road infrastructure and traffic
- Collaboration to create reliable traffic information services
- Effective traffic management measures through improved decision-making support
- Prioritisation of specific vehicle categories in traffic signals
- Support for fleets of automated vehicles

2. Measure category multimodal trips and transports

Multimodal trips and transports consist of two or more modes of transport. The digitalisation of the transport system provides access to useful data, which is needed for the introduction of innovative services that can contribute to more sustainable and multimodal trips and transports. This is largely about optimising travel and transport flows in order to effectively use the physical and digital infrastructure, as well as the vehicles.

Proposed measures:

- Multimodal travel information
- Coordination between nodes in the freight transport system
- Data sharing for higher fill rates in freight transports
- Combined mobility as a service

3. Measure category state of road structures

Understanding the state of roads is fundamental to being able to ensure the proper conditions for citizens' trips and business transports. By collecting data on the state of road structures from several different sources, knowledge increases and eventually, it may be possible to get real-time data on road structures. By combining different data sources and using automatic data extraction and data processing to conduct analyses, a system can be built where infrastructure is maintained more proactively.

Proposed measures:

- Efficient winter maintenance using vehicle data
- Connected measurements about the state of road networks
- Drone inspections and automated data management

4. Measure category data-driven planning documentation

In order to be able to plan the transport system in a long-term and sustainable way, information about the use of and demand for transports in the transport system is needed. Continuously improving planning documentation enables more precise measures that reduce the risks of sub-optimisation.

Proposed measures:

- Data-driven planning support for strategic choice of measures
- Development of cause-effect relationships regarding new technology and digitalisation
- Data-driven travel time analyses
- Analysis support to help traffic safety work
- New data sets for climate adaptation
- Data visualisation for air quality measures
- Mobile data on bicycle traffic flows

5. Measure category connectivity, geofencing and advanced driver-assistance systems

Information to and from vehicles and road-users is necessary to be able to utilise the potential of new, and development of existing, features and services based on connectivity of vehicles and advanced driver-assistance systems. To support advanced driver-assistance systems and more automated features in the future, access to qualitative road and traffic data is required, as well as applicable laws and regulations on the road network.

Proposed measures:

- Increased use of advanced driver-assistance systems
- Digital support for speed compliance in complex traffic environments
- Connected and co-operative traffic signals
- Warnings for oncoming trains at unguarded level crossings
- Dynamic restrictions and conditions for a flexible road transport system
- Geofencing to reduce idling
- Digital exemption management for wide, heavy or long vehicles

6. Measure category digitalised maintenance and construction of road infrastructure

Technological development and digitalisation can lead to substantial benefits in terms of maintaining and building infrastructure. Maintaining and building infrastructure with connected and automated machines means that people will be able to be moved away from unsafe work zones, as well as a reduction in environmental impact and traffic disruptions.

Proposed measures:

- Connected road work
- Connected management and maintenance of bicycle infrastructure
- Motorway maintenance using automated maintenance equipment
- Connected and automated road construction

7. Measure category digital trimming measures

Digital trimming measures will most likely become an increasingly important tool for the Swedish Transport Administration with the digitalisation of the transport system. To be able to utilise the benefits of technological development, the toolbox needs to be continually developed as new digital measures are taken. Solutions that use digitalisation can be used both as a complement to other measures and as an alternative to a physical measure in the transport system.

Proposed measures:

- Toolbox for digital trimming measures
- Automated night transports on state road network
- Digital measures in sparsely populated areas and peripheral areas
- Digital measures to manage seasonal congestion problems



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