TRANSPORT INFRASTRUCTURE 2030

Meeting the Challenges of Concentrating Population and Industrial Changes

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TRANSPORT INFRASTRUCTURE 2030
Meeting the Challenges of Concentrating Population and Industrial Changes

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FOREWORD

The three-year TRANSPORT INFRASTRUCTURE 2030 –research programme, which was initiated by the Ministry of Transport and Communications in the year 1999, has been completed. The objective of the programme was to examine the essential factors of change in operating environment with regard to transport infrastructure management and assess their impacts on the needs of transport infrastructure management in the future. The research programme was started by preparing preliminary studies. Based on these studies, two of the most significant factors of change having an impact on transport infrastructure were selected for more detailed analysis: the migration of population and the changes in the production structure and ways of operation of economic life.

The studies have been prepared by the best experts in this field. The research programme has been supported by a representative and competent Steering Committee, which I have chaired. The Steering Committee had representatives from the Tampere University of Technology, the VTT Technical Research Centre of Finland, the Centre for Urban and Regional Studies, the Confederation of Finnish Industry and Employers, the Association of Finnish Local and Regional Authorities, the Ministry of the Environment, the Uusimaa Regional Environment Centre, the Helsinki Metropolitan Area Council, the Central Association of Earth Moving Contractors in Finland, the National Technology Agency as well as the Finnish Civil Aviation Administration, the Finnish Maritime Administration, the Finnish Rail Administration and the Finnish National Road Administration. The names of the members of the Steering Committee can be found on the Internet pages of the research programme: ww.mintc.fi/vaylat. Senior Engineer Juha Parantainen has been the project manager of the research programme and the secretary of the Steering Committee.

The costs of the research programme have been about 700 000 €. The 12 studies contributing to this research programme have been listed in the last page of this summary report. Study results will be used in the preparation of action policies of transport infrastructure management, e.g. in the task of the Working Group on providing the basic level of service in road and railway network to meet the necessary needs of citizens and enterprises as well as in the preparation of the investment programme of transport infrastructure.

I wish to thank all the members of the Steering Committee, the researchers and other parties who have contributed to successful research work!

Helsinki, March 18, 2002

Juhani Tervala
Director of Infrastructure Unit

SUMMARY

Current shares of transport modes as well as the extent and value of transport infrastructure

The share of road traffic was about 90 % of the kilometres travelled in passenger traffic and about 70 % of the kilometres transported in freight traffic in the year 2000.

A major share of the kilometres travelled in passenger and freight traffic occurs on road network. Road traffic had a share of 92 % of the kilometres travelled in passenger traffic (passenger kilometres) and a share of 68 % of the kilometres transported in freight traffic (tonne kilometres) in the year 2000 (excluding pedestrian and bicycle traffic).

Road traffic had a share of 56 % of the trips in international traffic in the year 2000. A major share of about 80 % of the export and import tonnes of Finland are transported by sea. It is worth noting that, although the share of air traffic of the exports and imports in Finland was only 0,1 % measured by tonnes, this share was 16 % calculated in euro in the year 2000.

The total length of the transport networks (public roads, streets and planned roads, private roads, railways and waterways) of Finland was about 472 000 kilometres in the year 2000. The total capital value of transport networks and terminals (ports and airports) was about 30 billion € (180 billion FIM) at the end of the year 2000. The major shortcomings of the existing transport infrastructure can be found in road and railway networks.

Changes in operating environment and their impacts on transport infrastructure

Migration and the changes in production structure have the greatest impact on transport infrastructure management.

The impacts of different factors of change on transport infrastructure have been examined in various studies. The most significant changes occurring in society with regard to transport infrastructure management include national migration and the related problems to the transport infrastructure management of regions with growing and decreasing population. Other significant issues include the changes in transport needs and infrastructure caused by changes in industrial and production structure.

Transport infrastructure in growing regions

The direction of migration is from the rural areas to cities and built-up areas as well as to few growing areas from different parts of the country. A major share of the population growth concentrates on the regions of Helsinki, Tampere, Oulu, Jyväskylä and Turku. There were 20 sub-regions with growing population in the year 2000, which had a total population of less than 3 million people. According to forecast, the population of these sub-regions will be about 3,3 million in the year 2020.

It has been estimated that population growth contributes to an annual transport investment and financing need of about 25 million € (150 million FIM) in road and street network, in public transport and in pedestrian and bicycle network. If similar development of migration continues, the total additional investment need for roads and streets caused by the estimated population growth will be about 250-350 million € (1,5-2,0 billion FIM) during the years 2000-2020.

The most important measures for meeting the challenges of regional growth include:

- Regional development should have equal emphasis with other viewpoints in transport policy.
- Municipalities experiencing population growth should be committed to participate more in the investment needs caused by the land use decisions, also with regard to public road network.
- The cooperation and coincidence of transport system planning and land use planning should be emphasised in the transport policy of growing regions.
- The implementation of transport system plans should be made more efficient by preparing letters of intent between the Ministry of Transport and Communications and other organisations participating in the preparation of plans.
- In addition to infrastructure investments, measures based on information technology should be used more commonly to solve problems in transport and traffic demand management.
- The focus should be on the development of public transport in large urban areas.
- In addition to road traffic, the development of pedestrian and bicycle traffic should be regarded as an important investment especially in medium-sized cities.

Transport infrastructure in regions of decreasing population

The outlying areas of eastern, northern and central Finland have experienced the most significant absolute and relative decrease of population in recent years. There were 65 sub-regions with decreasing population in the year 2000 and the total decrease was about 20 000 people. The most significant population decrease has occurred in the sub-regions of Tornionlaakso, northeastern Lapland, Ilomantsi and Kärkikunnat (in southeastern Finland). According to forecast, migration to the growth centres will continue. The most significant estimated decrease of population will occur in the sub-regions of eastern and northern Finland by the year 2020. It has been estimated that the population of these sub-regions will decrease from about 2,2 million people to 2,0 million people or about 10 % during the years 2000-2020. The decrease of population will mostly affect the management of low-volume roads and private roads.

The most important measures for meeting the challenges of decreasing population include:

- The allocation of funds to the management of low-volume roads and railways to provide the basic level of service of these networks to meet the necessary needs of citizens and enterprises.
- The so-called "just-for-need road management" (customised road management to meet the exact needs of road users) should be adopted more widely in the management of low-volume roads.
- The transport system of built-up areas with decreasing population should also be improved so that the development of these areas will not be threatened.
- Smoothly flowing and rapid main transport connections to the nearest provincial and regional centre as well as to Helsinki include the factors, which contribute to the vitality of regions of decreasing population.
- The management of international connections in addition to national and regional connections.

Challenges of the changes in economic life to transport infrastructure

The demand for transports has changed due to changes in industrial and production structure. Transports should be more punctual and also faster in the future. This is especially important in the transports of trade and high technology as well as the products of food and textile industry. This development will probably also continue in the future. The significance of transport costs will still be high.

Cost efficiency is important particularly in the transports of wood raw material, fuel and the products of forest industry, construction industry, metal industry and chemical industry.

The demand for punctuality and speed in freight traffic sets the following requirements to transport infrastructure management:

- providing smoothly flowing transport connections through new and expansion investments on main roads, on the ring roads of the largest growth centres as well as on the port and airport connections of the Helsinki Metropolitan Area.
- increasing the degree of capacity utilisation and development of operations through e.g. new technology in ports and air cargo points.

The demand for cost efficiency in freight traffic requires:

- securing good structural condition of road and railway network through replacement investments.
- securing the operations on fairways through maintenance dredging.
- increasing the degree of capacity utilisation of ports and the development of port operations.

The share of so-called valuable freight transports has increased. Valuable goods include the products with high degree of processing, such as the means of transport, machines, equipment, electronics etc. medical and other chemical products, clothing, textiles, shoes, glass and ceramics as well as textile fibres etc. Punctuality and speed are also important factors for these transports.

With regard to transport infrastructure management, the challenge is, how the punctuality of transports or smoothly flowing transport connections will be secured on the main roads of southern Finland, on the ring roads of the largest growth centres as well as on airport and port connections. A more balanced regional policy is one solution, which will alleviate congestion in the Helsinki Metropolitan Area.

Providing the basic level of service is important in the management of low-volume roads and railways to meet the necessary needs of citizens and enterprises.

Transports must be more punctual and also faster in the future. The significance of cost efficiency in transports will still remain high.

Punctuality requires smoothly flowing transport connections and cost efficiency demands good condition of transport networks.

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1. CURRENT SHARES OF TRANSPORT MODES

1.1 Passenger traffic

Domestic traffic

According to the National Passenger Transport Survey (1998-1999), adult population made an average of three daily trips, about two of which were made by car. Pedestrian and bicycle traffic was the primary mode of transport on short trips, but a share of over half of the trips between 1-3 kilometres was made by car. A major share (60 %) of long transit trips was made by train. Airplane became a more common mode of transport on trips of over 300 kilometres.

According to the National Passenger Transport Survey, most of the trips were leisure trips. Their share has increased significantly in recent years. Work trips constituted the second largest group and shopping and business trips constituted the third largest group. According to passenger transport surveys conducted at different time periods, the growing use of passenger car is a common development trend. The number of daily trips has not changed too much.

The amount of kilometres travelled in domestic passenger traffic was 69,7 billion passenger kilometres in the year 2000 (excluding pedestrian and bicycle traffic). The kilometres travelled have doubled during the years 1970-2000. The growth in passenger traffic has almost exclusively occurred in car traffic, which has more than doubled during the same time period. Passenger car traffic has clearly the highest share, whether measured by kilometres travelled or by modal share.

More trips are made in large cities than in small cities or in sparsely populated areas. As the size of city grows, the share of public transport increases and the share of car trips decreases.

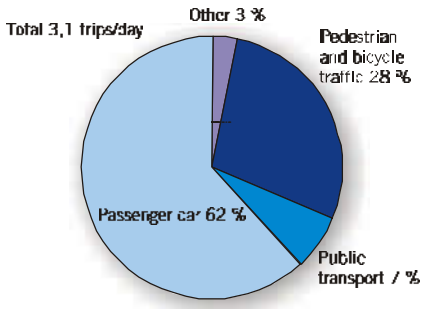
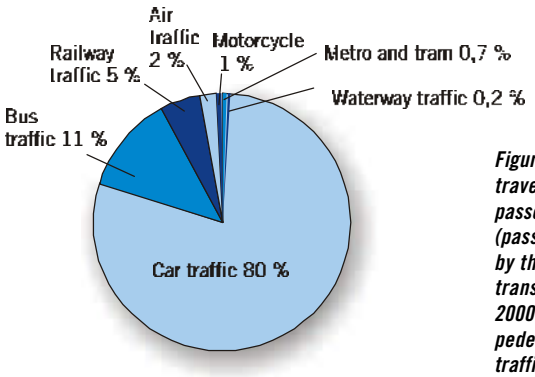


Figure. The distribution of trips by the mode of transport according to the National Passenger Transport Survey (1998-99).



Total kilometres travelled 69,7 billion passenger kilometres

Figure. Kilometres travelled in domestic passenger traffic (passenger kilometres) by the mode of transport in the year 2000 (excluding pedestrian and bicycle traffic).

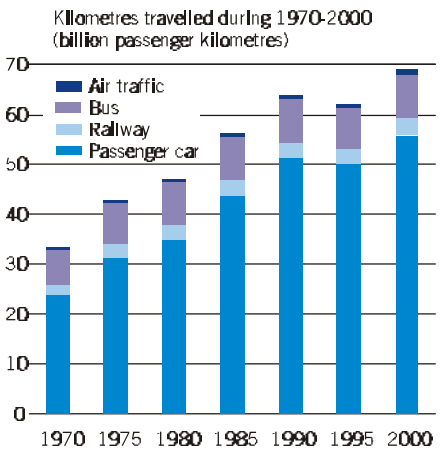


Figure. Kilometres travelled in domestic passenger traffic (passenger kilometres) during the years 1970-2000 (excluding pedestrian and bicycle traffic).

1.2 Freight traffic

International traffic

International traffic includes the traffic between Finland and foreign countries as well as through traffic. International trips consist of work related trips, holiday trips or other trips. There were a total of 54 million international trips in the year 2000. The highest share of them composed of sea or land transports between Finland and Sweden. A share of two-thirds of the trips in air traffic had a destination in the EU-countries.

Domestic traffic

The amount of kilometres transported in domestic freight traffic was 40,4 billion tonne kilometres in the year 2000. The amount of kilometres transported was 1,7 times higher in the year 2000 as compared to the year 1970. This growth has mainly occurred in road traffic. The share of road traffic is dominating, whether measured by kilometres or volumes transported. Similar to passenger traffic, the relative share of road traffic has continuously increased in freight traffic. The share of railway transports is clearly higher than the share of waterway transports, whether measured by kilometres or volumes transported. The share of air transports is very low.

The modes of transport hardly compete with each other, but operate in their specific sectors. They often constitute complementary transport chains. Road traffic is almost exclusively one part of the transport chain, although railway, waterway and air transports are the main modes.

The amount of kilometres transported in freight traffic in proportion to the length of both road and railway network is higher than the average share in Europe. In the year 1998, total freight volumes of over a million tonnes could be found on about 6 250 road kilometres, on about 3 350 railway kilometres and on about 1 250 waterway kilometres.

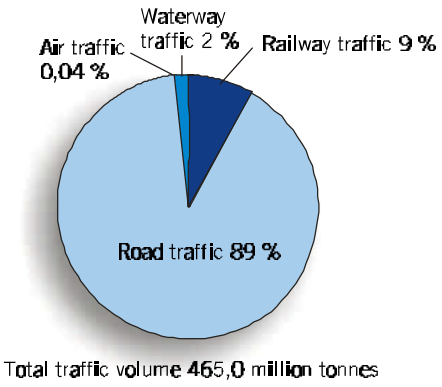


Figure. The distribution of domestic freight traffic volumes (tonnes) by the mode of transport in the year 2000.

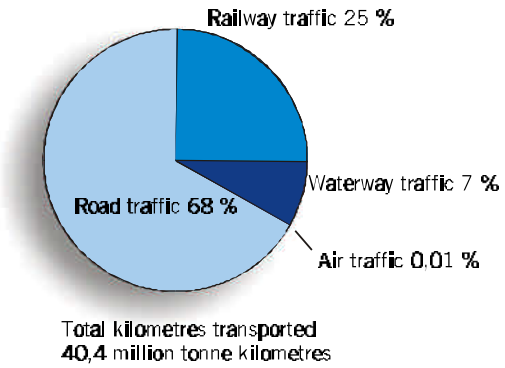


Figure. The distribution of the kilometres transported in domestic freight traffic (tonne kilometres) by the mode of transport in the year 2000.

The share of road traffic has continuously increased both in passenger and freight traffic.

The share of air traffic of the export and import volume of Finland in the year 2000 was only 0,1 % measured in tonnes, while it was about 16 % calculated in euro.

International traffic

The total export and import volume in Finland excluding transit traffic was 91,7 million tonnes having a value of 85 billion € (505 billion FIM) in the year 2000. The share of waterway transports of the export and import volume was about 80 % measured in tonnes and about 74 % calculated in euro. The share of air traffic was only 0,1 % measured in tonnes, while it was about 16 % calculated in euro.

The significance of air traffic in international high-speed transports has continuously increased in recent years.

Figure. Sections of road and railway network and domestic waterways having annual freight volumes of over 1,0 million tonnes in the year 1998.

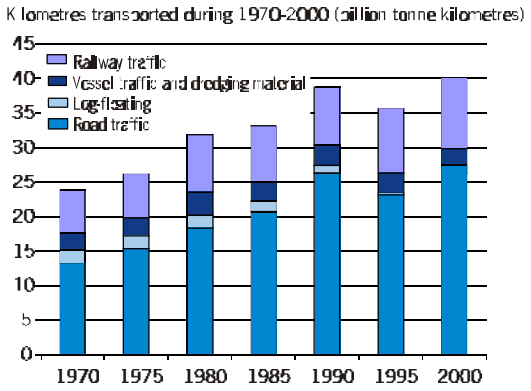


Figure. Kilometres transported in domestic freight traffic (tonne kilometres) during the years 1970-2000.

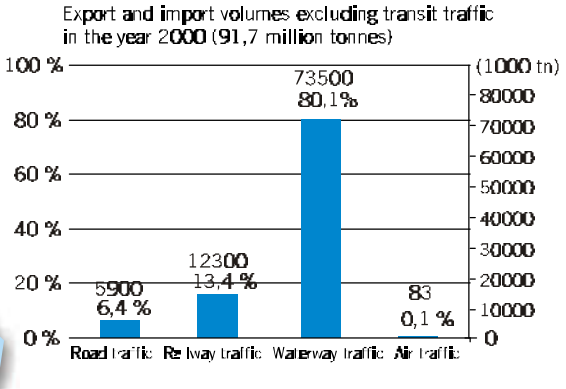


Figure. Export and import tonnes in Finland excluding transit traffic in the year 2000.

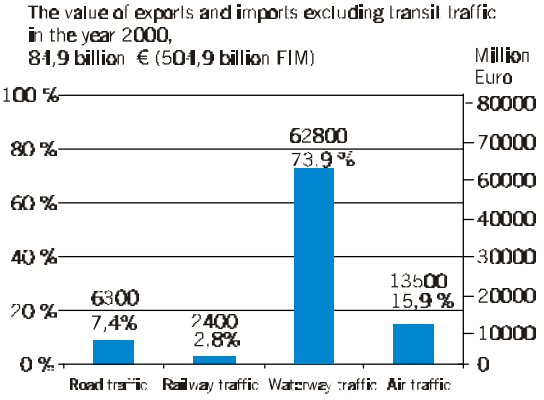


Figure. The value of exports and imports in Finland in euro excluding transit traffic in the year 2000.

2. CURRENT STATE OF TRANSPORT INFRASTRUCTURE

Transport system consists of transport infrastructure and traffic management. Transport infrastructure includes transport networks, terminals as well as traffic management and control systems. Different means of transport, organisations and regulations are needed for traffic management.

In this study, transport infrastructure is examined only with regard to passenger and freight traffic.

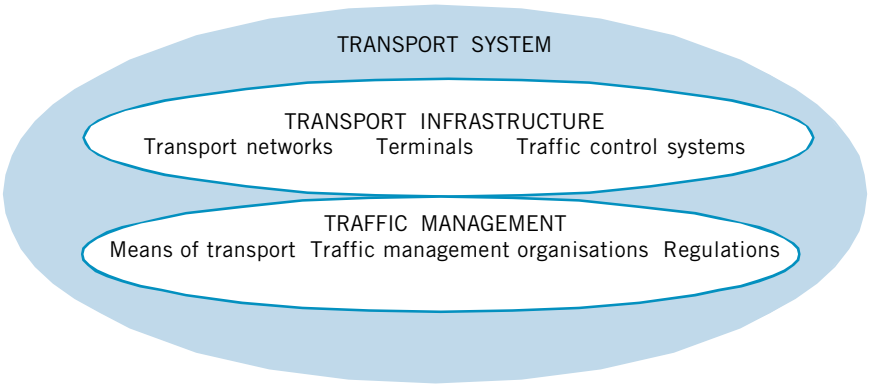


Figure. The structure of transport system.

The capital value of transport networks was about 30 billion euro or 180 billion FIM at the end of the year 2000.

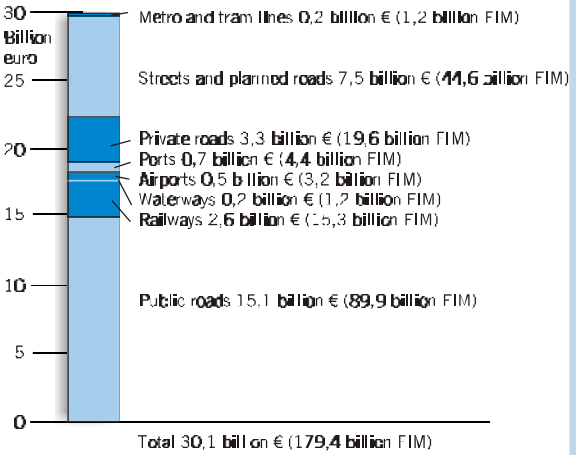


Figure. The capital value of transport networks owned by the state, municipalities and private bodies at the end of the year 2000.

2.1 The value and extent of transport infrastructure

The total capital value of transport networks (public roads, streets and planned roads, private roads, railways, waterways, metro lines and tram lines) and terminals (ports and airports) was about 30 billion € (180 billion FIM) at the end of the year 2000.

The total length of transport networks was about 472 000 kilometres in the year 2000. Road network is the most extensive of all transport networks. In the table below, only marked fairways have been included in the waterway network. The length of air traffic routes has not been determined.

Table. Transport infrastructure in Finland in the year 2000.

Transport infrastructure in Finland	
Road traffic	
Public roads	78 000 km
- bridges	11 000
- ferry connections	45
Streets	24 000 km
Private roads	350 000 km
Railway traffic	
Railways	5 800 km
- metro lines	20 km
- tram lines	70 km
Waterway traffic	
Fairways	7 800 km
Inland waterways	6 100 km
- deep-water channels in Lake Saimaa	800 km
- the Saimaa Canal	40 km
Navigational Aids	25 000
Significant coastal ports	50
- winter ports	23
- icebreakers	9
- significant inland ports	6
- fishing ports	100
Air traffic	
Airports (regular service)	25

2.2 Current state of transport infrastructure

The "Motorway of the Baltic Sea" is the most important connection for Finnish foreign trade. The freight volumes of it correspond to the daily traffic of almost 13 000 lorries.

International level

The European Union has started the development of the so-called TEN-networks (Trans-European Networks) to meet the needs of international transport. Through the Trans-European transport networks, the aim is to provide sustainable mobility for persons and goods in the European Union in best possible social circumstances emphasising traffic safety.

The European Commission adopted in October 2001 a proposal to amend the current decision of 1996 regarding the TEN Guidelines. This proposal is currently under the reading of the European Parliament and the Council. The Nordic Triangle will remain as one of the priority projects according to the proposal. A decision by the European Parliament and the Council to incorporate seaports and inland ports in the TEN network was adopted separately in May 2001.

The length of the TEN- road network in Finland is about 5050 kilometres and the length of the TEN-railway network is about 3280 kilometres. The TEN-airport network includes 22 airports in Finland which have been classified as international connecting points, community connecting points as well as regional and accessibility points. Only Helsinki-Vantaa airport belongs to the highest class in Finland. The TEN-port network includes 18 seaports as well as the ports in Lake Saimaa. The most important ports with regard to international passenger traffic are Helsinki, Turku, Mariehamn, Eckerö and Vaasa. The busiest ports in freight traffic are Sköldvik, Helsinki, Kotka, Naantali, Raahe, Rauma, Hamina and Turku.

The sea connection across the Baltic Sea is the most important connection for Finnish foreign trade. The freight volumes on this "motorway of the Baltic Sea" correspond to the daily traffic of almost 13 000 lorries. Long distance to the markets and severe weather conditions add to the logistics costs of the Finnish companies, which are about 2-3 times higher as compared to the core regions of the European Union. The Baltic Sea Route is a part of the intermodal transport chain from Finland to the EU markets, which should be operational in all circumstances around the year. The development of this connection requires e.g. efficient icebreaking, smoothly flowing ground transport connections to ports and logistic solutions as well as the use of modern telematics applications in the information management of transports.

The international road network is quite extensive and serves traffic well. Lorry traffic is occasionally congested at the Russian border stations. The growing traffic across the eastern border has also caused traffic safety problems on main roads 6 and 7 in southeastern Finland.

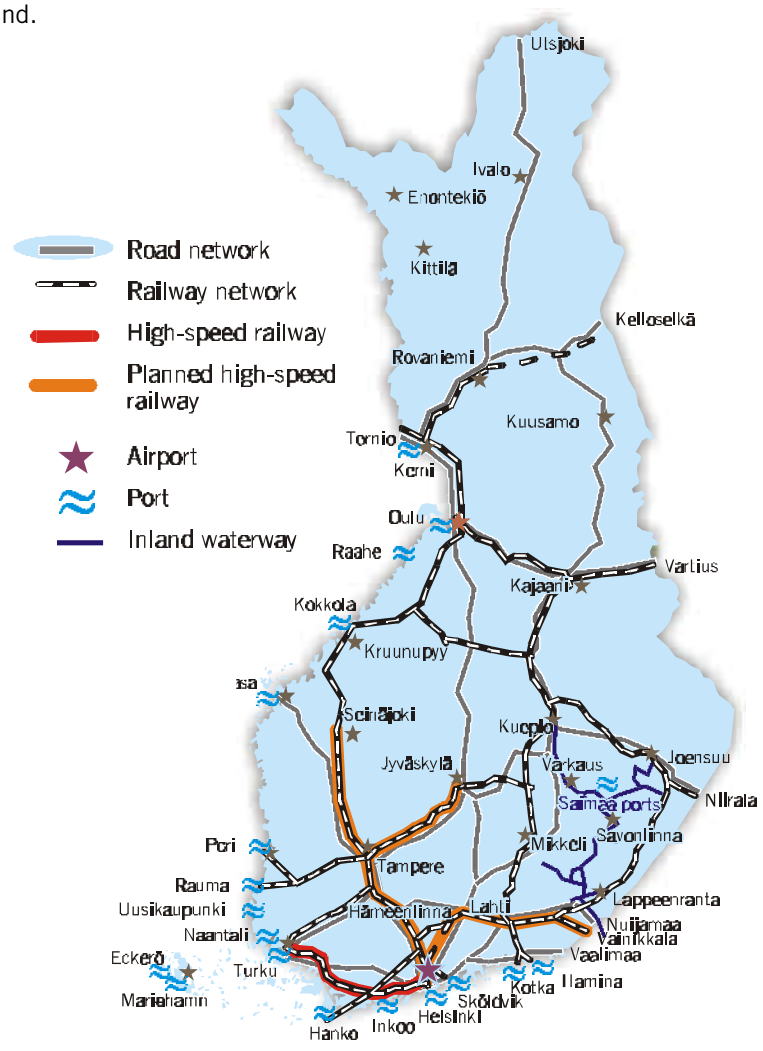


Figure. The Trans-European networks in Finland. Ports according to the decision of the European Parliament and the Council, other TEN-network according to the proposal of 2.10.2001 by the Commission.

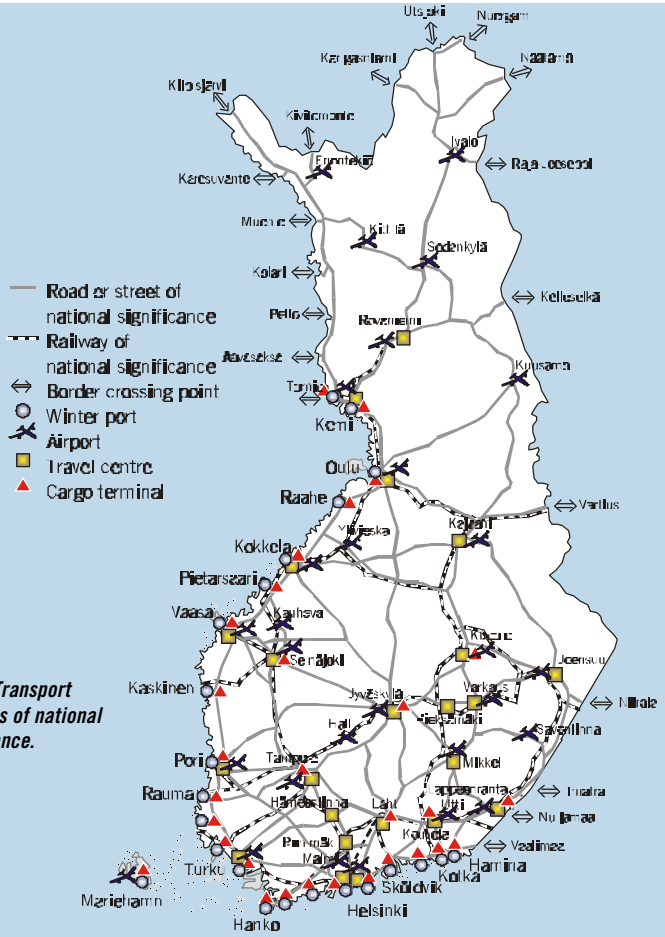


Figure. Transport networks of national significance.

Roads and streets of national significance include
- main roads
- roads of the TEN-network and European roads
- roads and streets leading to winter ports
- roads and streets leading to airports with regular service, also with military aviation
- roads and streets leading to travel centres and cargo terminals of national significance

Railways of national significance include
- main railway network
- railways leading to official border crossing points
- railways leading to winter ports
- railways leading to travel centres and cargo terminals of national significance
- metro lines in the Helsinki Metropolitan Area
- the following new rail lines:
  - railway to Helsinki-Vantaa airport (so-called Marja railway)
  - metro line extension to Espoo
  - Kerava-Lahti direct line

Ports and waterways of national significance include
- ports in year-round operation, so-called winter ports
- fairways for maritime commerce

Airports and air navigation systems of national significance include
- all airports with regular service, also airports of military aviation and air navigation systems

Telecommunication networks and systems of national significance include
- particularly national distribution networks and telecommunication networks of mass media
- air navigation systems in all airports with regular service and military aviation
- navigational aids and traffic control systems of fairways for maritime commerce and military navigation
- meteorological and hydrological survey systems
- telecommunication systems of national defence and frontier supervision

The duration of a train trip from Helsinki to St. Petersburg is currently about 5,5 hours. The goal is to reduce the travel time to 3 hours. This can be achieved through smoother border crossing operations, the development of rolling stock and railway investments (e.g. Kerava-Lahti direct line).

The biggest problem in international air traffic has been the congested European airspace and the resulting delays of flights. It is difficult to open up new connections from Finland to the congested Central European airports. The reasons behind the congested airspace include administrative structures and unorganised air navigation services.

Small measures for improvement are needed in waterway infrastructure to secure safety, as vessel fleet and navigation methods develop. In addition, the development of economic life may argue for the deepening of some fairways. Some of the fairways in the Gulf of Bothnia have become shallow and are in the need of dredging. There will be significant development needs in port infrastructure in the near future due to growing traffic volumes at ports and changes in cargo handling methods. The road connection to the port of Kokkola is the most problematic connection of existing ports. There are no significant problems in railway connections. Also, the icebreaker fleet should be modernised in the near future.

National level

Transport networks of national significance both in passenger and freight traffic as well as data communication networks and systems, which have been identified in the national land use goals, constitute the basis for the transport system at national level. The government made a decision on the national land use goals in 30.11.2000 and they became valid in 26.11.2001.

Passenger traffic requires safety and smoothly flowing traffic conditions in road network. The level of service on main roads is for the most part at adequate level. Some congestion occurs mainly on main road 1 and the main roads of some urban areas. Some main roads also have segments with insufficient geometry and cross section.

Freight traffic sets two essential requirements on road transports: cost efficiency and punctuality. Carrying capacity is important on those road network segments, which have transports of industry and construction activity that demand cost efficiency. Correspondingly, smoothly flowing traffic conditions are emphasised on those road network segments, which have transports of retail trade and products of high technology industry that demand punctual delivery times.

Many railway sections have met with poor traffic conditions during 1970s and 1980s. Also, many serious accidents have occurred in railway traffic in recent years. Therefore, a continuous upgrading of railway network, the electrification of some railway sections in northern Finland, the removing of level crossings and providing safety investments (e.g. the extension of automatic train protection) are essential measures for development in railway traffic. In passenger traffic, improving the competitiveness of railway traffic requires the extension of the high-speed railway network. There are capacity problems on some railway sections in the commuter rail traffic of the Helsinki Metropolitan Area.

Waterways are mainly in good condition with regard to transport needs. The waterways in Lake Saimaa are the only inland waterways, which are part of the transport networks of national significance. The lease contract of the Saimaa Canal will expire in the year 2013. According to the government policy made in the year 2000, the Saimaa Canal will provide the sea connection from the inland waterways of Finland also in the future.

Ports have normally a sufficient number of quay berths. The problem is that all the quay berths do not meet the current demands. The allocation of quay berths, or quay capacity at wrong locations with regard to demand, is also a national problem.

There are no significant problems in air traffic network, and airports are developed according to demand. The Finnish Civil Aviation Administration applies a network principle in the maintenance of airports, and thus individual airports do not have to be profitable.

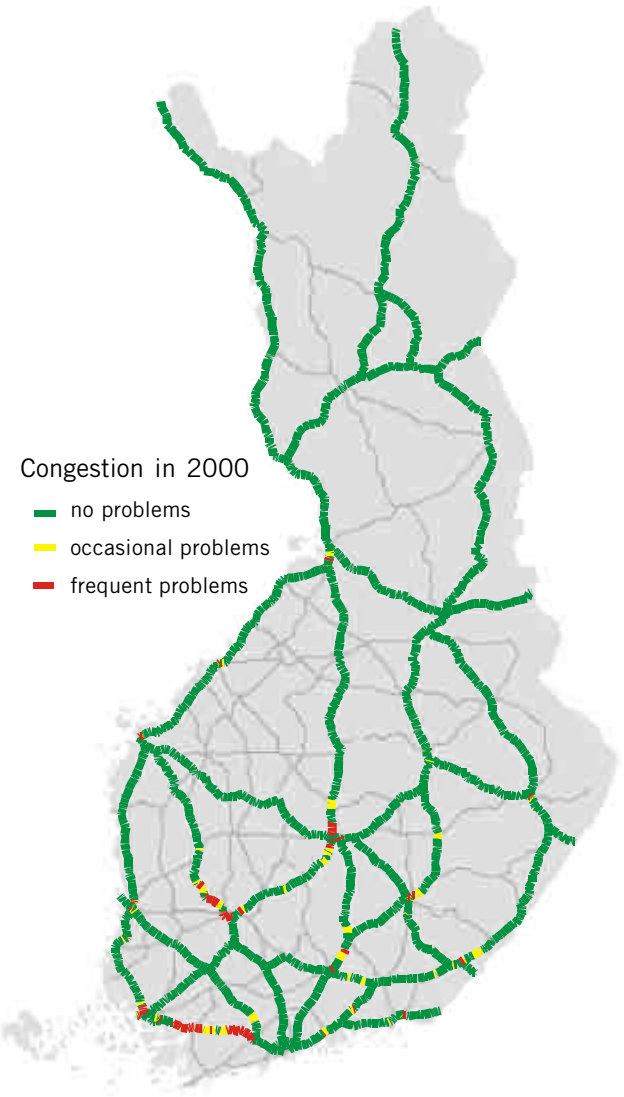


Figure. Problems in the level of service on the most important main roads due to insufficient capacity in the year 2000.

Continuing the upgrading of railway network is important for maintaining the competitiveness of railway traffic.

Administrative borders make the implementation of transport system plans difficult especially in large urban areas.

Urban areas

Street network and some entrance and through traffic roads constitute the basis of the passenger transport system in urban areas. Public transport also uses metro, tram and railway network in the Helsinki Metropolitan Area. Pedestrian and bicycle ways are significant elements of the transport system of urban areas.

Street network supplemented by public road network also constitute the basis of freight transport system. There is a railway connection for heavy transports to several industrial plants and areas as well as to cargo terminals in urban areas.

One significant problem in urban areas is the difficulty of coordination in the implementation of regional transport system plans. The biggest problem has been the fact that different organisations cannot commit themselves in the same way to the plan implementation, although the plans have been jointly prepared and adopted. For more efficient plan implementation, the Ministry of Transport and Communications has decided to start preparing letters of intent of all transport system plans with organisations participating in the preparation of the plan.

The extension of the metro line from Helsinki to southern Espoo has been argued for years in the Helsinki Metropolitan Area. Study on the alignments of the so-called western metro line is being conducted.

There are several hundred kilometres of main roads in poor or congested condition in urban areas. The discontinuity of the network of pedestrian and bicycle ways is a problem. There are also problems in the condition and maintenance level of pedestrian and bicycle ways.

Some road and transport connections to ports are narrow and congested. Some road connections to airports also have problems.

The industrial railways in urban areas are usually managed by the city or by a single industrial plant. Most of these railways are in poor condition.

Roads are usually the only transport connections in rural areas. Therefore, smoothly flowing road connections are the basic requirement for the vitality of rural areas.

Rural areas

Smoothly flowing road connections constitute the basic requirement for the development of rural areas. Road connections are very important in rural areas, as they usually are the only transport connection. Railways are not very significant in the passenger traffic of rural areas any more. Waterways are significant mainly in the archipelago municipalities.

Daily transports in rural areas use the low-volume road network (regional and local roads) and private road network.

Gravel roads have the biggest problems in the low-volume road network. Their condition has deteriorated, as measures for improving the road structure have been reduced in recent years. There are about 28 000 kilometres of gravel roads and weight limits have been set for 3000-7000 road kilometres in recent years. Spring thaw and weight limits cause delays to bus traffic and to daily transports of agricultural products and raw wood. Most of the problems of spring thaw can be found on the gravel roads of central and northern parts of the country. Also, paved low-volume roads have problems in carrying capacity and problems of poor pavement condition.

Also, the condition of private roads is deteriorating. After the year 1995, the government has hardly granted any financial support to the maintenance of private roads. Private roads are important to the vitality of rural areas, as considerable amount of residential and industrial activity is located along these roads.

Road connections will be important to the development of rural areas also in the future, as new means of livelihood, such as tourism and other service activities, require good road connections.

Summary of the existing problems in transport infrastructure

Table. The most significant existing problems in transport infrastructure.

Transport system	Road and streets	Railways	Waterways	Airports and air routes
International	• Road E18 Turku-Vaalimaa	• Capacity problems in the railway network of southern Finland, particularly between Helsinki-Riihimäki • Helsinki-St. Petersburg railway connection	• Fairways in the Gulf of Bothnia become shallow • Significant development needs in port infrastructure in the near future due to growing traffic volumes at ports and changes in cargo handling methods	• Delays of flights in Finnish airports due to the congested airspace in Europe • Competition and congested airports in Central Europe make it difficult to open up direct flights from Finland to Central Europe
National	• Inadequate level of service on some main road connections	• Ageing and poor condition of superstructure on many railway sections • Electrification still under construction • Traffic safety investments still under construction • Problems in extending the high-speed railway network	• The question of port location in the Helsinki Metropolitan Area • Connection of inland waterways to the Gulf of Finland	• Discontinuing services on routes with low number of passengers • Possible reduction of airport network
Urban areas	• Difficulties in the coordination and implementation of transport system plans • Congested main streets in poor condition • Discontinuity, poor condition and maintenance level of pedestrian and bicycle ways	• Poor condition of many industrial and other private railways • Extension of the metro line in the Helsinki Metropolitan Area • Capacity problems on some railway sections in the commuter rail traffic of the Helsinki Metropolitan Area	• Narrow and congested road and street connections to ports	• Problems in the road connections of some airports
Rural areas	• Poor condition of gravel roads • Spring thaw and related problems • Poor condition of paved low-volume roads • Condition of private roads is deteriorating	• Poor condition of low-volume railways	• No significant problems	• No significant problems

3. CHANGES IN OPERATING ENVIRONMENT

The changes in society also reflect in transport and its operating environment. Significant factors of change include economic development, changes in industrial structure, population development, the development of regional and community structure, technological development, internationalisation, the EU transport policy and different human values (environment, traffic safety, individualisation). Also, the development of logistics, intermodal cooperation and the competition between the modes of transport have their own impacts.

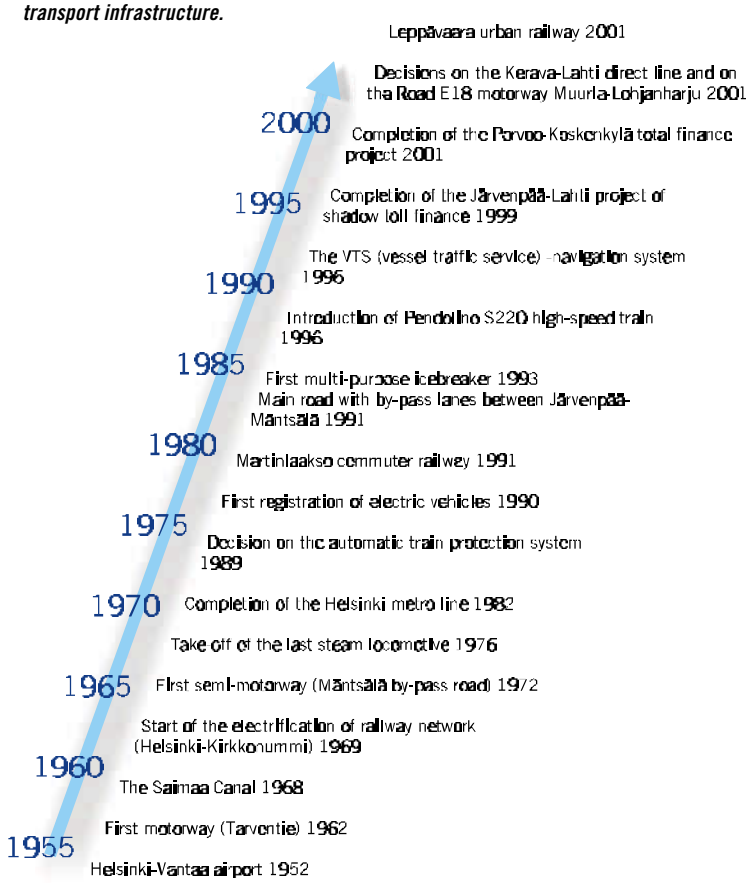
3.1 Economic development

The development of national economy has a direct impact on passenger and freight traffic. The growth in the GNP promotes the mobility of people by all modes of transport. Economic development is reflected in freight traffic through increasing volumes and value of freight. Economic development is directly reflected in company operations and trade volumes and the change in the number of trips is directly dependent on the activity of business operations.

The development of the GNP also affects the development of national economy. It is possible and there is need to invest more on transport networks during favourable economic development than during unfavourable economic development.

Economic development has a very significant impact on the demand of road and air traffic. The impact on the demand of railway and waterway traffic is slightly smaller.

Figure. Milestones of transport infrastructure.



3.2 Changes in industrial structure

The industrial and production structure of Finland is in the state of change. The traditionally strong branches of industry, forest industry and metal industry, have been supplemented by electronics and communications industry, which is a significant sector of national economy, and is mainly concentrated on large growth centres.

Retail trade structure has changed significantly. Especially, the construction of supermarkets outside of city centres has changed both shopping behaviour and work trips. Simultaneously, retail trade, banking and postal services have disappeared or decreased from smaller population centres.

In freight traffic, the changes in industrial structure have the most significant relative impact on the growth of air transports and the most significant absolute impact on the growth of road transports. Impacts are not so significant on other modes of transport. The growth in service sector somewhat contributes to the increase in light freight traffic. The changes in industrial and production structure have the most significant impact on road transport infrastructure.

3.3 Population development

The national migration in Finland has been very strong in the 1990s. The direction of migration has been from the rural areas to cities and built-up areas as well as to few growth areas from different parts of the country. The largest growth areas include the sub-regions of Helsinki, Oulu, Tampere, Turku and Jyväskylä.

The population of Finland is ageing. According to the forecast by the Statistics Finland, the share of persons over the age of 64 will increase from the existing 15 % to 26 % by the year 2030.

Household size has continuously decreased and the number of single dwellers has increased. The decrease of family size and the increasing number of single dwellers improve the opportunities for holiday travel.

Traffic volumes can experience significant local changes due to population development, which can especially affect the infrastructure needs of road traffic.

3.4 Changes in regional structure

At national level, the regional structure of Finland, which constitutes of centres at different hierarchical level and connections between them, can be divided into central regions and sparsely populated peripheral areas. The central regions act as both nationally and locally significant growth centres and constitute the basis of the regional structure in Finland. At national level, Finland can be divided into three development zones based on factors of regional development. These development zones can be characterised as follows:

- The centre regions of southern Finland adjacent to the Helsinki-Tampere and Helsinki-Turku transport networks as well as the centre region of Oulu constitute the development zone of international economic activity and growing population (primary zone)
- The centre regions of the development zone of middle-Finland include large growth centres, lower level centres of structural change as well as local centres of peripheral areas (secondary zone)

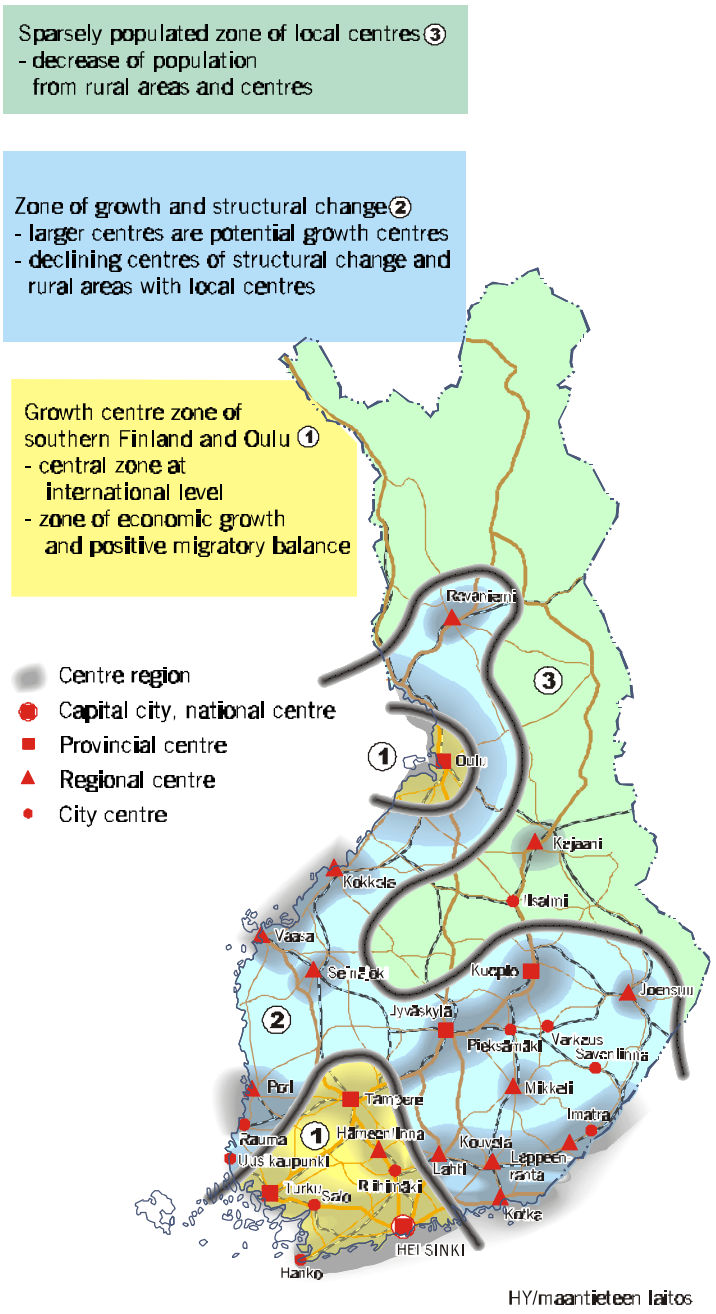


Figure. Development zones of regional structure in Finland.

Traffic volumes can experience significant local changes due to population development, which can affect the infrastructure needs of especially road traffic.

- The development zone of eastern and northern Finland includes lower level centres of structural change or declining development as well as sparsely populated peripheral areas (tertiary zone).

The changes in regional structure have a significant impact on the demand of road passenger traffic. It can be roughly stated, that the demand increases in the primary zone and decreases in the tertiary zone with the exception of some urban areas. The characteristics of the primary and tertiary zones can be found in the secondary zone. The concentration of population and economic development in southern Finland slows down the growth of domestic air traffic.

The changes in regional structure do not have a significant impact on the total demand of freight traffic. On the other hand, local changes can be significant.

The changes in regional structure have an impact on the transport infrastructure of all modes of transport.

3.5 Development of community structure

The community structure of many cities and built-up areas is dispersed. This is the case especially in growing urban areas. Simultaneously with dispersal, the community structure also integrates and becomes denser.

The development potential of traffic information and control systems is high.

Dispersed community structure promotes the demand for car traffic and the need for roads and streets, and at the same time, the operational conditions of public transport and pedestrian and bicycle traffic become weaker.

3.6 Technological development

Environmental questions, economic efficiency and changes in human values will guide technological development in the future. No special revolutions can be foreseen in the technological development with regard to the means of transport and transport networks excluding more environmentally-friendly engine technology of passenger cars.

The development potential of traffic information and control systems is significant. Many of the future applications cannot even be foreseen yet. Due to extensive transport network with relatively low traffic volumes, it can be argued for, that Finland could be the forerunner in adopting information technology based on satellite positioning of vehicles and telecommunications instead of technology based on roadside traffic guidance. One possible application of the new technology is traffic demand management through flexible pricing.

The impacts of technological development on national road network are relatively small. Qualitative changes are more significant in railway network (e.g. development related to automatic train protection, electrification and the introduction of high-speed trains). In urban areas, demand management technology creates a possibility for more efficient use of transport network, the adoption of flexible transport pricing systems, and thus reduces or postpones investment needs. The change is stronger with regard to terminals than to transport networks. The greatest pressure for change concerns the infrastructure of traffic information and control systems.

3.7 Internationalisation

Finland and Finnish companies have experienced rapid internationalisation. With the EU membership, the mobility of people and goods became significantly easier. The adoption of euro will make it even easier to travel in foreign countries and facilitate economic and other interaction with foreign parties. Also, at global level, Finland will participate more frequently in international cooperation.

The three dimensions of international cooperation in the transport sector include the EU transport policy, cooperation with other Nordic countries and cross-border cooperation with Russia and the Baltic countries. The enlargement of the EU will also have an effect on the transport sector.

Internationalisation will have significant impacts on the transport system of all modes of transport. However, internationalisation mostly contributes to the increasing demand of air traffic. The significance of global transport chains will be further emphasised and the

transport system and infrastructure of Finland should also be examined as part of the global transport chain. Therefore, special attention should be paid on the operation of ports and air terminals as well as on their ground transport connections.

3.8 The EU transport policy

The principles of the EU transport policy have been presented in the White Paper, which was adopted by the Commission in 12.9.2001. The main theme of the White Paper is the growth of transport and related problems in Europe as well as solutions to them. This challenge has been approached by:

- examining the transport system as a whole
- proposing measures for improving the efficiency and operation of transport system
- comparing social, economic, human and environmental impact relations
- promoting the use of transport pricing within a common framework
- utilising the development of technology and telematic systems.

The White Paper emphasises the need for making selections. The competition between the modes of transport should be controlled so that congestion and the dominance of road transports can be alleviated. Financing should be secured for the necessary improvements of infrastructure. The number of fatalities in traffic should be reduced to half by the year 2010. The methods of pricing should be adopted more commonly. Human needs and expectations should be satisfied with better transport services.

According to the White Paper, the harmonised development of the modes of transport requires the improvement of road traffic quality, the development of the vitality of railway traffic, the management of growth in air traffic, the development of the coordination between sea and inland waterway traffic as well as the promotion of intermodal cooperation.

3.9 Human values

Human values will change in time. Human values, which strongly affect traffic and transport infrastructure, include the growing significance of environment and traffic safety as well as the emphasis of individuality.

The significance of environment has increased in all sectors of life, as human knowledge on environmental aspects and problems as well as concern about the state of the environment has increased. The importance of environmental aspects has in many cases changed from a "factor worth considering" to a guiding factor. The significance and the impact of environment in transport can be examined at three levels: at local/company level, at national/economic area level (e.g. the EU) and at global level.

The importance of environmental aspects has changed from a "factor worth considering" to a guiding factor.

The aspects of environmentally-friendly transport system can be improved by technological development, regulations and agreements, economic guidance and pricing as well as by improving the environmental performance of transports and mobility (combined transports, environmental management systems).

The underlying principle of social policy is to aim at ecologically sustainable solutions: existing infrastructure should be developed and used as efficiently as possible, traffic minimisation is the goal in zoning, public transport as well as pedestrian and bicycle traffic are the favoured modes of transport and the management of environmental impacts is emphasised in transports during the entire life cycle of the product. "Green logistics" is an important part of the competitiveness of a company.

The restrictions of particularly carbon dioxide emissions affect mobility and transports at global level. The culmination of the carbon dioxide problem may lead to a new type of transport pricing and to need for mobility restrictions. This results in growing logistics costs and increasing challenges for international companies, so that the evaluation of the passenger and freight transport needs will have even stronger position in decision-making. In some cases, companies may even have to search for local market areas instead of global market areas.

Environmental aspects support the development of railway and waterway traffic.

The valuation of traffic safety has grown in recent years. According to the new "Traffic Safety Plan of 2001-2005" which was published in November 2000, the traffic safety vision in Finland is as follows:

"Road transport system should be planned so that nobody has to die or be seriously injured in traffic. The goal of this plan is to create preconditions for the continuous development of transport system so that there will be a maximum of 100 fatalities in traffic around the year 2025."

The implementation of the traffic safety vision will call for changes in several sectors of road transport system. The significance of traffic safety has also grown in railway and waterway traffic. The demand for traffic safety has traditionally been high in air traffic.

Individuality will become more important both with single dwellers and families. Individualisation is one of the essential forces of change in the development of logistics. Consumers wish to buy products and services that are tailored to their individual needs. The number of leisure trips and trips related to different spare time activities will increase. Individualisation will slightly promote the demand for road and air traffic both in passenger and freight traffic. The impacts of individualisation can mostly be seen in the growth of small and fast shipments in road traffic.

Vision on traffic safety: Nobody has to die or be seriously injured in traffic.

3.10 Development of logistics

The significance of know-how in logistics, as a competitive factor of companies, will become even more important due to the growing significance of customer orientation and individuality, the globalisation of trade, the networking of companies and the shortening of product life cycle. The characteristics of the development of logistics include the automation of terminal and port operations, the common utilisation of information technology at different parts of transport chain, the higher frequency of sea transports, the better integration of the different parts of transports into the transport chain, less warehouses and shorter storage times as well as the specialisation of terminals and transport entrepreneurs. The transport volumes of products with high unit costs will increase and then transport cost is not always the most important factor, but the good level of service and punctuality.

Although the development of logistics mostly affects the demand of air traffic, it will have a significant impact on the infrastructure of all modes of transport.

The level of service and punctuality are often more important factors than cost in the transports of products with high unit cost.

3.11 Intermodal cooperation and competition

Intermodal cooperation will increase both in passenger and freight transport chains. Travel centres and cargo terminals are in the key position in this development. Intermodal co-operation will also increase in road traffic; operational transport chains will develop (e.g. passenger car or bicycle – bus – pedestrian traffic).

High-speed railway traffic will increase the competition between railway traffic and air traffic especially on short and medium distances. The growing significance of environmental aspects and the changes in transport pricing may cause changes in the traditional shares of transport modes.

3.12 Summary of the impacts of the factors of change on traffic demand

A summary of the impacts of the different factors of change on the demand of passenger and freight traffic is presented in the figure below.

The figure shows that economic development and internationalisation have the greatest contribution to growing traffic demand. On the other hand, the growing emphasis of environmental issues mostly reduces traffic demand. The impacts of the factors of change on demand can primarily be seen in road traffic.

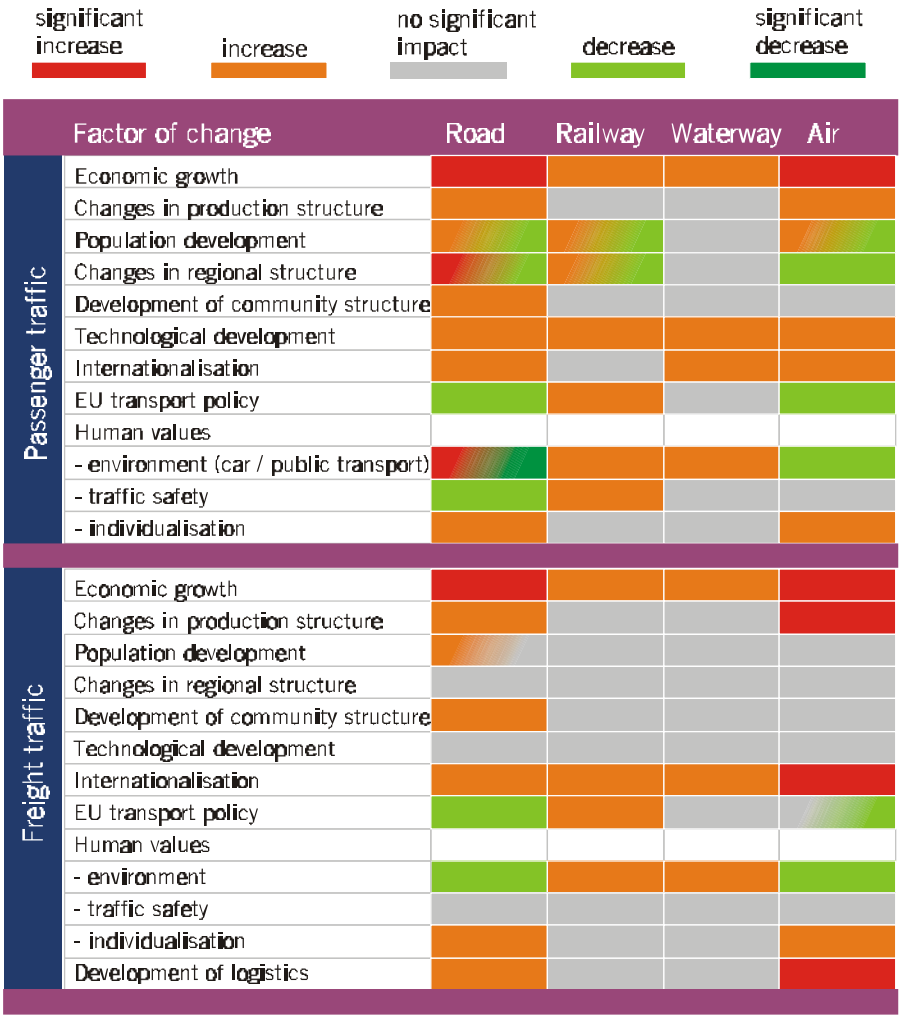


Figure. Impacts of the factors of change of operating environment on traffic demand during the years 2000-2020.

4. IMPACTS OF CHANGES ON TRANSPORT INFRASTRUCTURE

The more congested European airspace will cause delays to flights departing from Finland.

The changes in operating environment have different impacts on the transport infrastructure of different modes of transport. Impacts within the same mode of transport can be very different at different levels of transport system (international, national, local).

4.1 International transport system

The most significant factors of change, which affect the infrastructure of international transport system, include economic development, internationalisation and the EU transport policy, the growing significance of environmental aspects and technological development.

The impacts of the factors of change on the international transport system are primarily reflected in air and waterway traffic. The impacts of change on road and railway traffic are smaller.

The most essential impacts of change are the following:

- The increasing demand of air traffic both in passenger and freight traffic requires that international connections are also needed from other airports than Helsinki. The growth of air traffic contributes to increasing congestion in the European airspace, which is also reflected in the air traffic of Finland as even longer delays of flights.
- Air navigation systems are being developed. The European air navigation systems will develop towards a coordinated and, in the long run, centralised system managed by one organisation. The navigation system will develop from the existing ground radar technology towards satellite navigation.
- The congestion of airspace will shift trips and transports to fast ferry links in waterway traffic.
- The speed and frequency of vessels will increase in waterway traffic. The growing speed does not, however, have significant impacts on waterway infrastructure.
- With the automation of cargo handling methods, the need for land area at ports will decrease and land use will become more efficient. Also, storage needs will decrease. Therefore, more capacity is needed for the ground transport connections (roads, streets, railways) of ports.
- The networking of ports will increase. The cooperation of the pairs of ports, such as Kotka-Hamina, Turku-Naantali, Pori-Rauma, and Oulu-Kemi, will become more active.
- New types of ship technological solutions will promote the need for specific terminal and quay solutions required by ships.
- The growing significance of environmental aspects can be seen in waterway transport infrastructure, e.g. in the organisation of waste management and warehousing at ports.
- The development of navigation and traffic control systems will improve traffic safety and change the need and nature of fairway marking of waterway connections.
- Telematic and information technological solutions will allow for even faster and more accurate communication between the different bodies of the logistic chain. They will enable e.g. a scheduled flow of goods and the timing of freight traffic so that e.g. part of the cargo to RoRo-ships will be transported directly from road to ship. The

need for warehousing capacity will be smaller at ports.

- The smooth operation of the logistic chain will become an important competitive advantage in the international transport system. The reliability, sufficient capacity and traffic safety of ground transport connections to ports and airports should be attended to.

- Important road and railway connections include the Nordic Triangle, Helsinki-St. Petersburg-Moscow transport corridor, the Barents Euroarctic transport area, Via Baltica and the Bothnian Arc. The development need for connections to Russia will depend on the social development of Russia.

4.2 National transport system

Trips and transports in the national transport system usually occur between regional centres. Economic development, the changes in industrial structure, technological development, environmental and safety issues as well as intermodal competition have the most significant impacts on the national transport system. The impacts of the factors of change are mostly reflected in road, railway and air traffic. Impacts on waterway traffic are smaller.

No significant changes can be foreseen in modal split. Environmental and social viewpoints generate the greatest pressure on the shift in modal shares. The future of road traffic will also primarily decide the infrastructure development needs of the other modes of transport. The management of environmental hazards of vehicle traffic has a key role with regard to the future of the entire transport system.

The most significant changes in the national transport system are related to traffic information and control systems. Information and control systems will become a separate sector of infrastructure and they consist of traffic monitoring and measurement, traffic data banks and analysis systems as well as the transmission system of information and control data. Information and control systems overlap different areas and the modes of transport.

More intermodal terminals are needed. The travel centre network in passenger traffic enables flexible travelling using several modes of transport as well as supplies efficient and inexpensive information to passengers. The role of the technology serving feeder traffic is increasing. Particular technology with regard to the handling and compatibility of transport units is developing in freight terminals.

High-speed railway connections will be constructed between the regional centres of Finland. In addition to the upgrading of railway network, higher speeds require the renewal of rolling stock. There will be increasing competition between railway and air traffic,

Multimodal transport chains will become more common in passenger and freight transports, which create a need for more travel centres in passenger traffic and freight terminals.

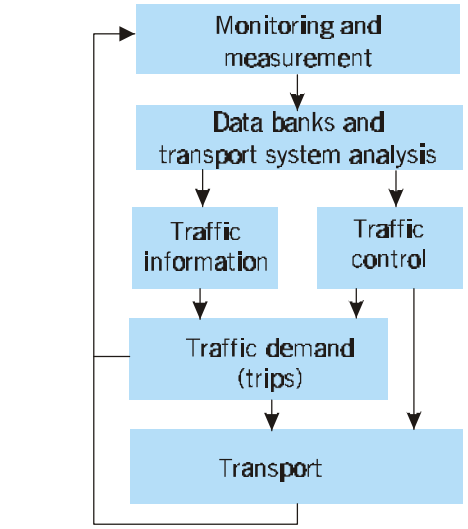


Figure. The process of traffic information and control system.

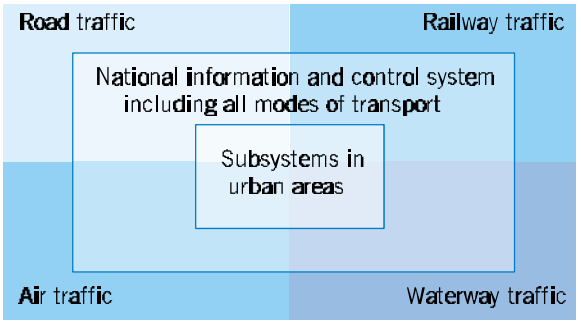


Figure. Traffic information and control system overlaps regions and the modes of transport.

when the high-speed railway network is extended. It is estimated that the number of passengers in air traffic will mostly decrease at short and medium distances (less than 350 km).

The proposed new charges due to environmental reasons will reduce the competitiveness of air traffic. The competition between airlines may also increase on domestic routes. There is a danger that regular services will be discontinued on short domestic routes. The role of municipalities in developing and maintaining the airports having low passenger volumes will increase in the future.

The demand of air traffic will grow significantly on long domestic routes. The level of service and safety of the road connections to busy airports should be paid more attention to so that the logistic chain in both passenger and freight transports would be competitive enough.

The qualitative development of road network focuses on completing the motorway network and improving the main road segments. New technological solutions include e.g. narrow four-lane motorways. Semi-motorways will be replaced by motorways or by narrow motorways. Traffic safety on main roads will be improved as part of other development or by separate measures. Pavement will be developed to be more durable and quiet. The development of construction technology will introduce more durable and lighter structures. New chemical and mechanical anti-skid methods will be developed to replace the use of road salt.

The greatest change with regard to road traffic is the development of information and control technology, which requires e.g. the development of traffic monitoring and information transmission systems. Due to extensive road network having relatively small traffic volumes, there are no similar pressures and possibilities to build an extensive information and control system based on roadside technology in Finland when compared to

The competition between railway and air traffic will increase, as the high-speed railway network is extended

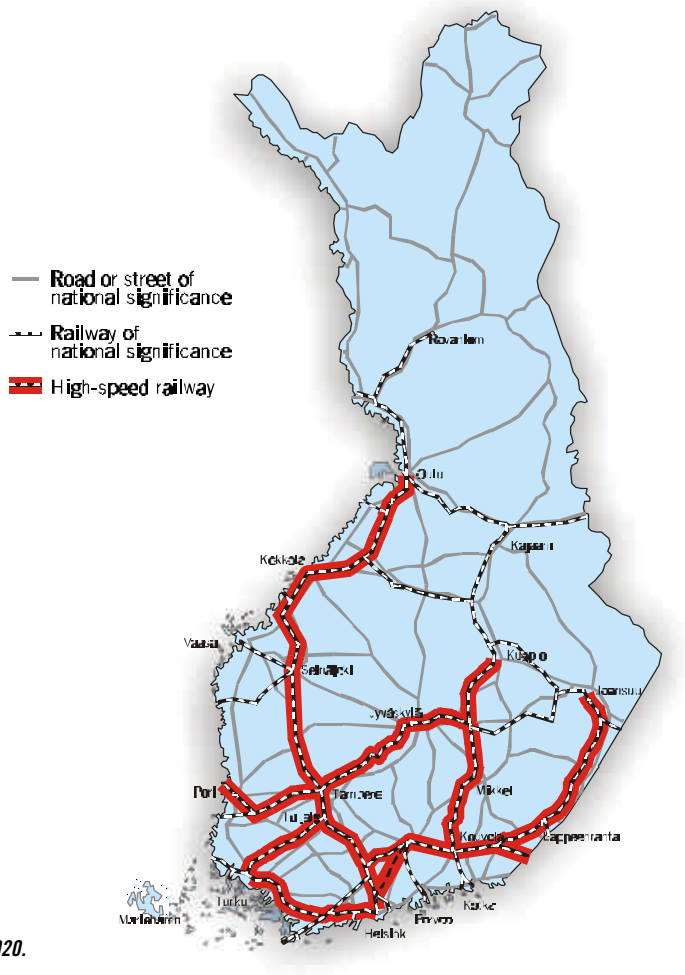


Figure. High-speed railway network in the year 2020.

Central Europe. Therefore, a potential alternative in Finland, unlike in Europe, is a quick adoption of information and control technology based on telecommunications and satellite positioning of vehicles.

High-speed railway traffic and the need for raising axle loads of freight trains require appropriate measures in railway network. Therefore, electrification, the construction of automatic train protection, the removing of level crossings and the upgrading of structure are under construction.

It is possible to slightly increase the share of combined transports on long railway connections. The profitability of transports requires, however, the development of terminal operations both at loading and unloading sites (particularly in Pasila and Oulu).

In air traffic, air navigation systems will develop towards a coordinated and, in the long run, centralised system based on satellite navigation.

Due to extensive road network having relatively low traffic volumes, the information and control technology based on telecommunications and satellite positioning of vehicles will be adopted faster in Finland than in the rest of Europe.

4.3 Transport system in urban areas

The location of an urban area or the development zone of the city has a significant impact on the development of the transport system in urban areas. The factors of change, that contribute most to the transport system in an urban area, include:

- in the zone of growing demand or the development zone of southern Finland and Oulu
  - favourable economic development
  - population growth
  - industrial structure (very high share of services, high share of industry)
  - changes in regional and community structure, dispersal and denser structure, great pressure on growth
  - changes in human values and increasing focus on environmental and safety values
  - utilisation of new technology;

- in the zone of growing/decreasing demand or the development zone of middle-Finland
  - economic development, tighter public finance imposes a threat
  - industrial structure (high share of services, high share of industry)
  - increasing focus on environmental and safety values
  - ageing of population;

- in the zone of decreasing demand or the development zone of eastern and northern Finland
  - decreasing and ageing of population
  - change in industrial structure and lower number of jobs
  - tighter public finance.

The changes in operating environment in urban areas affect the traffic volumes on roads and streets, and also the commuter rail traffic in the Helsinki Metropolitan Area. The impacts can be seen more clearly in urban areas than in national transport system.

High-speed railway traffic and the need for raising the axle loads of freight trains require appropriate measures in railway network.

The location of a city either in an area of growing population or in an area of decreasing population has a significant impact on the development urban transport system.

Urban areas in the development zone of southern Finland and Oulu

The growing traffic demand is partly met by the construction and improvement of transport networks and partly by traffic management (car traffic) to meet the tolerance of urban environment. Transport system will be occasionally congested, especially during rush-hour traffic.

Measures for improving traffic environment and safety as well as measures related to the traffic management of passenger cars are important in the development of urban transport infrastructure. Only few new roads will be constructed and some of them are ring roads. The level of service of old roads is mainly improved by junction improvements. City centres will be made more comfortable by reducing surface parking, increasing underground parking facilities and directing traffic underground. Right-of-ways and the service level of public transport will be improved. Public transport terminals and bus stop arrangements as well as feeder traffic (multimodal traffic) will be developed. The network of pedestrian and bicycle ways will be extended and the quality of this network will be improved. Pedestrian zones will be covered with roof and street heating will become more common. New technology will be widely adopted in traffic control. The information and control systems of urban traffic can be used in transport pricing, and thus reduce the demand of e.g. passenger car traffic.

The Helsinki Metropolitan Area has urban railway traffic, but it is possible to construct urban lines also in other large urban areas. Metro lines will be extended and tram traffic will be developed in the Helsinki Metropolitan Area.

Urban areas in the development zone of middle-Finland

The common direction of development is similar to the one in southern Finland. Municipal finance is not, however, at the same level, which limits transport infrastructure investments. Community structure will not become so dispersed as in the centres of southern Finland, although population will still grow.

Investments will be made for public transport terminals and public transport will be developed in central city regions. Simultaneously, the cityscape of centre areas will also be improved. Parking facilities or underground parking will be preferred. The network of pedestrian and bicycle ways will be developed. There will be less big investments, and the information and control systems of urban transport will not be developed so widely as in the centres of southern Finland.

In other centres, the focus of transport system development is on measures emphasising traffic safety and environmental issues.

Urban areas in the development zone of eastern and northern Finland

Population will only grow in built-up areas due to migration, and the average age of population is high. The amount of population will, however, enable the supply of versatile services. There will be no significant changes in the community structure of urban areas.

The focus of transport infrastructure management will be on maintenance. The number of public transport users is small, but transport services can still be provided without significant subsidies. Safety and environmental issues will be emphasised in urban transport system development. There will, however, be few investments. Typical investments include improvements in pedestrian and bicycle traffic and traffic environment.

4.4 Transport system in rural areas

The economic development of rural areas is often slow, but exceptions can be found. There are big differences in economic development between areas. The transport needs of rural areas mainly rely on road traffic. Waterway traffic has local significance in the archipelago municipalities. The significance of railway traffic is very small in rural areas.

Rural areas in the development zone of southern Finland and Oulu

The population centres of sub-regions are attractive with regard to economic activity and their economic development is mainly based on subcontractor industry and services. Population will grow in the centre areas of sub-regions and the age structure of population is favourable. The economic development of outlying areas will be slow and irregular. Population will be decreasing and ageing. Also, the number of jobs will decrease.

The focus of road management will be on maintenance in rural areas. "Just-for-need road management" will become more common in the road management of rural areas. The management of private roads is an economic burden to people.

Small traffic arrangements will be made in the population centres of sub-regions. They mainly deal with improvements in pedestrian and bicycle traffic as well as include small projects promoting traffic safety.

Rural areas in the development zone of middle-Finland as well as in eastern and northern Finland

Economic development will be steady in the population centres of sub-regions in middle-Finland, while it will be slow and irregular in other areas. Population will be decreasing and ageing. Also, the number of jobs will decrease. These zones are part of so-called recession areas. Public finance is primarily based on government subsidies. The increase in tourism will promote traffic demand.

The road network in rural areas consists of state-owned public roads and private roads. The emphasis will be on the maintenance of transport system and securing of connections. However, the road maintenance level has been lower with low level of financing and traffic conditions have deteriorated. Public transport will be based on on-demand traffic and the vehicle fleet mainly includes taxis. Schools have been closed due to decreasing number of schoolchildren. This results in longer school trips.

School trips become longer in rural areas due to the closing of schools.

Road traffic is the main mode of transport in rural areas. The focus of road management is on maintenance in the outlying areas.

5. MOST SIGNIFICANT FACTORS OF CHANGE AFFECTING TRANSPORT INFRASTRUCTURE

5.1 General

The most significant social changes with regard to transport infrastructure management include:

- national migration and the problems caused by it in the transport infrastructure management of growing and decreasing areas of population
- changes in transport needs and infrastructure provided by changes in industrial and production structure.

At national level, population concentrates on few growth centres. At regional level, population moves to cities and built-up areas. Most of the growth occurs in the regions of Helsinki, Tampere, Oulu, Jyväskylä and Turku. The areas of the greatest population decrease include the outlying regions of eastern, central and northern Finland.

Locally, population development has a significant effect on traffic demand and transport infrastructure management. In the areas of growing population, increasing traffic demand promotes both the need for transport infrastructure investments and the need for financing of public transport operations. In the areas of decreasing population, the greatest problem is to maintain low-volume road network in adequate condition with reasonable costs to serve permanent residents and the transports of agriculture and forestry.

The industrial and production structure of Finland has changed significantly in the 1990s. The structural change in agriculture has contributed to the decreasing number of jobs in agriculture. The traditionally strong branches of industry, forest industry and metal industry, have been supplemented by industry manufacturing high technology products. This branch of industry is a significant sector of national economy and is mainly concentrated on some growth centres, such as Helsinki, Oulu, Salo, Turku and Tampere as well as the surrounding municipalities.

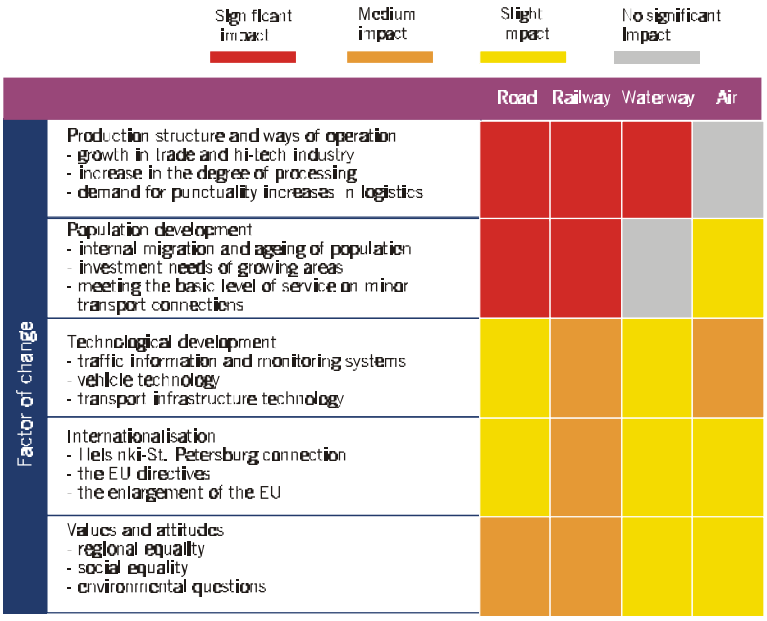


Figure. The impacts of the factors of change in operating environment on transport infrastructure management.

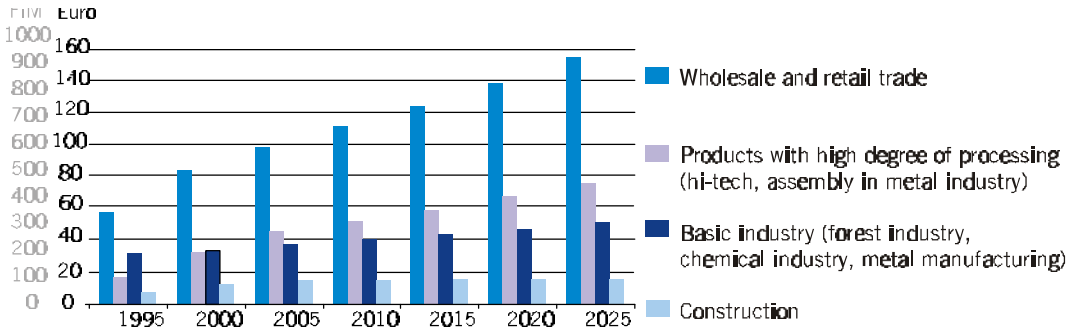


Figure. The turnover of the largest branches of industry in the year 1995 and forecast for the years 2000-2025.

5.2 Changes in industrial and regional structure

The industrial and production structure of Finland continues to change. With regard to the sectors of production, wholesale and retail trade will maintain its position as the largest sector of production measured by turnover also in the future. The industry manufacturing high technology products (manufacturing of electrotechnical and optical instruments = hi-tech as well as manufacturing of machines, equipment and the means of transport) has experienced the most significant relative increase which, measured by turnover, has risen to the level of so-called basic industry (forest and chemical industry as well as metal production). According to forecasts, the turnover of industry manufacturing high technology products will clearly exceed the total turnover of basic industry by the year 2025. The increase in the turnover of industry manufacturing high technology products will mostly come from the hi-tech branch.

The concentration of production is also connected to the change in industrial and production structure. After the recession of the past decade, the concentration of production to the Helsinki Metropolitan Area and to other university regions has accelerated. For example, a share of over 50 % of the turnover in trade came from the Uusimaa Region in the year 1998. The industry manufacturing high technology products has a very strong position in two regions, in Uusimaa and South-west Finland. On the other hand, basic industry is more evenly distributed all over the country.

As migration and the changes in industrial and production structure continue, the regional structure of Finland will also change: the development gap between regions will in-

The concentration of production to the Helsinki Metropolitan Area and to other university city regions will continue.

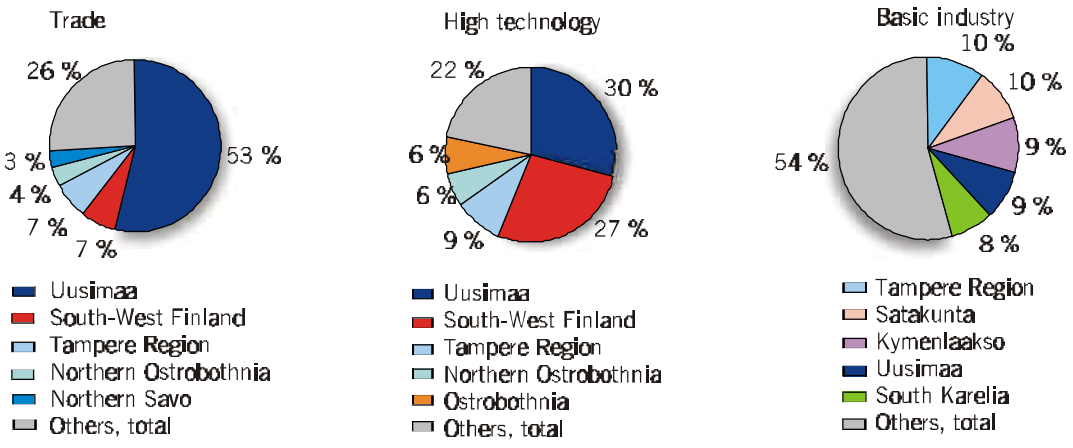


Figure. The most important regions with regard to trade, industry manufacturing high technology products and basic industry measured by turnover in the year 1998.

crease. As far as regional structure is concerned, Finland can be divided into the growth areas of southern Finland and Oulu, the areas of growth and structural change of middle-Finland as well as the sparsely populated areas of structural change and decline of eastern and northern Finland.

Due to the concentration of production and changes in regional structure, travel and transport needs will increase between growth centres. This may cause problems to smooth traffic operations in main transport networks. In areas of decreasing population, lower traffic volumes will cause problems to transport infrastructure management, which in turn, will affect e.g. the transports of forest industry and agriculture.

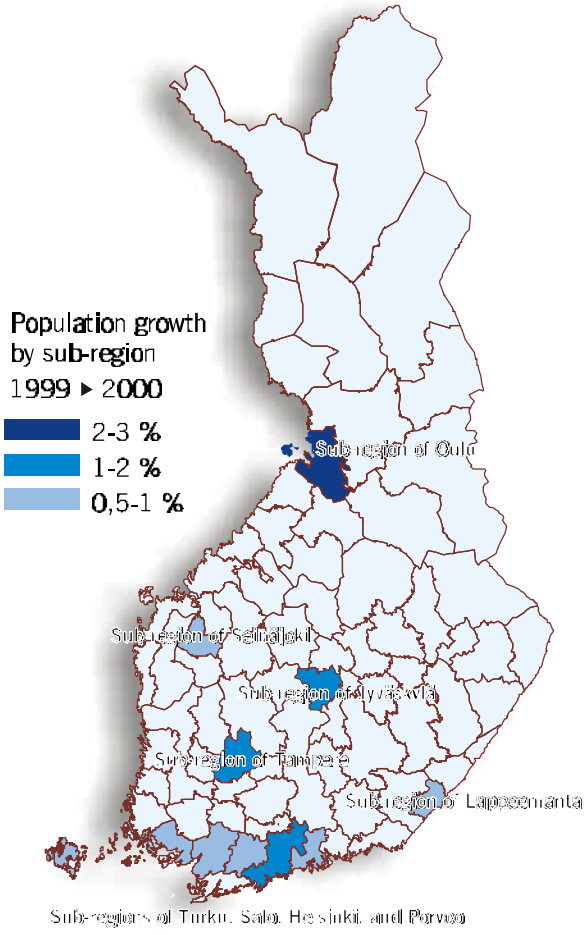


Figure. Sub-regions with the most significant population growth in the year 2000.

5.3 Transport infrastructure in growing regions

5.3.1 Growing regions and the rate of growth

Population growth has concentrated in the area of few sub-regions. Population increased in 24 sub-regions in the 1990s. There were 20 sub-regions with growing population in the year 2000 and the population growth was 29 400 people. The sub-regions of Helsinki, Oulu, Tampere, Turku and Jyväskylä had a share of about 85 % of this growth. The share of Helsinki sub-region was 13 300 people (45 %) and the share of Oulu sub-region was 4 600 people (16 %) of the increase in those sub-regions which had population growth in the year 2000. Oulu sub-region had the most significant relative increase of population (2,5 %) in the year 2000.

According to the forecast by the Statistics Finland, the migration of population to growth centre regions will continue. It has been estimated that the population in growing sub-regions will increase from less than 3 million to about 3,3 million people during the years 2000-2020. Most of this growth will be directed to the sub-regions of Helsinki, Oulu, Tampere, Turku and Jyväskylä also in the future. It has been estimated that the population of these sub-regions will increase from the existing 2,1 million people to 2,4 million people by the year 2020.

Also, economic growth has often been faster in the growing areas of population when compared to the rest of the country. Economic growth has also concentrated on the growth centre regions of southern Finland and Oulu.

5.3.2 The impact of change on the need for transport investments

Only part of the development need of transport system is caused by population growth. Economic development has a significant impact especially on vehicle traffic. Although it cannot be said that transport problems or measures for solving them are caused by population growth or by some other factors, the development need of transport infrastructure caused by population growth can be roughly estimated based on the traffic demand generated by population growth.

The need for transport investments caused by population growth has been calculated based on the fact, how significant is the need for public financing in satisfying the demand caused by population growth in growth centres. According to calculations, the annual cost of transport system development caused by population growth will be 26 million € (about 155 million FIM) during the years 1998-2010. This estimate only includes the calculated costs due to population growth and does not include all investment needs of growth areas.

The share of road and street investments is 50 %, public transport is 35 % and pedestrian and bicycle traffic is 15 % of the additional need for financing caused by population growth. Over a half of these investments are needed in Helsinki sub-region. The share of the financing need in public transport is over 70 % in Helsinki sub-region. The relative share of road and street investments of the additional need for financing caused by population growth is the highest in small growth areas and is the lowest in Helsinki sub-region. On the other hand, the relative share of public transport is the highest in Helsinki sub-region and the lowest in small growth areas. According to calculations, the annual need for financing of transport caused by population growth will be about 1700 € or about 10 000 FIM / new resident.

If migration continues at similar rate, the total additional need for financing of roads and streets caused by population growth will be 250-350 million € (1,5-2,0 billion FIM) during the years 2000-2020.

5.3.3 Threats and possibilities of growth

The most important threats and possibilities of growth include:

Threats

- Traffic congestion and environmental hazards caused by growing traffic volumes will reduce the attraction of growth centres, particularly in the Helsinki Region.
- The entrance roads, ring roads and terminal connections of large urban areas will become more congested.
- The growing congestion of transport network may contribute to increasing investments for improving the level of service of roads instead of improving the operational conditions of public transport as well as pedestrian and bicycle traffic.
- Due to growth, the focus of the financing of transport infrastructure management will be shifted to city regions and built-up areas which may lead to lower level of transport infrastructure management in areas of decreasing population.

Possibilities

- The development possibilities of public transport will improve in growth centres and in traffic operations between growth centres.
- The development possibilities of pedestrian and bicycle traffic will improve in all growing areas.
- The logistic efficiency of delivery traffic will improve, as retail trade and terminals concentrate.
- The concentration of growth will improve the competitiveness of railway transports.
- The demand for port services will grow in the vicinity of growth centres.
- Growth and globalisation will promote the demand and productivity of international transports. The growth of the Oulu, Turku and Tampere regions will create opportunities for more direct international flights from the airports of these regions.
- The improvement of the profitability and efficiency of public transport will free resources to maintaining the level of service of public transport also in the areas of decreasing population.
- The economy and efficiency of transport infrastructure and traffic management will improve in growth centres.
- Growing demand will provide opportunities for the improvement of connections.

Only part of the development needs of transport system are caused by population growth.

If similar development of migration continues, the total additional investment needs for roads and streets caused by the estimated population growth will be about 250-350 million € by the year 2020.

5.3.4 Measures for meeting the challenges of growth

The most important measures for meeting the challenges of regional growth include:

1 Regional development will be highlighted in transport policy as one sector among others. Transport policy measures and the impacts of single transport projects will be examined more systematically from the viewpoint of regional development in the future. This presumes closer cooperation with transport officials and officials responsible of regional development.

2 Growth centre municipalities should be committed to participate more in the investment needs caused by the land use decisions, also with regard to public road network. This would also have a guiding effect on land use planning, as then municipalities would aim at minimising total costs and not only their own costs. This may also guide the development towards more integrated community structure, and thus reduce traffic demand. Land use planning is an efficient way of managing traffic demand.

3 The cooperation and coincidence of transport system planning and land use planning should be emphasised in the transport policy of growth areas. Transport system planning should always be a part of master planning in urban areas. On the other hand, simultaneous land use planning (master planning) should not be forgotten in transport system planning. Significant results can also be achieved by influencing the overall values and attitudes.

4 The critical point of transport system planning is often the implementation of regional plans. Although the plans have been jointly prepared and adopted, different organisations do not always commit themselves to the implementation of plans. For more efficient implementation of plans, the Ministry of Transport and Communications has started the preparation of letters of intent of all transport system plans with organisations participating in the preparation of the plan. The first letter of intent was signed in November 2001.

5 In addition to infrastructure investments, measures based on information technology will be used more in transport and traffic demand management in solving the problems in large growth centres. E.g. transport pricing (e.g. parking fees, road tolls, tariffs in bus traffic) and regulations are potential measures in demand management.

6 The focus will be on the development of public transport in large urban areas. The development of pedestrian and bicycle traffic should be seen as an equal object for investments to road traffic especially in medium-sized cities, which have a high share and development potential of pedestrian and bicycle traffic. Passenger car is the dominating mode of transport in small growth centres and the operational conditions do not allow for high quality public transport due to small amount of population. The operation of pedestrian and bicycle traffic should, however, be developed particularly in the centre areas of growth centres.

5.4 Transport infrastructure in areas of decreasing population

5.4.1 Areas of decreasing population and the speed of migration

The most significant relative and absolute decrease of population has occurred in eastern, central and northern Finland. Population has decreased in 61 sub-regions in the 1990s. Population decreased in over 65 sub-regions in the year 2000 and the total decrease was about 20 000 people. The sub-regions of Tornionlaakso, northeastern Lapland, Kainuu, Ilomantsi and Kärkikunnat (in southeastern Finland) had the most significant relative population decrease in the year 2000. The decrease was 2-3 %.

According to the forecast by the Statistics Finland, migration to growth centres will continue. It has been estimated that the most significant decrease of population will occur in the sub-regions of eastern and northern Finland by the year 2020. According to the forecast by the Statistics Finland, the population decrease will be about 215 000 people in the sub-regions of decreasing population during the years 2000-2020. The population of these sub-regions would decrease from the existing about 2,2 million people to 2,0 million people. Judged by the population development in recent years, it seems that there may be even more sub-regions with decreasing population in the near future.

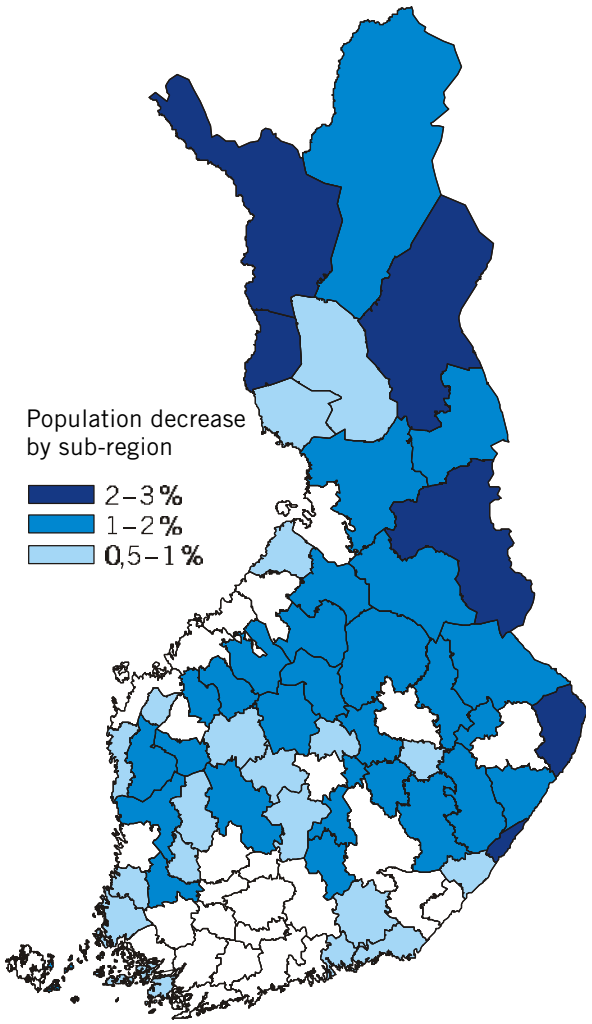


Figure. Sub-regions with the most significant population decrease in the year 2000.

5.4.2 The significance of infrastructure in areas of decreasing population and the impacts of population decrease on transport infrastructure management

Transport infrastructure is mostly located in the areas of decreasing population. About 57 000 kilometres (73 %) of public roads and about 3 900 kilometres (68 %) of railways were located in the sub-regions of decreasing population in the year 1999. There were 6 (26 %) ports having year-round operation (so-called winter ports) and 14 (61 %) airports of national significance in the regions of decreasing population. The number of ports and airports has been determined by region, as their impact area is larger than a sub-region.

The impacts of decreasing population are the result of many factors of change. Other simultaneous factors of change include e.g. changes in industrial and production structure, ageing of population, the concentration of services, the specialisation of agriculture and changes in regional structure. Changes in industrial and production structure often contribute to the decreasing number of jobs in traditional sectors and the creation of new jobs in new sectors. This leads to migration, as particularly young people of working age

It has been estimated that the population of the sub-regions of decreasing population will reduce from about 2,2 million people to about 2,0 million people or about 10 % by the year 2020.

have to move out from rural areas. The share of the elderly people (over 64 years) is estimated to grow to over 30 % in many municipalities of out-migration by the year 2030. In addition, birth rate has decreased significantly in areas of the greatest out-migration in recent years. Age structure has already become so distorted that population would decrease in most of the rural municipalities only due to low birth rate, even if out-migration would stop.

Due to the concentration of services (stores, banks, post offices) and schools, shopping and business trips as well as the transports of small goods and schoolchildren will grow. As the home care of the elderly people will become more common, the regular service traffic related to home care will grow. This service traffic occurs several times per day all year round.

As a result of the structural change in agriculture, agriculture and forestry will become more centralised and specialised. Currently, milk is collected from the farms every other day by large tankers. Also, the specialisation of other branches of agriculture (e.g. chicken, hog and cattle farms) will cause regular transports, several times per week all year round. Transport units have become larger, and the load on road has increased.

In forest industry, industrial plants have shifted to continuous, year-round wood transports (from forest to industrial plant). Wood is also transported at night time and during weekends. Wood is transported by full trailer combination lorries, which increase the load on roads. Also, peat transports to peat-burning power plants are continuous, all-season transports.

Tourism is fast growing branch of industry. It has a very significant role especially in Lapland and Kainuu. Functioning tourism requires good transport connections. E.g. the development of airports to meet the needs of the growing number of air passengers is important for the development of tourism in northern and eastern Finland.

The level of service of main transport connections will become even more important, as the activities of business life concentrate. Preserving the competitiveness of railway, road and waterway transports supports the activities of forest and metal industry in northern and eastern Finland. Also, daily flight connections to Helsinki are important.

Both internal connections and connections to other areas are important for the vitality of areas of decreasing population. The most significant impacts of decreasing population and related phenomena on transport infrastructure management are presented in the attached table.

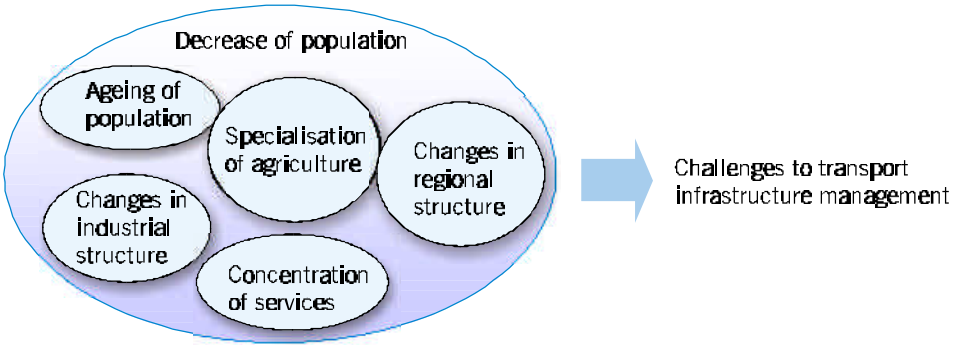


Figure. "Impact cluster" of population decrease.

The decrease of population mostly affects road management and primarily the management of low-volume public roads and private roads.

Also, traffic volumes will reduce with decreasing population, which will especially affect the economy of road management in the long run. Traffic volumes are not, however, the primary argument for low-volume road management. It is a question of sufficient accessibility of road network. Transport needs (e.g. commuter traffic and milk transports) should be secured for maintaining the vitality of rural areas, even if traffic volumes were low.

Although road management has developed towards "just-for-need road management" especially on the local connecting roads in areas of decreasing population, the condition of low-volume roads has, however, deteriorated in many areas. If this development continues, the basic services and transports in sparsely populated areas will become more difficult.

There are also similar problems on private roads. The need for road management does not change significantly on roads, which serve agricultural production. In some cases, year-

Table. The impacts of the factors related to the decrease of population on transport infrastructure management. (++ =significant impact, + =small impact, 0 =no significant impact)

Factor of change	Transport network						
	Roads		Railways		Waterways		Airports
	Main roads	Other roads	Main railways	Other railways	Main fairways	Archipelago Sea	
Internal connections within an area							
- Decrease of population		++		+		+	
- Change in population structure		+		0		0	
- Changes in service structure		+		0		0	
- Change in industrial structure and concentration of production		++		+		+	
- Changes in regional structure		+		0		+	
Connections outside of area							
- Decrease of population	+		0		0		+
- Change in population structure	0		0		0		0
- Changes in service structure	0		0		0		0
- Change in industrial structure and concentration of production	++		++		++		++
- Changes in regional structure	+		+		+		+

The decrease of population mostly affects low-volume road network.

As production concentrates, the significance of the level of service of main transport connections will increase.

round traffic may stop if the road is used only occasionally and there is no need to plough the road. The number of forest roads and roads to summer cabins will still increase to some extent. Simultaneously, existing private roads are used less and they will deteriorate.

The decrease of population does not have a significant impact on the maintenance level and condition of main roads. They will be kept in good condition through maintenance and replacements investments also in areas of decreasing population. Main roads cannot, however, be upgraded and developed.

In railway infrastructure management, the impacts of decreasing population mainly concern low-volume railways. Many of these railways have only freight traffic. The focus has been on maintaining their condition through minimum input. However, traffic operations may have to be discontinued on some low-volume railways. The decrease of population does not have an impact on the management of main railways.

The decrease of population will affect the management of the ferry traffic connections in the Archipelago Sea if regular traffic connections will be reduced due to lower number of passengers of if regular traffic operations will be stopped completely.

The decrease of population may affect the management of airports if regular traffic will be reduced due to lower number of passengers of if regular traffic operations will be stopped completely.

The decrease of population together with the change in industrial structure and the concentration of production will promote long-distance freight traffic. The level of service of main transport networks will become more significant.

The maintenance of main roads will be emphasised in the future, also in areas of decreasing population.

5.4.3 Measures for meeting the challenges of decreasing population

The most important measures for meeting the challenges of decreasing population include:

1 Funds will be allocated to the management of low-volume roads (public low-volume roads and private roads) and to those low-volume railways, which will be maintained also in the future. This provides for the basic level of service to meet the necessary needs of citizens and enterprises. The Ministry of Transport and Communications has established a Working Group in the autumn of 2001, which has a task of determining the basic level of service (the minimum level of service which is needed for securing equal regional development) for road and railway network by the end of the year 2002.

2 "Just-for-need road management" will be adopted more widely in the management of low-volume roads. Through "just-for-need road management", the scarce financial resources of public low-volume road management will be allocated as efficiently as possible to meet the demand by time and location. In this way, the additional need for financing the management of these roads is smaller. However, the savings through "just-for-need road management" are not necessarily significant. In some cases, costs may even increase. Every case should be examined separately.

3 Although the population of built-up areas will decrease in the areas of out-migration, it is important to consider the improvement of traffic arrangements in built-up areas so that their development will not be threatened. This concerns especially the development of pedestrian and bicycle traffic. This development has become even more important, as the number of the elderly people grows in the built-up areas.

4 It is important for maintaining and developing the vitality of areas of decreasing population that the main transport connections to the nearest regional centre and to Helsinki are in adequate condition, and smooth traffic operations are provided to these centres. It can be said, that the further the area locates from Helsinki, the more important fast transport connections are for regional development. Therefore, the development of the main road and railway network in areas of decreasing population is important. Also, regular air traffic services between Helsinki and the regional centres of central, eastern and northern Finland are important for the development of economic life in these regions.

5 In addition to national and regional connections, international connections should also be attended to and actively developed. The implementation of the projects in the Barents Euroarctic transport area will provide new possibilities for the development of northern Finland. Also, the development of other ground transport connections leading to the border crossing points of northern and eastern Finland will have positive effects on the municipalities and companies in these regions. Attending to the development needs of charter flights is a key issue for winter tourism in northern and eastern Finland, as winter tourism from foreign countries is mainly based on charter flights.

5.5 Challenges of the changes in economic life to transport infrastructure

5.5.1 Impacts of the changes in industrial structure on transport needs and transport infrastructure management

Economic growth will mostly promote the freight volumes of air traffic.

The development of the kilometres transported in road, railway and waterway traffic has been quite similar to the development of the GNP from the middle of the 1980s to the middle of the 1990s. A change has occurred in the latter part of the 1990s: the kilometres transported by mode have grown slower than the GNP. The most significant reason for this development has been the growing relative importance of trade and industry manufacturing products with high degree of processing in production structure.

The development during the late 1990s is also probable during the next decades. It is estimated that the GNP will grow by about 77 % during the years 2000-2025. With regard to freight transports, this indicates that the kilometres transported will increase by about 55 % in road traffic and by about 20 % in railway traffic. The freight volumes in waterway traffic will increase by about 35 %. International air transports will, however, experience the most significant increase, as freight volumes are expected to triple during the next twenty years. This is due to the strong growth of freight volumes in industry manufacturing products with high degree of processing, the increasing demand for speed and the internationalisation of shipments.

Due to changes in industrial structure, the share of road transports will still grow. Also, air traffic volumes will increase considerably. With regard to transport infrastructure management, this means that special attention should be paid to the level of service of the most important connections of main road network and to the most important road connections to airports and ports.

Main transport connections and road connections to ports and airports are very important to freight transports.

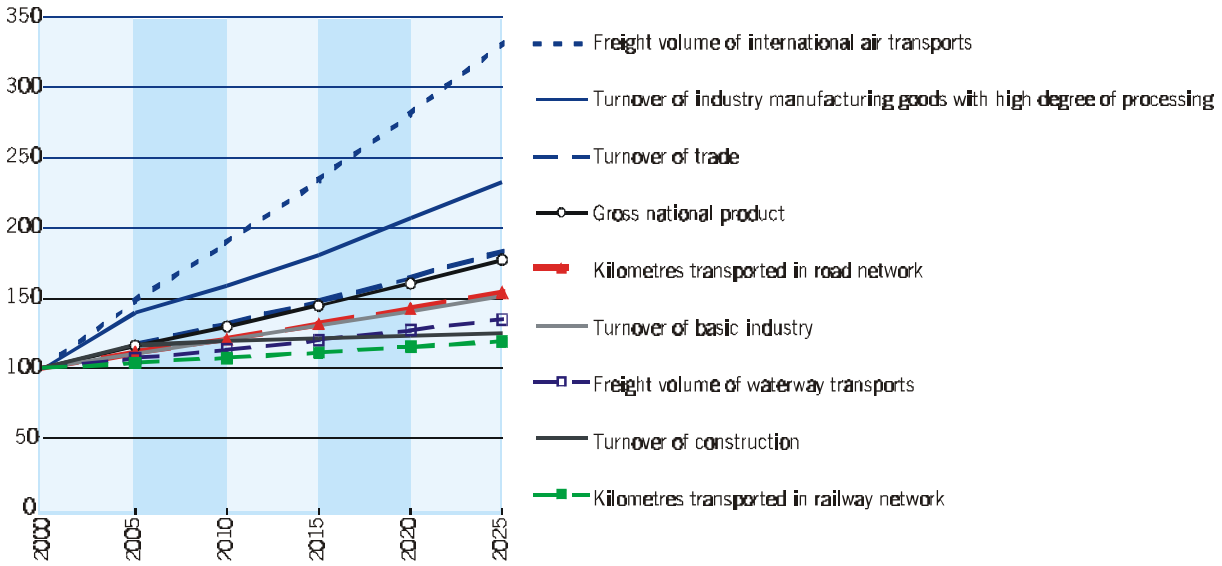


Figure. The estimated development of the turnover of the largest branches of industry and freight transports during the years 2000-2025 (2000 = 100).

5.5.2 Challenges to transports by different branches of industry

The characteristics of the current cargo flows in transports are determined by the branch of industry based on the transport quality criteria defined by customers. The characteristics (cost efficiency, punctuality and speed) are determined based on the primary desired factor (transport cost, punctuality of transport and transport time). Thus, one can talk about freight traffic having cost efficiency, punctuality or speed as a primary factor.

Cost efficiency is a very important factor in road transports of basic industry and construction as well as in all railway and waterway transports. Punctuality is the primary factor in road transports of trade, the industry manufacturing high technology products, food industry and textile industry, while cost efficiency is demanded in the sea transports of these branches of industry. Speed is an important factor in the air transports of trade and industry manufacturing products with high degree of processing.

By the year 2020, the characteristics of cargo flows are expected to develop so that even stricter demands will be set for transports, especially with regard to punctuality, but also to speed. On the other hand, the significance of cost efficiency will not decrease from the existing level. The demand for punctuality will become equally important to cost efficiency in road transports and equally important to speed in air transports. The demand for punctuality will also grow in the transports of basic industry.

The significance of punctuality in transports will grow in the future. Cost efficiency is still an important factor.

Table. Demand on transports by different branches of industry in the year 2020.

Branch of industry	Primary demand on cargo flows							
	Road		Railway		Sea	Air		
Wholesale and retail trade	Punctuality	Cost efficiency			Cost efficiency	Speed		
Hi-tech industry	Punctuality	Speed			Cost efficiency	Speed	Punctuality	
Metal industry: assembly	Punctuality	Cost efficiency			Cost efficiency	Speed		
Forest industry	Cost efficiency	Punctuality	Cost efficiency		Cost efficiency			
Chemical industry	Cost efficiency	Punctuality	Cost efficiency	Punctuality	Cost efficiency			
Metal manufacturing	Cost efficiency	Punctuality	Cost efficiency		Cost efficiency			
Construction	Cost efficiency	Punctuality			Cost efficiency			
Food industry	Punctuality	Cost efficiency			Cost efficiency	Speed		

The use of full loads is important in the transport network of cost efficiency.

5.5.3 Transports demanding cost efficiency, punctuality and speed

Cost efficiency is significant for the transports of particularly raw wood material, fuel as well as the products of forest industry, construction industry, metal industry and chemical industry.

The transport network of cost efficiency refers to the transport infrastructure, which is used in transports demanding cost efficiency. Cost efficiency can be achieved by using vehicle fleet that has capacity for heavy loads. Thus, carrying capacity is very significant on those network segments which have transports demanding cost efficiency. The carrying capacity of the network segment can be evaluated by its structural condition. The transport network of cost efficiency includes roads, railways, waterways, ports and cargo terminals.

The transport network of punctuality requires smooth traffic operations.

The transports of particularly the products of trade, high technology industry, food industry and textile industry will have a demand for punctuality and an increasing demand for speed in the future. The transport network of punctuality and speed refers to the transport infrastructure, which is used in transports demanding punctuality and speed. Smooth traffic operations are important on those network segments which have transports demanding exact transport time. The operational condition of the network segment is affected by the maintenance level and the level of service of traffic flow. The transport network of punctuality will include roads, airports and cargo terminals as well as some railways in the future.

The development needs of the transport networks of cost efficiency, punctuality and speed

Based on the characteristics of cargo flows, public road and railway network can be divided into transport networks of cost efficiency and punctuality. Categories of demand level can be determined to network sections based on freight volumes. The attached table presents the length of those road and railway sections which have very high, high, medium and low level of demand in the existing situation and in the year 2025.

Transport network of cost efficiency

The transports of basic industry will provide the highest freight volumes on transport networks also in the future. Cost efficiency is important for these transports. According to estimates, e.g. forest industry, which has an current share of almost one-third of the kilo-

Table. The distribution of public road and railway network into networks of cost efficiency and punctuality by categories of demand level (very high, high, medium and low) in the late 1990s and estimate for the year 2025.

Public road network

Category of demand level (freight volume on network segment)	Network of cost efficiency Existing situation		Year 2025		Network of punctuality Existing situation		Year 2025	
	km	%	km	%	km	%	km	%
Very high (> 2,0 million tonnes / year)	1 730	2	4 760	6	600	1	4 490	6
High (1,0 – 2,0 million tonnes / year)	3 410	4	3 000	4	1 850	2	2 610	3
Medium (0,5 – 1,0 million tonnes / year)	3 560	5	3 440	4	2 150	3	2 280	3
Low (0 – 0,5 million tonnes / year)	69 070	89	66 600	86	73 170	94	68 400	88

Railway network

Category of demand level (freight volume on network segment)	Network of cost efficiency Existing situation		Year 2025		Network of punctuality Existing situation		Year 2025	
	km	%	km	%	km	%	km	%
Very high (> 2,0 million tonnes / year)	n. 2 000	34	2 600	45	0	0	120	2
High (1,0 – 2,0 million tonnes / year)	n. 1 350	23	900	15	0	0	120	2
Medium (0,5 – 1,0 million tonnes / year)	n. 500	9	650	11	0	0	170	3
Low (0 – 0,5 million tonnes / year)	n. 2 000	34	1 700	29	0	0	5 450	93

metres transported on road and a share of about half of the freight volumes on railways, will experience a growth of about 55 % during the next 25 years.

With regard to transports demanding cost efficiency, the total length of road segments having at least high level of demand (>1,0 million tonnes/year) will grow from 5 100 kilometres to almost 7 800 kilometres and the total length of railway sections will grow from 3 300 kilometres to 3 500 kilometres. The road network at very high level of demand (>2,0 million tonnes/year) will extend from 1 700 to 4 800 kilometres and the railway network will extend from 2 000 kilometres to 2 600 kilometres. The demand level is very high on the ground transport connections of the most important ports.

The demand for cost efficiency in transports sets the following requirements on transport infrastructure management:

- The good structural condition of road network will be secured by maintenance and replacement investments on main roads and also partly on low-volume roads. Transport volumes will experience the most significant growth on almost all main road connections in southern Finland, on north-south road connections in central and northern Finland, on road connections to the largest ports and on some regional roads used primarily by forest industry.

- Good structural condition will be secured on railway network by renewing the superstructure.

- The carrying capacity of the most loaded sections of railway network will be increased so that it would permit the use of higher axle loads. In addition, cost efficiency will be promoted by extending the electrification in railway network, increasing the level of service of railways and developing rail yards.

- Maintenance dredging will conducted on fairways.

- The improvement of cost efficiency at ports will require higher degree of capacity utilisation and the development of operations through e.g. new logistics solutions. Cost efficiency is very important to all transports shipped through ports.

Transport network of punctuality and speed

It is very important for the transports of trade and hi-tech industry (manufacturing of electrotechnical products and optical instruments) that goods can be delivered in due time. These two branches of industry demanding punctual transports had a combined share of 44 % of the turnover of business activity in the year 1998 and this share is estimated to increase to 53 % by the year 2025. The significance of punctuality will also grow in the transports of basic industry.

The transports of basic industry will generate the greatest volumes on transport networks also in the future.

With regard to transports demanding punctuality, the total length of road segments at high level of demand (>1,0 million tonnes/year) will grow from more than 2400 kilometres to 7 100 kilometres. The total length of road segments at very high level of demand (>2,0 million tonnes/year) will grow from 600 to 4 500 kilometres. The significance of punctuality will also grow in sea transports, especially with regard to piece goods and industrial products. It is estimated that punctuality will become a very important factor in the railway transports of chemical industry. In railway network, the length of railway sections having at least high level of demand will be about 250 kilometres in the year 2025.

Transports demanding punctuality will grow particularly on connections between the largest urban areas. Cargo flows demanding speed will be concentrated in the vicinity of particularly hi-tech agglomerations and in the most important air cargo points primarily between the Helsinki Metropolitan Area and Turku, the Helsinki Metropolitan Area and Tampere as well as in the Oulu Region.

The demand for punctuality and speed in freight transports sets the following requirements on transport infrastructure management:

- Smoothly flowing traffic conditions will be secured especially on main road connections, on the ring roads of the largest growth centres and on airport and port connections of the Helsinki Metropolitan Area. These road segments include e.g. Road E18 between Muurla-Lohja, Ring Road III and the western by-pass road of Tampere. Currently, there are no significant problems of punctuality caused by transport infrastructure. For securing the competitiveness of the growing branches of industry, it should be ensured that no bottlenecks of traffic will be generated in the future.

The punctuality of transports will become even more important, as the turnover of trade and hi-tech industry increases. More punctual transports are also needed in basic industry.

- The improvement of punctuality and speed at ports and air cargo points requires higher degree of capacity utilisation and the development of operations through e.g. new logistics solutions. Ports having particularly export and import transports demanding punctuality (over a million tonnes in the year 1999) include Hamina, Kotka, Sköldvik, Helsinki, Hanko, Turku, Naantali, Rauma, Pori and Kemi.

The measures for improving cost efficiency in railway network (renewal of superstructure, electrification, increase of rail capacity, rail yard investments) also improve punctuality.

5.5.4 Transports of valuable products

Valuable products are products with high degree of processing. These include e.g. machines, equipment, electronics, means of transport, medical and other products of chemical industry, clothing, textiles, shoes, glassware and ceramics as well as textile fibres etc. The transports of these products have to be rapid and punctual. Industry manufacturing products with high degree of processing operates primarily in international markets and the transport chains of it are mostly international. Several modes of transport (road, air and waterway transports) are used. The weakest link of the entire transport chain determines the success of the transport.

The "value network of transport" refers to the part of transport infrastructure which is used for the transports of products with high degree of processing. Road network constitutes an essential part of the "value network of transport". Due to international transports, ports and air cargo terminals also have an

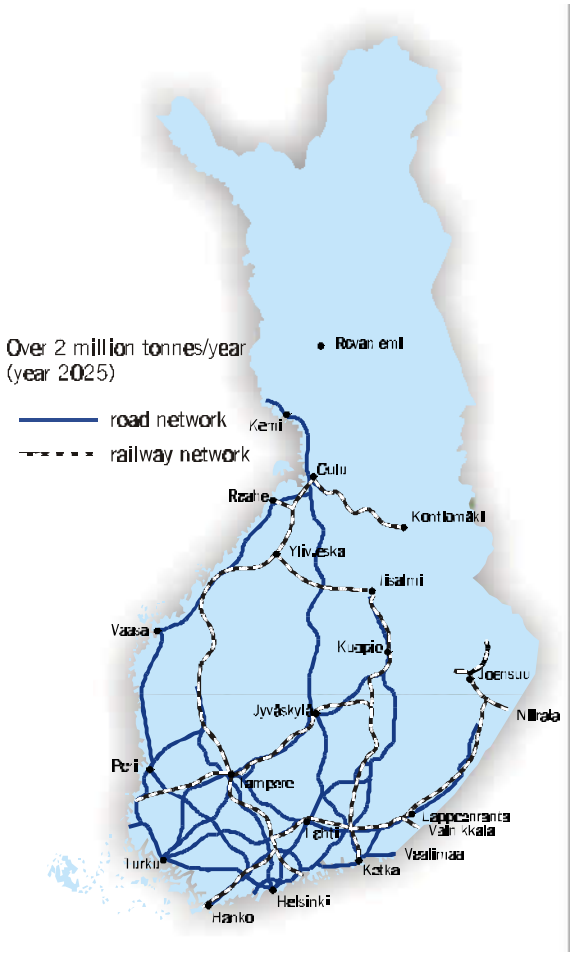


Figure. Road and railway network of transports demanding cost efficiency in the year 2025.

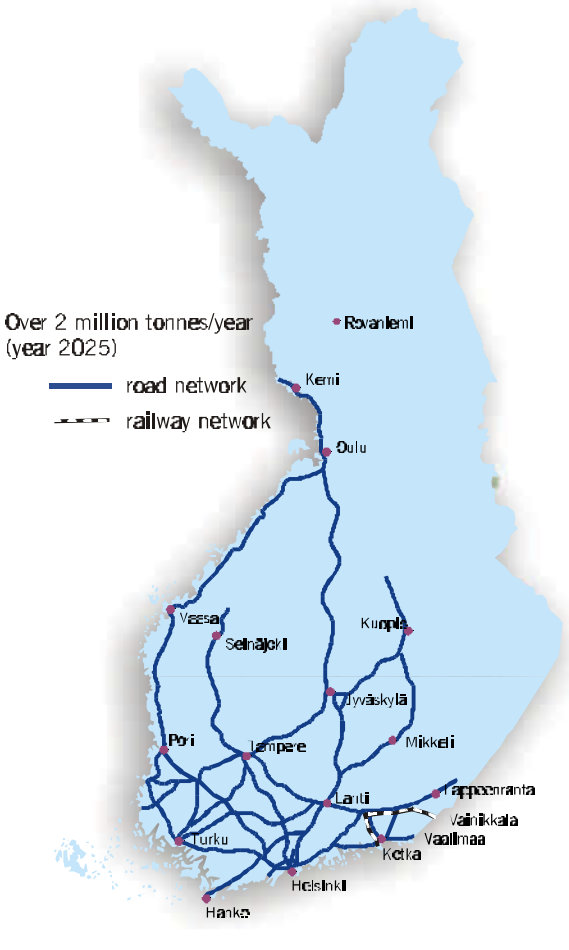


Figure. Road and railway network of transports demanding punctuality in the year 2025.

important role as part of the "value network of transport". The rapid development of information and communications technology has provided considerable opportunities for smoothly flowing transport chains.

The cargo flows of industry manufacturing products with high degree of processing have concentrated on some main road connections and on some ports as well as on the Helsinki-Vantaa airport. This concentration will probably continue in the future.

The attached figure shows the sections of the transport network, which had the highest transport volumes of products with high degree of processing in the year 2000. The criteria with regard to road network is, that freight volumes should exceed 100 000 tonnes/year. With regard to air transports, only the Helsinki-Vantaa airport, which had a total freight volume of almost 100 000 tonnes in the year 2000, is part of this network. It is complicated to define the criteria with regard to ports, as the share of products with high degree of processing cannot be determined exactly. However, three ports, Helsinki, Turku and Naantali, are undoubtedly part of the "value network of transport".

Transport volumes of products with high degree of processing are significant on road segments, which also have the most significant growth of passenger traffic. With regard to transport infrastructure management, the challenge caused by these transports is, how punctuality or smooth traffic operations will be secured on the roads of southern Finland, on the ring roads of the largest growth centres as well as on airport and port connections. The problem is that the implementation of infrastructure projects of this kind would, in some cases, seem to be in conflict with balanced regional development.

Shifting of the focus of production structure towards high technology and the development of logistics will increase the demand for air cargo services. Many companies would be ready to use more air cargo services, if sufficient capacity exists. In the determination and implementation of transport policy, air cargo services should be examined particularly from the viewpoint of economic life and not only as a small part of air traffic.

Many problematic points in the transport chain of products with high degree of processing are not directly related to infrastructure, but to operations and services. Information flow has an important role in the management of the existing, complicated delivery chain. Many companies have problems and improvement needs in the management of this. The harmonisation of the customs operations in the EU countries with regard to transports directed outside of the EU is also considered important by companies.

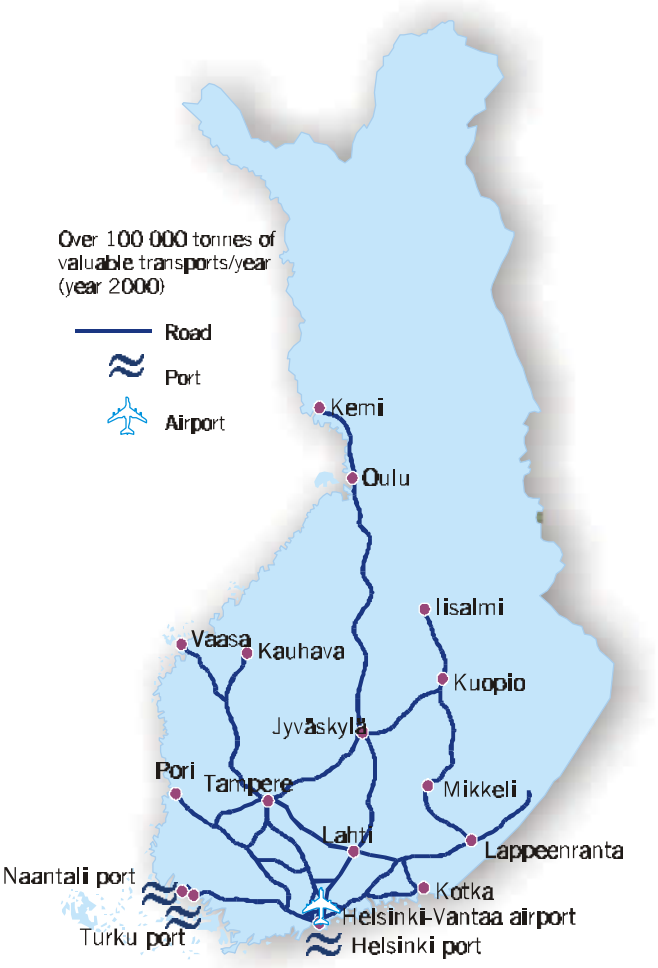


Figure. The network of valuable transports in the year 2000.

The supply of air cargo services does not entirely satisfy the demand.

5.5.5 Example of setting priorities to transport investments from the viewpoint of economic life

The benefit-cost analysis has currently a central role in the evaluation of transport projects. The benefit-cost ratio, which is the result of this analysis, indicates the ratio between the calculatory benefits and costs of the project discounted to the implementation year. The benefit-cost ratio provides a good indication of the advantages of the project to the society, and is often an adequate tool for the comparison of projects. However, it has been criticised of being "non-transparent", as the reasons behind the advantages or disadvantages of the project are not very obvious. The benefit-cost ratio neither indicates, how the project will achieve the common goals of transport policy. Indicators would be needed for this kind of analysis, which describe the impacts of the project by the sectors of transport policy.

It was experimented in the TRANSPORT INFRASTRUCTURE 2030 -research programme, how the information produced in the studies on the characteristics of transports in economic life (cost efficient, punctual and rapid transports) can be utilised in setting priorities to projects. Investments in road, railway and waterway network were ranked according to their freight traffic volumes (cargo volumes or kilometres transported) converted to lorry units. At the same time, it was also estimated what is the share of transports demanding cost efficiency or punctuality or is defined as "valuable transports".

The comparison by freight volumes (daily lorry units) describes the differences in traffic demand at every cross-section of road, railway or waterway. For example, it has been estimated that there are less than 2 000 daily lorry units on the western ring road of Tampere. A share of 60 % of them includes transports demanding cost efficiency and 40 % include transports demanding punctuality. A share of about 15 % of the transports demanding punctuality is "valuable transports". Road projects, which have high freight volumes, succeed in this kind of comparison, which only considers traffic demand.

The comparison by kilometres transported (daily lorry kilometres) describes the potential benefits of projects. The comparison by kilometres transported highlights such railway and waterway projects which have small cargo flows, but long transported distances. These projects include e.g. the improvement of the Naantali entrance fairway and the electrification of the railways in northern Finland. It should be remembered when comparing the projects that the impact area of the project is larger than the area where daily lorry kilometres are calculated for. For example, the deepening of fairways permit the use of bigger and more cost efficient vessels in the transports between Finland and the port of destination.

The presented evaluation can be used to supplement the benefit-cost analysis. It helps to understand, what the benefits to economic life are caused by, and it allows for the allocation of investments so that the benefits to economic life are as comprehensive as possible. A similar approach could also be tested in setting priorities to projects with regard to other sectors of development (e.g. the balancing of regional development, safety and environment).

When setting priorities to projects, the benefit-cost analysis can be supplemented by a method of comparing freight volumes, kilometres transported and the characteristics of transported goods (cost efficient, punctual and rapid transports).

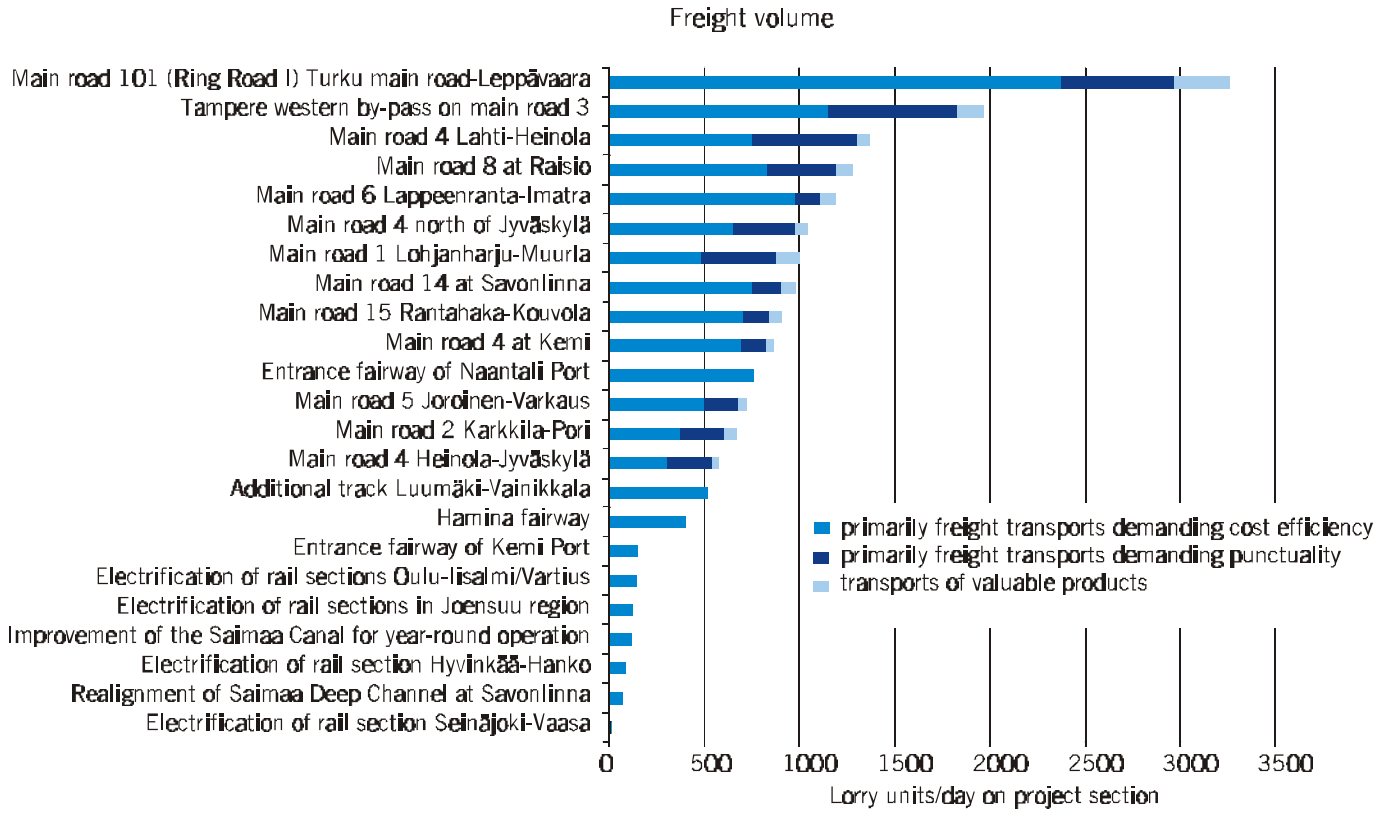


Figure. Priority development projects in transport network ranked by current freight volumes.

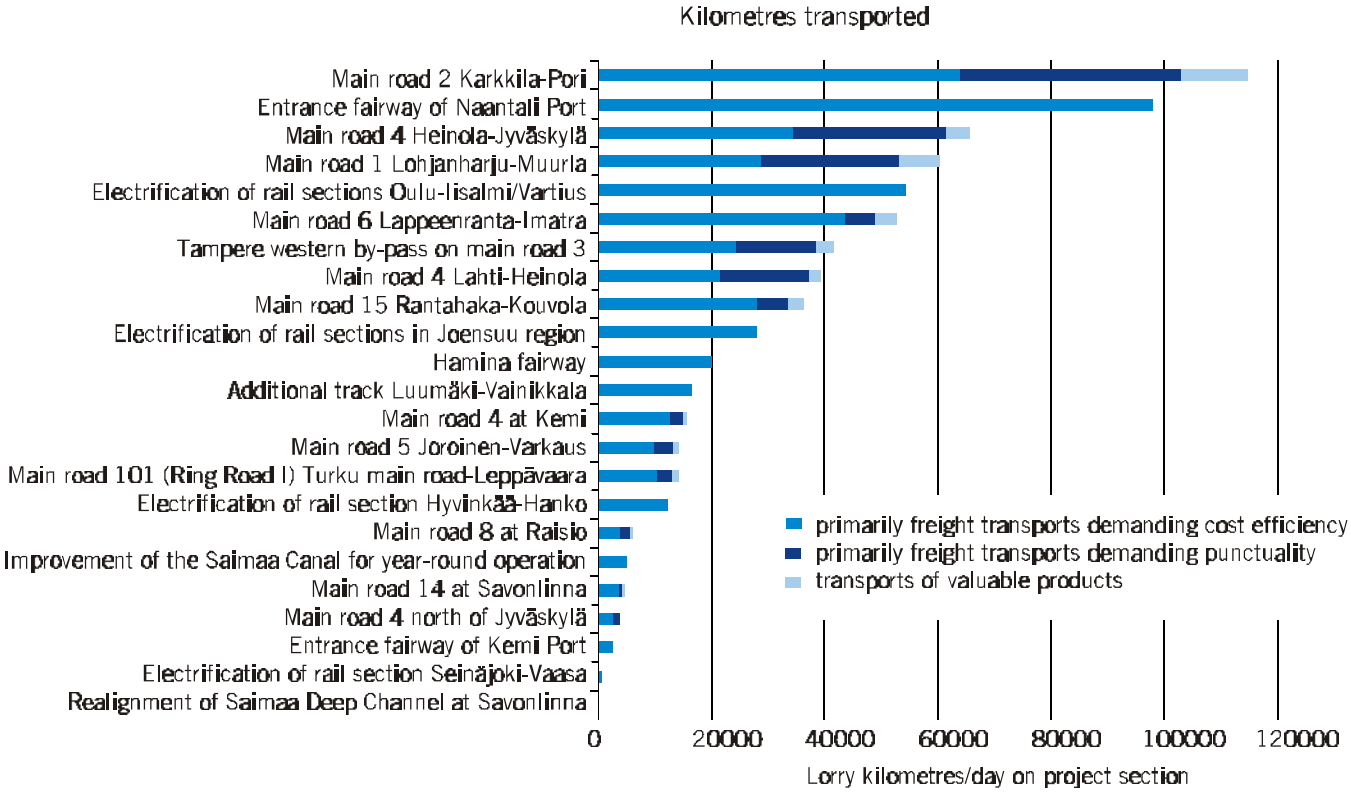


Figure. Priority development projects in transport network ranked by current kilometres transported.

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