HERMES

Healthy, Safe and **E**cological
Road Transport, **M**obility and
Energy use for better
Sustainability
in Finland with ITS-Intelligent
Transportation Systems

This Study was prepared for the
Ministry of Transport and Communication
(MINTC) Finland,
by Moving Forward Consulting;
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MOVING FORWARD
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HERMES - The Greek God of Roads and Travel.

He was also the Greek God of astrology and astronomy, hospitality, gymnasiums, heralds, diplomacy and trade, writing and language, thievery, persuasion, and athletic contests.

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1 Management Summary

The Study "HERMES" shall serve as a thinking paper and give orientation for the upgrade the Mobility of People and Goods in the transport ecosystem in Finland, and focuses on four ITS innovations: Robot Cars (Autonomous Driving), Mobility as a Service (MaaS), Mobility Pricing, and innovations for Freight & Logistics.

Up to date information is collected on international expectations, developments and best practices. They serve as a base for an analysis, conclusions and recommendations for their deployment in Finland. Critical questions initially made by MINTC how to build the future mobility in Finland are also handled to find out answers for the impacts to the Convergence of Transport happening in Finland - and also worldwide. HERMES also analyses how the ITS Innovations will support businesses and competitiveness in Finland.

Intelligent Transportation Systems - ITS - have proven worldwide to deliver better (road) safety, increase efficiency, reduce congestion, ensure financing, and foster environmentally friendly mobility of People and Goods. Implications for urban (greater cities and regions), inter-urban and rural areas of Finland are handled.

Innovations in ITS that have started to happen, they will bring new services and new possibilities as well as create opportunities and synergies for all modes of Transport. We need to acknowledge that innovations are happening anyway around us, due to digitalization, automation, and servitization. The Study undertakes the effort make a global analysis and to proactively analyze their strengths, opportunities, weaknesses and threats (SWOT), and then develop proper Policies and strategies for deployment for the benefits of Finland.

HERMES analyzes the **impacts of these ITS Innovations** related to major sectors in Finland, which are: Transport, Infrastructure & Construction, Energy, Environment, Road Safety & Health, ICT, and the Economy.

The major picture for the four ITS Innovations handled by this study can be described as follows:

Robot Cars – supported by a fast deployment of electric vehicles - will create new transport services for Cities / Regions and for rural areas, support high capacity public transport, reduce the amount of vehicles, reduce parking spaces needed, reduce congestion, improve road safety, and modernize the vehicle fleet. Robot Cars will also foster Shared Mobility and give the society a wider access to mobility. Robot Cars have a strong link to MaaS to manage the services offered by Robot Cars, and also to Mobility Pricing, to ensure sustainability. The timeline can be seen from 5-15 years, dependent on the degree of automation. Robot Cars will work most effectively (less spacing between vehicles is needed) if own lanes are offered, and in many cases existing road infrastructure can be utilized for this. Good communication is needed to reach acceptance by the users. Robot Cars require reliable (24/7) and strong communication & ICT back bones. Robot cars will also require adaptation of regulations, also for data privacy. (Electric) Robot cars contribute also to environmental protection.

Mobility as a Service upgrades and combines existing transport services with the goals of better offering and more efficiency. MaaS will support the (future) increase of Mobility needs. MaaS will offer new or improved services in intermodal passenger transport, and will create more efficient end to end mobility offerings, and give better information before, during and after travel. MaaS will require strong cooperation between Public and Private stakeholders.

MaaS also support the "Shared Economy". MaaS requires and "Independent Mobility Service Platform" offering neutrality and a fair business model. Mobility Pricing will ensure implementation of Sustainability Policies and also sustainability of pricing. MaaS will help to interconnect better Cities or regions, and support Twin City developments, like Helsinki-Tampere, Helsinki-Turku-Stockholm, or Helsinki-Tallinn. MaaS depends on reliable 24/7 ICT structures, and needs to ensure data privacy rules. MaaS contributes to reduction of emissions.

Mobility Pricing is an efficient Policy tool to guarantee and observe policies for fair and sustainable mobility. Mobility Pricing (MP) included all internal cost (investments and operation) and all external cost (pollution, noise, energy risks, etc.) for each trip and for all transport modes, for both local and international users. MP helps to change the behavior of users toward more sustainability. It throttles the existing capacity with the demand, and is thus a lever against congestion. Mobility Pricing creates fairness and cost transparency. Mobility Pricing supports to include "Pay as you use" models to relief tax financing. MP requires harmonization of existing transport and taxation policies. MP also supports environmental protection.

Freight and Logistics are supported by ITS Innovations and best practices in order to increase efficiency, foster a better position against (international) competition, supporting and modernizing Finnish Hauliers, Ports, or Transport Service Providers. ITS innovations for Freight and Logistics (F&L) will also foster cost reduction, automation, multi-modal and inter-modal services as well as modernization of fleet. Mobility as a Service principles and business models shall be also applied to F&L (MaaS for Goods). Mobility Pricing will generate better cost transparency, fairness, less energy consumption, and ensure sustainability. ITS Innovations applied to F&L will also support better environmental protection.

Key Performance Indicators - KPIs – with relevance to Mobility and Transport have been summarized, being based on publicly available and neutral statistical data, in order to describe the tendencies and impacts on the major sectors in Finland. SWOTS, strategic summaries, and policy recommendations are generated to allow Policy and strategy development.

The Study suggests also to initiate inter disciplinary work groups or task forces to introduce these ITS Innovations to the public, and foster their deployment:

1. WG for Policy and legal framework development;
2. WG to develop a dynamic communication platform and argumentation toolkit;
3. WG for KPI definition and EU harmonization;
4. WG to develop a Dynamic Mobility Simulation (DNS) Model for the quantification, monetization, and analysis of inter-dependence of KPIs and impacts;
5. WG to define and manage pilot projects and specific research topics.

Best utilization of the mentioned ITS Innovations can happen only in **close cooperation of all public and private stakeholders**. Finland has many strengths and is in good position in regard of ICT and ITS, but the situation may change, since many global risks exist. The Public Sector shall serve as a dynamic Enabler. The convergence of Mobility needs strong Policies and wise actions.

Table of Content

2 Introduction

2.1 Goals for the Study

We are facing critical questions how to build the future transport ecosystem and mobility in Finland. HERMES analyses the strategic potentials of new and innovative future ITS technologies, solutions and services – hereafter named "**ITS innovations**", and describe their principal benefits and impacts when deployed to Mobility and Transport in Finland. HERMES may serve as an input to the Finnish Government Program on Transport and Mobility as well as for the stakeholders in the ITS Industry.

Four ITS Innovations have been selected for the Study:

- Robot Cars (Autonomous Vehicles)
- Mobility as a Service (MaaS)
- Mobility Pricing
- Innovations in Freight & Logistics

HERMES addresses the following SIX questions:

1. Policy and Structure of a new Pricing Model for Mobility:
   How a future Pricing Model needs to be designed and structured to support the successful deployment for MaaS, Robot Cars, or Freight & Logistics, as well as to foster sustainability, inter-modality and full cost aspects**?**
2. What effects of MaaS are to be expected?
3. What impacts and tendencies will the Convergence of Transportation have on major Key Performance Indicators (KPI) in related sectors in Finland?
4. What major impacts shall the future Transport Eco-System have on Finland's Financing, Safety, Mobility, Congestion, Energy, and Inter-Modality?
5. How will the future Transport Eco-System support businesses and competitiveness in Finland?
6. How these ITS Innovations can be supported by an "argumentation toolbox".

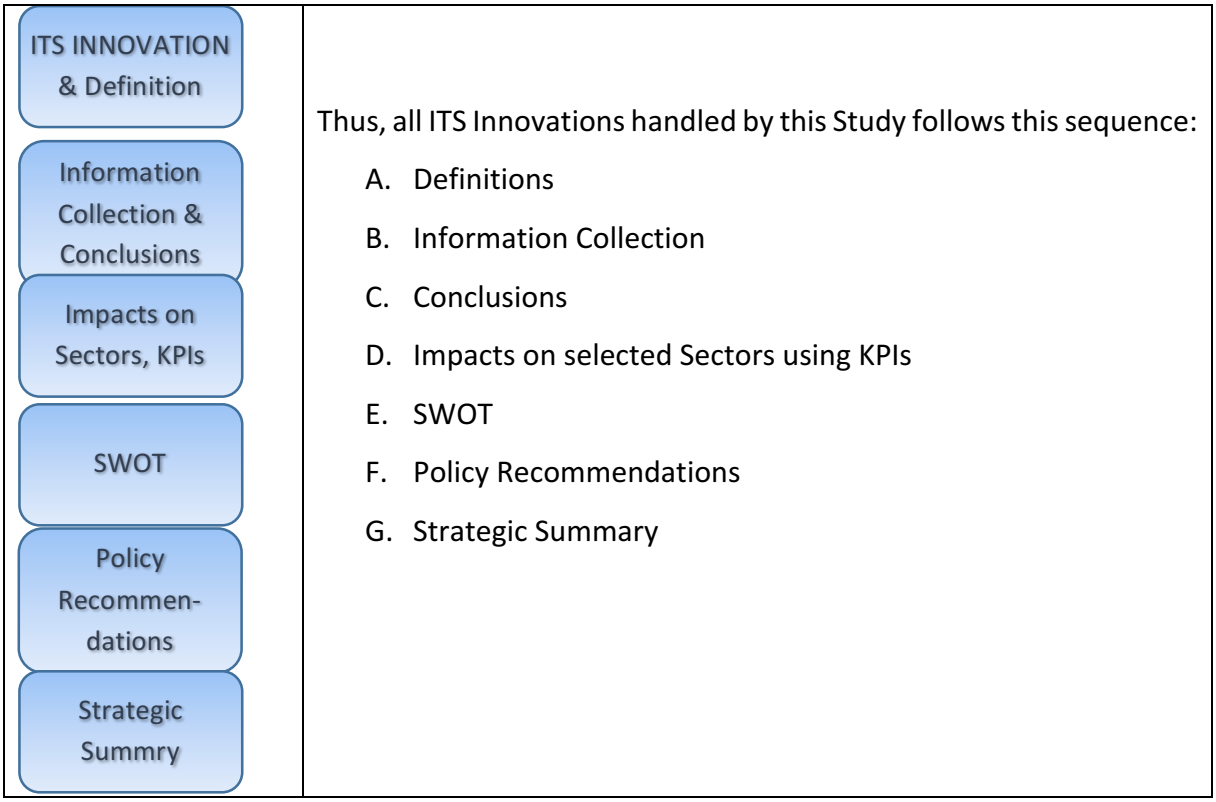
It is understood that the initial starting point for HERMES is road traffic, but the Study also focuses on the implications of the ITS Innovations for Public Transport.

2.2 Methodology of the Study

HERMES is structured as an Applied Study. The information gathered from a variety of sources, including government publications, trade journals, newspaper articles and web sites, was subsequently synthesized into an assessment of existing and forthcoming challenges. Please, find the list of information sources in the attachment.

The up to date information from global and multidisciplinary fields related to the analyzed ITS Innovations created the content of HERMES with the following aims:

- Information collection on **Policies and Strategies related** up to date **information on global trends** and directions from major global regions (Europe, the United States of America, Asia/Pacific) to give an **overview** on developments, best practices, studies, projects, newsroom, etc. from publicly available sources in the context required;
- to describe **positions of global Governmental Organizations and Associations**;
- to project and **apply the impact of the four ITS Innovations to selected Sectors in Finland**;
- to identify **publicly available statistical data** to be related as **Key Performance Indicators** (KPIs) for the ITS innovations; also to give recommendations are made for new KPIs needed in the future.
- to give **policy recommendations**;
- to generate **SWOT** and **strategic summaries**.



2.3 Key Performance Indicators used in the Study

In the context of this Study, neutral KPIs are used to describe and evaluate the success of the ITS innovations analyzed. The KPIs shall help to understand and quantify to make progress toward the deployment. The KPIs selection and information sources finding were strongly supported by The Ministry of Transport and Communications (MINTC), and TRAFI, the Finnish Transport Agency.

For the KPI bases, mainly publicly available sources have been chosen.

The following "KPI Matrix" has been created Attachment 1 lists the KPI Matrix (inclusive sources).

a) to relate the KPIs to the selected ITS Innovations [*)], and

b) to cross reference the KPIs to the selected Sectors [**)] to describe the impacts of the ITS innovations

[*)] Robot Cars, MaaS, Mobility Pricing, Freight and Logistics

[**)] Transport, Infrastructure, Energy, Environment, Safety & Health, ICT, and Economy

Notes:

A. In order to describe the impacts of the ITS innovations, also definition and collection of some new KPIs and statistical data will be needed.
B. A projection of the impacts of the ITS Innovations on the Health sector was difficult to quantify because of lack of available statistical data.

The KPIs will be referred to in the following sections of the document. The findings of the Study shall be applied to the relevant KPIs as a "first projection" in order to give an overview on the effects the various Sectors.

For the final document, structured tables will be incorporated into the Study document.

In this context it should be mentioned, that a new Model of European Key Performance Indicators do exist and should thus be integrated into Finnish statistics for better standardization.

2.4 Benefits of ITS Innovations for various sectors in Finland

The impacts of the ITS Innovations analyzed in the Study are applied to the major sectors related to mobility in Finland. The following sectors have been selected:

1. Transport
2. Infrastructure & Construction
3. Energy
4. Environment
5. Road Safety and Health
6. ICT
7. Economy

For each sector, the available KPIs are associated, and a projection of their impacts is made.

2.5 Alignment of the Study with MINTC

During the entire development phase of the Study, constant communication has been maintained with the team of MINTC, to align the structure, KPI model, and the draft versions of the Study. In addition, Prof. Risto Kulmala (FTA) and Prof. Georg Hauger (TU Vienna) were consulted.

3 Mobility Challenges and Potential Solutions

3.1 Global or National Trends, Conditions and Challenges

We are facing many global or national trends, conditions, and challenges. There is a relevant interaction in the following sectors:
Economy with regard to competitiveness of enterprises, GDP and growth issues, employment, servitization with new service models, innovation management, or sharing economy;

Ecology and Environment particularly in view of reduction of emissions and to mitigate health issues, the change to renewable energies, use of electric vehicles, global warming, climate change, emission trading, new environmental laws;

Society is facing challenges with regard to employment, aging of population, urbanization/ trends to live in cities (increase of population in cities), deficits in accessibility and affordability, tendency towards **shared mobility** and thus reduction of car ownership, privacy protection;

Traffic and Transportation main challenges are aging of infrastructure, increase of traffic, increase of mobility needs, congestion is constantly rising, better inter modality, crowd sourcing. In this context two main issues must be considered: First issue is **(Road) Safety**, inclusive accidents and fatalities which are unacceptable high, huge losses also to the society, etc. and the second one is Lack of **Financing** with regard to bottlenecks in tax financed (road) infrastructure, going hand in hand with reduced gas tax incomes due to better energy efficiency of vehicles and upcoming electric vehicles, the increase cost of maintenance, or increase of external cost;

Legal Requirements and Regulations like privacy and data protection requirements, enforcement of laws and regulations, and to give new perspectives and conditions for mobility.

ICT interacts to the other issues due to Big Data, Digitalization, Automation, Internet of Things, Security, Privacy, or Crowd Sourcing.

3.2 ITS as part of a Greater and Integrated Automation and ICT Schemes

ITS Innovations have a significant potential to improve safety and efficiency, financing, and to foster environmentally friendly Mobility for People and Goods.

ITS (Intelligent Transportation Systems) for Mobility and for Transport of People and Goods - is an extremely wide and complex subject area. It touches many areas of technology, market segments, transport, mobility provider, use cases and products. ITS forms a new market for Mobility, which is still in its infancy and the large growth is expected. These ITS solutions come hand in hand with other global technology trends, like Digitalization, Big Data, Automation, and Connected Vehicles. Please, see the next figure.

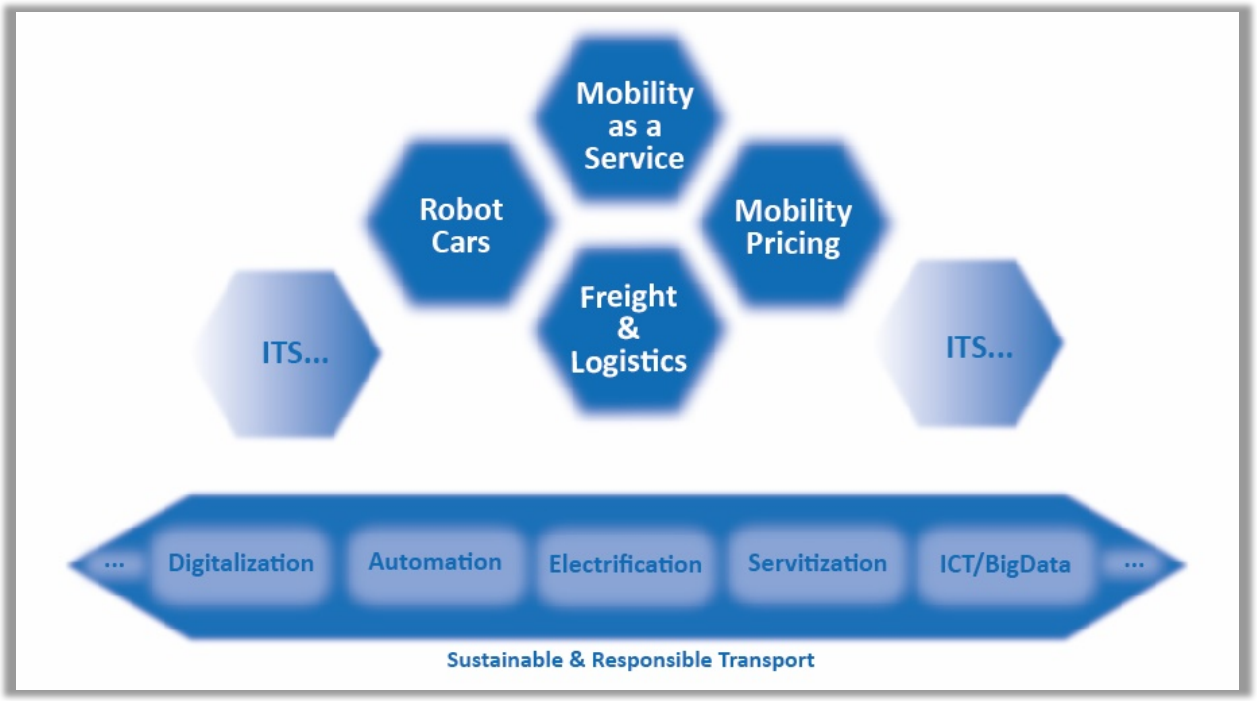


Figure 1: Link between ITS Innovations and Digitalization, Automation, Electrification, Servitization, ICT/Big Data

Automation or Robotization affect not only road transport, but also maritime solutions with self driving boats in the archipelago or delivery services by air with drones will appear. ITS Innovations have to be seen together with the global trends mentioned. Their success depends very much on their deployment requiring a dedicated communication policy to cover societal, legal, labor, economic, or political local situation.

3.3 Sustainable Mobility

The ITS innovations are to serve major **Sustainability Goals**, which are understood:

- Better information for the users and society
- Support the change for more sustainable use of available transport services
- Increase the efficiency and inter modality of the transport network
- Reduce congestion
- Reduce negative impacts of transport to the environment
- Secure financing for required restructures and maintenance of infrastructure and services
- Reduce accidents and fatalities
- Foster public transport.

4 European and International Perspectives

4.1 International Perspectives

4.1.1 The World Economic Forum: What are the top global risks for 2016?[1]

As the Director of Media Relations of the World Economic Forum, Oliver Cann, published the following view: The number one risk in 2016 in terms of likelihood, meanwhile, is large-scale involuntary migration, followed by extreme weather events (2nd), failure of climate change mitigation and adaptation (3rd), interstate conflict with regional consequences (4th) and major natural catastrophes (5th). (see figure 2)

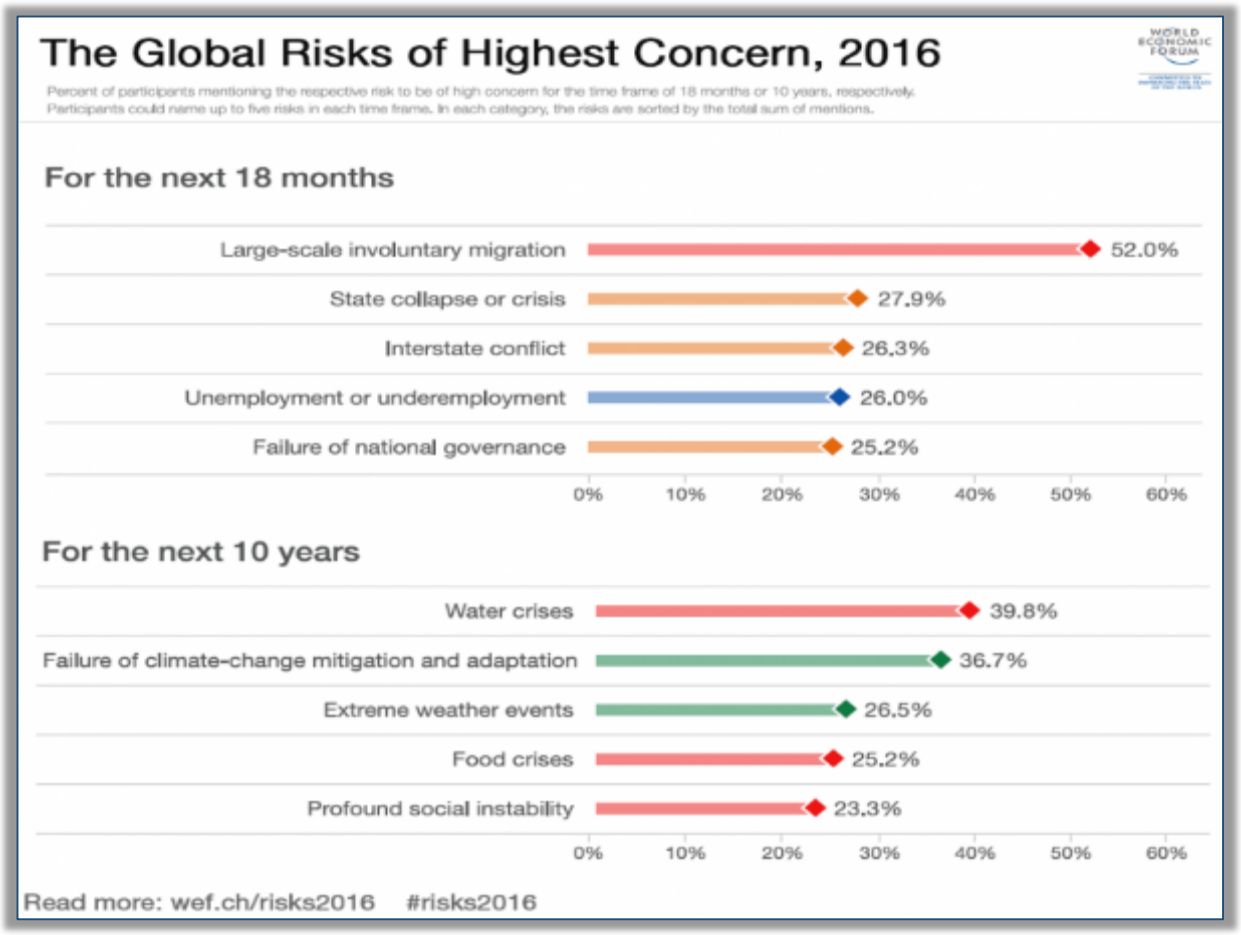


Figure 2: Global Risk of Highest Concern, 2016

CONCLUSION # 1: ITS has an important role to reduce Global Risks in the World
ITS contributes by delivering affordable access to Mobility, and mitigation of the negative impacts of Mobility and Transport to the Environment.

[1] World Economic Forum. Oliver Cann. 14.01.2016. Source: http://www.weforum.org/agenda/authors/oliver-cann, 22.02.2016

4.1.2 OECD: Fostering Innovation for Sustainable Growth in a Time of Economic Crisis[2]

The current crisis is the first of this severity to hit OECD countries, since they have shifted to knowledge-based service economies where investment in intangible assets is of equal importance as investment in machinery, equipment and buildings. Efforts to stimulate the economy need to both reflect the current drivers of economic growth and take advantage of the process of "creative destruction" to accelerate structural shifts towards a stronger and more sustainable economic future. Innovation policies need to be adapted to current conditions both in terms of how such policies are crafted to work, but also as elements of stimulus packages that may often be the foundation for these medium- and long-term initiatives.

CONCLUSION # 2: Innovation supports the structural shift towards more sustainable economic future

4.1.3 International Road Federation (IRF)

⇨ **Mr. Kapila, Chairman IRF Geneva, Interview in ITS International[3]**

"Around 1.3 million people die every year on the world's roads, many more suffer grave injuries and millions of families have to live with the trauma of losing a loved one. It is about time the world woke up to this problem and made greater use of ITS technology to help solve it. For reducing environmental impact and improving mobility also, it makes real sense to develop and deploy ITS systems. We are saying wake up, do something about it and do it now."

⇨ **Intelligent Transport Systems (ITS) contribute to all major transport policy objectives**

Through the application of ITS, road networks can be operated and utilized more efficiently. The term ITS encompasses many systems with different objectives and applications that can be found everywhere.

Safe roads and safe driving: ITS plays an important role in both preventing accidents and mitigating their impacts. ITS also helps to implement ambitious policy objectives set by national governments and supra-national bodies.

Delivering road sustainability: As with road safety, ITS contributes to the improved sustainability of roads through a multifaceted approach. Many ITS applications are aimed at either optimizing the available supply of road infrastructure or reducing demand for it. The result of ITS technology is a more efficient and reliable road transport network that operates with a minimized effect on the environment.

⇨ **IRF Policy Committee on ITS**

[2] OECD. Policy Responses to the Economic Crisis: Investing in Innovation for Long-Term Growth. June 2009. Source: http://www.oecd.org/sti/42983414.pdf, 22.02.2016

[3] ITS International. IRF takes politicians to task on road safety. 2012. Source: http://www.itsinternational.com/sections/associations/features/irs-takes-politicians-to-task-on-road-safety/,22.02.2016

To foster the deployment of ITS by encouraging governments to integrate ITS as a major tool to achieve their transport policy objectives, the IRF has established a high level Policy Committee on ITS. The areas of work of the **ITS Policy Committee** are:

- ITS applications and relevant policy objectives Financing ITS ITS Research, education and social issues Legal frameworks for ITS
- ITS strategy development and benchmarking.
- The Committee aims to raise awareness about ITS and to brief politicians and policy makers on the parameters and policy considerations when deciding over ITS deployment.

The IRF Vienna Manifesto on ITS[4] describes ITS policy recommendations for political leaders and high level decision makers to create the proper policy frameworks to unleash the full potential of Intelligent Transport Systems (ITS) in addressing key mobility challenges of safety, sustainability and efficiency.

4.1.4 IBTTA – International Bridge, Turnpike and Tunnel Association[5]

"The toll industry was an early adopter and advocate of Intelligent Transportation Systems through the application and implementation of electronic toll collection (ETC) systems more than 20 years ago," said Patrick D. Jones, Executive Director and CEO of the International Bridge, Tunnel and Turnpike Association. "ETC has proven to be the most broadly implemented and mature of the Dedicated Short Range Communications (DSRC) applications in use worldwide. We continue to be very interested in both preservation of dedicated telecommunication spectrum for transportation purposes and in the increasing application of vehicle to vehicle (V2V) and vehicle to infrastructure (V2I) communications for the purposes of driver safety and information, traffic management and facility operations."

4.1.5 UNECE – United Nations Economic Commission for Europe[6]

Statement of the United Nations Secretary-General Mr. Ban Ki-Moon:

Transport and Communication are among the key assets of every governmental policy in our fast changing world. In the present times of economic impasse, the **adoption of cost-efficient measures** in order to **make the transport system as efficient as possible** brings **transport policies at the utmost priorities,** demanding urgent efforts and specific dedication from all the social, political and economic policy makers all over the world. Furthermore, mobility policy is part of a complex pattern which need coordinated vision, commitment and investments so as to have visible results, **have safer and reliable transport networks as well as safer and performing vehicles**. **In this context, the deployment of Intelligent Transport System must be considered as the sole tool able to maximize the chances of making the best use of investments, planning and resources, and create a visible profitable outcome**. The international scenario is essential to build up a defined and shared policy of intents and operative rules, so to reach a rewarding operational flexibility through proper agreements in the international

[4] IRF-INTERNATIONAL ROAD FEDERATION. The IRF Vienna Manifesto on ITS. 2012. Source: http://www.irfnet.ch/files-upload/caroline/irf_itsvienna_final_web.pdf, 22.02.2016

[5] IBTTA. 2016. Source: http://www.ibtta.org, 22.02.2016

[6] UNECE. 2016. Source: http://www.unece.org/info/ece-homepage.html 22.02.2016

field. Hence, the whole transport system **will benefit from technology and from Intelligent Transport System** application.

4.1.6 MIT: „Innovation also brings destructions?"[7]

Andrew Paul McAfee is the co-director of the MIT Initiative on the Digital Economy, and the associate director of the Center for Digital Business at the MIT Sloan School of Management. According to him, we need to fight against destructions caused by innovation with Education, and fostering innovative enterprises.

4.2 European Perspectives

4.2.1 European Commission [8]

Statement of Mrs. Violeta Bulc, EU Commissioner responsible for Transport, at the ITS World Congress 2015 in Bordeaux/France:

Innovation and Intelligent Transport Systems play a significant role in determining our transport compositions for the future. The main theme: **'Towards Intelligent Mobility – Better use of space'**, focuses on the importance of using existing transport infrastructure more intelligently.

Shifting from capacity to connectivity – achieving a cooperative, better interconnected transport system – is a priority for public authorities, including the European Commission. Improving multimodality will be a very important step in building a functional and sustainable future.

Global mobility needs are evolving. They are becoming increasingly diversified. While **citizens and businesses wish to see flexible services**, more representative of their needs and expectations, we **must also significantly reduce the impact of the transport sector on the environment**, minimizing land use and substituting finite fossil fuels.

Efficient information and communication technologies can effectively reconcile the different streams. They help people move around more easily, safely and economically, in a more environmentally friendly manner. At the same time, they can provide smarter mobility, transport options as well as other **benefits to Smart Cities**.

Reliable information based on widely available and accessible transport data is therefore crucial in making the vision of a seamless transport system, as presented in the 2011 White Paper on Transport, be- come a reality.

Better modal integration also requires the selection of the right financing instruments. Both Horizon 2020, the new framework programme for supporting research and innovation, and the Connecting Europe Facility, for large-scale deployment on the TEN-T network and beyond, will co-finance projects that will help us advance towards a seamless transport system.

[7] Andrew Paul McAfee. ITS World Congress in Bordeaux 2015. Source: http://andrewmcafee.org, 22.02.2016

[8] European Commission. 2015. Source: http://itsworldcongress.com/wellcome-letters/european-commission/, 22.02.2016

4.2.2 ERTICO - ITS EUROPE

Statement of Hermann Meyer, CEO of ERTICO: "ITS services leading to reduced fuel consumption"[9]

ITS is a highly organized sector with a high degree of cooperation between stakeholders. Cooperation is essential for the long-term competitiveness of Europe on this topic.

The secret of success lies in the people involved, the motivation of their respective organizations and the quality of the coordination. We had projects which were laying the foundations for the architecture of Cooperative ITS, which are pre-deploying eCall services in Europe, which developed a framework for interoperable tolling, which tested services of Cooperative ITS in the context of safety, comfort and reducing pollution, which implemented traffic management approaches in cities worldwide.

Automation will become a major topic. Mainly in the context of safety and comfort, but I see important CO2 emission reduction potential.

4.2.3 ASECAP - European Association of Operators of Toll Road Infrastructures

ASECAP Days 2015 in Lisbon examined the role of toll motorways in creating the realistic and multimodal system.

President of ASECAP, **Mr. Oyvind Halleraker** (Norway)[10] reminded the participants that use of motorway is a service which includes a package of different services that constitute a product that we are selling to our users. User is in the focus of motorway operator's interest and activities. Our objective is to provide necessary information to users without distracting him or overwhelming him with too many information.

4.2.4 Summary of Conclusions European Perspectives

CONCLUSION # 3: Support innovative enterprises, research, and education
To secure the future, we need to support innovative enterprises, research, and education.

CONCLUSION # 4: ITS also mitigates the negative impacts of transport to environment
ITS also mitigates the negative impacts of transport to the environment.

CONCLUSION # 5: New technologies, products and services create new jobs
New technologies, products and services create new jobs.

CONCLUSION # 6: Transport and Mobility are a global Challenges
Transport and Mobility are a global Challenges. Sustainable solutions with ITS need thus to be developed also globally.

CONCLUSION # 7: International Transport and Traffic Associations offer interesting potentials
International Transport and Traffic Associations offer an interesting potential to exchange know-how, cooperation, best practices, and learn from experiences.

[9] Interview with Hermann Meyer, CEO of ERTICO. 16.06.2014. Source: http://www.frankfurt-holm.de/de/hermann-meyer-ertico-our-main-challenges-matching-ambitions-organisations-and-people-within, 22.02.2016

[10] Øyvind Halleraker is a Norwegian politician representing the Conservative Party. He is currently a representative of Hordaland in the Storting and was first elected in 2001.

5 Digitalization vs. ITS

ITS innovations need strong support by ICT platforms. This chapter shall give an overview on the (good) situation of the ICT sector in Finland.

5.1 Digitalization Development Project (Finnish Transport Agency 2016 – 2018 [11])

The Finnish Transport Agency has launched a three-year digitalization project, which paves the way for Finland, for example, new transport services and automated driving.

For roads it expresses: “Roads and the collection, processing and analysis of data relating to the maintenance, are also targets of development. “

5.2 “21 Paths to a frictionless Finland”, Report of the ICT2015 Working Group [12]

5.2.1 Overview

In April 1012, Minister of Economic Affairs Jyri Häkämies set up the ICT 2015 working group, chaired by Board Chairman Pekka Ala-Pietilä. The working group was tasked with preparing a strategy to alleviate the impacts of the sudden structural change experienced in the ICT industry, alongside reforming the information and communications technology industry and increasing its competitiveness. During its work, the group expanded its perspective and approach to cover broad-based application of ICT in all industries and within the public administration.

The ICT 2015 group submitted its report to Minister of Economic Affairs Jan Vapaavuori and Minister of Labor Lauri Ihalainen on 17 January 2013. As illustrated in the report, the “21 paths to a friction-free Finland” establish a roadmap for long-term efforts to make Finland a leader in information technology applications over the next 10 years. The report contains proposals for measures to be carried out in 2013. New measures will be decided on over the coming years, taking account of the results achieved and changes in the world.

The working group makes the following crucial proposals for the initial stage:

1. Building a common national IT service architecture. Harnessing of this common architecture will enable easier creation of services across organizational boundaries.
2. A ten-year research, development and innovation programme, ICT 2023. This programme would bring together key actors in the sector, such as universities, research institutions, companies and funding agencies.
3. A new financing programme to ensure sufficient funds for start-ups and companies in the growth phase.

[11] Liikenneviraston digitalisaatiohanke käynnistyi - näin raivaamme tietä tulevaisuuden liikenteelle. Julkaistu. 15.01.2016. Source: http://www.liikennevirasto.fi/-/liikenneviraston-digitalisaatiohanke-kaynnistyi-nain-raivaamme-tieta-tulevaisuuden-liikenteelle#.VqeXdzbIQck, 22.02.2016

[12] Publication 18/2013 of the Ministry of Employment and the Economy Innovation. 21 paths to a Frictionless Finland. Source: https://www.tem.fi/files/36671/TEMjul_18_2013_web_15052013.pdf, 22.02.2016

To ensure the rapid implementation of the working group's proposals, on the day of the report's submission the Prime Minister's Office established an ICT expert group, chaired by State Secretary Olli-Pekka Heinonen.

More than 250 experts working in various industries across Finland participated in the work of the ICT 2015 group. Several of the measures outlined in the report are based on suggestions obtained from these experts. Industry clusters and regional ecosystems will also play a key role in practical efforts to make Finland a leading country in information technology applications.

5.2.2 ICT 2015 working group's proposal for 2013 - Creation of an open data ecosystem

A cooperation network for open data, composed of key actors, will be created and a director with overall responsibility, core team and support group appointed for the network. A data-opening programme will be launched under the direction of the Ministry of Transport and Communications.

The functionality of legislation and regulations with regard to utilization of open data will be ensured.

An expert pool and developer model in accordance with Code4Europe will be created – consisting of data experts, entrepreneurs, public servants and developers – from which agencies and organizations can recruit competence for fixed periods for the implementation of projects.

TEKES will launch a fast and agile funding programme (based on Digi Demo) for SMEs.

CONCLUSION # 8: Requirements for deployment of integrated mobility
For the deployment of integrated mobility by the support of ITS, a fully connected, standardized, open data ICT backbone between all mobility stakeholders – i.e. users, infrastructure, vehicles, etc. is essential.

5.3 MyData human-centered operation model – a new opportunity for Transport

Finland is a forerunner of the human-centered MyData operation model which includes developing personal databased services that take privacy protection and information security into consideration (**http://www.lvm.fi/en/-/mydata-a-nordic-model-for-human-centered-personal-data-management-and-processing-860616**).

The aim is to create a framework for utilization of personal data and give each person opportunity to decide which firm, service or apps may use his personal information. Several sectors in Finland are piloting MyData services based on transparent relationship management.

Mobile profile for traffic is under development: a person could define his own mobility behavior which could be used by a Mobility as a Service operator to tailor services according to user needs.

MyData operation model is seen as a powerful tool in order to increase user acceptance towards new innovations.

Figure 3A: MyData Model

5.4 Big Data and Transport – Understanding and Assessing Options (ITF/CPB)[13]

Transport is a complex activity but at its most basic expression it is simply about connecting locations with flows. These locations may be proximate, well-connected and displaying high levels of access – as in many urban areas – or not. The flows between these locations may concern people or goods and may involve any number of vehicle types – or not, as in the case of walking.

Resolving the location-flow equation requires delivering and managing the use of infrastructure assets such as roads, bridges, tracks, airports, ports, bus stations and cycle paths – but it may also involve decisions regarding where to site activities so that the need to move is obviated. All of these decisions require information – a lot of information – regarding places, people and activities. Big Data holds much promise for improving the planning and management of transport activity by radically increasing the amount or near-real-time availability of mobility-related data. Likewise, access to more detailed and actionable data regarding the operation of vehicles and of the environment in which they operate holds much promise for improving the safety of transport.

These three fields – operations, planning and safety – are areas where authorities must critically evaluate where and how new, or newly available data and data-related insights, can improve transport policy.

5.5 Major requirements for ICT

Finland has already started many initiatives and processes in ICT and Digitalization. They represent an effective platform for aforementioned ITS innovations.

The major requirements are as follows:

⇨ Ensure a fully connected, standardized, local, open data ICT backbone, having highest availability and backup levels.
⇨ Cover the privacy and data protection requirements.

Other requirements have been mentioned in the related context.

[13] OECD - International Transport Forum. Big Data and Transport - Understanding and Assessing Options. 2015. Source: http://www.internationaltransportforum.org/Pub/pdf/15CPB_BigData.pdf, 22.02.2016

6 Innovations with Robot Cars

6.1 What is a Robot Car?

A robot car is a car with artificial intelligence and the ability to drive itself without any human interaction.

In the market, also other expressions exist: Full Autonomous Driving, Driverless Cars, Self-Driving Cars for the further handling, the Study uses the synonym “Robot Cars”.

Let’s start first with information collection.

6.2 Robot Car: Present Situation

6.2.1 How will humans react to driverless cars? (BBC Report)[14]

The biggest unknown factor when it comes to driverless cars is us: humans. **How quickly can we take charge again if the computer stops**? What will we get up to while we're being driven around? The University of Southampton is leading an £11m, four years’ research project to test these so-called "**human factors**". They are beginning by putting drivers of all ages through their paces in a driverless car simulator. Our transport correspondent, Richard Westcott, was taken through the test by Professor Neville Stanton, of the University of Southampton.

The time horizon mentioned is „5-10 years when people can start to buy them“. Also it is mentioned that „road and insurance regulations“ are required.

CONCLUSION # 9: Time horizon of integrated Robot Cars
Robot Cars: The time horizon is 5-10 years to get robot cars really started.

CONCLUSION # 10: Regulations for Robot Cars
Robot Cars: Regulations are needed to cover legal and technical problems.

6.2.2 Shared Mobility (Pratik Mukerji)[15]

Instead of having 1 car for 1 person, there are now systems where the ratio is rather 1 car for 50 people, and in some cities, one can now combine the health benefits of riding a bike with the range and weather protection of an electric car - all without owning a vehicle.

CONCLUSION # 11: Foster high capacity public transport and sharing society
High capacity public transport and sharing society needs to be fostered.

6.2.3 The CONTINENTAL Mobility Study 2013: Users attitude towards automated driving[16]

On the following illustration (see figure 3) you can see the attitudes towards Automated Driving between different states. While Germany has a balanced – positive and negative - opinion towards

[14] BBC Report 07.01.2016. Source: http://www.bbc.com/news/business-35169168, 22.02.2016

[15] Move Forward. Pratik Mukerji. 14.12.2016. Source: https://www.move-forward.com//news/details/back-to-the-future-flying-cars-and-shared-mobility/, 22.02.2016

[16] Continental Mobility Study 2013. Project modules and methodological approaches. Source: http://www.continental-corporation.com/www/download/pressportal_com_en/themes/initiatives/channel_mobility_study_en/ov_mobility_study2013_en/downl

Automated Driving, the tendency of China and Japan is more positive. People in USA consider Automated Driving more skeptical than the other states. So we can say, that the success of Automated Driving will depend on the acceptance by the users. This needs to be considered carefully. Intensive communication is required. Also, pilot projects will help to implement Automated Driving.

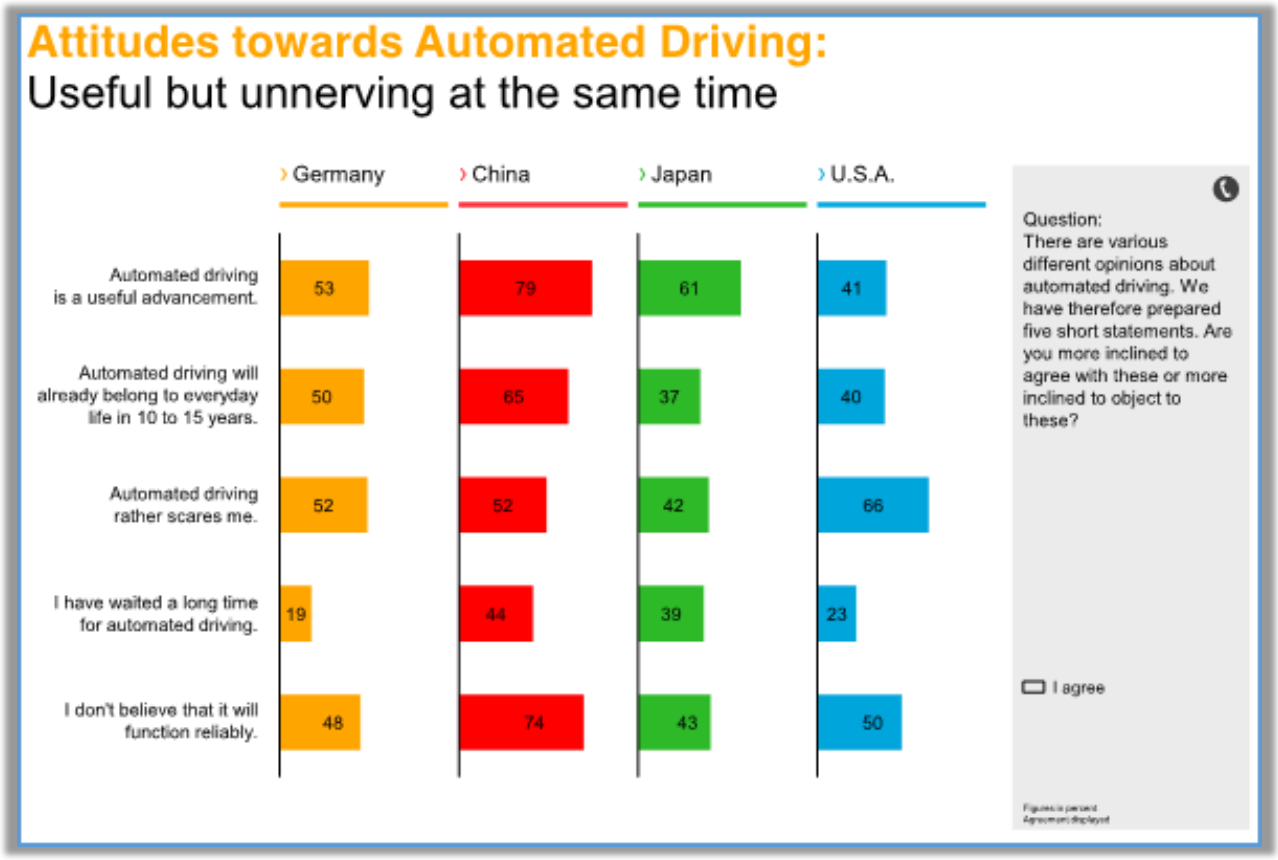


Figure 4: Attitudes towards Automated Driving

CONCLUSION # 12: Acceptance of Robot Cars
Robot Cars: The success will depend on the acceptance by the users. This needs to be considered carefully. Intensive communication is required. Also, pilot projects will help.

6.2.4 What GARTNER teaches us about the Autonomous Vehicle [17]

The trough of disillusionment: The Autonomous Vehicle

A lot of excitement (and hype) has indeed built since 2010, but as with all technologies studied by Gartner, the autonomous vehicle is now inescapably poised to fall to the trough of disillusionment and recover on the slope of enlightenment before it reaches the plateau of productivity sometime after 2020.

oad_channel/pres_mobility_study_en.pdf, 22.02.2016

[17] Move Forward – Gartner Report. What Gartner teaches us about the Autonomous Vehicle. Grush Niles. 04.01.2016. Source: https://www.move-forward.com//news/details/what-gartner-teaches-us-about-the-autonomous-vehicle/, 22.02.2016

One of these many barriers is that humans generally come to rely on assistive technologies very quickly and incautiously. The reliability with which drivers will remain attentive while using intermediate levels of semi-autonomy, or be able to rapidly re-focus their attention in the event the vehicle requests oversight is very challenging. Driving becomes the distraction.

Near term consumer access to autonomous vehicles implies either mixing them with non-autonomous ones on the same roadway, setting up separate lanes and safe-havens at great expense, or as Google (and now reportedly, Ford) has elected, jumping immediately to fully autonomous, level 5 vehicles skipping the intermediate levels altogether.

Of course fully autonomous vehicles would suffer severe access limitations in their first decade or so. The owner of an autonomous vehicle would be able to use it only on fully qualified lanes and areas which would not likely appear quickly as the infrastructure funding crisis grinds on. Access-anxiety would be far worse than the range-anxiety that has afflicted early EV (Electric Vehicle) adoption.

CONCLUSION # 13: Time Steps of Robot Cars
Robot Cars: At the moment we are at a "Peak of Inflated Expectations" (Gartner). The "Trough of Disillusionment" will happen until 2020. The "Plateau of Productivity" will be reached in 2025.

6.2.5 McKINSEY: Electric vehicles in Europe: The Amsterdam Roundtable[18]

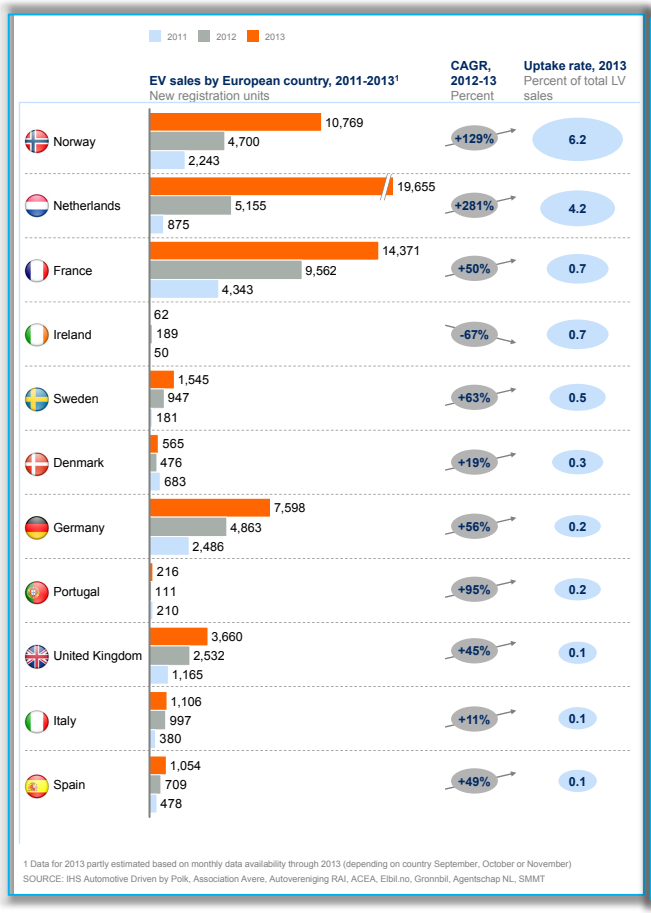
Europe is entering the initial adoption phase of electric mobility, with sales moving beyond the margin of 1% in some countries. 2013 was an important year with strongly increased momentum. Although EU-wide sales numbers are not yet impressive, some pockets of growth have clearly emerged, with high uptake rates in countries such as Norway and the Netherlands.

6.2.5.1 Deployment of electric vehicles in Europe and in Finland[19]

Regarding deployment of Electric Vehicles in Europe, you can see - by comparing both illustrations below (see figure 4 and 5) - that Finland is strongly behind.

[18] Amsterdam Roundtable Foundation and McKinsey Company. Electric vehicles in Europe: Gearing up for a new phase?. April 2014. Source: http://www.mckinsey.com/~/media/McKinsey%20Offices/Netherlands/Latest%20thinking/PDFs/Electric-Vehicle-Report-EN_AS%20FINAL.ashx, 22.02.2016

[19] Source: http://www.trafi.fi/tietopalvelut/tilastot/tieliikenne/ajoneuvokanta/ajoneuvokannan_kayttovoimatilastot/sahkokayttoiset_autot, 22.02.2016



MERKKI	LKM
NISSAN	250
TESLA MOTORS	245
VOLKSWAGEN, VW	22
THINK	20
CITROEN	20
PEUGEOT	13
MITSUBISHI	10
MERCEDES-BENZ	8
TOYOTA	5
FORD	3
FIAT	3
VOLKSWAGEN	3
FORD-CNG-TECHNIK	3
RENAULT	2
Tuntematon	2
BMW	2
SUBARU-ELCAT	1
OMAVALMISTE	1
MICRO-VETT	1
YHTEENSÄ	**614**

Figure 5: Deployment of Electric Vehicles in Europe (2013)

Figure 6: Deployment of Electric Vehicles in Finland (2015)

CONCLUSION # 14: Finland and electric vehicles

Finland is strongly behind regarding the introduction of electric vehicles.

6.2.5.2 Worldwide Targets for CO2 emissions[20]

The following diagram (see figure 6, next page) shows the planned emission standards in China, Japan, Europe and USA. 2015 the emission is still high especially in the US and in China. One of the key factors to reduce the emission seems to be the electrification of vehicles.

[20] Amsterdam Roundtable Foundation and McKinsey Company. Electric vehicles in Europe: Gearing up for a new phase? April 2014. p.14.Source: http://www.mckinsey.com/~/media/McKinsey%20Offices/Netherlands/Latest%20thinking/PDFs/Electric-Vehicle-Report-EN_AS%20FINAL.ashx, 22.02.2016

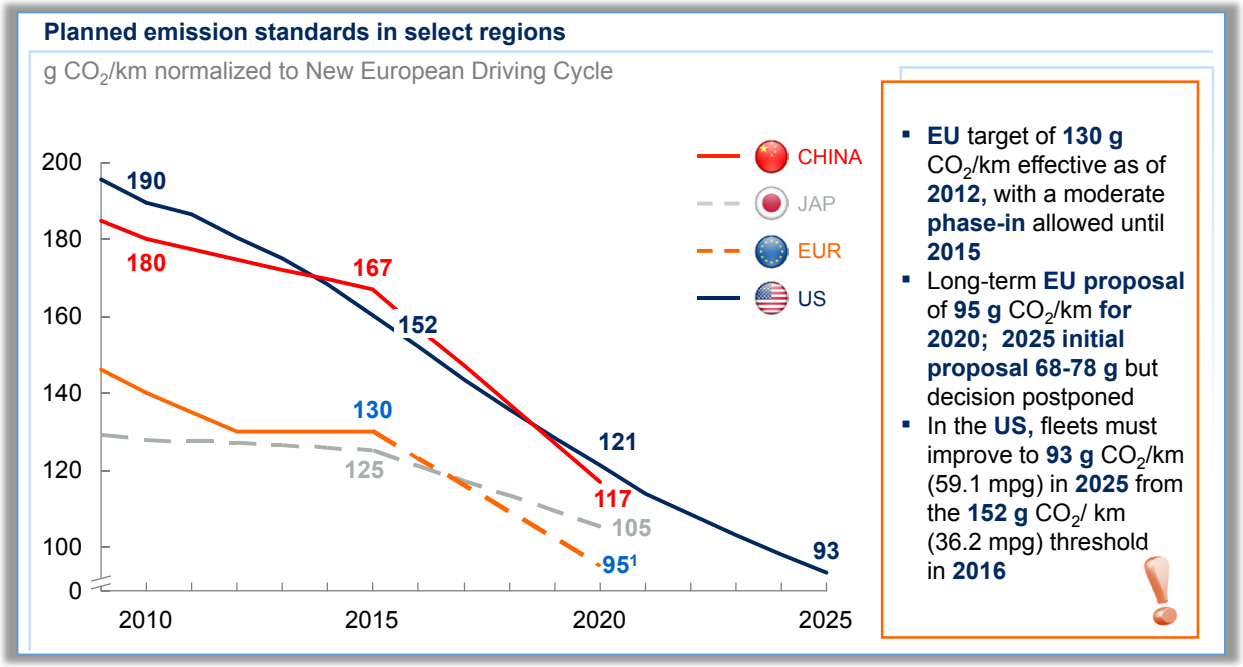


Figure 7: Targets for Light Vehicle CO2 emissions

CONCLUSION # 15: Impacts of electric vehicles
Electrification of vehicles are a strong driver to reduce emissions.

6.2.5.3 MaaS vs. Electric Vehicles[21]

To the degree that mobility as a service, and specifically car-sharing as an important new model, can integrate the usage of EVs, it offers new opportunities for EV adoption by removing some of the barriers. First, on the user side, these models eliminate the hurdle of high initial purchase price, because users do not have to buy the cars they are driving. Mobility as a service can also alleviate the "range anxiety" that makes some consumers reluctant to purchase an EV by allowing them to opt for BEV usage only for driving distances that they're comfortable with. Car-sharing fleet operators could possibly benefit from lower fuel and maintenance costs, because they should be able to realize higher utilization rates (especially in dense, urban areas) as compared to private car use.

CONCLUSION # 16: Timeline of deployment: Robot Cars and electric vehicles
The deployment of Robot Cars is also linked to the timeline of deployment of electric vehicles.

CONCLUSION # 17: Goals of Robot Cars and electric vehicles
Electric cars have similar goals and frame conditions: reduction of CO2 emissions, new technologies, power charging infrastructure, digital maps, connected vehicles technologies (V2X), regulations on privacy and data protection, and high level real time communications.

[21] Amsterdam Roundtable Foundation and McKinsey Company. Electric vehicles in Europe: Gearing up for a new phase? April 2014. p.53.Source: http://www.mckinsey.com/~/media/McKinsey%20Offices/Netherlands/Latest%20thinking/PDFs/Electric-Vehicle-Report-EN_AS%20FINAL.ashx, 22.02.2016

6.2.6 An Outlook: The Potential of Autonomous Driving with Self Driving Vehicles

6.2.6.1 The Wall Street Journal

„Prevent two million injuries a year... Save 30,000 lives a year... Slash expenses by $400 billion a year... Boost fuel consumption by up to 50%... – would you embrace it?“[22]

6.2.6.2 Report "Urban Mobility System Upgrade. How shared self-driving cars could change city traffic" [23]

This report examines the changes that might result from the large-scale uptake of a shared and self-driving fleet of vehicles in a mid-sized European city. The Study explores two different self-driving vehicle concepts, for which we have coined the terms "TaxiBot" and "AutoVot". TaxiBots are self-driving cars that can be shared simultaneously by several passengers. AutoVots pick-up and drop-off single passengers sequentially. We had two premises for this Study: First, the urban mobility system upgrade with a fleet of TaxiBots and AutoVots should deliver the same trips as today in terms of origin, destination and timing. Second, it should also replace all car and bus trips. The report looks at impacts on car fleet size, volume of travel and parking requirements over two different time scales: a 24-hour average and for peak hours only.

- Cars are underused assets. They are mainly active during peak hours and rarely for more than 10% of the day – in fact, most cars are used for less than one hour a day … often with only one occupant per vehicle.
- Nearly the same mobility can be delivered with 10% of the cars.
- The overall volume of car travel will likely increase.
- In peak hours, only 35% of vehicles are in operation.
- Reduced parking needs will free up significant public and private space.
- Improvements in road safety are almost certain. Environmental benefits will depend on vehicle technology.
- Public transport, taxi operations and urban transport governance will have to adapt.
- Managing the transition will be challenging.

Please, see the next paragraph.

6.2.7 OECD-ITF REPORT - Urban Mobility System Upgrade: How shared self-driving cars could change city traffic[24]

This report was prepared by the Corporate Partnership Board (CPB) of the International Transport Forum (ITF)[25]. The results mentioned in the Report from the model developed for the City of Lisbon will be applied in this Thinking Paper to Finland with a focus to the Greater Helsinki Region.

[22] Wall Street Journal Daily 19.01.2016

[23] OECD/ITF – Corporate Partnership Board Report, 2015: "Urban Mobility System Upgrade. How shared self-driving cars could change city traffic"

[24] OECD- International Transport Forum. Urban Mobility System Upgrade: How shared self-driving cars could change city traffic.2015. Source: http://www.internationaltransportforum.org/Pub/pdf/15CPB_Self-drivingcars.pdf, 22.02.2016

[25] The International Transport Forum at the OECD is an Intergovernmental Organization with 57 member countries. It acts as a think tank for transport policy and organizes the Annual Summit of Transport Ministers. ITF is the only global body that covers all transport modes. The ITF is administratively integrated with the OECD, yet politically autonomous.

6.2.7.1 Main Findings of ITF Report - Urban Mobility - Lisbon

The following table (see table 1) describes the main pillars of the Study. Only high capacity transport is considered, since Helsinki has an equivalent situation.

Urbanization growth		**Value**
Lisbon inhabitants 2010		545.245
Lisbon inhabitants 2050		632.484
Growth		116%
Cars will account for travel for approx.		80%
Average car use per day (mins)		50
Fleet size baseline		203.000
TaxiBot Ride-Sharing - with HCPT - Reduction to (vehicles)		21.220
equals reduction to		10%
AutoVot Car-Sharing - with HCPT - Reduction to (vehicles)		34.082
equals reduction to		17%
Volume of car travel, scenario 24 hours		
TaxiBot Ride-Sharing - with HCPT - reduction to (mio-car-km)		4,01
equals reduction to		106%
AutoVot Car-Sharing - with HCPT - Reduction to (mio-car-km)		5,44
equals reduction to		144%
Scenario peak hours		
TaxiBot with HCPT number of vehicles required to provide the same trips as before		35%
Impacts on Congestion (Scenario: peak hours only)		
Fleet size (vehicles)		60.000
TaxiBot Ride-Sharing - with HCPT - Reduction to (vehicles)		21.105
equals reduction to		35%
AutoVot Car-Sharing - with HCPT - Reduction to (vehicles)		33.975
equals reduction to		57%
Impacts on parking space		
TaxiBot Ride-Sharing - with HCPT Reduction to (vehicles)		8.901
equals reduction to		6%
AutoVot Car-Sharing - with HCPT Reduction to (vehicles)		17110
equals reduction to		11%
Mixing with conventional cars		
TaxiBot Ride-Sharing - with HCPT - mix with conventional cars (mio-car-km)		4,9
because of conventional cars, **increase** by		130%
AutoVot Car-Sharing - with HCPT - mix with conventional cars (mio-car-km)		5,69
because of mix with conventional cars, **increase** by		151%

Table 1: Main Findings of ITF-Report - Urban Mobility System Upgrade: How Self-driving cars change City Traffic

To evaluate the social-economic benefits of (1) technology based improvement of the traffic system or of (2) different strategies within the transport sector it is crucial to consider the very specific environment of the projects as well as knowledge of system dynamics. The following projects aimed

to do so and therefore could be seen as important references for the HERMES Study.

Some work in this sector has been done by Prof. Dr. Georg Hauger [26] [27], Technical University of Vienna:

(1) Hauger, Georg et al. 2012: Strategic evaluation tool for technical infrastructures 2030/2050.

(2) Hauger, Georg et al. 2012: "Give&Go" - develops and proves an innovative, brand new mobility service for areas with poor supply of public transportation.

(3) Hauger, Georg et al. ongoing: TraSaCu - Traffic Safety cultures at the Safe Systems Approach - Towards a Cultural Change Research an Innovation Agenda for Road Safety.

The comparison of different cities or regions is not possible on a strategic level only. To do so one must use sophisticated developed KPIs from the involved areas. Simple conclusions by analogy must be treated with caution. Currently works form Prof. Hauger et al. show the weakness of some statistical data and therefore he suggested a set of new criteria to be considered in evaluation processes as well as in appraisal activities. See the ongoing project OPERMO: http://www.opermo.at/- available in German only.

The Study also shows a huge variety of positive impacts from Robot Cars:

CONCLUSION # 18: Robot Cars impacts vehicle population
Robot Cars foster the reduction of vehicle population.

CONCLUSION # 19: Robot Cars regarding to congestion
Robot Cars foster reduction of congestion, thus reduction of emissions.

CONCLUSION # 20: Robot Cars impacts parking space in cities
Robot Cars are freeing up the parking space in the city.

CONCLUSION # 21: Robot Cars offering new services
Robot Cars enable the offering new services for shared mobility.

CONCLUSION # 22: Robot Cars and structures
It is recommended to apply the ITF-CPB Study handling Lisbon to the Helsinki Region, considering that the structures in Helsinki are different: e.g. inhabitants of region, public transport modal split, mobility pattern, GDP, social behavior, etc. This can be implemented within the development of a "DNS-Model" (see point 9.1).

CONCLUSION # 23: Timeline for evolution of Robot Cars
The timeline for the evolution of Robot Cars across needs to be considered.

[26] Prof. Dr. Georg Hauger has a Degree (M.Sc tech.) in Landscape Planning from University of Bodenkultur Vienna and a Dr.techn. in transportation planning from the Vienna University of Technology (VUT). Since 2004, Prof. Hauger is Head of Institute for Transportation Planning IVS in the Department of Spatial Planning at VUT. Moreover he is President of ConnectSouthEast, partner of Stratum International, one of the founders of the consulting company science:talk, and Scientific Advisor at Austrian Road Safety Board (KFV). Prof. Haugers key qualifications are in expertise in transportation studies, road safety and transportation planning and transport economy.

[27] Curriculum Vitae of Prof. Dr. Hauger. Source: http://info.tuwien.ac.at/ivs/homepage/images/stories/pdfs_docs/Georg%20Hauger_CV_2015. pdf, 22.02.2016

CONCLUSION # 24: Impacts of Robot Cars for taxi services
The impacts of Robot Cars for taxi services need to be analyzed.

CONCLUSION # 25: Robot Cars and Road Safety
Robot Cars have huge positive impacts in road safety

6.2.8 NEW ZEALAND HERALD: The robot cars are coming [28]

The car barreling down a Japanese freeway with New Zealand's transport minister on board lacked a driver. Instead of drifting into a side barrier, the state-of-the-art Nissan seamlessly changed lanes to overtake other cars.

Simon Bridges was joined by long-serving Ministry of Transport chief executive Martin Matthews for the ride in one of Nissan's - autonomous vehicle prototypes, during a visit to Japan last July.

"There was a person in the driver's seat but not doing anything, and we were on a motorway and this vehicle was changing lanes and passing other vehicles," Matthews recalled.

"The manufacturer said that vehicle will be on showroom floors in five years."

The hype around driverless vehicles and the revolutionary effect they could have has produced sceptics, and much remains unknown, including how the vehicles might operate in normal traffic.

But the Nissan ride impressed our top transport official, and his ministry is working out how radically the country's transport system could change as technologies arrive.

Car-makers and safety regulators hope self- driving cars could eventually eliminate the 94 per cent of fatal crashes that involve human error. They also believe the technology could reduce greenhouse gas emissions and loosen gridlock.

CONCLUSION # 26: Robot Cars eliminate fatal crashes
Robot Cars could eliminate up to 94% of fatal crashes that involve human error.

6.2.9 McKINSEY: Disruptive trends that will transform the auto industry [29]

Today's economies are dramatically changing, triggered by development in emerging markets, the accelerated rise of new technologies, sustainability policies, and changing consumer preferences around ownership. Digitization, increasing automation, and new business models have revolutionized other industries, and automotive will be no exception. These forces are giving rise to four disruptive technology-driven trends in the automotive sector: diverse mobility, autonomous driving, electrification, and connectivity.

[28] NZ Herald. The Big Read: The robot cars are coming. Nicholas Jones. 16.01.2016. Source: http://www.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=11575047, 22.02.2016

[29] McKinsey and Company. Disruptive trends that will transform the auto industry. Paul Gao, Hans-Werner Kaas, Detlev Mohr, and Dominik Wee.Jan. 2016. Source: http://www.mckinsey.com/insights/high_tech_telecoms_internet/disruptive_trends_that_will_transform_the_auto_industry, 22.02.2016

1. Driven by shared mobility, connectivity services, and feature upgrades, new business models could **expand automotive revenue pools by about 30 percent**, adding up to $1.5 trillion.

   The automotive revenue pool will significantly increase and diversify toward on-demand mobility services and data-driven services. This could create up to $1.5 trillion—or 30 percent more—in additional revenue potential in 2030, compared with about $5.2 trillion from traditional car sales and aftermarket products/services, up by 50 percent from about $3.5 trillion in 2015 (Exhibit 1).

2. Despite a shift toward shared mobility, vehicle unit sales will continue to grow, but likely at a lower rate of about 2 percent per year.

   Overall global car sales will continue to grow, but the annual growth rate is expected to drop from the 3.6 percent over the last five years to around 2 percent by 2030. This drop will be largely driven by macroeconomic factors and the rise of new mobility services such as car sharing and e-hailing.

3. Consumer mobility behavior is changing, leading to up to **one out of ten cars sold in 2030 potentially being a shared vehicle** and the subsequent rise of a market for fit-for-purpose mobility solutions.

4. Consumers today use their cars as all-purpose vehicles, whether they are commuting alone to work or taking the whole family to the beach. In the future, they may want the flexibility to choose the best solution for a specific purpose, on demand and via their smartphones. We already see early signs that the importance of private-car ownership is declining: in the United States, for example, **the share of young people (16 to 24 years) who hold a driver's license.**

5. **dropped from 76 percent in 2000 to 71 percent in 2013**, while there has been over **30 percent annual growth in car-sharing members in North America and Germany** over the last five years.

6. Once technological and regulatory issues have been resolved, up to **15 percent of new cars sold in 2030 could be fully autonomous**.

   Fully autonomous vehicles are unlikely to be commercially available before 2020. Meanwhile, advanced driver-assistance systems (ADAS) will play a crucial role in preparing regulators, consumers, and corporations for the medium-term reality of cars taking over control from drivers.

   Prepare for uncertainty. ... will require a sophisticated degree of scenario planning and agility to identify and scale new attractive business models.

   Leverage partnerships. The industry is transforming from competition among peers toward new competitive interactions, but also partnerships and open, scalable ecosystems. To succeed, ... for example, around infrastructure for autonomous and electrified vehicles.

   Drive transformational change. ... need to align their skills and processes ... like software-enabled consumer value definition, cybersecurity, data privacy, and continuous product updates.

   Reshape the value proposition. Car manufacturers must further differentiate their products/services and change their value proposition from traditional car sales and

maintenance to integrated mobility services. ... including new business models such as online sales and mobility services, and cross-fertilizing the opportunities between the core automotive-business and new mobility-business models.

CONCLUSION # 27: Timeline of Significant availability of Robot Cars
Significant availability of Robot Cars will happen after the year 2025.

CONCLUSION # 28: New business models with Robot Cars
Robot Cars will enable new business models.

CONCLUSION # 29: Robot Cars and automotive revenues
Robot Cars could expand automotive revenues by about 30 percent.

CONCLUSION # 30: Shared vehicles
One out of ten cars sold in 2030 potentially being a shared vehicle.

CONCLUSION # 31: Growth in car-sharing
30 percent annual growth in car-sharing members in North America.

CONCLUSION # 32: Robot Cars and driver's license
Robot Cars: The share of young people (16 to 24 years) who hold a driver's license, dropped from 76% in 2000 to 71% in 2013.

CONCLUSION # 33: Robot Cars in year 2030
15% of new cars sold in 2030 could be fully autonomous (Robot Cars).

CONCLUSION # 34: Robot Cars: Prepare for uncertainty
With Robot Cars, we need to prepare for a certain time period to prepare for uncertainty.

CONCLUSION # 35: Transforming of industries
The industry is transforming from competition among peers toward new competitive interactions.

6.2.10 PRESIDENT OBAMA: Pledged $4 Billion to Develop Autonomous Cars [30]

The government hopes to use the first six months of 2016 to create a nationwide framework for the "safe development and operation" of autonomous vehicles. And these aren't half-hearted "autonomous" vehicles that depend upon a human driver being behind the wheel. Rather, the government will work to ensure that "fully autonomous vehicles, including those designed without a human driver in mind, are deployable in large numbers when they are demonstrated to provide an equivalent or higher level of safety than is now available."

[30] Motherboard. Obama Just Pledged $4 Billion to Develop Autonomous Cars. Nicholas Deleon. 14.01.2016. Source: https://motherboard.vice.com/read/obama-just-pledged-4-billion-to-develop-autonomous-cars, 22.02.2016

CONCLUSION # 36: Benefits of Auto industries
The auto industry is supported with excellence to invest into engineering and development. This somehow guarantees the evolution of Robot Cars. How much will Finland "invest"?

6.2.11 THE WASHINGTON POST - What happens when cities and states try to prepare for self-driving cars?

(Matt McFarland, Washington Post)[31]

1. In Oregon, there's consideration of adapting crash reports. If autonomous vehicles deliver the expected safety improvements, there will be fewer accidents, cutting out a lot of paperwork. But the state could require manufacturers of driver-less cars to provide a report each time a vehicle is in a crash, to explain crashes caused by software and sensor failures.
2. There's also the consideration of specific lanes for autonomous vehicles. How many should be built, and when? "Do we need 12-foot lanes? Can we get by with 91⁄2- or 10-foot lanes?" said Biter, the Florida transportation official. "We can turn that four-lane express highway into a six-lane express highway with literally the same right-of-way footprint." Depending on how fast autonomous vehicles arrive, a highway might need only one lane for such vehicles in 2025 — or maybe multiple lanes. With the average car on U.S. roads being 12 years old, the fleet is unlikely to change over quickly. States and cities will probably face a prolonged transition period.
3. One thing is for certain. While self-driving software may update in mere moments — like a smartphone app — the ability to adjust on the fly is a luxury that infrastructure planners won't have.

CONCLUSION # 37: Robot Cars and high-level roads
For faster deployment of Robot Cars, existing high-level roads, with e.g. 3 lanes, could be changed to 4 lanes, adding more capacity.

CONCLUSION # 38: ITS/ICT offer high flexibility for adapting changes
ITS/ICT offer high flexibility for adapting changes, such as Robot Cars, to the Mobility and Transport ecosystem.

6.2.12 TECH DISRUPTOR, California: Requirements for Vehicle to Vehicle (V2V) communication? [32]

1. It is obvious that cars are the next data battlefield and they are often referred to as a big smart phone. They will eventually start collecting huge amounts of data from different sources. They will need to talk to each other in order to exchange information and alerts about road and weather conditions, construction zones, but more importantly real time

[31] Washington Post. What happens when cities and states try to prepare for self-driving cars. Matt McFarland. 25.11.2015. Source: https://www.washingtonpost.com/news/innovations/wp/2015/11/25/what-happens-when-cities-and-states-try-to-prepare-for-self-driving-cars/?postshare=1731449520909380&tid=ss_mail, 22.02.2016

[32] Move Forward. What are the requirements to make Vehicle to Vehicle communication work. TechDisruptor. 23.09.2015. Source: https://www.move-forward.com/news/details/what-are-the-requirements-to-make-vehicle-to-vehicle-communication-work/, 22.02.2016

traffic information such as an accident which just occurred seconds ago a few blocks ahead of you.

2. And this is where the challenge lies. Existing wireless bands are not meant and not built yet to upload these amounts of data into the cloud – on a mass scale. A single car nowadays easily collects 40 MB of data per month which is then mostly stored in internal memory devices (via the On-board Diagnostics (ODBII) port) or uploaded into the cloud using Wi-Fi connections.

   Some of the data such as location data is of course made available real-time, but that is only a fraction of the amount of data that are being collected in a vehicle.

   The benefits not just for drivers, but also for communities and cities are obvious. The data provided will help to cut down on traffic jams and subsequently improve driver safety.

   Governments, law makers, regulators and Telco's need to pay attention to this and open up new frequencies especially for V2V and V2I communications. Additionally, they need to define an open data standard that information sent from one vehicle brands' system can be read on another vehicle's brands system – and even for third party devices. This will help to speed up new V2V and V2I communications based business models to thrive which are appearing in every corner of the world.

CONCLUSION # 39: Robot Cars and data exchange
For Robot Cars, new frequencies need to be opened to cover the data exchange demands.

6.2.13 MINTC Finland: Strategy in Finland for Robots on land, in water and in the air [33]

6.2.13.1 Anticipated Market Schedule for Robot Cars from different vehicle manufacturers

The following illustration on the next page shows a possible schedule for "automated cars" from different vehicle manufacturers (see figure 7). While Tesla and Volvo estimate the release for "automated cars in the next two years, the other vehicle manufacturers give a prediction more carefully.

[33] Finnish Ministry of Transport and Communications. Publication 14/2015. Robots on land, in water and in the air. Promoting intelligent automation in transport services. Source: http://www.lvm.fi/documents/20181/514467/Julkaisuja+14-2015/0567d84e-2a01-4cb7-9b6f-6148ba47047c?version=1.0, 22.02.2016

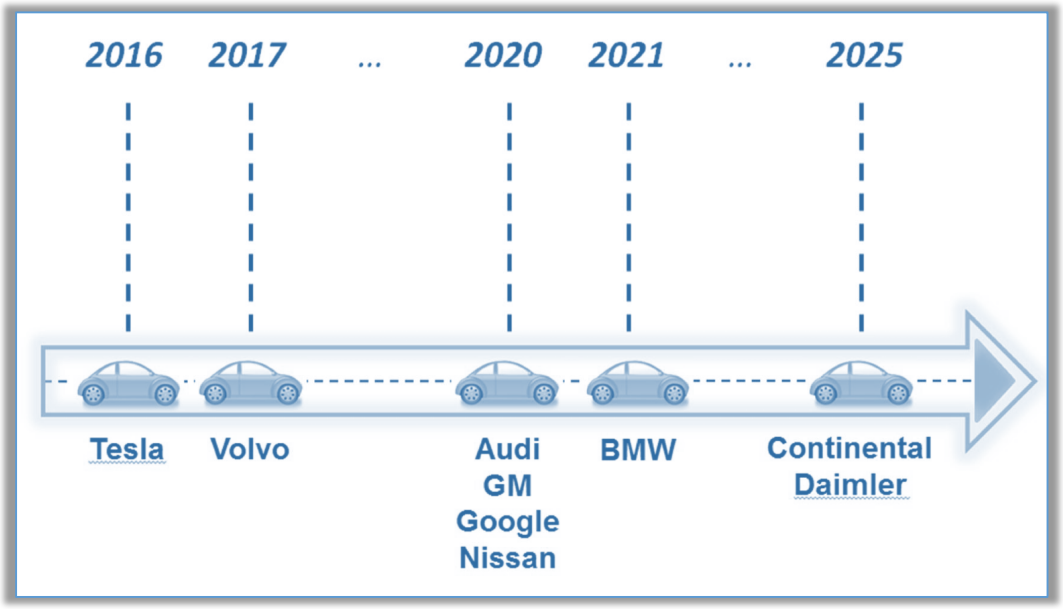


Figure 8: Car manufacturers' estimates of when automated cars will be released

CONCLUSION # 40: Realistic schedule Robot Cars 2015+
The year 2025+ shows up more often is the realistic schedule for a wider use of Robot Cars.

6.2.13.2 How Automation will change the impacts of Accidents?

Robot cars will have a significant impact on the change of reasons for accidents (see figure 8). Eliminating most of the human caused reasons, new reasons arise from automation (this applies also to robot cars).

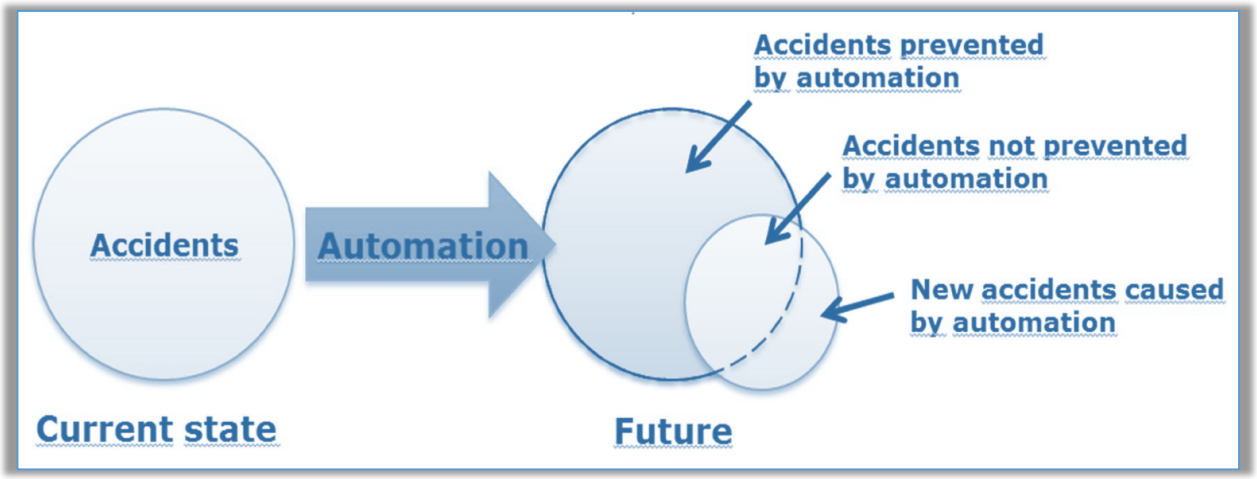


Figure 9: Driving automation will prevent accidents, but also cause new types of accidents

(Finnish Transport Safety Agency, 2015)

CONCLUSION # 41: Robot Cars: New types of accidents
For Robot Cars, it is required to define a value for these new types of accidents, caused by the software of Robot Cars.

CONCLUSION # 42: Legal regulations for Robot Cars
For Robot Cars, it is also required to develop the appropriate legal regulations in case accidents are caused by the software of Robot Cars.

6.2.13.3 Perception of the Finnish eco-system for intelligent automation of transport

The ecosystem for intelligent automation in transport, similarly to any other ecosystem, will unavoidably consist of different subsectors and different types of actors. It is by no means certain that the actors will engage in effective cooperation that benefits all parties even within the individual subsectors, to say nothing about having this ability between the different subsectors of the ecosystem. See the Figure below for an illustration of this.

Figure 10: perception of the Finnish ecosystem for intelligent automation of transport

CONCLUSION # 43: Robot Cars need strong partnerships and cooperation
For Robot Cars, strong partnerships and cooperation, both public and private, need to be developed to support their deployment in Finland.

6.3 Impacts of Robot Cars to various Sectors in Finland related to Mobility

The "Sector Tables" below show the different impacts of Robot Cars to various sectors (transport, infrastructure and construction, energy, environment, safety and health, ICT and economy) related to Mobility. Please, note the graphic legend used in the Sector Tables:

Graphic Legends				
Forecast	**light**	**moderate**		**Severe**
Positive Impact	+	+ +	+ + +	+ + + +
Negative Impact	–	– –	– – –	– – – –
Numeric Increase	↗			
Numeric Decrease	↘			

6.3.1 Impact of Robot Cars to Transport Sector

Sector	Impacts	KPI	Forecast
Robot Car 	⇪ Robot Cars improve traffic flow and reduce congestions.	🗝 **KPI-007:** TomTom Traffic Congestion Index for Helsinki	+ ↗
		🗝 **KPI-008:** Traffic density (vehicles per hour)	+ + ↘
		🗝 **KPI-009:** Average travel speed (km per hour)	+ + ↗
		🗝 **KPI-024:** Hours of Congestion per year	+ + ↘
		🗝 **KPI-028:** Amount of persons/vehicle	+ ↗

Table 2: Impacts of Robot Cars to Transport Sector related to Mobility

6.3.2 Impact of Robot Cars to Infrastructure Sector

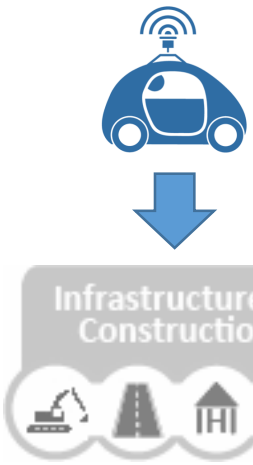
Sector	Impacts	KPI	Forecast
Robot Car 	⇪ Robot cars require, in a long term, own lanes. ⇪ Robot Cars need (similar) infrastructure for electricity charging.	🗝 **KPI-030:** (NEW) Available road capacity to manage available capacity and demand	
		🗝 **KPI-032:** Amount of users of public space	
		🗝 **KPI-048:** Investments into capacity (change lanes or build own lanes) and investment into infrastructure for charging.	

Table 3: Impacts of Robot Cars to Infrastructure and Construction Sector related to Mobility

6.3.3 Impact of Robot Cars to Energy Sector

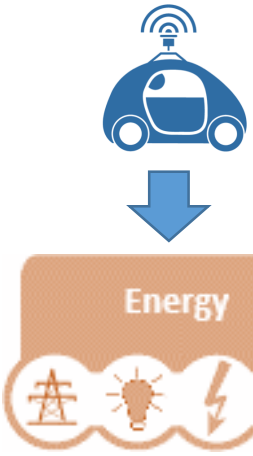
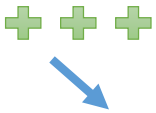
Sector	Impacts	KPI	Forecast
Robot Car 	⇪ The energy consumption of vehicles will be reduced because of automated driving based on sustainable programming of automation.	🗝 **KPI-026:** kWh for energy consumption per vehicle km travelled.	
		🗝 **KPI-047:** Passenger Car Performance (vehicle km travelled)	

Table 4: Impacts of Robot Cars to Energy Sector related to Mobility

6.3.4 Impact of Robot Cars to the Environment Sector

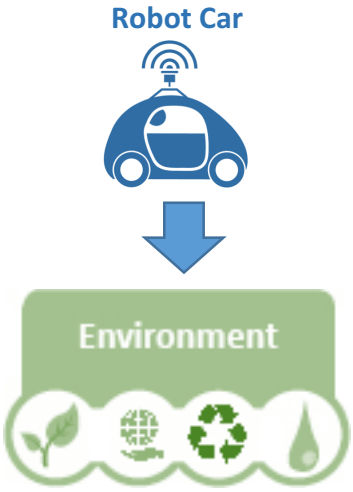
Sector	Impacts	KPI	Forecast
	⇪ Because of the reduced energy consumption of (electric) Robot Cars, CO2 emissions are reduced. ⇪ On the other hand, the mileage of vehicles could increase while new shared services and increase of mobility offering. At the same time the rate of occupation could decrease.	🗝 **KPI-027:** Vehicle CO2 emissions per vehicle km	✚ ✚ ✚ ↘
		🗝 **KPI-028:** Amount of persons in vehicle.	✚ ↗

Table 5: Impacts of Robot Cars to Environment Sector related to Mobility

6.3.5 Impact of Robot Cars to Safety and Health Sector

Sector	Impacts	KPI	Forecast
	⇪ Accidents will be reduced significantly by elimination of human errors. This will imply to lower the cost of the health care system.	🗝 **KPI-015:** Number of people killed per year in road transport	✚ ✚ ↘
		🗝 **KPI-016:** Number of people seriously injured per year in road transport	✚ ✚ ↘
		🗝 **KPI-017:** Number of injured per year in road transport	✚ ✚ ↘
		🗝 **KPI-029:** Number of accidents per year (reduction)	✚ ✚ ✚ ↘
		🗝 **KPI-031:** (NEW) Cost of health care to cover injuries from road transport accidents	✚ ✚ ↘

Table 6: Impacts of Robot Cars to Safety and Health Sector related to Mobility

6.3.6 Impact of Robot Cars to ICT Sector

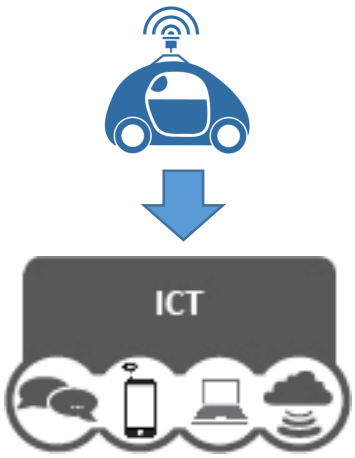
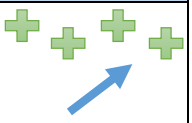
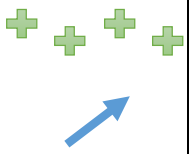
Sector	Impacts	KPI	Forecast
Robot Car 	The success of Robot Cars depends on availability of efficient high capacity ICT backbones and communication platforms.	**KPI-037:** Amount of APIs in transport sector	
		KPI-038: Digibarometer index ranking	
		KPI-039: Use of Cloud Services	

Table 7: Impacts of Robot Cars to ICT Sector related to Mobility

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6.3.7 Impact of Robot Cars to the Economy

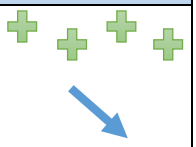
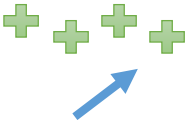
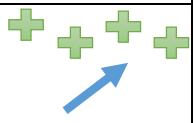
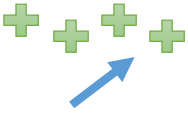
Sector	Impacts	KPI	Forecast
Robot Car  Economy 	⇪ Economic effects of (travel) time savings by reduced congestion, better efficiency, or new forms of travel will be possible. Thus, extra capacity can be achieved.	🗝 **KPI-010:** Energy consumption	
		🗝 **KPI-024:** Hours of Congestion per year	
		🗝 **KPI-026:** Vehicle Energy consumption per km	
		🗝 **KPI-033:** GDP	
		🗝 **KPI-034:** Value of time	
		🗝 **KPI-046:** Electric vehicle population	
		🗝 **KPI-050:** (NEW) Sales of Robot Cars (Full autonomous electric vehicles)	
		🗝 **KPI-051:** Employees in Finnish ITS industry	
		🗝 **KPI-052:** Size of Finnish ITS market	

Table 8: Impacts of Robot Cars to Economy Sector related to Mobility

6.4 SWOT Robot Cars

The following illustration shows the SWOT-Analysis with the strength, weaknesses, opportunities and threats related to Robot Cars. (see figure 10)

Robot Cars has more strength and opportunities than weaknesses and threats. But points like acceptance by users can be change to major challenges.

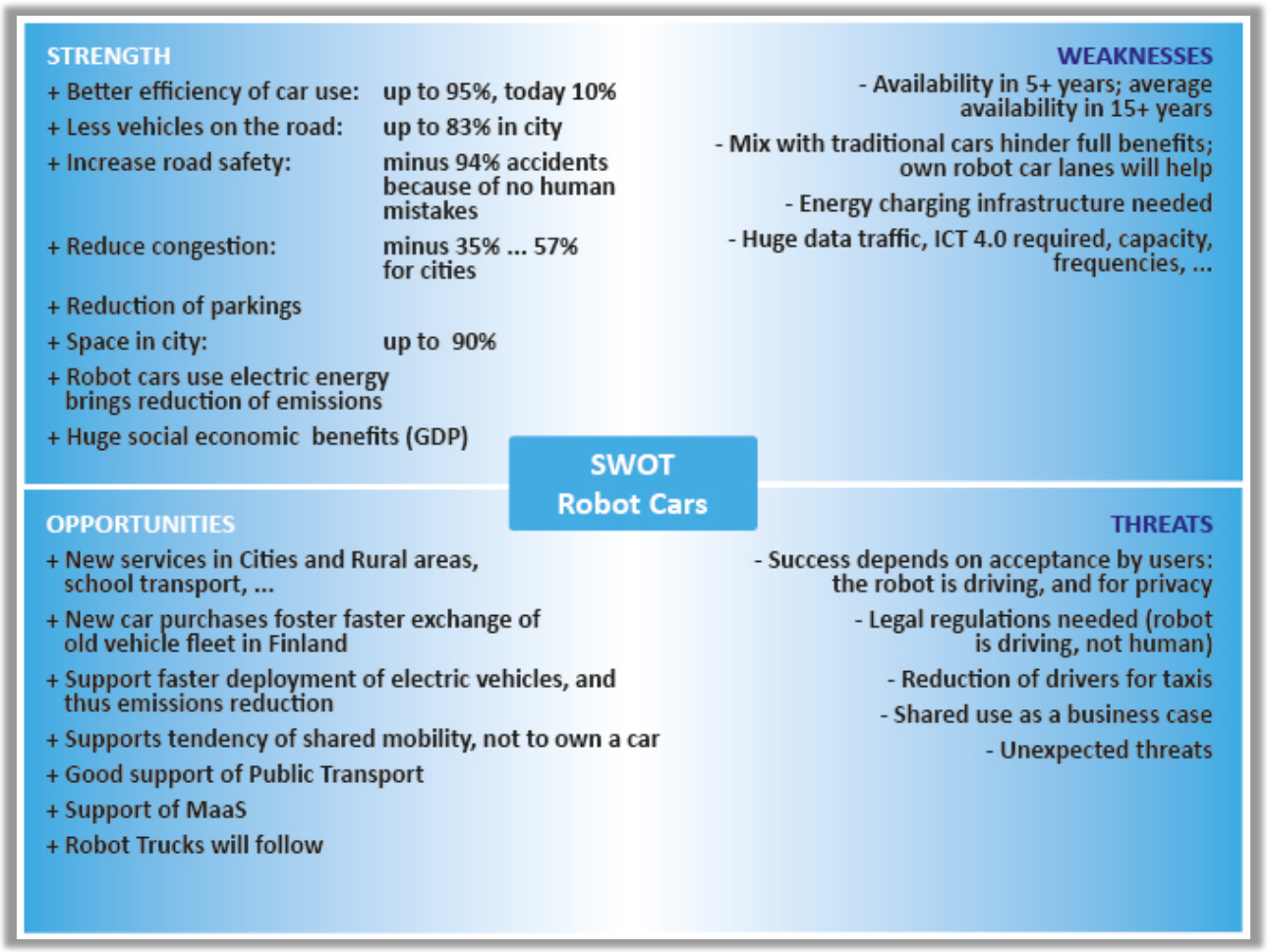


Figure 11: SWOT Robot Cars; Lisbon figures Source OECD/ITF [34]

6.5 Policy Requirements for Robot Cars

1. An "official" time horizon for the availability of Robot Cars shall be created to serve as a road map for the discussions.
2. Alignment of services using Robot Cars with Public Transport taxi, rail, buses, bike-sharing, etc. to optimize the mix.
3. Define appropriate business models as being defined in Mobility as a Service (MaaS).
4. Inclusion of Mobility Pricing to foster rules for sustainable deployment and use of Robotic Cars.

[34] OECD- International Transport Forum. Urban Mobility System Upgrade: How shared self-driving cars could change city traffic Case Study: The City of Lisbon. p.13ff. 2015. Source: http://www.internationaltransportforum.org/Pub/pdf/15CPB_Self-drivingcars.pdf, 22.02.2016

5. Intensive communication and dialogue is required with the users of Robot Cars.
6. Harmonize the potentials of future ICT platforms offering Big Data access.
7. Regulations are required for legal liability, privacy, and data protection.
8. Define the responsibilities and roles of fiscal and regulatory authorities to support the deployment.
9. Evaluation of the present (road) infrastructure plans to consider future requirements, e.g. assigned lanes for Robot Cars, Park & Ride facilities to interconnect with Public Transport, cycling, etc.
10. Electric Cars shall be strongly supported.
11. Pilot projects for RC shall be supported strongly.
12. Research on City, Inter-Urban and Rural implications of Robot Cars is required. This shall also include to analyze the free-up of parking space.
13. Robot Cars development and deployment shall be seen in conjunction with the other automation projects in Finland being developed for air and sea applications.
14. It shall be discussed whether to subsidize Robot Cars for faster deployment.

6.6 Strategic Summary Robot Cars

1. Robot Cars have huge positive effects for both, Cities and Inter-Urban roads: better use of road capacities, reduction of congestion, higher safety, fostering new mobility services, reduction of emissions, etc. all together leading to huge social economic savings.
2. Robot Cars are a strong extension to public transport services.
3. Robot cars will foster **Shared Economy**. Some possibilities of Shared Economy learned from studying the possibilities with Robot Cars (e.g. car sharing) work also without robot cars. These possibilities shall be initiated or extended independently from Robot Cars already now.
4. Robot Cars will increase the access to mobility for the entire society (all age groups, no car owners, etc.), and for all regions. In rural areas, e.g. in Lapland, new services can be offered.
5. The existing infrastructure will benefit from Robot Cars by increase of capacity. Adaptions will be required for own lanes for Robot Cars.
6. The deployment of Robot Cars is strongly linked with other ITS services and solutions, such as Mobility as a Service (MaaS), Mobility Pricing (to control e.g. potential increase mileage), or electric vehicles (also with faster renewal of the old car fleet).
7. Robot Cars will help to renew the car population in Finland, offering thus better environmental protection, better road safety, less accidents, and business opportunities for the Finnish car retail industry.
8. Robot Cars, in conjunction with Vehicle to Vehicle (V2V) and Vehicle to Infrastructure Communications (V2X) need strong ICT and communication backbones and high level of data security.

9. Intensive cooperation and communication with all public and private stakeholders, with a strong inclusion of the users is required.
10. Mobility in Finland depend very much on cars. Good and convincing arguments (save money, save time?) are needed to make users to change toward the use of Robot Car services.
11. Effects of Robot Cars shall be analyzed via a “DNS Model”.

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7 Mobility as a Service (MaaS)

7.1 What is MaaS

Mobility as a Service - the new transport paradigm: MaaS represents a new “mobility services business model” where users can buy packaged services according to their mobility needs.

Prof. Risto Kulmala wrote once: “Mobility as a Service means that the user acquires his/her travel from original to destination in an effortless, reliable and affordable way from a stakeholder providing the mobility service with the expected quality”.

The MaaS packages include all modes of transport. The vision for MaaS is to see the whole transport sector as a co-operative, interconnected eco-system, providing services reflecting the needs of customers. The boundaries between different transport modes are blurred or disappear completely. The ecosystem consists of transport infrastructure, transportation services, transport information and payment services.

7.2 Mobility as a Service: Present Situation

7.2.1 ITS Finland: Liikuminen Palveluna – Mobility as a Service[35]

MaaS can be thought as an all-in-one mobility package, like "Spotify for Mobility", where the user can include all services that he decides to be necessary.

The MaaS concept brings in a new kind of a (neutral) „MaaS Mobility Operator“.

Transport Operators (e.g. rail, taxis, local operators) should provide open interfaces timetable information, mobility equipment for real-time location information and payment systems to the MaaS Mobility Operator.

Traffic Digitalization is expected to create over 20.000 jobs in Finland by the year 2020.

A variety of mobility services: Public transport, trains, buses, carpool, call buses, taxi, city bike, rental cars, car sharing, with a relation to other services layers like air or sea.

Parking problems ... car utilization rate is as low as 4%.

MaaS could create different packages:

- „Urban Job Mobility Package“ for 95€ per month:
  free public transport in home town; 100 km taxi rides; 500km rental car; 1.500km public transport use in Finland.
- „15 Minutes Package“ for 135€ per month:
  pickup by a shared taxi guaranteed within 15 minutes from call; EU taxi fare of 0,50€ per km; free public transport in home town; 1.500km public transport use in Finland.
- „Business World Package“ for 800€ per month:
  pickup all over the EU by a shared taxi guaranteed within 5 minutes from call; rental cars including tolls.

[35] ITS Finland. Sampo Hietane. 2013. Source: http://www.its-finland.fi/index.php/fi/palvelut/mobility-as-a-service.html, 22.02.2016

- „Family Package“ for 1.200€ per month:
  rental car and tolls; pickup by a shared taxi guaranteed within 15 minutes from call for all family members; free public transport in home town for all family members; 2.500km public transport use in Finland.

See next illustration - Mobility Operator Packages[36]

CONCLUSION # 44: New methodology with MaaS
MaaS offers a new methodology to solve the mobility needs. The User can buy “packages” covering their mobility pattern. In this context, MaaS needs to prove its quite challenging business case.

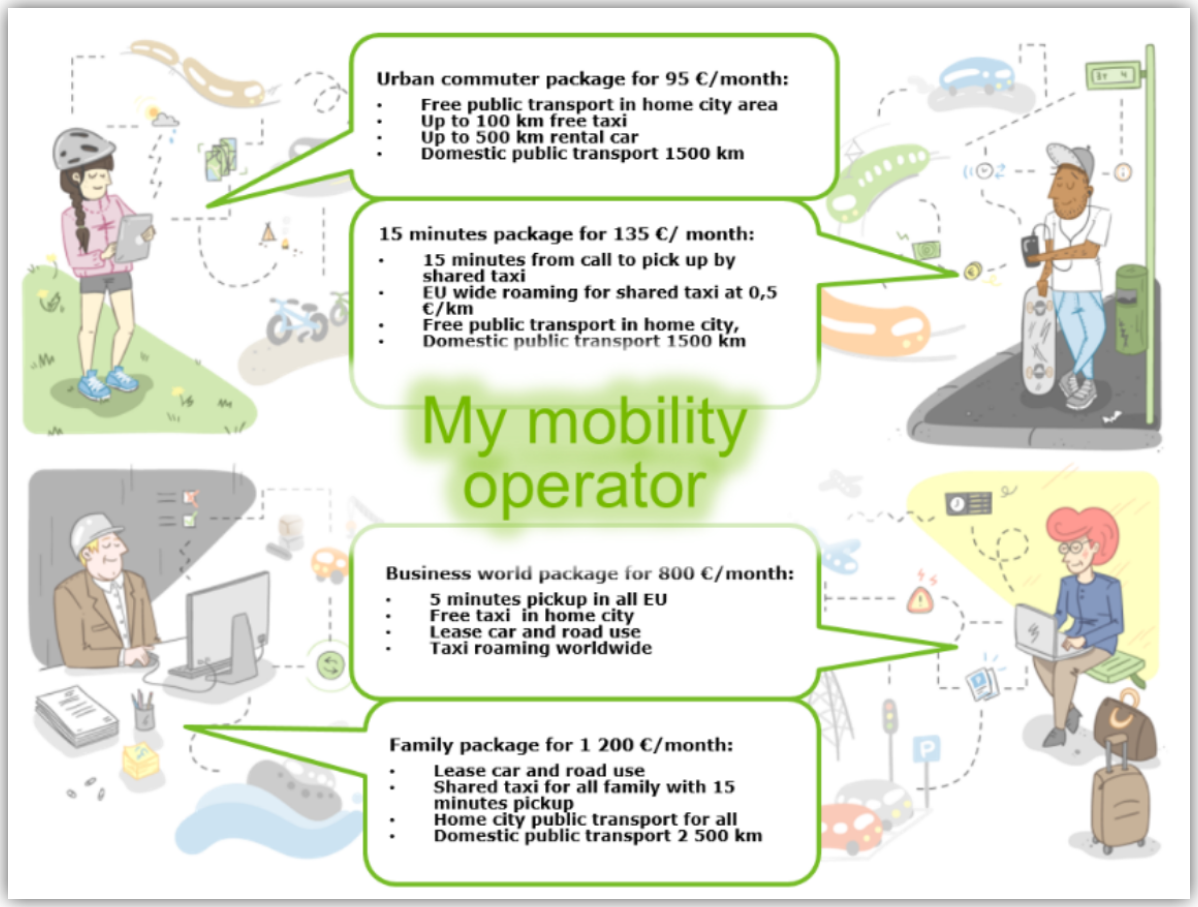


Figure 12: My Mobility Operator Packages

7.2.2 KANTA HÄME Newspaper: Hämeenlinna tried out first in the world new intelligent transport solutions [37]

The new application could revolutionize traveling. Hämeenlinna Citizens travel later this month to make the journey home from door to Helsinki or Tampere in a new way. The Sonera trip app can be freely combined public transport trips. In the beginning users, it is possible to combine taking place in

[36] ITS Finland. Mobility as a Service. Source: http://www.its-finland.fi/index.php/en/palvelut/mobility-as-a-service.html, 22.02.2016

[37] KANTA HÄME Newspaper. Sanna Heinonen. 19.01.2016. Source: http://www.hameensanomat.fi/uutiset/kanta-hame/301775-hameenlinnassa-kokeillaan-ensimmaisena-maailmassa-uutta, 22.02.2016

Hämeenlinna taxi trips with VR train. In the future, the application of use and transport of choice is widening. The Hämeenlinna pilot is the first in the world. It initially takes about three months, after which users will be asked for their experiences and suggestions for improvement.

“Trips to no longer have to book and pay for separately. The application ordered a taxi ride is also cheaper than separately ordered local taxi journey”, says Sonera's Business Development Director Jouni Sintonen.

The aim is to reduce the need for private cars and to replace some of the private car, for example, by shared taxis. The pilot is a Helsinki-Hämeenlinna-Tampere-growth corridor (HHT) in the region because the area of passenger and traffic volumes are so large.

“Hämeenlinna won this race by jumping in actively”, says Senior Adviser Seppo Öörni from Finnish Transport and Communications Ministry.

Application developers feared that Sweden, for example, would have this at first, but now it is in Hämeenlinna, Finland, and we are pioneers in the world. The application is sent during next weekend to different operating systems, app stores, and it comes to the purchase by no later than within a couple of weeks, depending on the system. Sonera trip works on iPhone as well as Android and Windows phones that use.

CONCLUSION # 45: Connectivity with MaaS
Existing transport providers can be EASILY connected to one MaaS platform.

CONCLUSION # 46: Small cities for MaaS pilot projects
Smaller cities offer a good ground for MaaS pilot projects.

7.2.3 PURUVESI Newspaper: “Public transport to renew completely“ [38]

Hanna Kosonen, Article in Puruvesi, Savonlinna

In rural populated areas, the “call service” based public transport is the main means to provide transport services. I am pleased to tell the Minister Berner requesting that, for example, the Savonlinna region could be a pilot in this kind of pilot experiment.

In addition to public transport coverage of road maintenance throughout Finland is essential. Basic Routes to and subordinate road networks rehabilitated throughout Finland, with separate financing of EUR 600 million during this government term.

The government intends to carry out a comprehensive reform of public transport. For the first time, public transport will be considered and developed as a whole by utilizing modern technology. The reform does not happen in a few months. All of us are required composure in front of this historic reform.

CONCLUSION # 47: Robot Cars - efficient and cost effective Public Transport
Robot Cars could deliver efficient and cost effective Public Transport in rural areas.

CONCLUSION # 48: Good Road Maintenance is very important
Good Road Maintenance in the countryside is very important, and at present underfinanced.

[38] Puruvesi. Kolumni: Joukkoliikenne uudistuu täysin. Hanna Kosonen. 24.01.2016. Source: http://www.puruvesi.net/Mielipiteet/15874295.html, 22.02.2016

7.2.4 ELECTRIC FEEL: Shared services: One Car for Fifty People - instead of One Car for One Person

Pratik Mukerji:[39] Instead of having 1 car for 1 person, there are now systems where the ratio is rather 1 car for 50 people, and in some cities, one can now combine the health benefits of riding a bike with the range and weather protection of an electric car - all without owning a vehicle.[40]

CONCLUSION # 49: High capacity public transport
High capacity public transport is essential.

7.2.5 CHICAGO TRIBUNE: Big Ideas - 2016 Ridesharing, apps could fill remaining gaps in Chicago transit [41]

New services, as well as Divvy and car-sharing, “have the potential to really have some impact on how people get around the city — and perhaps make a dent in congestion and CO2 emissions,” said Sharon Feigon, executive director and co-founder of the Chicago-based non-profit Shared-Use Mobility Center.

Though UBER and Lyft have existed in Chicago since 2011 and 2013 respectively, both companies said the city needed to build a critical mass of riders before shared rides could begin to reach their potential.

“You have to have an ecosystem: You have to have enough drivers, you have to have enough riders, you have to have enough people going in the same direction to be able to pair them up effectively,” said Chris Taylor, an UBER general manager. “Chicagoans have all kind of adopted UBER enough that there are enough of them going in the same direction that we can pair people really well.” The company says 1.2 million unique users have taken an UBER trip in Chicago in the last three months.

The new Pool and Line rides also may be cheap enough to pave the way for commuters ditching their cars for shared rides downtown this year.

The economics may make sense for someone who travels from Lincoln Park to downtown, for example, who might weigh a $2.25 ride on the Red Line against a $5 shared UberPool or Lyft Line ride, said Joseph Schwieterman, a DePaul University transportation expert and head of the Chaddick Institute for Metropolitan Development.

CONCLUSION # 50: Shared Mobility impacts congestions
Shared Mobility reduces congestion and CO2 emissions.

CONCLUSION # 51: Discussion: New Pool and Line lanes for shared vehicles
New Pool and Line lanes shall be considered for shared vehicles.

[39] Founder and CTO of ElectricFeel providing intelligence for transportation systems with bikes, e-bikes and e-scooters. Source: www.electricfeel.com, 22.02.2016

[40] Back to the Future: Flying cars and shared mobility. Pratik Mukerji. 14.12.2015. Source: https://www.move-forward.com//news/details/back-to-the-future-flying-cars-and-shared-mobility/

[41] Chicago Tribune. Meg Graham. 15.01.2016. Source: http://www.chicagotribune.com/bluesky/originals/ct-big-ideas-2016-transit-bsi-20160115-story.html, 22.02.2016

7.2.6 ARTHUR D. LITTLE: The Future of Urban Mobility, towards networked, multimodal Cities of 2050 [42]

Summary: Arthur D. Little's (ADL) new global Study of urban mobility assesses the mobility maturity and performance of 66 cities worldwide and finds most not just falling well short of best practice but in a state of crisis. (see next figure)

Indeed, it is not putting it too strongly to say that many cities' mobility systems are standing on a burning platform and if action is not taken in the very near future they will play a major role in slowing the growth and development of their host nations. What is needed is innovative change. This report highlights what is holding them back, showcases best practice and identifies three strategic imperatives for cities and three clusters of future business models for mobility suppliers that will enable cities to meet the urban mobility challenge.

Methodology: **ADL assessed the mobility maturity and performance** of 66 cities worldwide using 11 criteria ranging from public transport's share of the modal mix and the number of cars per capita to average travel speed and transport-related CO2 emissions.

Trend: The world's population is increasingly city-based; 51% or 3.5 billion people currently live in urban areas and by 2050 this is expected to reach 70% of the population or 6.3 billion people. Urban mobility is one of the toughest challenges that cities face; accordingly, we will see massive investment in the future. Today, 64% of all travel kilometer made are urban and the amount of travel within urban areas is expected to triple by 2050.

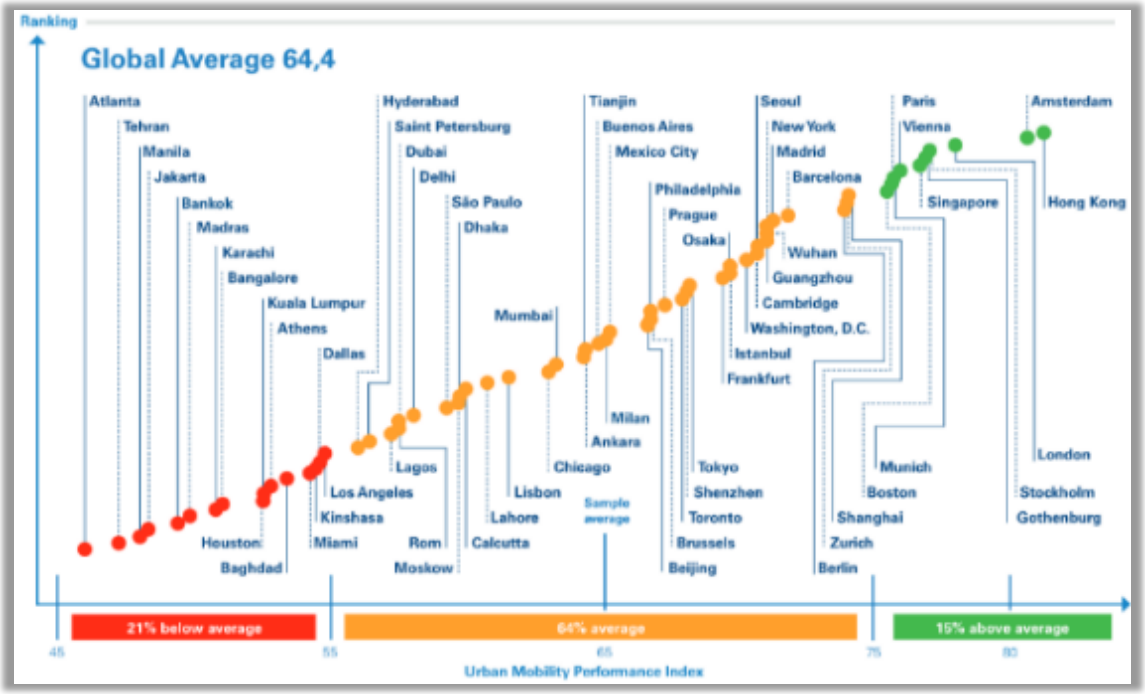


Figure 13: Urban Mobility Performing Index. Note: Helsinki can be positioned near Vienna.[43]

[42] Arthur D. Little Future Lab. Study No.1.Future of Urban Mobility. W. Lerner. 2011. Source: http://www.adlittle.com/downloads/tx_adlreports/ADL_Future_of_urban_mobility.pdf, 22.02.2016

[43] Arthur D. Little Future Lab. Study No.1.Future of Urban Mobility. W. Lerner. 2011. p.10. Source: http://www.adlittle.com/downloads/tx_adlreports/ADL_Future_of_urban_mobility.pdf, 22.02.2016

Existing mobility systems are close to breakdown. By 2050, the average time an urban dweller spends in traffic jams will be 106 hours per year, three times more than today. Delivering urban mobility will require more and more resources. In 2050 urban mobility will:

- Cost €829bn per year across the globe, more than four times higher than in 1990.
- Use 17.3% of the planet's bio capacities, which is five times more than in 1990.

Western Europe: Overall best regional performance with an average of 71.4 points, with seven out of the 18 analyzed cities scoring above 75 points. Amsterdam (81.2) and London (78.5 points) lead the way, while Rome (57.9 points) and Athens (53.3) are the worst performing cities.

CONCLUSION # 52: Strategy regarding mobility maturity and performance criteria

Study the mobility maturity and performance criteria shown by ADL if applied to the urban planning strategy of the Helsinki region. This needs to consider the growth of trips in the greater city region and its impact on urban resources.

City	Share pubic transp. + walking/ cycl. in modal split [%]	Mobility strategy/ vision [points]	Car sharing performance [points]	Number of shared bikes per million citizens	Penetration of smart cards [cards / capita]	Transport related fatalities per million citizens	Transport related CO_2 emissions [kg per capita]	Vehicles registered per citizen	Average travel speed [km/h]	Satisfaction with transport [points]	Mean travel time to work [minutes]
1 Hong Kong	84%	10	1	0.0	2.9	23.0	378	0.08	25,1	12	39,0
2 Amsterdam	56%	10	5	305.1	1.0	27.0	1100	0.40	34,0	13	22,0
3 London	62%	10	5	695.1	2.3	39.0	1050	0.40	17,7	14	44,1
4 Stockholm	54%	10	4	1944.9	0.2	21.0	1430	0.40	28,6	13	29,1
5 Goteborg	48%	9	5	1220.4	0.6	48.0	1800	0.41	24,0	13	18,7
6 Singapore	55%	9	5	0.0	2.0	47.0	900	0.10	26,9	8	36,0
7 Vienna	69%	9	3	703.6	0.0	16.0	1250	0.39	26,7	13	27,6
8 Paris	56%	10	5	1964.7	0.2	91.0	950	0.39	31,0	14	35,0
9 Munich	63%	8	5	926.4	0.0	22.2	1390	0.42	32,0	14	30,2
10 Boston	55%	8	4	132.8	1.4	23.0	1028	0.63	29,0	12	30,4

Figure 14: Top Ten City Index Performance (1).[44]

CONCLUSION # 53: The City Index Performance of Helsinki

The City Index Performance of Helsinki (comparable to Stockholm or Vienna?) shall be prepared, and applicable scenarios for the Helsinki Region need to be analyzed.

Three strategic imperatives for cities: To meet the urban mobility challenge, cities need to implement one of the following three strategies dependent on their location and maturity:

- Network the system: For high per- forming cities the next step must be to fully integrate the travel value chain, increasing convenience by aggressively extending public transport,

[44] Arthur D. Little Future Lab. Study No.1.Future of Urban Mobility. W. Lerner. 2011. p.11. Source: http://www.adlittle.com/downloads/tx_adlreports/ADL_Future_of_urban_mobility.pdf, 22.02.2016

implementing advanced traffic management systems and further reducing individual transport through greater taxation and road tolls.

- Rethink the system: Cities in mature countries with a high proportion of motorized individual transport need to fundamentally redesign their mobility systems so that they become more consumer and sustainability orientated. This group contains the majority of cities in North America along with those in Southwestern Europe.

- Establish a sustainable core: For cities in emerging countries the aim must be to establish a sustainable mobility core that can satisfy short-term demand at a reasonable cost without creating motorized systems that need to be redesigned later. With access to new and emerging transport infrastructure and technologies these cities have the opportunity to become the test bed and breeding ground for tomorrow's urban mobility systems.

CONCLUSION # 54: Urban Mobility as an end-to-end offering
Urban Mobility has to be served as an end-to-end offering for the entire travel chain.

CONCLUSION # 55: Urban Mobility extend public transport
Urban Mobility shall aggressively extend public transport.

CONCLUSION # 56: Urban Mobility and advanced traffic management systems
Urban Mobility shall apply advanced traffic management systems.

CONCLUSION # 57: Mobility regarding taxation and road tolls
Mobility shall reduce individual transport by greater taxation and road tolls.

Consider Urban mobility demand patterns: One of the most difficult challenges facing policymakers in mature markets is satisfying the needs of a diverse array of users. (see figure 15)

Urban Mobility Lifestyle	"Vienna – 1A type"	"Hong Kong – 1B type"	"Beijing – 1C type"	"Rome – 2A type"	"Los Angeles – 2B type"	"Kuala Lumpur – 2C type"
Greenovator						
Family Cruiser						
Silver Driver						
High-frequency Commuter						
Jet Setter						
Sensation Seeker						
Low-end Mobility						
Basic						
Smart Basic						
Premium						

Figure 15: Urban Mobility Demand Pattern.[45]

CONCLUSION # 58: Helsinki needs Demand Platform for MaaS

Helsinki needs to define the appropriate and best suitable Demand Platform in order to create the best and appropriate MaaS offering.

The mobility services platform manager A supplier adopting this business model offers any traveler a platform through which she can get travel information, plan a journey, make a booking and/or pay for the journey.

CONCLUSION # 59: "Mobility Services Management Platform" for MaaS

In order to ensure fair and sustainable use of all transport modes, an independent "Mobility Services Management Platform" for MaaS needs to be created.

7.2.7 UNIVERSITY of CALIFORNIA, Dr. Susan Shaheen: Corporate Car Sharing, impact on employees and businesses [46]

Corporate car sharing enables commercial businesses to reduce or eliminate private vehicle fleets by providing their employees with access to shared or "exclusive-use" car sharing vehicles.

Impacts of corporate car sharing: A North American Case Study

In a recent case Study of a large North American corporate car sharing program (over 175,000 members), researchers found two in five members sold or avoided a vehicle purchase due to corporate car sharing. Around 20 percent of corporate car sharing users reported that they sold a privately-

[45] Arthur D. Little Future Lab. Study No.1.Future of Urban Mobility. W. Lerner. 2011. p.11. Source: http://www.adlittle.com/downloads/tx_adlreports/ADL_Future_of_urban_mobility.pdf, 22.02.2016

[46] Move Forward. Corporate car sharing: Impact on employees and businesses. Susan Shaheen.18.08.2015. Source: https://www.move-forward.com/news/details/corporate-car-sharing-impact-on-employees-and-businesses/

owned vehicle after joining the program, and another 20 percent avoided buying a car as a result of joining the car sharing service.

The Study also found the use of corporate car sharing for work-related travel has helped to decrease the need for at least 33,000 privately-owned vehicles across North America. Of the corporate car sharing members who abandoned car ownership, 41 percent take public transportation more often, 22 percent travel via bicycle more often, and another 41 percent walk more.

The future of corporate car sharing

Corporate car sharing is poised to expand in the future as companies look for solutions to reduce costs, parking demand, reduce their carbon footprint, and improve the quality of life for their employees. The impacts of corporate car sharing demonstrate many of its benefits. Such findings can help to diffuse this innovative mobility option to employers, in both the government and corporate sectors, as a sustainable transportation strategy.

CONCLUSION # 60: MaaS as a service for "Corporate Car Sharing"

MaaS shall consider also a service for "Corporate Car Sharing". It will be an interesting application with good potentials for MaaS, but also to increase Sustainability of mobility in Finland.

7.2.8 SUSTAINABLE BRANDS: Mobility as a Service Charting the Course for Customized On-Demand Mobility [47]

Traditionally, the public transport sector has focused on providing relatively inflexible services through a 'take it or leave it' model with an established but limited range of transport modes on offer. For those whose needs are not met by public transport, mobility often depends to a great extent on car ownership. **In Europe, for instance, 83 percent of land-based passenger kilometers are met by cars.** The particular set of circumstances in the transport sector — such as cost and complexity of entry, incumbent economies of scale, and the regulatory environment — have also long helped it avoid major change.

Several key technological developments however, such as the rise of **mobile broadband, widespread dissemination of smartphones, big data, and advances in electric vehicles and autonomous driving are now acting as enablers for the emergence of a new mobility model known as Mobility as a Service (MaaS)**. Various megatrends including rapid urbanization and the sharing economy help further fuel the nascent disruption of the transport sector.

MaaS is a mobility distribution model that considers all transport modes as one co-operative, interconnected ecosystem. Under MaaS, consumers' day-to-day mobility needs are met via one unified online interface, offered through a dedicated service provider. The starting point of a journey is therewith not a map or timetable but the point-to-point trip the customer seeks to make, whenever and wherever that may be. This in turn leads to a **much more dynamic, flexible and customer-centered means of providing on-demand mobility**.

[47] Sustainable Brands. Mobility as a Service Charting the Course for Customized On-Demand Mobility. Renilde Becque. 08.02.2015. Source: http://www.sustainablebrands.com/news_and_views/business_models/renilde_becque/mobility_service_charting_course_customized_-demand_mo, 22.02.2016

MaaS platforms of the near future are anticipated to typically **offer monthly (targeted or customized) subscription packages, somewhat similar to mobile phone plans**, whereby users pay a monthly fee to get access to, for example, unlimited travel on urban public transport plus a capped amount of other transport services; as well as Pay-as-you-go (PAYG) options, whereby the MaaS interface would act more like flight search engines, drawing providers into one system to readily provide the user with all options available and allowing instant single payment.

MaaS therewith offers a one-stop-shop client interface, delivered through a highly integrated service system beyond what is commonplace today and bringing collaborative customization to the transport market. Evidenced by the growth in bike and car sharing and on-demand bus services, the further personalization and customization of transport is likely to see a flood of such platforms emerge in years to come.

For well-connected cities, introducing MaaS might mainly be a matter of integrating existing systems and building an overarching user platform; for others, a range of new or emerging transport modes and related soft and hard infrastructure will have to be built out in order to provide sufficient functionality and flexibility of door-to-door transport. Although these transitions may result in high transaction costs, it can also create opportunities to truly connect transport to other city systems and services, such as energy and health, turning transport into an integrated component of a smart, connected and resource-efficient city.

One thing is clear, though — whether innovative or just integrative, **the MaaS interface is part of an ecosystem of emerging and evolving forces revolutionizing the transport sector, whereby its sum is greater than the parts, ensuring tomorrow's transport is bound to keep us moving at the highest convenience and efficiency.**

CONCLUSION # 61: MaaS Services depend on efficient road network
MaaS Services depend to high degree on an efficient road network („in Europe, 83 percent of land-based passenger kilometers are met by cars"), since the road network is used by both public and private motor vehicles.

CONCLUSION # 62: Enablers for MaaS
Mobile broadband, widespread dissemination of smartphones, big data, advances in electric vehicles, and Robot Cars are now acting as enablers MaaS.

CONCLUSION # 63: MaaS: Dynamic, flexible and customer-centered
MaaS leads to a much more dynamic, flexible and customer-centered means of providing on-demand mobility.

CONCLUSION # 64: MaaS offers subscription packages
MaaS offers subscription packages, somewhat similar to mobile phone plans.

CONCLUSION # 65: MaaS offers one-stop-shop client interface
MaaS offers a one-stop-shop client interface.

CONCLUSION # 66: Needs of well-connected cities
For well-connected cities, introducing MaaS might mainly be a matter of integrating existing systems and building an overarching user platform.

CONCLUSION # 67: The MaaS interfaces

The MaaS interface is part of an ecosystem of emerging and evolving forces revolutionizing the transport sector, whereby its sum is greater than the parts, ensuring tomorrow's transport is bound to keep us moving at the highest convenience and efficiency.

7.2.9 HELSINKI AND TALLINN: Twin Cities? [48]

7.2.9.1 Jussi Pajunen - MAYOR OF HELSINKI

The interaction between the cities of Helsinki and Tallinn is frequent and easy. **Transport has rapidly increased during the last decades and is on a continuous rise and even speeding up.**

Work, studies and leisure activities ensure a constant flow of citizens across the Gulf of Finland. The cultural exchange is vivid. is evident by this joint publication and also earlier research works. Further development requires a good, compatible and up-to-date information base about both cities and their functional urban regions.

The aim is to provide this evolving information base as open data. e current joint publication is actually the first step towards establishing a continuously updated and open Helsinki-Tallinn database. e goal is to create an information service describing the twin city development which at its best would offer interoperable open data for various applications making everyday life of the citizens and visitors easier.

Helsinki and Tallinn, Finland and Estonia already have well-functioning cooperation for example in the ICT sector and to a large extent also in the sectors of education, research and innovation. Such a wide- scale cooperation platform, supported by the joint open and up-to- date information service together with good accessibility creates an outstanding base for cooperation between city administrations of Helsinki and Tallinn as well as companies, education and research.

The twin city area Tallinn – Helsinki is currently one of the most exciting entities of the Baltic Sea region. Different dynamics in the economy attract complementary international investments and companies into the cities. Drawing on compatible statistics on Helsinki and Tallinn we could say that these two cities already today make up a continuous metropolitan region. e better the transport connections, the more we will benefit from the proximity of our cities.

7.2.9.2 Edgar Savisaar - MAYOR OF TALLINN

Looking from a distance, there is only a river between Tallinn and Helsinki. Historically goods have been traded (so-called seprakauppa) between Virumaa and Southern Finland already for over 700 years.

The increasing cross-border cooperation between Helsinki and Tallinn is today supported by the leading role both capital cities have in the economic and social development of its country. More than 80% of the total direct investments to Estonia are made to the district of Tallinn, Harjumaa.

Finland is the most important trading partner for Estonia.

[48] City of Helsinki Urban Facts, The Development Service of Tallinn City Office. HELSINKI – TALLINN: facts and figures 2014. Source: http://www.tallinn.ee/Helsinki-Tallinn,Facts-and-Figures, 22.02.2016

More than 4000 companies with the Finnish shareholding have been registered in Estonia. **Over 7.5 million trips are annually made between Helsinki and Tallinn.** Tallinn's students from abroad include mostly students from Finland – more than 700.

The Helsinki-Tallinn Science Twin-City Project is being implemented.

We are different enough, to be of interest to each other, and similar enough to make cooperation possible. Estonia has one of the world's best developed e-solution packages, Finland has priceless experience in industry development and branding. Both countries share the common currency – euro, we are both EU and OECD members. Estonia is also a NATO member.

The special (1.5 h ferry ride), cultural, historical and linguistic closeness (60% of similar words) enhances economic and social cooperation. Uusimaa (Helsinki region) and Harjumaa (Tallinn region) form a closely integrated economic district, thus the creation of interstate joint labor resources is just a matter of time.

Opportunities for cooperation may be compared to a startup – not a lot of money, but we have the manpower, lots of ideas and the will to take over the world. Together we can be better and more attractive than separately and this cooperation could expand to the whole Baltic Sea region.

In the following tables you can compare the Motorization and Public Transport in Helsinki and Tallinn. (see table 3 and 4) [49]

Motor vehicles

	Helsinki	Tallinn
Cars	244,178	157,494
Trucks, vans	34,434	24,003
Motorcycles	16,250	5,032
Scooters	14,630	1,637
Buses	1,796	1,393
Private car density per 1000 inhabitants	410	264

Table 9: Motorization in Helsinki and Tallinn

[49] Source: Statistic Finland, Statistics Estonia and Helsinki Region Transport. Tallinn Transport Department

Public transport

	Helsinki	Tallinn
Number of lines	326	70
Length of lines (km)	1,243	763
Vehicles in traffic	1,585	456
Buses	1,345	332
Trams	132	54
Trolleys		70
Metro cars	108	
Train units	106	
Ferries	5	
Vehicle km (1,000 km)	118,120	29,006
Place kilometres (Mio pkm)	9,736.5	2,889
Number of boardings (Mio)		134
Internal traffic	230.6	
Regional traffic	335.7	

Table 10: Public Transport in Helsinki and Tallinn

CONCLUSION # 68: Transport between Helsinki and Tallinn

Transport between Helsinki and Tallinn has rapidly increased during the last decades and is on a continuous rise and even speeding up. Over 7.5 million trips are annually made between Helsinki and Tallinn.

CONCLUSION # 69: MaaS Estonia-Finland

Helsinki and Tallinn, Finland and Estonia already have well-functioning cooperation. Thus, Helsinki and Tallinn could serve in an excellent way to design, develop, and deploy "MaaS-EF" (MaaS Estonia-Finland) as a worldwide flagship project for Twin Cities.

CONCLUSION # 70: MaaS may expand cooperation in the whole Baltic Sea region

MaaS supports opportunities for expand cooperation in the whole Baltic Sea region.

7.2.10 HSL/HRT HELSINKI REGIONAL TRANSPORT AUTHORITY: MaaS to support the Helsinki Region Transport System Plan HLJ 2015 [50]

The Helsinki Region Transport System Plan "HLJ 2015" is a long-term strategic plan that **represents the common will** for transport policy and the development of the transport system in the region. The plan has been prepared in close cooperation with the regional land use plan (MASU) developed in accordance with the Letter of Intent on Helsinki Region Land use, Housing and Transport (MAL). The goals of HLJ 2015 are based on the MAL goals and they emphasize the **accessibility of the region and flow of traffic as well as social, economic and ecological sustainability**.

[50] Helsingin seudun liikennejärjestelmä-suunnitelma HLJ 2015 -luonnos. Source: https://www.hsl.fi/sites/default/files/uploads/hlj2015_luonnos_raportti.pdf, 22.02.2016

The following four policy statements summarize the contents of the Draft HLJ 2015:

- The service level of sustainable modes of transport is improved
- Information and steering tools are effectively utilized
- The needs of logistics and flow of road traffic are catered to
- Results are achieved by effective methods.

Measures derived from the policies **effectively address challenges** in different parts of the region within the **limits of funding** available. The key is to make the region more effective and competitive by **utilizing the existing structure** to the full and investing in the public transport trunk network and its service level. Measures are primarily targeted to support a **more coherent urban structure**. The measures **improve the overall performance of the transport system** and support land use development in which construction is primarily concentrated in the broad main center of the region as well as in the existing and emerging rail corridors. The use of the transport system is directed in a more responsible direction by making **efficient use of vehicular traffic pricing** and **traffic management tools**.

The Draft HLJ 2015 **helps to direct the increase in travel resulting from population growth to sustainable modes of transport.** The share of public transport of motorized journeys will increase by about six percentage points. The cost of public transport management will increase on the whole but as the system becomes more effective, the cost per journey will decrease. Vehicular traffic pricing diverts journeys to sustainable modes of transport and produces additional funding for public transport services and for the road investments necessary for the competitiveness of the region. Transverse public transport trunk routes strengthen the network structure of the region and create attractive nodes for employment and services. The efficiency of trip and transportation chains improves when public transport, Park & Ride, nodes and the ticketing system are planned as a whole utilizing information and incident management. Pricing will slightly increase the cost of driving but reduce congestion. Without vehicular traffic pricing the road network becomes congested, which impedes the flow of bus, goods and car traffic.

The preparation of and negotiations on the next Letter of Intent on Land use, Housing and Transport are a vital part of the implementation of the transport system decision. **The different parties must promote measures set out in the transport system decision** and the Letter of Intent and make provisions for planning and implementation conformable with them in their own financial and operational planning. The joint planning of the transport system and land use and decision-making need to be even more closely coordinated and tools for them developed together regardless of the future administrative model or organizational structure. We also need to consider developing transport system planning into a continuous process.

CONCLUSION # 71: Helsinki Region Transport System Plan for effective mobility

For the Helsinki Region Transport System Plan, the accessibility of the region and flow of traffic as well as social, economic and ecological sustainability is of top importance. Thus, an effective ecosystem of Mobility needs to be ensured.

CONCLUSION # 72: Helsinki Region Transport System Plan for sustainable modes of transport
The Helsinki Region Transport System Plan shall help to direct the increase in travel resulting from population growth to sustainable modes of transport.

CONCLUSION # 73: Challenges are addressed
HSL expects that the challenges are addressed: limitation of funding, best utilization of existing infrastructure, improvement of efficiency of overall transport infrastructure, efficient use of vehicular pricing, and efficient traffic management tools.

CONCLUSION # 74: „Vehicular traffic pricing“
Without „vehicular traffic pricing“ the road network becomes congested, which impedes the flow of bus, goods and car traffic.

CONCLUSION # 75: Measures for transport system
The different parties must promote measures set out in the transport system decision. (Note: this requires collaboration).

7.2.11 VTT Technical Research Centre Finland of Report: Smart Sustainable Mobility [51]

Transport systems are evolving continuously and rapidly. Today's transport system differs greatly from that only a few decades ago. The shift of the paradigm is also on its way. **Transport is no longer seen as a value in its own right but rather as an enabler for people mobility and logistics.** This shift of paradigm poses challenges but it also opens great possibilities for society and businesses. **These possibilities create niches for new innovations and services that different stakeholders (public and private sector, transport users, etc.) should pursue from their respective perspective.**

Traffic and mobility are more linked to services, economy and business than ever: The development of information and communication technologies (ICT) has contributed to the shift of paradigm. This not only applies to the development of traffic but also to people's everyday life in general. Traffic and mobility are more closely linked to services, economy and business than ever. Different stakeholders approach new traffic systems from different perspectives and have their respective needs. However, traffic systems need to be developed in parallel from perspectives in partnership with the public and private sector, as well as the people using it.

[51] VTT Technical Research Centre of Finland. Smart sustainable mobility. A user-friendly transport system is a combination of intelligence, low carbon energy, and adaptable services. Source: http://www.vtt.fi/inf/pdf/visions/2014/V5.pdf, 22.02.2016

Figure 16: Mobility, The Game is Changing

'Mobility as a Service': In recent years, a more customer- and service oriented approach has evolved in the field of transport. The concept of 'Mobility as a Service' (MaaS) has been predicted to change the transport system. A push towards this kind of thinking has – at least partly – been induced by several challenges of the current traffic system and society. These challenges include an increasing demand for mobility and investments as traffic flows have grown along with economic activity. At the same time, the funding for traffic infrastructure has struggled to cope with increasing quality demands, also in Finland. In addition, economic, societal and environmental issues have been at the center of the debate on traffic. More cost-efficient mobility can be achieved by means of intelligent services that allow less driving, less congestion, less idle time and optimized traffic services. At the same time, traffic has a **key role in reducing emissions, as it corresponds to some 25 % of the CO2** emissions in Europe. Finally, the concept can contribute greatly to improved traffic safety, which also has major economic and societal impacts.

Great economic potential in intelligent transport systems: Mobility as a service is closely linked to intelligent transport systems (ITS), **which cultivate the shift of paradigm**. The range of ITS services covers various transport modes and users. The core of these services is information, which may, among other things, enhance safety and consumer experience, increase efficiency of operations and productivity of the transport system as a whole or promote new value-added services. As an enabler of MaaS, the great economic potential of ITS has been recognized, and reports indicate significant growth projections for the ITS market as a whole. The total volume of the ITS industry has been estimated at 20-59 billion EUR on an annual basis with a growth projection of 20 % by BCC Research in their Intelligent Transport Systems Review. According VTT's Study (Leviäkangas et al., 2012[52]), **the Finnish ITS industry had about 1700 employees with markets of approximately 300 million EUR in 2010**. Recent developments have further increased the attractive- ness of the industry and generated new business. Thus, new traffic services offer possibilities for new business, jobs and wellbeing. Finland

[52] Technology and Investment – Scientific Research. The Size, Structure and Characteristics of Finland's ITS Industry Zulkarnain, Pekka Leviäkangas. 2012. Source: http://dx.doi.org/10.4236/ti.2012.33022, 22.02.2016

has an advantage as a relatively small nation with high-quality infrastructure and technological expertise (especially in mobile services), providing an ideal environment for developing and piloting new services.

Mobility service packages – tailored to all needs: The MaaS concept is closely linked to end-users of transport services. One example of MaaS is the mobility service package, which would revolutionize people mobility. Based on their respective needs, different mobility service packages could be offered to people. For example, a 'light mobility package' could consist of free use of commuter transport with limited use of taxis and rental cars (e.g. 200 km/ month) in certain areas, while a 'heavy user pack- age' could comprise free use of public transport, taxis and rental cars in predetermined cities (or, for example, some European capitals). Crucial issues with end-user services are user friendly interfaces, data transfer (especially roaming abroad) and clearing between systems and areas.

CONCLUSION # 76: Transport as an enabler for the mobility of people and goods

Transport is no longer seen as a value in its own right but rather as an enabler for the mobility of people and goods.

CONCLUSION # 77: Great possibilities for society and businesses

This shift of paradigm opens great possibilities for society and businesses. The Finnish ITS industry had about 1700 employees with markets of approximately 300 million EUR in 2010.

7.3 Impacts of Mobility as a Service to various Sectors in Finland

The tables below show the different impacts of Mobility as a Service to various sectors (transport, infrastructure and construction, energy, environment, safety and health, ICT and economy) related to Mobility.

Graphic legend				
Forecast	**light**	**moderate**		**severe**
Positive Impact	+	+ +	+ + +	+ + + +
Negative Impact	–	– –	– – –	– – – –
Increase	↗			
Decrease	↘			

7.3.1 Impacts of MaaS to the Transport Sector

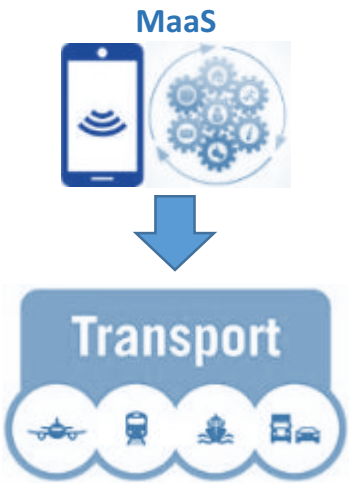
Sector	Impacts	KPI	Forecast
	⇪ Better service offering for mobility, especially in city areas. ⇪ Higher efficiency of transport network. ⇪ Reduced need to own a private car. ⇪ Environmental protection.	🗝 **KPI-013:** Level of service	
		🗝 **KPI-020:** Citizen satisfaction with transport system	
		🗝 **KPI-021:** Transport service turnover	
		🗝 **KPI-028:** Amount of persons in vehicle	

Table 11: Impacts of MaaS to Transport Sector related to Mobility

7.3.2 Impacts of MaaS to the Infrastructure Sector

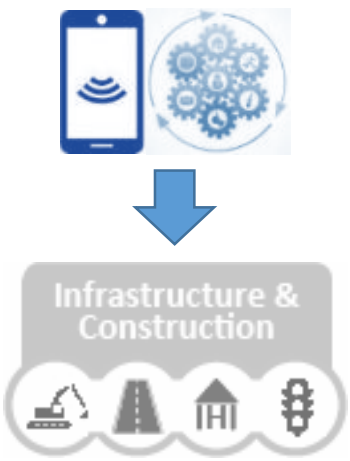
Sector	Impacts	KPI	Forecast
	⇪ Existing infrastructure is better utilized because of higher efficiency of a connected transport ecosystem. ⇪ Increase of interchange points needed to allow intermodal easy travel with the different transport providers (e.g. Park & Ride, train & cycling, Metro & shared taxi to support inter-modality	🗝 **KPI-048:** Capacity investments	

Table 12: Impacts of MaaS to Infrastructure and Construction Sector related to Mobility

7.3.3 Impacts of MaaS to the Energy Sector

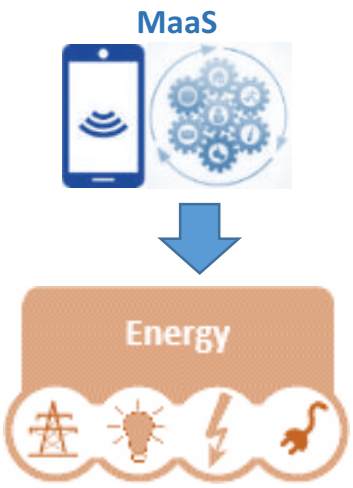
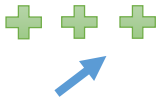
Sector	Impacts	KPI	Forecast
	⇪ Increase of efficiency reduces the energy consumption of transport.	🗝 **KPI-023:** Sustainability of transport	

Table 13: Impacts of MaaS to Energy Sector related to Mobility

7.3.4 Impacts of MaaS to the Environment Sector

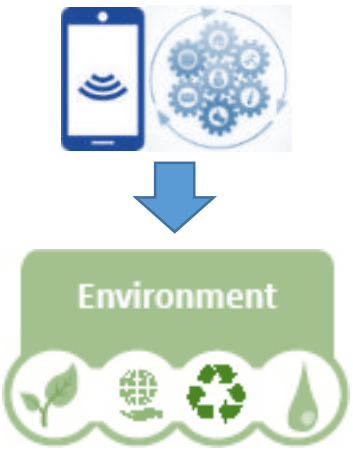
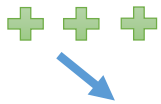
Sector	Impacts	KPI	Forecast
	⇪ Increase of efficiency reduces environmental impacts.	🗝 **KPI-023:** Sustainability of transport	

Table 14: Impacts of MaaS to Environment Sector related to Mobility

7.3.5 Impacts of MaaS to Safety & Health Sector

Sector	Impacts	KPI	Forecast
	⇪ Since MaaS strongly supports Public Transport, accidents will be reduced.	🗝 **KPI-015-017:** Amount of people (seriously) injured/ killed per year in road transport	
		🗝 **KPI-029:** Number of accidents per year in road transport	

Table 15: Impacts of MaaS to Safety and Health Sector related to Mobility

7.3.6 Impacts of MaaS to the ICT Sector

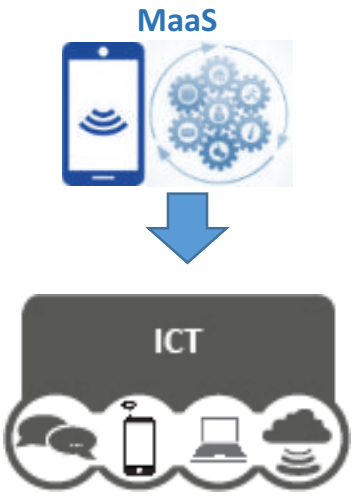
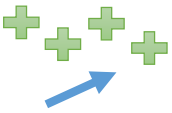
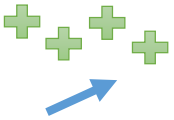
Sector	Impacts	KPI	Forecast
	⇪ Mobile broadband, widespread dissemination of smartphones, Big Data, and advances in electric vehicles are now acting as enablers MaaS.	🗝 **KPI-037:** Amount of APIs in transport sector	
		🗝 **KPI-039:** Use of Cloud Services	

Table 16: Impacts of MaaS to ICT Sector related to Mobility

7.3.7 Impacts of MaaS to the Economy

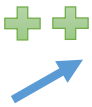
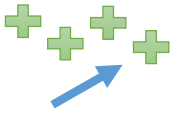
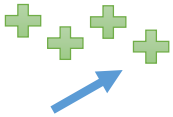
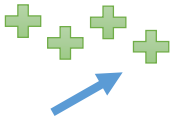
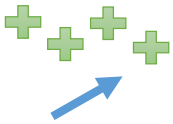
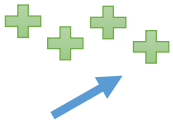
Sector	Impacts	KPI	Forecast
MaaS 	More efficient mobility services support the movement of people and goods.	**KPI-003:** Value adding services business market (NEW)	
		KPI-010: Energy consumption	
		KPI-023: Sustainability of transport	
		KPI-034: GDP Finland	
		KPI-034: Value of time	
		KPI-049: Household spending in transport	
		KPI-051: Employees in Finnish ITS industry	
		KPI-052: Size of Finnish ITS market	

Table 17: Impacts of MaaS to Economy Sector related to Mobility

7.4 SWOT for Mobility as a Service

The following illustration shows the SWOT-Analysis with the strength, weaknesses, opportunities and threats related to Mobility as a Service. (see figure 17)

Mobility as a Service has also more strength and opportunities than weaknesses and threats. The major challenges are the increasing of mobility and the market response. On the one hand the vulnerability of ICT-availability and electric power is a serious danger of MaaS, but on the other hand, a user-friendly service for an inter-modal and complete mobility is offering for all modes of Transport.

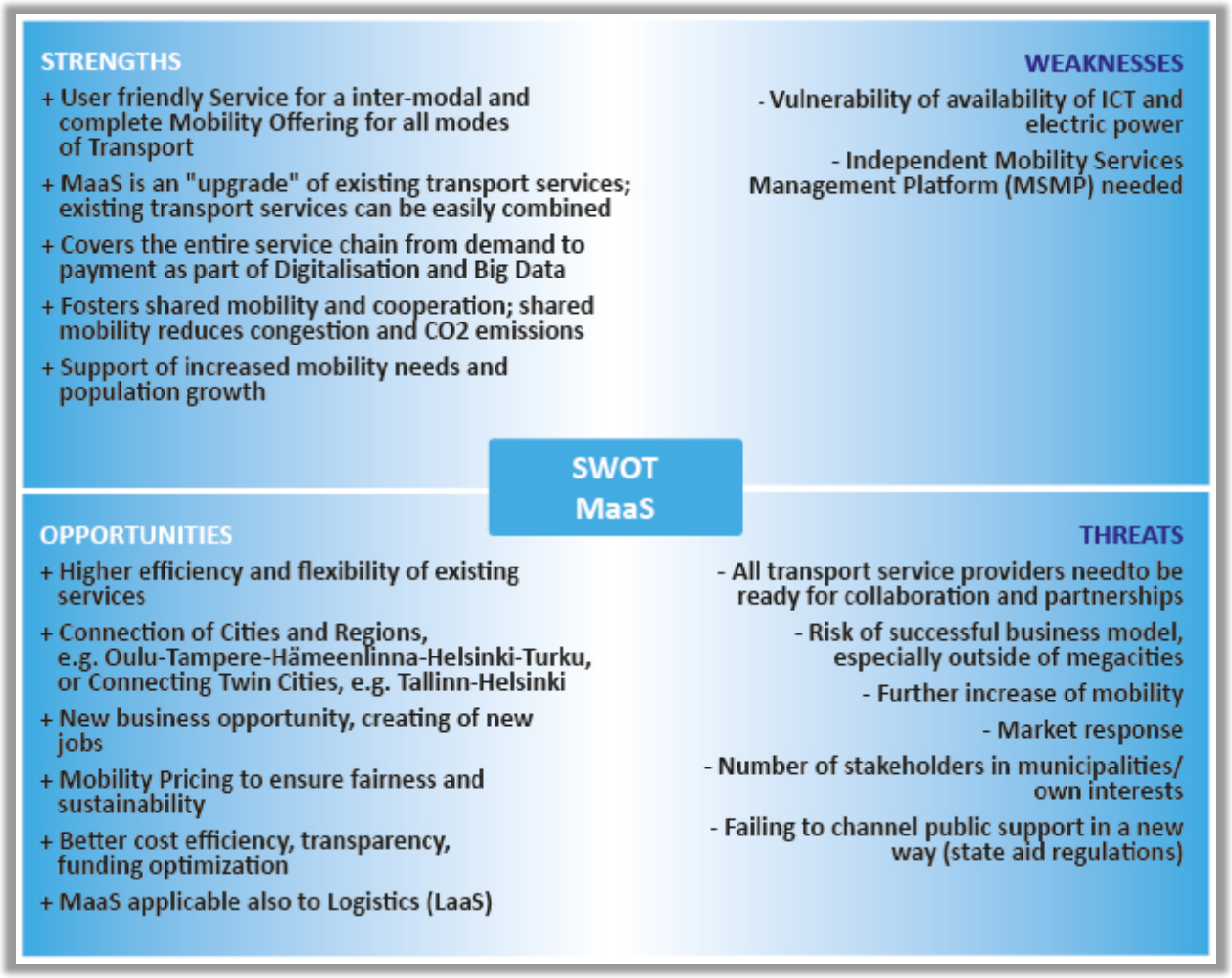


Figure 17: SWOT Mobility as a Service (MaaS)

7.5 Policy Recommendations for Mobility as a Service

1. Ensure transparent market conditions for all Public and Private transport service providers.
2. Secure the rights of the users in regard of service guarantees and data privacy.
3. Creation of the “Independent Mobility Services Management Platform”.
4. Base MaaS on Mobility Pricing, guaranteeing sustainable and fair use of all transport services.
5. To support border crossing MaaS offerings, a European Policy for MaaS is required.
6. The Helsinki Region Transport System Plan shall be aligned with MaaS.

7.6 Strategic Summary for Mobility as a Service

1. MaaS is the framework for a new, fully integrated, end-to-end Transport ecosystem.
2. It offers “Mobility Subscription Packages” similar to mobile phone plans; (“Small/Medium/Large/Business”).
3. MaaS is introducing new mobility offerings and one-stop-shop access to further support the

growth of cities and regions, is more easy to use, customer driven, supports shared mobility, and increases the quality of life by better mobility.

4. MaaS fosters shared mobility.
5. MaaS interconnects all (existing) modes of transport, and helps to better manage capacity and demand. MaaS is suitable for the entire Country.
6. MaaS fosters cooperation between all transport service providers to deliver integrated and inter-modal mobility.
7. MaaS requires an independent Mobility Services Management Platform (MSMP) and must be supported by Mobility Pricing to ensure sustainability.
8. MaaS decreases cost of transport, and increase cost transparency. Higher efficiency and sustainable pricing lead also to reduction of emissions.
9. MaaS supports new businesses and creates jobs.
10. MaaS interconnects (not only transport wise) neighbor cities and regions. Twin-cities or twin-regions are fostered.
11. MaaS requires strong ICT and communications back bones.
12. MaaS shall be applied also to the mobility of goods.

This space is left free intentionally.

8 Mobility Pricing

8.1 What is Mobility Pricing

1. Mobility Pricing is a potential new Policy Tool to create and ensure Sustainable Mobility.
2. Mobility Pricing is the application of market based, full cost pricing mechanisms on all modes of Transport.
3. Mobility Pricing includes a change from tax based to the user-pays principle.
4. Mobility Pricing shall be based on incentives rather than on prescriptions. Benefits shall motivate to increase the sustainability of the individual mobility.
5. Mobility Pricing covers the entire process chain of Mobility, from financing, planning, management, or payment, and includes all transport modes.
6. Mobility Pricing is also a tool to manage the demand with the available capacities.
7. Mobility Pricing creates transparency on all cost, internal and external, public subsidies or ticket prices.

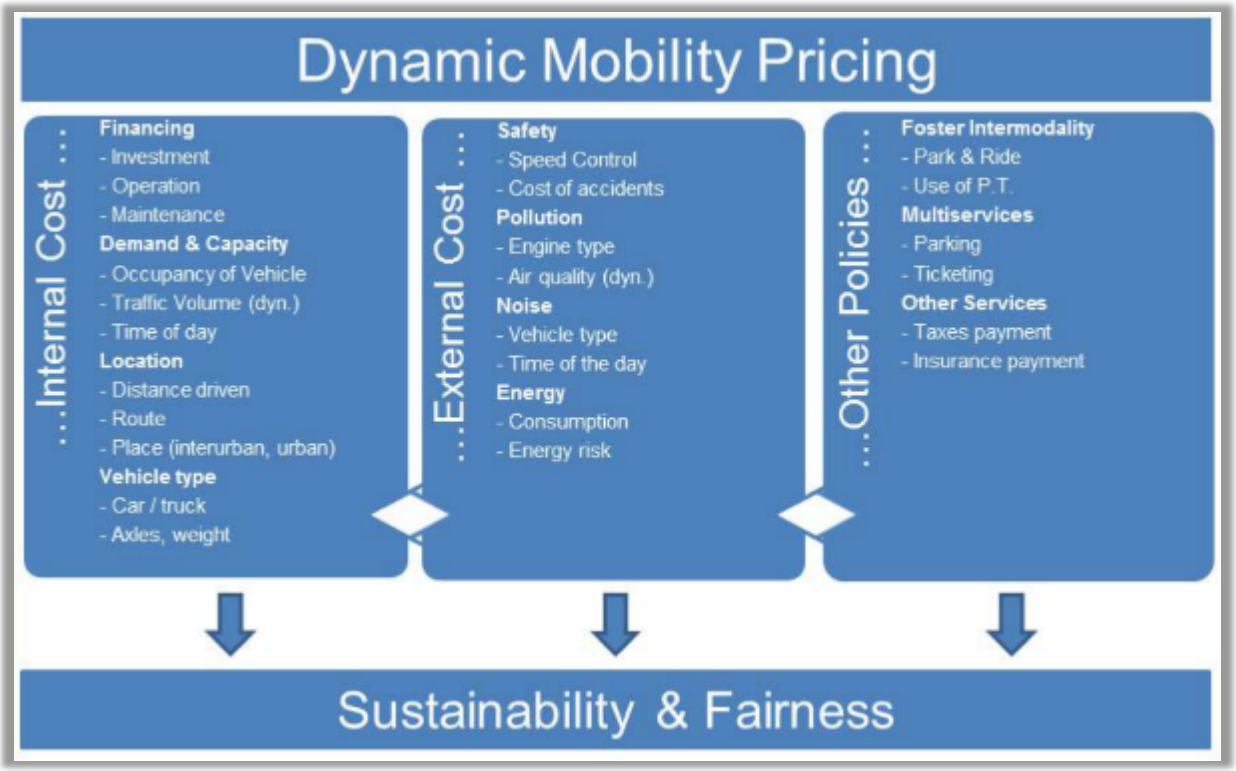


Figure 18: Bases of Mobility Pricing [53]

8.2 Possibilities of Mobility Pricing

Mobility Pricing is a new innovative and sustainable pricing tool to be applied for all transport services, being based on real, complete, and fully comparable cost model.

Mobility Pricing considers both, the “internal cost” (investment and operation), and the “external cost” (e.g. noise, pollution, congestion, safety, energy risks) of each trip.

[53] Swiss Federal Road Administration ASTRA. Grundprinzipien von Mobility Pricing. p.13. Source: http://www.astra.admin.ch/themen/00901/06983/index.html?lang=de, 22.02.2016

For each trip all direct trip cost, e.g. the time of the day, the distance, the location, the infrastructure used (tunnel, bridge), the mode of travel, the environmental sustainability of the vehicle, the amount of persons in the vehicle, the mode of energy used, etc. are considered.

Mobility Pricing is to be applied neutrally to all modes of transport (road, rail, air, sea).

Mobility Pricing is to implement and manage the Sustainability Policies for Transport:

- Sustainable Prices (including internal and external cost)
- Sustainable Efficiency (manage demand and capacity, thus ensuring best use and harmonization of transport services, reducing congestion)
- Sustainable Safety (reduction of accidents)
- Sustainable and Green Transport (reducing the negative impacts of transport to the environment)
- Local sustainability goals; e.g. in City centers, around schools or hospitals, in nature reserves, in environments to be secured, etc.
- Other national, regional or social Policies

8.3 Mobility Pricing: International Outlook

8.3.1 AVENIR SUISSE - In 2030 we will live in a completely new world of mobility [54]

Interview with **Mr. Daniel Müller-Jentsch**, Traffic Expert at Avenir Suisse[55] in Bern, Switzerland:

So, you are in favor mobility pricing systems? But how big is the scope in this regard, is this the face of a largely underutilized infrastructure at all?

"**Mobility pricing offers two important lever against congestion.** Firstly, **it throttles the traffic demand** through higher prices. Currently Motorists pay only a portion of the direct and indirect costs of their mobility itself. Here we need more cost transparency. Secondly, **it directs the traffic through differentiated tariffs**. The roads and rails are in fact overloaded only during rush hours and on certain bottleneck routes. At night there is a gaping void in the streets, and in the week compared to remain 70 to 80 percent of the seating capacity unused at the SBB (Swiss Railways). Especially the freight traffic could be relocated on little-used off-peak times in the night. For this, however, appropriate pricing systems are required, as well as new technologies such as electric vehicles who are driving quieter."

CONCLUSION # 78: Mobility Pricing as "lever against congestion"
Mobility Pricing is seen as a "lever against congestion". It "throttles" the demand, and it directs the traffic through differentiated tariffs.

[54] Der Bund. «2030 werden wir in einer völlig neuen Mobilitätswelt leben». Robert Meyer. 26.01.2016. Source: http://www.derbund.ch/wirtschaft/konjunktur/Selbstfahrende-Autos-oder-EMobility-sind-nur-einige-Beispiele/story/28691265, 22.02.2016

[55] Avenir Suisse. Think Tank for economic and social issues. Source: http://www.avenir-suisse.ch/en/, 22.02.2016

8.3.2 ASTRA Switzerland: Report on Concept of Mobility Pricing (May 2015) [56]

8.3.2.1 Scope

The report was prepared by ASTRA, the Swiss Federal Road Administration.

Mobility in Switzerland has risen sharply in recent decades. Today's transport system faces increasingly confronted with major challenges. On one hand, **capacity limits are increasing**ly being achieved at peak times; On the other hand, the **demand for mobility is continuously growing** strongly. **Mobility Pricing opens up possibilities to react purposeful to these challenges to have the use-related levy for infrastructure and services in private and in public transport with the aim of influencing the demand for mobility.**

The Federal Council in its infrastructure strategy "future of national infrastructure networks in Switzerland" states: "In the longer term is a new financing model for road and rail to examine that generates not only the necessary resources in the long run, but also the mobility in terms of an **economically efficient and ecologically sustainable use of network capacity** affected. This is in the context of a market economy only by means of performance, quality and achieve demand-dependent rates for open access to transport infrastructures ".

In the message to the current legislative planning (2011-2015), the Federal Council sees below the target 21 before developing a concept report Mobility Pricing. This is intended to show the models for Switzerland, but contain no order for later implementation. Tariffs and pricing are also not the subject of the report.

CONCLUSION # 79: Mobility Pricing: Economically efficient and ecologically sustainable
Mobility Pricing generates the terms of economically efficient and ecologically sustainable use of network capacity.

CONCLUSION # 80: Mobility Pricing allows to react on the challenges
Mobility Pricing allows to react on the challenges of constantly increasing mobility and capacity limitations, and influencing the demand by a use related levy.

8.3.2.2 Facts about Mobility Pricing

The following questions need to be answered:

- What's Mobility Pricing?
- What is the aim of Mobility Pricing?
- What can mobility pricing contribute to tackling the traffic problems?
- What mobility pricing means for road and rail?
- What models of road and rail could be purposeful in the Swiss context for solving actual and future problems?
- What synergies and limits involves intermodal approach?
- What can impact on mobility pricing have on the economy, society and the environment?

[56] Swiss Federal Road Administration ASTRA. Source: http://www.astra.admin.ch/themen/00901/06983/index.html?lang=de, 22.02.2016

With the sharp increase in traffic performance by road and rail three requirements are connected: Capacity problems, Rising costs, Externalities.

Mobility Pricing is a concept based on economic principles and represents an efficient management of transport infrastructure, a performance based pricing and an improved implementation of the polluter pays principle.

With Mobility Pricing to intermodal traffic spikes broken and a more even utilization of the transport infrastructure can be achieved.

8.3.2.3 Principles of Mobility Pricing

The Following principles shall apply:

"Pay as you use": mobility pricing is performance-related prices for products and services instead of indirect taxes and unit prices. Who consumed mobility, should have an incentive to behave Budget (this would mean not pay for owning an automobile, but for its use).

Compensation: With Mobility Pricing the total amount paid is not more, but otherwise paid otherwise.

Distributional impact / Social Policy configuration: Mobility Pricing has to be collectively as refinement that that mobility remains affordable for all users

Intermodality: mobility pricing pursues a multi-modal approach and includes road and rail.

Modular design: mobility pricing is a modular conception approach.

Privacy: The privacy as part of a mobility pricing system has to be incorporated as an integral principle both in the planning and in the implementation and operation.

Transparency: Mobility Pricing is transparent and clear for the user. The user must be able to adapt the mobility behavior on the corresponding information.

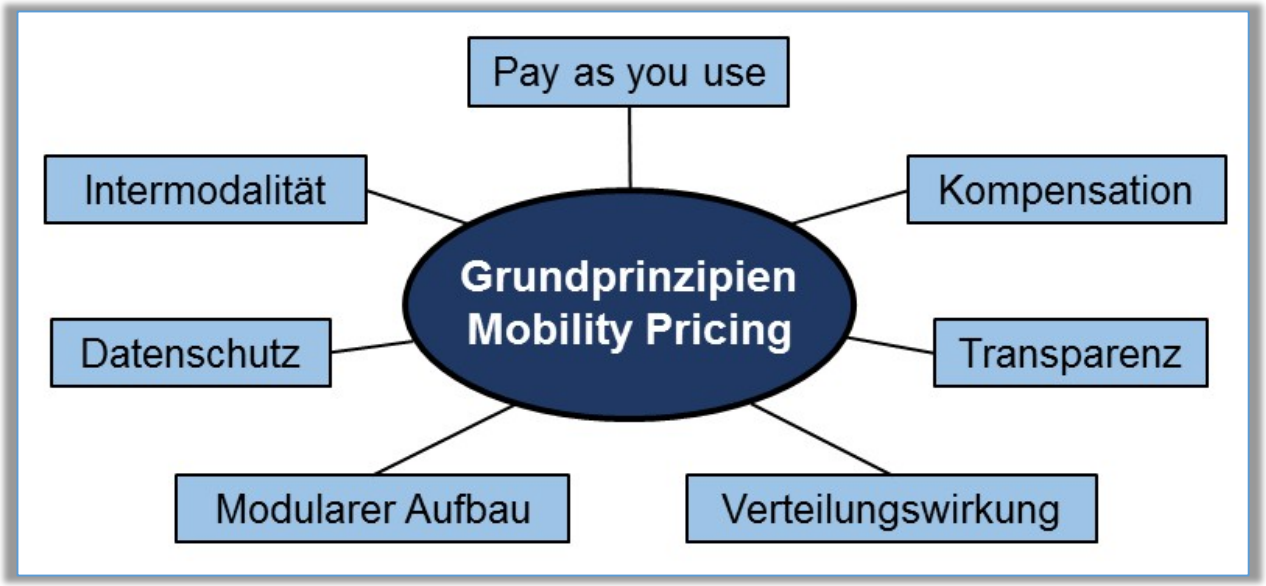


Figure 19: Bases of Mobility Pricing [57]

[57] Swiss Federal Road Administration ASTRA. Grundprinzipien von Mobility Pricing. p.13. Source: http://www.astra.admin.ch/themen/00901/06983/index.html?lang=de, 22.02.2016

CONCLUSION # 81: Mobility Pricing is based on the "Pay As You Use" Principle
Mobility Pricing is based on the "Pay as You Use" Principle. This allows fair pricing according the actual usage.

CONCLUSION # 82: Mobility Pricing shall cover all Transport Modes
Mobility Pricing shall cover all Transport Modes.

CONCLUSION # 83: Mobility Pricing - transparent and protect privacy
The users expect transparency and protection of privacy.

CONCLUSION # 84: Mobility Pricing includes also the "external cost"
Mobility Pricing includes also the "external cost".

8.3.2.4 Mobility Pricing - Morphological Box - Public Transport

The morphological box public transport describes where, on what, who, how paid, whereby it is determined what is replaced and is thus applicable. Unlike the road there is inherent in the system in public transport some categories more. Below those mentioned above in morphological box model parameters are described summarily. For details on each model parameters, please see the illustration below.

Wo wird bepreist?	Kunstbaute	Linie	Strecke	Knoten	Zone	Netz	Gebiet
Was wird bepreist?	Personenverkehr				Güterverkehr		
	Orts- / lokaler Verkehr		Regionalverkehr			Fernverkehr	
	Bahn	Bus		Tram	Schiffahrt		Luftseilbahnen
Wer bezahlt?	Verkehrsunternehmen		Kunde			Nutzniesser	
Tarifgestaltung	Trassenpreis		Endkundentarif			Nutzniesserbeitrag	
	örtlich variabel	zeitlich variabel		qualitativ variabel	umweltspezifisch variabel		Pauschalabgabe / Flatrate
Tariffestlegung	Vertragliche Auflagen	Vorgaben im Rahmen von Konzessionen	Eignervorgaben	Gesetzliche Festlegung für einzelne Bereiche	Regulatorische Vorgaben	Tarifhoheit zu Bund	Tarifhoheit bei Transportunternehmen / Infrastrukturbetreiberin
Kompensation	keine		Tariferhöhungen		Abgeltungsanpassungen		Allgemeine Rückerstattung
Erfassungstechnik	Manuell Ticket/Chip	CICO: Check In / Check Out		WIWO: Walk In / Walk Out	BIBO: Be In / Be Out	Trassenabrechnung	Nutniesserrechnung

Figure 20: Mobility Pricing - Morphological Box - Public Transport [58]

8.3.2.5 Mobility Pricing - Morphological Box – Individual Road Transport

The morphological box Street describes where and what is priced and explained tariffs, compensation and detection technology. Below the those specified in the morphological box model parameters are described summarily. For details on each model parameters, please see the illustration below.

[58] Swiss Federal Road Administration ASTRA. Mobility Pricing - Morphological Box - Public Transport. Mai 2015. p. 17. Source: http://www.astra.admin.ch/themen/00901/06983/index.html?lang=de, 22.02.2016

Wo wird bepreist?	Parkraum	Abschnitt	Netz	Zone	Zone-Netz-Zone	Gebiet			
Was wird bepreist?	leichte Personenwagen (<3,5t)	schwere Personenwagen (>3,5t)	leichte Sachentransport-FZ (<3,5t)	schwere Sachentransport-FZ (>3,5t)	Motorräder	Langsamverkehr			
Tarifgestaltung	Objektgebühr	Pauschalabgabe / Flatrate	Kilometer-Abgabe	örtlich variabel	zeitlich variabel	dynamisch (Verkehrsmenge)	Emissionsstufe	Gewicht	
Kompensation	keine	Vignette	Mineralölsteuer	Mineralölsteuer-zuschlag	Automobilsteuer	Schwerverkehrs-abgabe	Motor-FZ-steuer	Parkgebühren	Versicherungs-prämien
Erfassungstechnik	Zahlstelle	e-Vignette (Selbstdeklaration)	Videomaut	Funkmaut	Smart Device				

Figure 21: Morphological Box – Individual Road Transport [59]

CONCLUSION # 85: "Morphological Box" as a toolkit Sustainable Pricing Model

The "Morphological Box", applied to Mobility Pricing, can serve as a toolkit for developing a Sustainable Pricing Model for Public and Private Transport and Mobility. It includes existing conditions of infrastructures, service providers, taxation, energy, or Payment.

8.3.2.6 Mobility Pricing Structures for Roads

Where will be priced? Parking space, section, network, zone, zone-power zone and area.

1. What is priced? light passenger cars, heavy passenger cars, light goods transport vehicles, heavy goods transport vehicles, motorcycles and motorized traffic
2. Tariffs? Property tax, flat-rate charge, kilometer indication, delivery locally variable, output variable in time, effort by traffic volume, according to emission level or by weight / axes.
3. Compensation? National road tax, fuel tax, fuel tax surcharge, automotive control, HVF, road tax, parking fees and insurance premiums.
4. Detection technique? Paying agent, e-Vignette, video toll, wireless mouse or SmartDevice.

8.3.2.7 Mobility Pricing Elements for Public Transport

1. Where is the pricing introduced? Special sections (e.g. tunnels, bridges), track, line, node, zone, power and area.
2. What or what "kind" of traffic is priced? 1) between passenger and freight transport, 2) between local / local transport, regional transport and long-distance traffic and 3) by mode of transport, i.e. rail, bus, tram, boat and funicular.
3. Who pays? Transport companies, customers, passengers, shippers, forwarders and operators.
4. What is the basis the pricing and if / how is differentiated? If the infrastructure, the transport or the usufruct priced?
5. Tariff-fixing: What determines how and by whom the tariffs are designed?
6. Compensation: What will be replaced with the pricing (partially)?

[59] Swiss Federal Road Administration ASTRA. Mobility Pricing - Morphological Box - Public Transport. Mai 2015. p. 17. Source: http://www.astra.admin.ch/themen/00901/06983/index.html?lang=de, 22.02.2016

7. Detection technique Wherein which technical implementation?

8.3.2.8 Individual mobility behavior impacts

1. Is the trip really necessary?
   - Can I plan my day so that I will not be during the rush hour on the go have to be?
   - Can by driving I do more things with the same trip?
   - Can I choose to address and / or place of work, that I have the lowest possible cost of mobility even at a distance-based billing?
2. Displacement of departure times
3. Exchange or other mode of transport
4. Change the route selection / Detours
5. Change the speed dial
6. Living and siting (spatial effect)

CONCLUSION # 86: Changes in "Mobility Behavior" of the Users
Mobility Pricing shall change also the "Mobility Behavior" of the Users. In a final meaning, this could also apply to choose a closer place of living to the work place.

8.3.2.9 National Economy impacts

Efficient transport infrastructures are a necessary condition for economic and social prosperity welfare and provide the global competition a substantial contribution to maintaining and improving Switzerland's attractiveness.

From an economic perspective are congestion time losses that transport users inflict upon each other.

The economic consequences of congestion can be monetized. Congestion costs result to a large extent, approx. 85%, from the cost of time wasted in Congestions. This amounts (in Switzerland) to nearly 1.25 billion CHF in the year 2010 (equals to €1.13 bn).

CONCLUSION # 87: Congestion cost in Switzerland
Congestion cost in Switzerland in 2010 were €1.13bn (wasted)!

8.3.2.10 Environmental impacts

The impact on the environment correspond quantitatively majority the impact on the volume of traffic and the flow of traffic. As a result of decreasing congestion on roads can locally positive environmental effects can occur such as a reduction of noise and emissions. An increased use of motorized traffic would also benefit the environment. The smoothing of the morning peak traffic, however, could selectively lead to increased noise in the early morning hours. An important effect of mobility pricing relation to environmental effects is that thanks to the efficient use of infrastructure, the pressure for the creation of new infrastructure with the associated negative effects such as land use, landscape fragmentation, and new traffic can be reduced.

8.3.2.11 Costs and benefits of a system change

The transport infrastructure access at peak times especially in the morning and evening traffic at their capacity limits. This results in public transport trains full, not enough seats, crowding on the platforms.

In the stations and on the streets, there is friction such as congestion or congested traffic. Overall, this leads to negative effects such as travel time losses, delays and inadequate satisfaction of road users. Viewed over the whole day or the whole week, it has, however, both on the road as well as rail spare capacity.

8.3.2.12 Data protection, privacy

In the processing of (personal) data are partly opposing interests. Having data protection legislation, inter alia, therefore aim to compensate for this. By notice therefore the following principles are connected:

1. Legality
2. proportionality
3. earmarking
4. accuracy and integrity
5. transparency for data subjects
6. Information security

CONCLUSION # 88: Guaranty of data protection and privacy
Data protection and privacy have to be guaranteed.

8.3.2.13 Summary of Mobility Pricing (ASTRA)

Mobility Pricing opens up new opportunities to respond to challenges in leading traffic goal - have the concept of usage - related charges for use of infrastructure and services in the MIV and in public transport. With Mobility Pricing traffic peaks to intermodal broken and a better and more uniform utilization of the transport infrastructure can be achieved.

A key to success on the way to a possible introduction of mobility pricing is likely to be in addition to several other factors also synchronize with accompanying societal measures (e.g. living and trips to work, school and shop opening times, land use planning, inter-modal access).

CONCLUSION # 89: Finish interdisciplinary, inter-modal Working Group on Mobility Pricing
It is recommended that Finland would initiate a Study and create an interdisciplinary, inter-modal Working Group on Mobility Pricing, and apply the "Morphological Box" to the Finnish Transport and Mobility ecosystem.

CONCLUSION # 90: Mobility Pricing shall become a core element for MaaS
In addition, Mobility Pricing shall become a core element for MaaS.

8.3.3 SWINBURNE UNIVERSITY MELBOURNE, Prof. Hussein Dia: How to fix Traffic Congestion in Australia [60]

Prof. Hussein Dia, Associate Professor at Swinburne University of Technology, Melbourne, Australia:

[60] GIZMODO. Australia. How To Fix Traffic Congestion In Australia. Hussein Dia. 16.12.2016. Source: http://www.gizmodo.com.au/2015/12/how-to-fix-traffic-congestion-in-australia/, 22.02.2016

Traffic congestion impedes economic growth. The avoidable cost of congestion in capital cities alone is estimated to be around $16.5 billion for 2015, up from about $12.8 billion for 2010. The Bureau estimates the cost will increase if the current trends are not controlled and the most likely scenario is that it will blow out to around $30 billion by 2030 if nothing changes. Transport is also one of the major sources of emissions related to the combustion of fossil fuels in Australia. In 2010, transport contributed 83.2 Million tonnes of CO_2, or 15.3% of Australia's net emissions with road transport accounting for 71.5 Million tons of CO_2 or 86% of national transport emissions. Passenger car usage in urban areas was the largest transport source, contributing 8.5% of Australia's net emissions and accounting for around 39.7 Million tons of CO_2.

CONCLUSION # 91: Global situation of CO2 emissions
The amount of CO2 emissions is enormous, and steadily climbing in Australia, and also globally.

Congestion pricing has been proposed by planners, economists, policy makers and peak bodies as a likely solution to address the shortfalls of the current system. It is also the most likely solution to curb transport emissions in congested urban areas. Through this approach, drivers would pay directly, through a user charge, for travel into congested areas (a road user driving in a regional area and not contributing to congestion in the city would not pay). The charge can be dynamic and would change to reflect the current congestion levels (higher charges would apply during peak hours). This would be part of an overall tax reform that would remove or reduce other transport taxes (e.g. vehicle registration which is essentially a 'property' tax as it is not a charge related to the amount of travel).

CONCLUSION # 92: Dynamic prices to be included in Mobility Pricing
The charges in the Mobility Pricing Model should be real time and dynamic, reflecting the expected or current traffic and congestion situation.

CONCLUSION # 93: Mobility Pricing as a part of an overall tax reform
Mobility Pricing could be part of an overall tax reform.

The benefits reported for these cities are compelling. In the 12 years since London started the scheme, traffic congestion was reduced by around 10% in the central city area. This included a 34% drop in private cars entering the area, and 28% increase in cyclists. The scheme also resulted in a 16% reduction in emissions within the charging zone, amounting to 30,000 tonnes annually. A recent Study has also found that the program resulted in reducing traffic collisions by 40% between 2000 and 2010. In addition to saving money and lives, congestion pricing is also reported to raise more than $300 million every year which would go towards improving the city's transport services.

CONCLUSION # 94: International experiences from Pricing Schemes
International experiences from Pricing Schemes in London, Stockholm, Gothenburg or Singapore are very promising to reduce emission, congestion, and to finance the required infrastructure build up and maintenance.

CONCLUSION # 95: Results of London's Pricing Scheme
London: In the 12 years since the start of the scheme, traffic dropped by 34% from private cars, emissions are reduced by 16%, cycling increased by 28%.

In Stockholm, the congestion pricing scheme **removed 20% of peak hour vehicles**. In the densely populated city center, emissions decreased by around 10-14%. Sweden's lesser-known congestion charging program in Gothenburg is also reported as a big success. The scheme was effective in reducing traffic by 12% during the peak hours, with many travelers switching to public transport.

Singapore's experience with congestion pricing dates back to 1975. This was in the form of an Area License System (ALS) which was based on a flat rate charge. The ALS reduced traffic by 45% and vehicle crashes by 25%. The ALS was replaced by an electronic road pricing system in 1998 resulting in a further 15% decrease in traffic.

CONCLUSION # 96: Congestion charging schemes as a part of Mobility Pricing
Congestion charging schemes, being a part of Mobility Pricing, have been adopted successfully in Cities like London, Stockholm Gothenburg or Singapore. The success is measured by KPIs: Stockholm: 20% less peak hour vehicles, emissions decreased by 10-14%. Gothenburg: traffic is reduced by 12% in peak hours. Singapore: traffic reduced by 45%, and 25% less accidents. Thus it is also demonstrated that reduced congestion is a major driver for better road safety.

CONCLUSION # 97: Good Road Maintenance is very important
Good Road Maintenance in the countryside is very important, and at present underfinanced.

8.3.4 IBTTA, Bill Cramer: Get ready for surge-priced parking [61] (IBTTA)

Bill Cramer, IBTTA – International Bridge, Tunnel and Turnpike Association: Now, the city is testing a program under which the price of parking at meters in one of the city's most popular neighborhoods would change based on demand. This "surge pricing" means you could be paying $8 an hour to park in Chinatown-Penn Quarter at peak times. You read that right: $8. An hour.

City officials say the idea is to reduce downtown traffic congestion, 25 percent of which, studies show, is caused by vehicles circling the block looking for a parking space. It is simple supply and demand, they say.

"By using pricing as a level, we are trying to balance the supply and demand for parking," said **Soumya Dey**, director of the DDOT's research and technology transfer division. "From a customer perspective, I think this is about making the parking experience improve. So they know where the available spaces are, they know how much they need to pay and the parking search time, the amount of time you spend to find an open parking space, improves."

CONCLUSION # 98: Impacts of Pricing for Parking
Pricing for parking considering the day of time or level of congestion has advantages to reduce the "parking search traffic", and thus save emissions.

CONCLUSION # 99: ITS replace all parking vending machine infrastructure
Implemented with ITS, this could replace ALL parking vending machine infrastructure, and thus save cost, and be more comfortable for the users.

[61] IBITTA. Bill Cramer. 2015. Source: http://www.itsinternational.com/categories/charging-tolling/news/global-ranking-report-reveals-kapschs-electronic-tolling-growth/, 22.02.2016

8.3.5 MINTC FINLAND - Report "Fair and Intelligent Transport" [62]

8.3.5.1 Overview

This Report of the MINTC (Ministry of Transport and Communication Finland) investigates the impacts that would result from an overhaul of passenger car taxation so that taxes would be based exclusively on car use. In practice this would mean substituting fixed taxes (the motor car tax and annual vehicle tax) with taxes based on kilometers driven.

The kilometer tax would be a more flexible transport policy tool than the current tax system. It would also better serve the achievement of transport and environmental policy objectives than the existing tax regime. On the other hand, the kilometer-based system would be less cost effective. The estimated impact of taxing motorists based on kilometers driven lends support to a possible move towards the introduction of a kilometer tax in Finland.

Before any final decisions are taken it is crucial to ensure that the necessary technology works as intended and that it is suited to taxation purposes; that the cost estimates are accurate; and that privacy protection is maintained. The Working Group recommends a step-by-step approach through trials and experiments. The first stage should involve extensive testing of technical systems, information security and monitoring methods.

CONCLUSION # 100: „Kilometer tax" as a flexible transport policy tool
The report shows, that a „kilometer tax" would be a more flexible transport policy tool than the current tax scheme.

CONCLUSION # 101: Cost efficiency of „kilometer tax" has to be re evaluated
The report explains that the cost efficiency of a kilometer tax scheme is not satisfactory. This needs to be re evaluated, since the report bases its calculations on not up to date ITS technologies.

8.3.5.2 Oregon National kilometer charge[63]

In 2013 the US state of Oregon adopted a law that paves the way to the introduction of a state-wide mileage tax system for passenger cars. The system was put in place from the beginning of 2015, when 5,000 voluntary motorists started paying the mileage tax. In return, they are exempted from fuel tax (i.e. the tax will be paid back to them). State officials in Oregon are keen to stress that this is no longer just a trial, but the beginning of an alternative way to paying taxes for driving. The plan is to gradually replace the fuel tax with the mileage tax.

CONCLUSION # 102: Time span needed for VMT (being a tax reform)
In Oregon, the project started in 2007. In 2013, the legislation has been passed. In 2015, a real pilot project has been launched. This describes the time span needed for VMT.

Fuel tax cannot be used to internalize congestion costs. Driving in heavy traffic increases fuel consumption, but these costs are internal to the motorist and do not cover the external costs caused by the motorist, i.e. the extra amount of time that other road users have to spend getting to their destination. It is true that the problem of congestion in the metropolitan Helsinki region could be

[62] Finish Ministry of Transport and Communication. Fair and Intelligent Transport. 05/2014. Source: http://www.lvm.fi/documents/20181/797516/Fair+and+Intelligent+Transport+%28Publications+5-2014%29/5f1ab2ab-07d3-4fa9-a441-dcc55d8ffd04?version=1.0, 22.02.2016

[63] OReGo-Homepage. Source: http://www.myorego.org, 22.02.2016

resolved by effecting a sharp hike in fuel tax, but this would mean that all motorists around the country would have to pay for resolving the congestion problems in Helsinki.

CONCLUSION # 103: Fuel tax cannot be used to internalize (external) congestion costs
Fuel tax cannot be used to internalize (external) congestion costs.

8.3.5.3 Congestion Charging

The findings showed that a transport system that incorporates congestion charging better meets the objectives set for the Helsinki region than a transport system that does not include congestion charging. Congestion charging would reduce congestion in the region, make traffic move faster, increase the competitiveness of public transport and the proportion of travel by public transport, reduce greenhouse gas emissions and other environmental harm, and improve traffic safety.

CONCLUSION # 104: Congestion charging needs to be matched
Congestion charging needs to be matched and updated with the possibilities offered by Mobility Pricing.

8.3.5.4 Socio-Economic effects

The following figure shows the socio-economic effects of road taxing based on vehicle use:

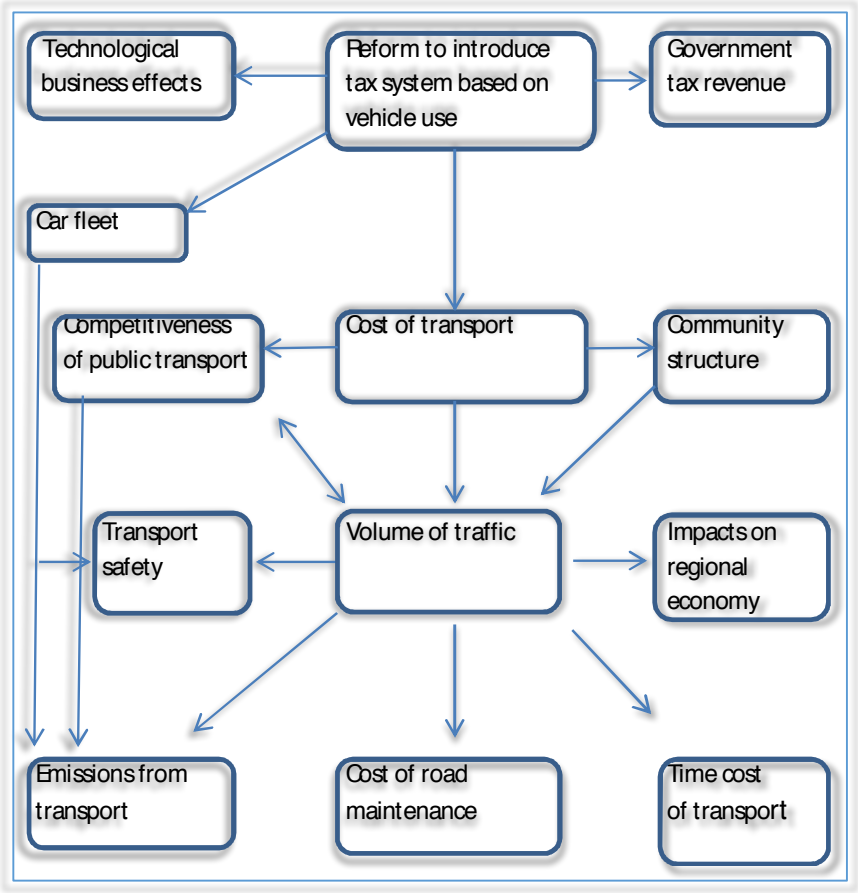


Figure 22: Socio-economic effects of road taxing based on vehicle use

CONCLUSION # 105: Finland´s illustration has similar aspects of the Swiss „Morphological Box"

The illustration from the Report in Finland is similar to many aspects of the „Morphological Box" mentioned before from Switzerland.

8.3.5.5 Impacts on number of trips taken

The next illustration shows the impacts on transport performance at a national level. The kilometer models would reduce the volume of passenger car traffic four times more than the current tax system. Overall the differences between the models are minor, but it does seem that transport performances decrease somewhat more under the flat rate option than under the other kilometer models.

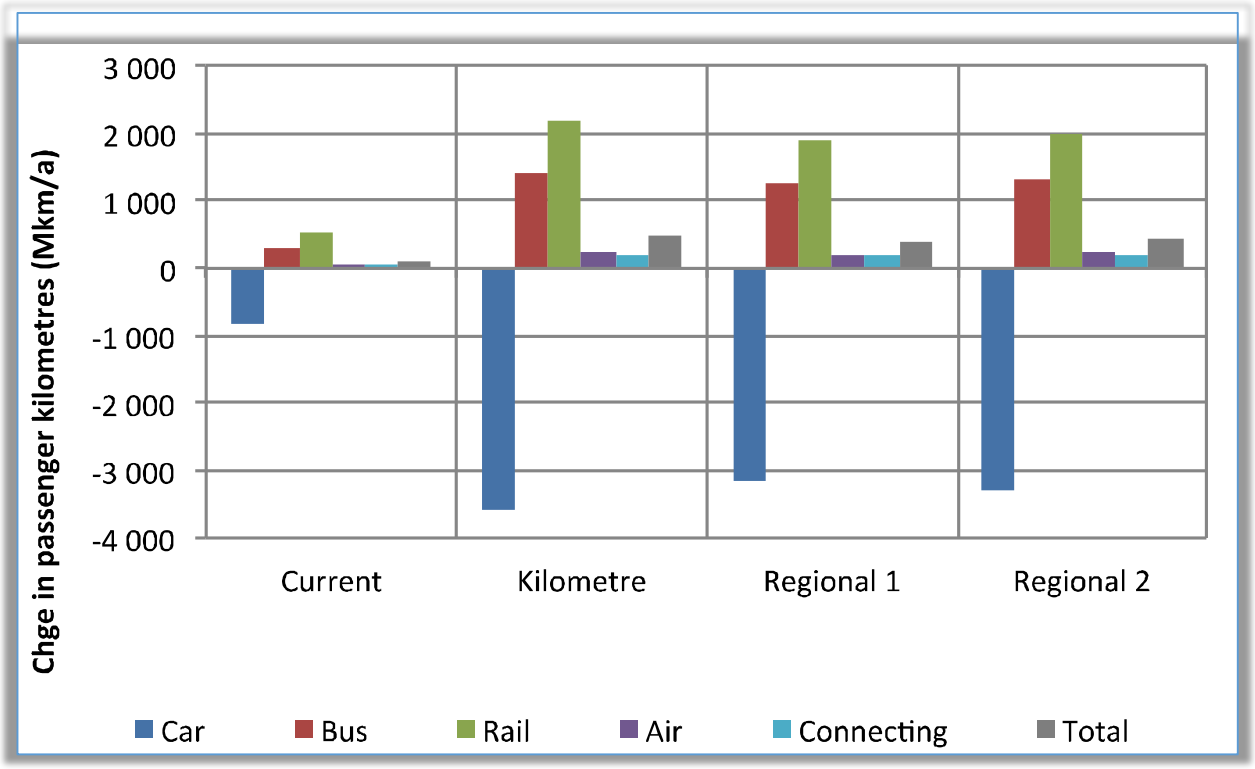


Figure 23: Impacts of current tax system and different kilometer models on passenger performances compared to 2025 trend projection

CONCLUSION # 106: km-based Pricing Scheme reduces car driven passenger kilometers

A km-based Pricing Scheme has also the potential on national level to reduce car driven passenger kilometers four times more than the current tax based scheme, accompanied by a significant increase of passenger kilometers in bus and rail.

8.3.6 EYEWITNESS NEWS: California Considers Replacing Gas Tax with Mileage Fees [64]

Will Kempton, executive director of the California Transportation Commission:

"The pilot (mileage based fees) is an excellent opportunity to Study road charging and should provide the Legislature with the data it needs to better determine whether and how this idea might work," he said.

[64] ABC7.com. CALIFORNIA CONSIDERS REPLACING GAS TAX WITH MILEAGE FEES. 20.01.2016. For source ask author,24.022016

According to Caltrans, the 36-cents-a-gallon state gas tax generates **only** enough revenue to fund $2.3 billion of $8 billion worth of highway repair and maintenance that is needed every year.

CONCLUSION # 107: Potential of replacing the gas tax by a mileage based fee
Not only the State of Oregon, but at present 12 States in the U.S. are evaluating the potential of replacing the gas tax by a mileage based fee.

CONCLUSION # 108: Gas tax funds only 29% of expenditures in the USA
Gas tax funds only 29% of expenditures in the USA.

8.3.7 FTA Finnish Transport Agency: MaaS Services and Business Opportunities [65]

There are five main functions in a society and economy: transfer service; organizing activity, minding function, cash, credit card or any other payment mechanisms are conventions, vehicle manufacturing.

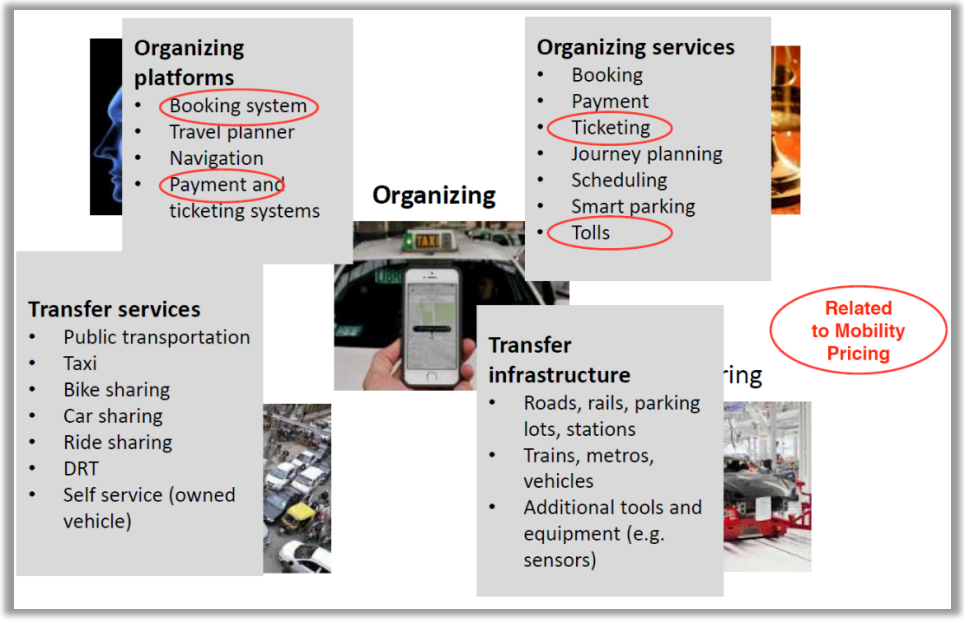


Figure 24: Payment and Mobility Pricing
Transfer and Organizing services from transportation services/operations

The "amount of power" given to Mobility Pricing in conjunction with MaaS will depend on the strengths of the "independent mobility services management platform" mentioned in MaaS.

CONCLUSION # 109: Major element of MaaS is pricing
A major element of MaaS is pricing. Mobility pricing, understood to serve as a policy tool for sustainability, could support the sustainability of MaaS.

8.4 Impacts of Mobility Pricing to various Sectors in Finland

The tables below show the different impacts of Mobility Pricing to various sectors (transport, infrastructure and construction, energy, environment, safety and health, ICT and economy) related to Mobility.

[65] Research reports of the Finnish Transport Agency.56/2015. MaaS Services and Business Opportunities.p13. http://www2.liikennevirasto.fi/julkaisut/pdf8/lts_2015-56_maas_services_web.pdf, 22.02.2013

Graphic legend				
Forecast	**light**	**moderate**		**severe**
Positive Impact	+	+ +	+ + +	+ + + +
Negative Impact	–	– –	– – –	– – – –
Increase	↗			
Decrease	↘			

8.4.1 Impacts of Mobility Pricing to the Transport Sector

Sector	Impacts	KPI	Forecast
Mobility Pricing 	⇪ Increase of efficiency by managing capacity and demand, sustainable pricing, and better Intermodality.	🗝 **KPI-004:** Quality of logistics	+ ↗
		🗝 **KPI-008:** Traffic density	+ + ↘
		🗝 **KPI-009:** Average travel speed	+ + ↗
		🗝 **KPI-022:** Average scrapping age of passenger vehicles	+ ↗
		🗝 **KPI-024:** Congestion	+ + ↘
		🗝 **KPI-047:** Passenger car performance	+ ↗

Table 18: Impacts of Mobility Pricing to Transport Sector related to Mobility

8.4.2 Impacts of Mobility Pricing to the Infrastructure sector

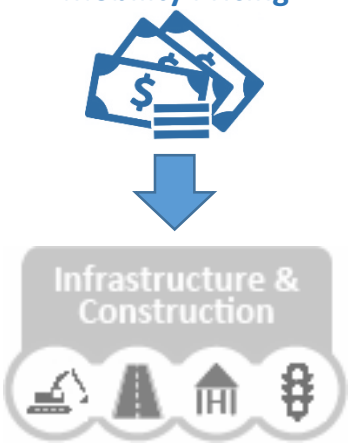
Sector	Impacts	KPI	Forecast
Mobility Pricing 	⇪ Inclusion of "User Pays" principle allows change from tax based financing to usage based financing of infrastructure, for both, investment and maintenance. ⇪ This will increase the revenue income for investment and maintenance	🗝 **KPI-053:** Incomes from Gas Tax	
		🗝 **KPI-054:** Spending for Road Infrastructure	
		🗝 **KPI-055:** Subsidies for Public Transport	

Table 19: Impacts of Mobility Pricing to Infrastructure and Construction Sector related to Mobility

8.4.3 Impacts of Mobility Pricing to the Energy Sector

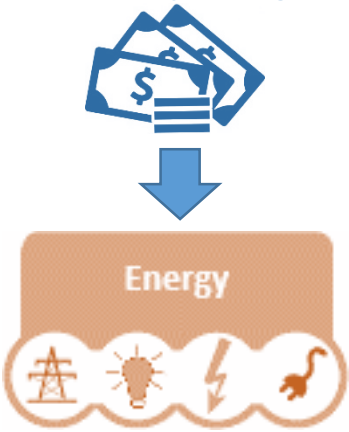
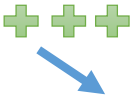
Sector	Impacts	KPI	Forecast
Mobility Pricing 	⇪ Reduction of congestion reduces energy consumption.	🗝 **KPI-023:** Sustainability of transport	
		🗝 **KPI-026:** Vehicle energy consumption per year	
		🗝 **KPI-047:** Vehicle energy consumption per year	

Table 20: Impacts of Mobility Pricing to Energy Sector related to Mobility

8.4.4 Impacts of Mobility Pricing to the Environment Sector

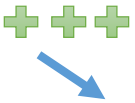
Sector	Impacts	KPI	Forecast
	Reduction of congestion reduces emissions.	**KPI-023:** Sustainability of transport	
		KPI-027: vehicle CO2 emissions per km	

Table 21: Impacts of Mobility Pricing to Environment Sector related to Mobility

8.4.5 Impacts of Mobility Pricing to the Safety and Health Sector

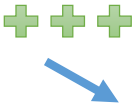
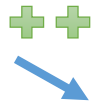
Sector	Impacts	KPI	Forecast
	Reduction of congestion reduces accidents with injuries and fatalities.	**KPI-015:** Number of people killed per year in road transport	
		KPI-016: Number of people seriously injured per year in road transport	
		KPI-017: Number of injured per year in road transport	
		KPI-029: Number of accidents per year (reduction)	
		KPI-031: (NEW) Cost of health care to cover injuries from road transport accidents	

Table 22: Impacts of Mobility Pricing to Safety and Health Sector related to Mobility

8.4.6 Impacts of Mobility Pricing to the ICT Sector

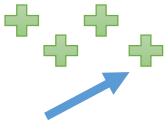
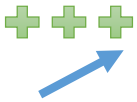
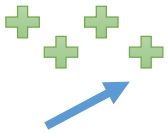
Sector	Impacts	KPI	Forecast
Mobility Pricing  	Mobility Pricing fosters availability of efficient ICT networks and communication channels	**KPI-037:** Amount of APIs in transport sector	
		KPI-038: Digibarometer index ranking	
		KPI-039: Use of Cloud Services	

Table 23: Impacts of Mobility Pricing to ICT Sector related to Mobility

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8.4.7 Impacts of Mobility Pricing to the Economy

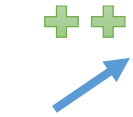
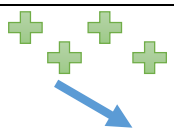
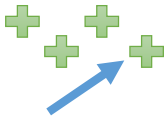
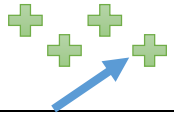
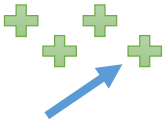
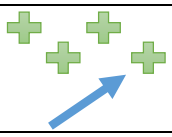
Sector	Impacts	KPI	Forecast
Mobility Pricing 	⇪ Social economic benefits are significant by reduction of social economic cost of congestion, accidents, and emissions.	🗝 **KPI-003:** Value adding services business market (NEW)	
		🗝 **KPI-010:** Energy consumption	
		🗝 **KPI-023:** Sustainability of transport	
		🗝 **KPI-024:** Hours per congestion per year	
		🗝 **KPI-026:** Energy consumption	
		🗝 **KPI-033:** GDP Finland	
		🗝 **KPI-034:** Value of time	
		🗝 **KPI-051:** Employees in Finnish ITS Industry	
		🗝 **KPI-052:** Size of Finnish ITS Market	
		🗝 **KPI-055:** Tax subsidies for public transport	
		KPI-056: Tax spending on road infrastructure maintenance	
		KPI-056: Tax spending on road infrastructure maintenance	

Table 24: Impacts of Mobility Pricing to Economy Sector related to Mobility

8.5 SWOT for Mobility Pricing

The following illustration shows the SWOT-Analysis with the strength, weaknesses, opportunities and threats related to Mobility Pricing.

Mobility Pricing is an instrument with a main influence of changing usage behavior. Improving economically efficiency and ecological sustainability of transport and mobility are one of the main objectives. But for achieving these objectives, a political agreement is needed, also all transport providers have to participate on a long term. A big challenge will be the harmonization between them.

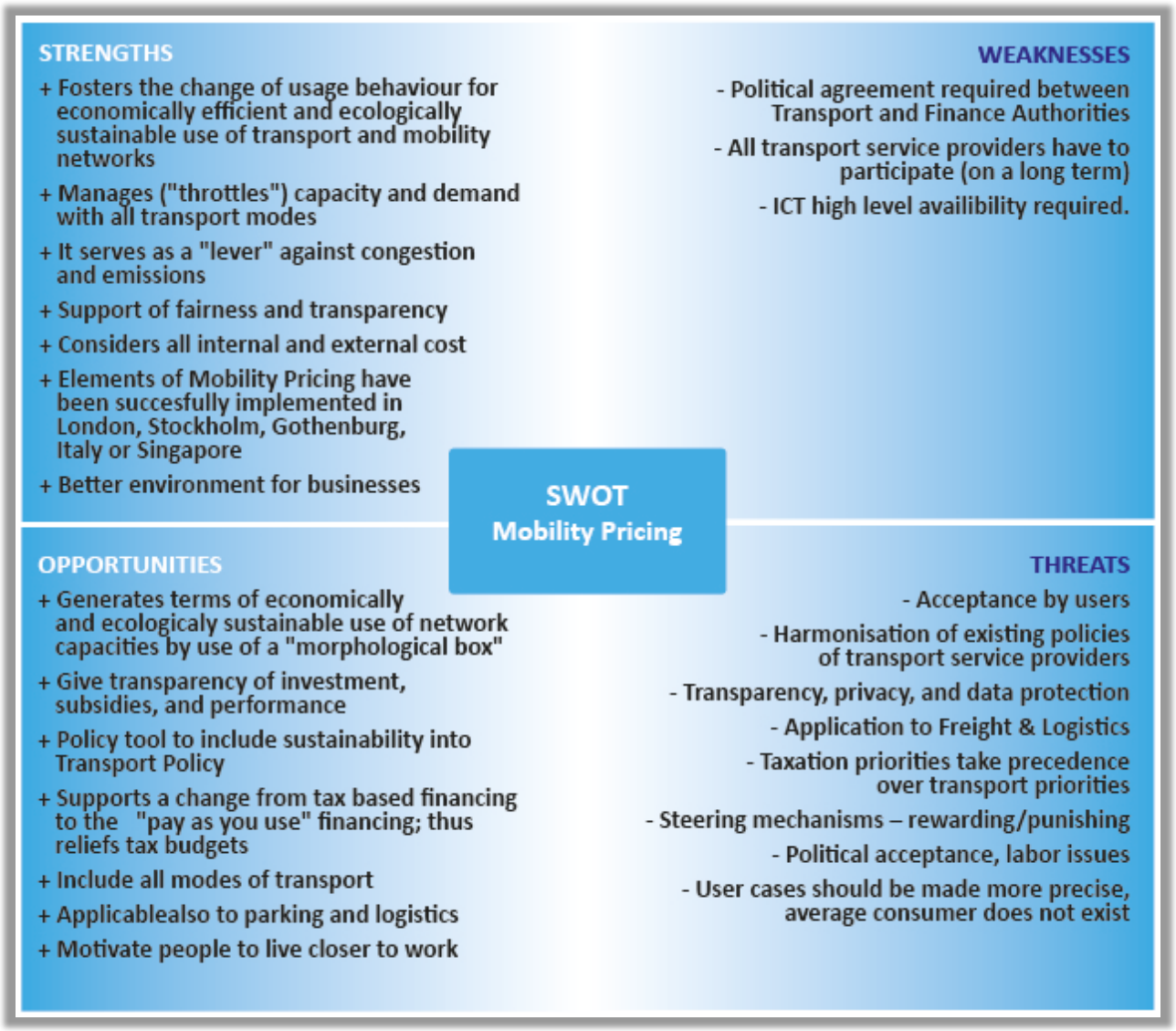


Figure 25: SWOT Mobility Pricing

8.6 Policy Recommendations for Mobility Pricing

1. In order to “enforce” sustainability and fairness for mobility of all transport modes and all users, Mobility Pricing is to be applied to all (public and private) transport services in Finland.
2. Financing could be (partially) shifted from tax based schemes to user financed models, including the “Pay as you Use” model.
3. Regulations for privacy and data security need to be adapted.
4. Mobility Pricing shall be also the base for the Vehicular Pricing Scheme discussed for the Helsinki Region.
5. Mobility Pricing to be used also for Parking Payment.
6. Societal KPIs need to be considered, since the social economic savings exceed by far the cost of implementation and operation.

8.7 Strategic Summary for Mobility Pricing

1. The main goal of mobility pricing is to foster sustainable transport and mobility, with less congestion, better efficiency and better capacity use, full inter modality, inclusion of the user in decision making, protecting the environment.
2. The pricing model is the tool to enforce the Countries Transport Policies and other Policies fostering Sustainability.
3. Switzerland and Oregon are a front runner in mobility pricing. Finland shall follow their developments closely, and consider co operation.
4. In Finland, the full potential of Mobility Pricing can be applied not only to the existing transport system, but also to MaaS and for Freight and Logistic Services.
5. Mobility Pricing with careful design provides very effective tools that specifically target to achieve transport policy and transport planning objectives and thus for optimizing of traffic and transport.
6. Instruments of mobility pricing offer more opportunities than risks; therefore, an objective and informed discussion are required.
7. The social economic benefits of Mobility Pricing are very promising. KPIs need to be defined to manage and measure the deployment.

9 Innovations for Freight & Logistics

9.1 ITS Potentials for Freight & Logistics

Given the country's dependence on the freight transportation industry for product delivery and the significance of the industry's role in economic development, it is important to consider what is required to ensure that the freight transportation system of Finland will be able to reach and maintain a competitive level of performance.

9.2 Freight and Logistics: Situation and international Outlook

In many countries, huge efforts have been made to optimize freight and logistic services. Also, global bodies like the World Bank are closely following this sector. In the following, the Study mentions innovative solutions and selected applications.

To address this concern, we have to identify critical safety, security and efficiency issues affecting freight forwarding operations, and their corresponding intermodal connectivity.

Safety challenges were identified on the basis of impacts to human health and the environment. Security considerations focused on events that could cause a disruption or compromise of information, people, goods or infrastructure. Efficiency concerns were identified on the basis of the industry's ability to meet customer demand with available supply in a timely, reliable and economic manner.

9.2.1 WORLD BANK Logistics Performance Index (LPI) for Finland [66]

9.2.1.1 International Scorecard

The international score uses six key dimensions to benchmark countries' performance and also displays the derived overall LPI index. The scorecard allows comparisons with the world (with the option to display world's best performer) and with the region or income group (with the option to display the region's or income group's best performer) on the six indicators and the overall LPI index.

The logistics performance (LPI) is the weighted average of the country scores on the six key dimensions:

1. Efficiency of the clearance process (i.e., speed, simplicity and predictability of formalities) by border control agencies, including customs;
2. Quality of trade and transport related infrastructure (e.g., ports, railroads, roads, information technology);
3. Ease of arranging competitively priced shipments;
4. Competence and quality of logistics services (e.g., transport operators, customs brokers);
5. Ability to track and trace consignments;
6. Timeliness of shipments in reaching destination within the scheduled or expected delivery time.

[66] The World Bank. Country Score Card: Finland 2014. 2016. Source: http://lpi.worldbank.org/international/scorecard/radar/254/C/FIN/2014#chartarea, 22.02.2016

The scorecards demonstrate comparative performance—the dimensions show on a scale (lowest score to highest score) from 1 to 5 relevant to the possible comparison groups—of all countries (world), region and income groups.

9.2.1.2 Logistics, International Shipments, Infrastructure Finland Country Score Card 2014

The following illustration shows the development of the LPI Country Score Card of Finland since 2007. A negative trend of development for all performance indicators has appeared (infrastructure, international shipments, logistic competence and overall development) since 2012. This requires fast action to find the reason for this trend.

Figure 26: LPI Country Score Card – Finland

CONCLUSION # 110: Negative LPI index development in Finland
Unfortunately, the LPI index development trend is not positive for Finland. This needs a more in depth analysis for the reasons, and for the definition of measures

9.2.2 Freight Volumes are low in Finland

9.2.2.1 Volume of Freight & Logistics decreasing constantly [67]

Since many years, the Volume of Freight & Logistics relative to GDP is decreasing and low in Finland. (see table 25 and 26)

[67] EUROSTAT. Volume of freight transport relative to GDP. 2016. Source. http://ec.europa.eu/eurostat/tgm/table.do?tab=table&plugin=1&language=en&pcode=tsdtr230, 26.02.2016

In 2014, finally a positive trend was visible with a growth rate of approximately + 2%.

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Finland	100	93.7	95	91.6	91.1	86.7	81.4	76.4	79	75.8	78.5	70.5	68.3	67.6

Table 25: Volume of Freight Transport in Finland relative to GDP 2000-2013

	2005	2013	Change 2005-2013
EU 27	104,7	96	-8,7
Finland	86,7	67,6	-19,1

Table 26: Volume of Freight Transport in EU-27-average and Finland relative to GDP 2005-2013

9.2.3 ARTHUR D. LITTLE: How to unlock value from last mile delivery for cities, transporters and retailers [68]

The world's population is concentrating in cities, which, as a result, are ever growing. Fifty-two percent of the population currently lives in urban areas, and by 2050 this number is expected to reach 67%. (see figure 26.). A similar trend is anticipated in terms of urban goods distribution, with e-commerce being the fastest-growing driver of urban deliveries, which also impacts the length and fragmentation of urban logistics flows. Last mile delivery of goods is a difficult issue to apprehend, as it involves several levels of complexity. In addition to the heterogeneity of the goods transported and of the means of transportation, urban logistics encompass diverse levers and multiple stakeholders. A comprehensive urban logistics strategy can typically contribute to several objectives, each of which can be influenced by different factors.

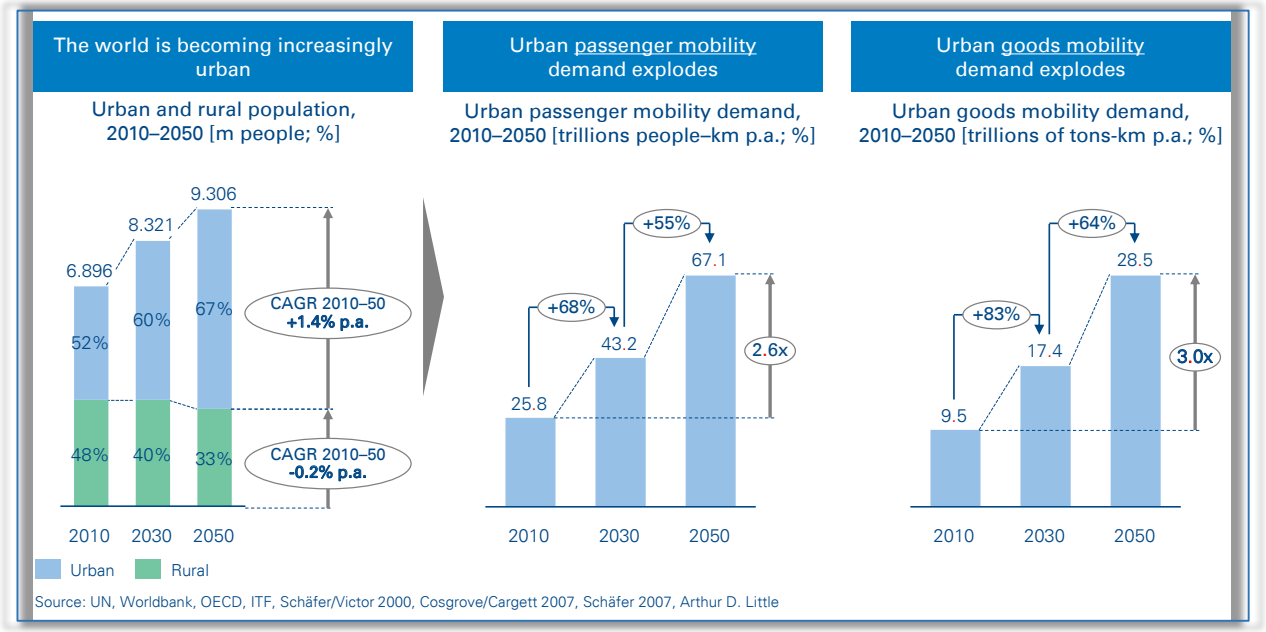


Figure 27: Impact on Passenger Goods Mobility Demand

[68] A.D. Littlle. Urban Logistics. 2016. Source http://www.adlittle.com/future-of-urban-mobility.html, 26.02.2016

9.2.3.1 Objectives ADL

Some of these objectives may even conflict, thereby requiring careful prioritization:

- Urban congestion reduction, influenced by distance travelled, vehicle capacity & length and ease of coming to a halt
- Reduction of number of trucks in the city, influenced by vehicle capacity, vehicle filling ratio and congestion level
- Pollution reduction (i.e. NOX and PM), influenced by vehicle type, distance travelled and congestion level
- Energy conservation (including CO2 reduction), influenced by vehicle type & age, distance travelled and congestion level
- Noise reduction, influenced by vehicle type, distance travelled and congestion level
- Development of local retail, influenced by solution costs, which are defined by service quality (speed, delivery time slots, flexibility/reactivity, etc.)
- Contribution to housing policy (increasing housing space within city limits), influenced by the footprint of the inner-city logistics platform.

An integrated approach of all public and private stakeholders is essential, see the next figure. The categories of solutions are listed below.

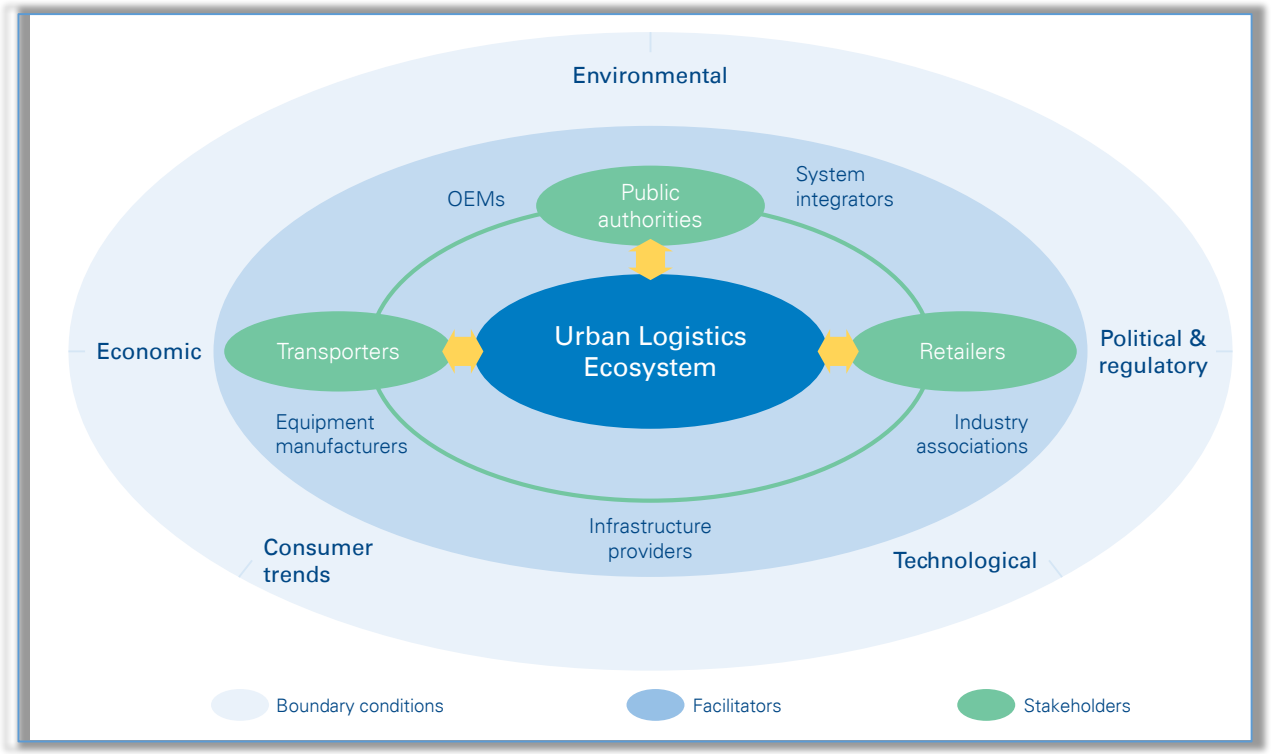


Figure 28: Stakeholders, facilitators and boundary conditions in an Urban Logistics EcoSystem

9.2.3.2 *Regulatory and land planning:*

These measures allow authorities to impose certain rules and restrictions on the use of urban transportation and land planning for logistics within the city. Typical examples are:

- Restricted access to certain areas, based on a set of criteria for vehicles (e.g. emissions, weight, size)
- Time slots for when certain vehicles can enter certain streets
- Exclusivity zones for urban deliveries (in which only one or a limited number of transporters can perform deliveries)
- Urban land planning to cluster zones of retail and logistics in order to reduce the logistics sprawl

9.2.3.3 *Infrastructure:*

Alternative transportation and logistics infrastructures are created, or existing infrastructures are adapted, to better suit the needs of urban freight transport.

- Urban Distribution Centers
- Direct Injection
- Reserve parking fort rucks
- E-Commerce pick up

9.2.3.4 *Financial incentives:*

Public authorities can give financial incentives to urban transportation providers based on a supply-demand mechanism, to steer their transportation decisions and lower the externalities caused by urban freight transport.

- Urban (Anti) Congestion Charges
- Variable Smart fare (distance travelled, volume shipped, time of the day, etc.)
- Subsidies, tax deductions and other incentives

9.2.3.5 *Equipment:*

New or improved equipment and technologies reduce the impact created by last mile deliveries, and are enablers for implementing last mile delivery strategies.

- Greener trucks
- Innovative alternative transportation, e.g. by public transport, taxies in addition to passengers, drones, …
- Big data analytics and ITS
- Crowd sourced delivery

CONCLUSION # 111: Mobility Pricing also to be applied to Freight & Logistics
Mobility Pricing in Freight & Logistics will ensure sustainability in respect fair pricing, of emissions, and to regulate capacity with demand.

CONCLUSION # 112: Use of electric vehicles in logistics is essential

Use of electric vehicles in Freight & Logistics is essential.

CONCLUSION # 113: Cargo sharing models need to be implemented

Cargo sharing models need to be implemented.

9.2.4 CHINA/BEIJING: E-Tricycle for Last-Mile Delivery of Goods [69]

The era of global exchange and ubiquitous information availability has boosted e-commerce. The requirement for capillary distribution has increased dramatically, emphasizing the significance of the 'last mile'. E-tricycles have been widely used in Chinese cities for the last mile delivery since an e-tricycle can park anywhere without request of additional loading space. They are made of a steering front wheel, the seat upon the battery, and a tray behind over the carriage two wheels. No public charge points are available. The vehicles are recharged with standard power sockets. It is estimated that in Beijing, 15,000 to 20,000 are used for parcel delivery. Approximately 90% of home deliveries in Beijing are carried out by e-tricycles.

Use of e-tricycles for last mile delivery has been a controversial topic for the Chinese transport and vehicle authorities as well as law enforcement bodies. Many cities including Beijing had banned or limited use of e-tricycles for delivery for safety reasons. However, because of the huge market and increasing demand on e-commerce, e-tricycles have never disappeared. In July 2014, China Post, commissioned by the central government, published a National Standard of Goods Delivery e-Tricycle. The standard came into force in October 2014. According to the standard, all e-tricycles have to be registered as motor vehicles and must meet certain safety standards.

Success Factors

- The pressure of real time delivery demand and need for responsive solutions
- High quality of service through low tech design solution (cost efficiency)
- Affordable investment for the service provider
- Emission free mobility service at point of use
- Allowance for informal (but not illegal) activities and for parking of vehicles on the pavement
- Business support embedded solution accessible to single private venture
- Proximity and density of customer clusters
- Multiple applications of the wheelbase: parcel delivery, goods delivery, street vendor display, etc.

Looking into the future: Charging and parking issues need to be perfected, as well as their integration in the whole eco-system of vehicles, infrastructure, service and operation management. However, the use of e-tricycles demonstrates the feasibility of using small and green vehicles for last mile delivery. The solution can also be integrated with other initiatives such as "Twizy cargo" and the "Twizy R plug concept" being developed by Renault, which use electric quadricycles.

[69] Cooperate ITS in Verona. ViajeoPlus. TOP 10 Urban Mobility Solutions. Source. http://19343a27nxyv1ifure2nq0aw.wpengine.netdna-cdn.com/wp-content/uploads/sites/4/2015/12/Best-practices_Vp_v2.pdf, 24.02.2016

CONCLUSION # 114: Delivery by e-Tricycles foster sustainability
Delivery by e-Tricycles (or even normal cycles) foster sustainability in logistics.

9.2.5 HRT - HELSINKI REGIONAL TRANSPORT AUTHORITY (HSL): The Freight Situation in Helsinki [70]

Helsinki Region freight characteristics:

- In Finland heavy traffic transportation are almost 330 million tonnes per year. Internal Uusimaa region The transports about 52 million tons per year.
- Helsinki Region key logistical nodes include ports, airports and logistics center.
- Port of Helsinki passes more than 10 million tons of goods per year.
- Helsinki-Vantaa Airport's air transportation of approximately 0.2 million tonnes per year.
- The vast majority of logistics operators have concentrated on Ring Road III in the zone.
- Logistics operations have been reduced by Ring I grown inside the Ring Road III and the outside, especially after the construction of the harbor.
- The busiest freight routes used by the Ring Road III, as well as highways 1, 3, 4 and 7.

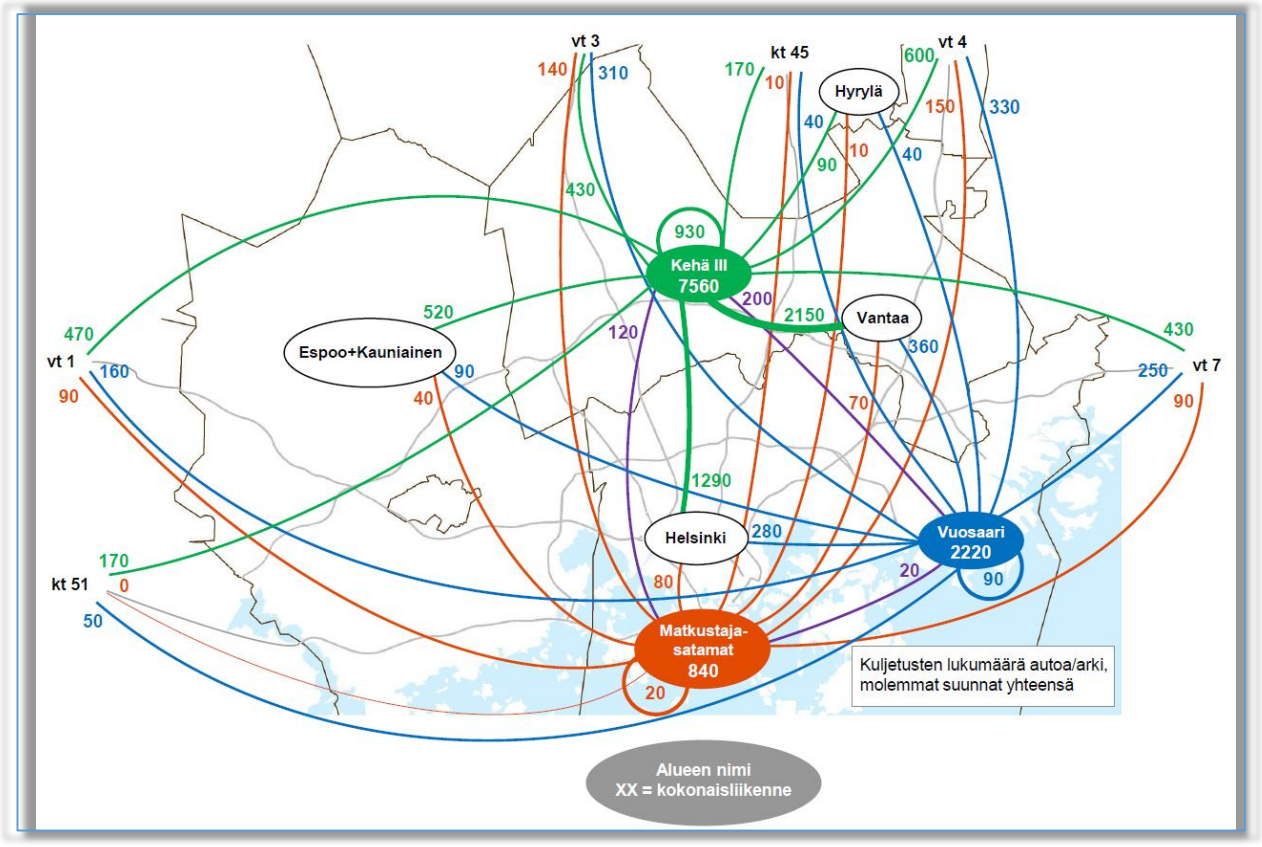


Figure 29: Logistics structure in Helsinki Region

[70] HSL - Helsingin seudun liikennejärjestelmäsuunnitelma HLJ 2015 Luonnos. 21.10.2014 Source: https://www.hsl.fi/sites/default/files/uploads/hlj2015_luonnos_raportti.pdf, 24.02.2014

9.2.6 AVENIR SUISSE: In 2030 we will live in a completely new world of technologies in logistics [71]

Interview with **Mr. Daniel Müller-Jentsch**, Traffic Expert at Avenir Suisse [72] in Bern, Switzerland:

Which innovations do you expect to most likely a relief from our infrastructure still every year rapidly increasing traffic? … but until then we will live in a completely new world of mobility, we still do not know today. Self-driving cars, car sharing, apps for finding a parking space or E-Mobility are just a few examples of the profound transformation. Maybe there will be **small trucks with electric motors that are even may go leaderless and night largely silent driving** around. Or **drones who do the distribution of goods by air**. If we involve ourselves with "Cargo Sous Terrain" (underground freight tunnel system), we are committed for decades to a specific traffic engineering.

CONCLUSION # 115: "Cargo Sous Terrain" may support city logistic processes

"Cargo Sous Terrain" (underground freight tunnel system) may support city logistic processes. For acceptance, a cost-benefit-analysis is needed because of the expensive infrastructure.

9.2.7 CO-GISTICS – ERTICO ITS EUROPE

9.2.7.1 Interview on CO-GISTICS with Dr. Hermann Meyer, CEO of ERTICO ITS EUROPE[73]

My expectation on CO-GISTICS is that it will provide a kind of lighthouse for using ITS for hubs. Visible and an example to follow. With CO-GISTICS we want to strive real impacts on reducing fuel consumption and carbon dioxide emissions.

How can we achieve this objective?

The ITS services applied in CO-GISTICS are obviously leading to reduced fuel consumption. The real challenge lies in acceptance by the users and business cases for the suppliers of these services.

9.2.7.2 What is CO-GISTICS? Statements by Mrs. Lina Konstantinopoulou, Program Manager at ERTICO ITS EUROPE [74]

Seven logistics hubs, Arad, Bordeaux, Bilbao, Frankfurt, Thessaloniki, Trieste and Vigo strongly believe in the integration of currently existing freight and transport systems and services, with new solutions such as cooperative services and intelligent cargo. This will help making operation of their goods, trucks, roads, harbours, airports and rail terminals more sustainable, i.e. reduce CO_2 emissions and improve cost- efficiency.

Each of the pilot sites includes all the partners for a successful after-project life, from public authorities to logistics operators. The user groups will include fleet operators, trucks, freight forwarders, terminal operators and logistics providers. The consortium will install the services on at least 315 vehicles (trucks and vans).

[71] Der Bund. «2030 werden wir in einer völlig neuen Mobilitätswelt leben». Robert Meyer. 26.01.2016. Source. http://www.derbund.ch/wirtschaft/konjunktur/Selbstfahrende-Autos-oder-EMobility-sind-nur-einige-Beispiele/story/28691265, 24.02.2016

[72] Avenir Suisse. Think Tank for economic and social issues. Source: http://www.avenir-suisse.ch/en/,24.01.2016

[73] HOLM Frankfurt. "ITS services leading to reduced fuel consumption". Jürgen Schultheis. 16.06.2014. Source: http://www.frankfurt-holm.de/de/hermann-meyer-ertico-our-main-challenges-matching-ambitions-organisations-and-people-within, 24.02.2016

[74] ERTICO-IST EUROPE. What is CO-GISTICS? Lina Konstantinopoulou. Source: http://ertico.com/projects/co-gistics/,24.02.2016

CO-GISTICS has 9 partners and 3 pilot sites in common with Compass4D and endorses the same potential to become a lighthouse project on deployment of Cooperative ITS (C-ITS) in Europe.

9.2.7.3 Services of CO-GISTICS [75]

CO-GISTICS will deploy 5 services:

- Intelligent Truck Parking and Delivery Areas Management: optimizing the vehicle stops along their route, the delivery of goods in urban areas and the interface with other modes of transport.
- Cargo Transport Optimization: supporting planning and synchronization between different transport modes during the various logistic operations.
- CO_2 Footprint Monitoring and Estimation: measuring the CO_2 output of the vehicles and providing an estimation of CO_2 emissions of a specific cargo operation.
- Priority and Speed Advice: saving fuel consumption, reducing emissions and heavy vehicle presence in urban areas.
- Eco Drive Support: supporting truck drivers in adopting a more energy efficient driving style, therefore reducing fuel consumption and CO_2 emissions.

CONCLUSION # 116: The CO-GISTICS Project
The CO-GISTICS Project - being the newest initiative to cover freight at TEN-T Roads - has its major focus on fuel efficiency: bringing cost reduction followed by environmental protection, transport optimization including truck parking, and support of truck drivers to adopt a more energy-efficient driving style.

9.2.8 BESTFACT – URBAN LOGISTICS - Examples of Best Practices in Europe[76]

BESTFACT is the first portal of freight transport best practices, contacts and policies. The objective of BESTFACT is to develop, disseminate and enhance the utilization of best practices and innovations in freight transport that contribute to meeting European transport policy objectives with regard to competitiveness and environmental impact.

BESTFACT builds upon the work of the projects BESTUFS, PROMIT and BESTLOG, and integrates four interrelated areas of the key freight logistics challenges the European Union is confronted with. The resulting three main working areas (clusters) are:

- Urban Freight
- Green Logistics & Co-modality
- eFreight

The BESTFACT consortium includes 18 partners made up of European research institutes, universities, international associations and industry partners. The projects 4-years-development will lead to the production of a public-oriented knowledge base, conferences and workshops, to promote the best practices that contribute to European transport policy objectives. BESTFACT receives funding from the EC's 7th Framework Programme.

[75] CO-GISTICS. Website. Services. Source: http://cogistics.eu/services/, 24.02.2016

[76] BESTFACT. The first portal of freight transport best practices, contacts and policies. Source: http://www.bestfact.net, 24.02.2016

9.2.8.1 STRAIGHTSOL Study (Strategies and measures for smarter urban freight solutions)

- DHL Supply Chain's Urban Consolidation Centre in L'Hospitalet de Llobregat - Barcelona (Spain).
- TNT Express in Brussels - City Logistics Mobile Depot (Belgium) Remote 'bring-site' monitoring for more reactive and sustainable logistics (United Kingdom).
- Kuehne-Nagel - rail tracking and warehouse management (Greece).
- GS1 - Smart Urban Transport Solution - Retail supply chain management and "last mile" distribution by use of standardized information (Norway).
- Colruyt and Delhaize - Night-time distribution in Brussels (Belgium).
- Loading / unloading operations management and regulations Lisbon (Portugal)

9.2.8.2 Smartfusion - Smart Urban Freight Solutions (Regions Newcastle, Berlin and the Lombardy)

Public-private partnership (PPP) which will build upon the existing urban freight development strategies of three demonstration city-regions. It will demonstrate smart urban freight solutions in urban-interurban supply chains.

9.2.8.3 Cooperative Mobility for Urban Freight Energy Efficiency in Helmond - The Netherlands

The city of Helmond's mobility policy has a strong emphasis on traffic solutions based on technology, supporting and showcasing smart mobility schemes. During the last ten years, the municipality has invested in an extensive adaptive urban control network which allowed the city to serve as a test-site for cooperative systems projects such CIVIS, SAFESPOT and FREILOT.

9.2.8.4 Promotion of Sustainble Freight Logistics in Ljubljana – Slovenia

As a first step, a computer simulation model and a web portal for better freight transport in the city has been developed.

9.2.8.5 Reducing Air Pollution by engaging with Fleet Operators through Ecostars in Edinburgh – Scotland

Along with other councils in the UK and the EU, Edinburgh has tough air quality targets to meet. Seeing a significant proportion of pollution originating from diesel-engined road vehicles led the Council to set up the fleet recognition scheme ECOSTARS. It provides the city with a method of engagement with operators of freight and passenger fleets of HGVs, buses, coaches and vans.

9.2.8.6 Campaign to deliver Goods by Bike in Pamiers – France

The French City of Pamiers set up a pilot delivery service of goods using an E-tricycles. The approach was not successful due to insufficient communication of the campaign to the end users.

9.2.8.7 Microcarrier - An Innovative, Electric, Parcel-Delivery Vehicle tested in Berlin - Germany

The vehicle was developed by the Frauenhofer Institute. The focus was developing a micro carrier that could be used as a multiple trailer vehicle as well as a separate hand guided transportation unit. The first generation of the micro carrier consisted of three parts: the tractor, the platforms, the containers. The tractor can carry up to 300 kilos, with a maximum operating speed of 5 km/h.

9.2.8.8 Distripolis: A new City Logistics Solution in Paris - France

To the two regular links in the supply chain – grouped shipments to warehouses and deliveries by truck or light vehicle to towns – Distripolis adds a third link: logistics bases located in cities, from which vehicles adapted to final-kilometer logistics make deliveries.

9.2.8.9 Padova Cityporto: A Success Model of Urban Logistics – Italy

The Cityporto model is based on a voluntary subscription. Logistic operators who choose to join the initiative benefit from easier access to the city centre for freight delivery: enter the city 24hrs a day, use reserved public transport lanes, use dedicated loading bays for their load/unload operations.

9.2.8.10 Silent Inner-City Overnight Deliveries in Barcelona - Spain

The main objective was to demonstrate the feasibility of silent overnight deliveries both in terms of social impact (i.e: avoid noise nuisance to residents; reduce the number of daytime delivery vehicles) as well as from the operator's point of view (return on investments for vehicle adaptation and night shifts).

9.2.8.11 Ecologistics Parma - Italy: Consolidation and Last Mile Delivery of Goods Logistic Scheme

ECOLOGISTICS Parma is an integrated and systemic urban delivery scheme where a consolidated last-mile delivery service promoted by local authorities (Ecocity) is combined with a system of permits and certifications of green vehicles and platforms of other freight transport operators. This allows free competition among all players in a multi-hub city logistics system. The scheme is complemented by a set of rules and regulations and includes the delivery of perishable fresh goods. ECOLOGISTICS makes use of ITS technologies for managing the platform and monitoring delivery vehicles. Recently, a revamp of all OBUs (on-board-unit) for traceability began in order to harmonise all data and send it to a central control traffic unit. The partners of ECO CITY are not only local SME's, but also multinational companies (Coca-Cola, Galbani, etc.) and large-scale retailers.

9.2.8.12 The Food Distribution Model of Borlänge - Sweden

The municipality of Borlänge has developed a food distribution model where food procurement and food transportation have been separated. The model has been in place for 10 years and it is now a good example of best practice.

The deliveries take place during the night and very early in the morning. This is more convenient for people working in the kitchens as the food has already been delivered when they arrive at work. Levels of noise near schools have significantly decreased, Road safety has greatly improved, Food is at immediate disposal of kitchen staff when they start to work.

9.2.8.13 Cargo-Tram and E-Tram, Bulky and Electric Waste Collection by Tram in Zurich (Switzerland)

Introduced in April 2003, the Cargo-Tram service offers a car-free alternative to Zurich residents who need to dispose of their bulky waste. In 2006 the E-Tram started a similar service for the removal of electrical and electronic waste. Today, cargo trams make about 18 round trips every month. The service is free of charge. It's not surprising that Zurich introduced the Cargo-Tram and E-Tram for its residents: the city, with its 385,000 inhabitants, has 165 kms tram network and actually 43 per cent of household waste remain in the recycling process.

9.2.8.14 Recicleta - Cargo-Bicycles to Collect Waste Paper in Bucharest – Romania

Launched by ViitorPlus NGO as a pilot project in September 2009, RECICLETA is the first carbon neutral initiative in Romania. With the help of cargo-bicycles, disadvantaged individuals (with financial

difficulties, from large families, unemployed) get ecological jobs: to collect waste paper from small companies in Bucharest and transport it to recycling agents.

9.2.8.15 Emission-Free Last Mile Delivery Service in London – United Kingdom

Within central London, an innovative emission-free last mile goods delivery service was set up. The system is based on micro consolidation centres in the inner city, which are used as starting points for cargo bikes and electric vans. These emission-free bikes and vans are used to deliver the cargo the last few miles to the customer.

9.2.8.16 Urban Logistics in Budapest - Hungary

The city's biggest bicycle courier service company Hajtás Pajtás started 1993 as a three-person enterprise and became one of the market leaders for local parcel and mail delivery after 10 years of operations. With a staff of 160 people it frees the congested capital from 100 cars, saving an estimated 150 tons of CO2 emissions annually. The company takes a leading role in promoting biking in Budapest.[77]

9.2.8.17 Regulations

Once the current situation is characterized, particular proposal can be done, such as new local regulations.

- To develop a plan of action with different types of measures and different time horizons.
- Establish a working group with the participation of agents.
- Encourage coordination among stakeholders
- Creation of common terminals to several carriers
- Use of private parking spaces in buildings for performing certain activities of UL
- Regulation of the access to pedestrian areas
- Allow double line parking for vehicles of UL, limiting the time.
- Foster the distribution on peak hours.
- Interaction with urban traffic systems

CONCLUSION # 117 Some BESTFACT experiences may be applied to Finland

An analysis is recommended in order to find out what potentials for an upgrade of the present structures in Freight & Logistics could be utilized for Finland.

9.2.9 ELTIS: Global Mega Trends and Implications to Urban Logistics [78]

Mr. Sandeep Kar, Global Director, Commercial Vehicle Research:

1. Urbanization 2. Connectivity and Convergence 4. Future Infrastructure Development. There will be 35 Mega Cities Globally by 2025 Demanding for Unique City Logistics Solutions by 2025, each person will have a minimum of five connected devices by 2025, 20% of retail will happen through online

[77] Eltis. The urban mobility observatory. Source: www.eltis.org, 24.02.2016

[78] Frost and Sullivan Analysis. Mega Trends Impact on Urban Logistics presented at eyefortransport's 3PL Summit- North America. Source: http://de.slideshare.net/FrostandSullivan/mega-trends-impact-on-urban-logistics-for-eyefortransports-3pl-summit-north-america, 24.02.2016

channels by 2025, globally over $800 billion will be spent on high speed rail projects. What does this mean for Urban Logistics? 500 million deliveries per person per day to cities 'On-the-fly' deliveries will have to made anywhere, anyhow, faster and quicker Demand for urban parcel deliveries will increase – shipments to become smaller and frequent Multi-modal, low carbon footprint, mission critical utilization of road, rail, marine, and air infrastructure 3. Bricks & Clicks. [79]

8. Bricks and Clicks: New Retailing Business Models Case Study: Tesco Virtual Store Sparks New Generation of Grocery Shopping 1 2 3 4 Choose grocery item from "virtual shelves" Smartphone app registers product of choice The product lands in customer's "virtual cart" The product is delivered to the customer at a time and date of his choice Number 1 shopping app in Korea, with over 900,000 downloads Online sales increased by 130% since launch in 2011 Home plus online membership increased by 76% since launch in 2011. Virtual Store—The Fourth- generation Retail Store Virtual Store: Tesco Virtual Store Sparks New Generation of Grocery Shopping Single virtual store opened in a subway.[80]

20. NA99-13 Future of Connectivity in Urban Logistics: Smart Urban Fleet Design of Future Delivery Vans Will Revolve Around Technology Improvement, Carbon Footprint Reduction, Weight Reduction, Fuel Efficiency, Eco Driving and Aerodynamics Improvement Before Delivery During Delivery After Delivery • On-board real-time telematics (vehicle to grid communication, routing) • Smart sensors and access cards for security and quality control • Noise reduction technology, such as engine isolation • Lightweight vehicles • Low loading floor constructions [81]

CONCLUSION # 118 Urban Freight& Logistics need a full restart
Retail will be completely different. Increase of Demand. Virtual stores. New smart urban vehicles. On-the-fly deliveries. Transport Analytics. Etc.

9.2.10 citylog / ERTICO: Trends of urban logistics in Europe [82]

9.2.10.1 Policy and legal developments affecting city logistics

Urban transport systems are integral elements of the European transport system and as such an integral part of the Common Transport Policy under Articles 70 to 80 EC Treaty. In addition, other EU policies (cohesion policy, environment policy, health policy, etc.) cannot achieve their objectives without taking into account urban specificities, including urban mobility. In recent years, EU policy and legislation relevant to urban mobility has been developed. Significant funding has been provided through the Structural and Cohesion Funds. EU-funded initiatives, often supported by the Framework Programmes for research and technological development, have helped to develop a wealth of innovative approaches. EU-wide dissemination and replication of these approaches can enable public authorities to achieve more, better and at lower cost. (3.1)

A freight transport logistics action plan has been developed by the Commission to foster the efforts on the logistics sector in Europe, described as strategically important for the European economy, whilst it is responsible for some of its major societal and environmental problems, such as pollution, congestion

[79] United Nations, Department of Economic and Social Affairs, Population Division (2012). World Urbanization Prospects: The 2011 Revision, Frost & Sullivan, 2012 Mega Trends Driving Urban Logistics Industry.

[80] RetailNet and Frost and Sullivan Analysis.

[81] Volvo, OECD and Frost & Sullivan Analysis.

[82] http://www.city-log.eu

and oil dependence. This Action Plan is constructed around a number of core applications, namely innovation, simplification, quality, green corridors and the update of the regulatory frameworks. To achieve these overall objectives, a set of actions with dead-lines has been chosen. (3.1.6)

9.2.10.2 Potential urban policy measures and instruments (3.2.1)

Usually the countries do not have a national policy framework to support the cities in establishing urban logistics plan. The cities are trying to implement ideas on their own, but they normally concentrate their few available capacities on planning public transport and cars.

Cities can implement a set of measures and take different policy initiatives on Urban Logistics to tackle the whole issue of city centre traffic and pollution. As mentioned before, it is clear that the current trend is for cities to analyse the local situation, and to act and take measure accordingly. The measures are therefore highly "city-dependant", and are also sensible to potential changes in the local politics.

However, the BESTUFSUFS Good practices guide on Urban Logistics has identified five main objectives that cities are targeting and the set of measures available to achieve it.

Usually the countries do not have a national policy framework to support the cities in establishing urban logistics plan. The cities are trying to implement ideas on their own, but they normally concentrate their few available capacities on planning public transport and cars.

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However, the BESTUFSUFS Good practices guide on Urban Logistics has identified five main objectives that cities are targeting and the set of measures available to achieve it.

1. Gaining freight industry support for freight strategies and initiatives
    - Develop and support fright transport partnerships
2. Improving journey time reliability of goods vehicles
    - Support R&D and deployment of telematics for urban goods transport
    - Enhance signing
    - Enhance and make available Urban Freight information and maps
    - Implement road pricing
    - Operate and manage night deliveries
    - Deploy lorry lanes or no car lanes
3. Assisting the journey of goods vehicle drivers and reducing goods vehicle trips and kilometres
    - Support R&D and deployment of telematics for urban goods transport
    - Enhance signing
    - Develop and implement lorry routes
    - Simplification & harmonization of vehicles weight, size and construction regulations
    - Enhance and make available Urban freight Information and maps

- Develop and operate Urban consolidation centres

4. Assisting freight transport companies at the point of delivering and collection
   - Provide on-street loading bays
   - Define and operate Nearby Delivery Area (Environmental Loading Points)
   - Develop and operate Urban Consolidation Centres
5. Reducing environmental impacts and the risk of accidents involving goods vehicles
   - Regulate weight, size and emissions standards
   - Regulate time for goods vehicle access and loading
   - Operate and manage night deliveries
   - Define environmental zones
   - Deploy lorry lanes
   - Improve the infrastructure
   - Encourage the use of environmentally friendly vehicles
   - Enforcement

One other measure that is supported by the cities would be to ease the intermodal logistics, e.g. by tackling the issue of bottlenecks at intermodal hubs or by promoting the modal shift.

9.2.10.3 Cross Comparison of reported impacts of single measures (p.21)

Figure 29. shows cross comparison of reported impacts (economic, environmental and social) of single measures, which clustered in three groups: Logistics and Transport Organisation, Restrictions and Infrastructure, Technology and Equipment. Prominent is , that all measures have a positive influence regarding reduction of pollution.

Impact[6]= Negative: – or (–) Limited/neutral: ≈ or (≈) Positive: + or (+)		Economic Impacts				Environmental Impacts			Social Impacts		
		City attractiveness	Transport costs reduction	Reduction of congestion	Efficiency/ productivity	Reduction of pollution	Reduction of (truck)-km	Noise reduction	Quality of life	Reduction of accidents	Working conditions
Infrastructure, Technology and Equipment	CityPLUS (IT)	(+)	(+)	≈	+	+	+		(+)		
	LogUrb (PT)	(+)	(+)	+	+	+	+		(+)		
	Packstation (DE)	(+)	(+)	+	+	+	+		+	(+)	
	PIEK (NL)		+	(+)	+	+	+	(+)	+	(+)	≈
	Night Delivery (ES)		+	+	+	+	+	≈	(+)	(+)	≈
	City Cargo (NL)	+	(+)	+	+	+	+	+	+	+	
	BILK (HU)	(+)	(+)		+	+	+				
	Route planning (HU)		+		+	+	+				(+)
	Trip Planning Program (DE)		(+)		+	+	+				+
Restrictions	London Congestion Charging (UK)	+	–	+		+	+		(+)	+	
	Congestion Charging (SE)	+	–	+	+	+	≈		+	+	
	Low emission zone (NL)	+	–	(≈)		+	(–)	(+)	+	+	
	Environmental zone (SE)	+	–	+		+	(–)	+	+		
	Protected zones (CZ)	(+)	–	+		+	(–)	+	(+)		
	Truck Total-Weight Restr. Zone (HU)	(≈)	–	≈		≈	≈		(≈)	(≈)	
	Time Windows and Restrictions (NL)	(+)	–	–		≈	–	+	+	+	–
Logistics & Transport Organisation	Kiala		+	≈	+	+	+		(+)		
	IWT Household Wastes		+	+		+	+	+	(+)	+	
	RegLog®, City Logistic	+	+	(+)	(+)	+	+		+		
	SpediTHUN	+	+	+	+	+	+	+	+	+	

Figure 30: Cross Comparison of reported impacts of single measures (Fig. 2)

9.2.10.4 Policy Solutions (5.3)

Policy solutions aim at reducing nuisance caused by or experienced by urban freight transport. Urban freight policy measures and instruments are already discussed in paragraph 2.2.2. To prevent overlap, we limit the policy solutions in this section.

On the one hand policy solutions solve (or at least lessen) nuisance caused by urban freight transport; think about vehicle restrictions (improve traffic safety, reduce risk on damaged infrastructure and buildings), time-windows and vehicle bans (reduce nuisance at times residents or shopping public notices large delivering vehicles), low emission zones / environmental zones (reduces the local emitted pollutants, such as PM10 and NOx), vehicle load factor controls (very difficult to enforce, but should reduce the number of vehicles in a city center), dedicated urban freight vehicle routes (reduce the impact of large vehicles on all other streets that are not included in the urban freight network and reduces the maintenance cost for local authorities).

On the other there are policy solutions that aim at making urban freight transport more efficient (which differs from the discussed measure that aim at reducing the nuisance only). These policy initiatives are related to spatial (and town) planning. Solutions that fit in this group of policy solutions include: the use of bus lanes for urban freight transport vehicles (large vehicles can make the deliveries faster, resulting in less time-spent in the cities, less accelerating and decelerating and thus in fewer emissions), good and a sufficient amount of unloading areas in city centers (which are also available for urban freight transport vehicles and not used by illegal parked passenger vehicles, so enforcement is important), enough space allocated for urban freight transport activities (also in the (re)development of city centers) and spatial planning – make land available for activities that demand lots of urban freight transport at areas that are good accessible.

9.2.10.5 Vision of future city freight transport and Conclusion (6.)

With more than 80% of the EU population living in cities, it is obvious that sustainable urban mobility must be a vital strategic objective for the EU. City governments have a key role to play in achieving policy objectives at local, national and EU level not only on transport, but also on economic growth, environment (particularly air quality), climate change, health and quality of life.

The conference on the Future of Transport organized by the European Commission in March 2009 rightly identified the urban context as one of the main challenges to transport policies in terms of both sustainability (CO2, air pollution) and competitiveness (congestion). This will have an impact on the design of the transport system as a whole, and the urban context will increasingly serve as a "laboratory" for the transport sector in the years to come; a testing ground for the development of new technological and financial solutions. While close cooperation at all levels is needed to ensure a coherent integrated strategy, it is important that the principle of subsidiarity prevails and that action at EU level does not restrict the flexibility of cities to design and implement the most appropriate transport solutions for their local situation. Freight is a particular problem for cities, especially in terms of the last mile delivery of goods.

As the backbone of the "real" economy of cities and Europe in general, both passenger and freight transport planning must be considered in a strategic way. An efficient freight transport sector makes an important contribution to the competitiveness of industry in regions. The EU should play a coordinating role to ensure that time and space management of freight is optimized in all Member States.

Setting standards for safer vehicles and developing Europe-wide education campaigns on road safety are some of the many tools to meet the targets of a 50% reduction of fatal road accidents by 2020. The EU should not forget to address problems like blind spots for lorry drivers and cross-border enforcement of traffic offences.

Electric vehicles and new tools such as ITS will be created and tested in the urban context and in cooperation with different stakeholders, therefore creating a need for further promotion of PPPs and the development of innovative financing models. The integrated package of measures that cities will need to implement in order to achieve sustainable mobility solutions in the future will require financial support from various sources, whether local, regional, national or European. This support will need to be integrated into a broader policy context, for the functional urban area, through which cities will set their targets and design their tools. Facing challenges such as climate change and congestion, European cities will need to be further involved in pilot research projects and must be the pioneers for deployment of ITS technologies and applications. By 2030 vehicles will be smart enough to 'sense' their surroundings and navigate through traffic safely and efficiently, while providing their occupants personalized comfort and convenience. The vehicle will be a 'node on the internet', and will be 'online' with other vehicles (V2V), with the transport infrastructure (V2I), and with homes, businesses and other sources (V2X). Support systems will assist the driver by offering automated responses to developing traffic situations, by coaching the driver to operate the vehicle in the most energy efficient way etc.

By 2030, urban mobility will have changed due to socio-demographic evolution (ageing and immigration) urbanization, the increase of energy costs, the implementation of environmental regulations, and the further diffusion of sophisticated Information and Communication Technology (ICT) application in virtually all aspects of life. The results will be a complex, integrated mobility system, managed with greater efficiency to answer the challenges of reducing environment impact and minimizing urban congestion, while providing comfortable mobility to the traveler. Urban development and environment policies, land use and sustainable urban mobility planning will become increasingly integrated. Pan European efforts to generalize approaches for sustainable urban mobility plans will further support this trend. This will only partly contain urban sprawl and it will encourage an evolution towards polycentric urban areas. Public transport systems (bus and rail) will contribute to shape the future urban environment. The urban vehicle fleet (both passenger and goods delivery) will undergo a transition towards energy efficiency, electrification and diversification in design (e.g. modular), that ensures that vehicles are more suited to the urban environment and the diversified mobility demand.

9.2.11 SYNCHROMODALITY in the Netherlands [83]

Synchromodality is the optimally flexible and sustainable deployment of different modes of transport in a network under the direction of a logistics service provider, so that the customer (shipper or forwarder) is offered an integrated solution for his (inland) transport.

Not one single kind of party is leading in finding and implementing a synchromodal solution. Sea shipping lines develop synchromodal solutions for carrier haulage volumes. As cargo nodes, seaport terminals have good insight into flows and organize synchromodal solutions for them. Inland barge terminals have good insight into local volumes and organize synchromodal solutions with this in mind.

[83] Platform Synchomodaliteit. What is Synchomodality. Source: http://www.synchromodaliteit.nl/en/definition/, 26.02.2016

Shippers jointly organize synchromodal solutions and involve smaller regional shippers in this.

It is essential for a synchromodal solution that the shipper books a-modally. The decision on the mode(s) of transport to be used is left up to the logistics service provider. The latter consequently has the flexibility to seamlessly switch between modalities, an important mechanism for synchromodal transport solutions. This applies to both the planning of transport and dealing with unexpected circumstances just before or during the transport. In addition, Synchromodality makes it possible to consolidate consignments of cargo, thus achieving additional efficiency benefits. Synchromodal transport especially has potential on corridors and in regions where sufficient volumes are present; this allows for highly frequent transport by train and barge.

Synchromodal transport encompasses a wide range of multimodal services which enable the logistics service provider to meet the transport requirements of the shipper. Following on deep sea transport, mostly road, inland shipping and rail are relevant modalities, but feeder transport (transport by sea in and around Europe) and air transport are also options. The choice of a mode is determined by several factors and depends on the level of service a shipper expects for the transport.

Synchromodal transport offers potential benefits for shippers, logistics service providers and society. With innovative control solutions, the Netherlands can sustainably and effectively facilitate the growing demand for transport.

The ambition is to ensure that by 2020, the Netherlands is internationally leading in the handling of cargo flows and as a chain director of (inter)national logistics activities; the country must have an attractive innovation and business climate for shippers and logistics companies.

Synchromodality is mainly possible with high volumes and highly frequent hinterland connections. Like no other, the Netherlands therefore had the potential to profile itself in this field in Europe. We have the logistics scale sizes, the volumes, the network, the connections via all modes of transport, the knowledge and the organizational skills. The Netherlands is truly a logistics top location which encompasses more than just Rotterdam. It is up to companies to ensure that customers optimally reap the benefits from this.

Furthermore, the Netherlands is able to explicitly position itself as a combined seaport/airport; this is also unique. Amsterdam Schiphol Airport and the seaport of Rotterdam are less than 100 kilometers apart.

Please, visit the website http://www.synchromodaliteit.nl/en/opportunities/companies/ to find out more on the advantages for Government, companies, knowledge institutes, and the Country detailed.

CONCLUSION # 119 Some experiences from SYNCHROMODALITY in the Netherlands may be applied to Finland. Also a cooperation is recommended.

An analysis is recommended in order to find out what potentials for an upgrade of the present structures in Freight & Logistics could be utilized for Finland.

9.3 Summary of Innovations in for Freight & Logistics

The information collected shows a huge potential for the sector. A bundle of ITS, new and co-operative models create new possibilities. This is to summarize the major possibilities:

1. Urban distribution centers.
2. Cargo sharing models.

3. Greener (electric) trucks, eBikes. Micro-Carrier vehicles.
4. Big Data analytics.
5. Drones.
6. Mobility pricing, also for international users, with benefits for sustainability.
7. Night deliveries with silent vehicles.
8. Intelligent truck parking.
9. CO_2 footprint monitoring.
10. Eco driver support for drivers.
11. Include trams, taxis, passengers for deliveries.
12. Include all modes of transport for deliveries. Cargo-Trams.
13. Computer simulation models.
14. Food distribution models for schools and employees.

In order to deploy these possibilities for Finland, it is recommended to launch a working group or task force for Innovative and Intelligent Freight & Logistics Solutions, possibly in cooperation with **ITS Finland**. The working group shall analyze, initiate research, create pilots und funding, and manage the deployment. All necessary stakeholders shall participate.

9.4 Impacts of ITS innovations for Freight and Logistics to various Sectors in Finland

The tables below show the different impacts of ITS innovations for Freight and Logistics (F&L) to various Sectors (transport, infrastructure and construction, energy, environment, safety and health, ICT and economy) related to Mobility.

Graphic legend				
Forecast	**light**	**moderate**		**severe**
Positive Impact	+	+ +	+ + +	+ + + +
Negative Impact	−	− −	− − −	− − − −
Increase	↗			
Decrease	↘			

9.4.1 Impacts of ITS Innovations in Freight & Logistics to the Transport Sector

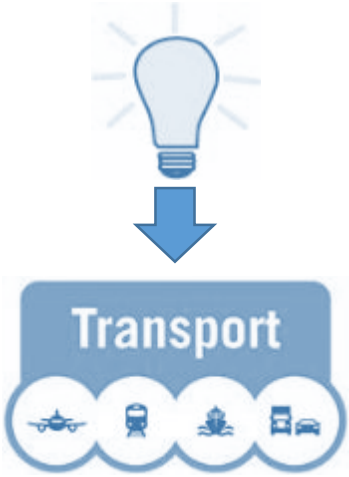
Sector	Impacts	KPI	Forecast
ITS innovations for Freight and Logistics 	⇪ Increase focus on clients (groups). ⇪ Optimization of load capacities. ⇪ optimization of deliveries to the last mile (in Cities). ⇪ Utilization of different transport modes. ⇪ Potential for co-operation. ⇪ In future, truck pooling will have also positive effects.	🗝 **KPI-004:** Quality of logistics	✚ ✚ ✚ 

Table 27: Impacts of ITS innovations for Freight and Logistics to Transport Sector related to Mobility

9.4.2 Impacts of ITS Innovations in Freight & Logistics to the Infrastructure Sector

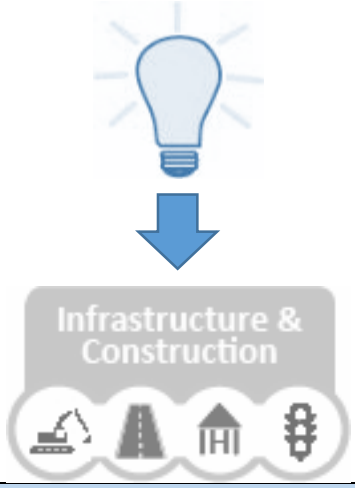
Sector	Impacts	KPI	Forecast
ITS innovations for Freight and Logistics 	⇪ Installation of Urban Hubs, and Multimodal & Intermodal Terminals. ⇪ Increase of collaboration between Ports.	🗝 **KPI-057:** (NEW) Construction for F&L infrastructure (e.g. truck parking facilities, urban hubs)	✚ 

Table 28: Impacts of ITS innovations for Freight and Logistics to Infrastructure and Construction Sector related to Mobility

9.4.3 Impacts of ITS Innovations in Freight & Logistics to the Energy Sector

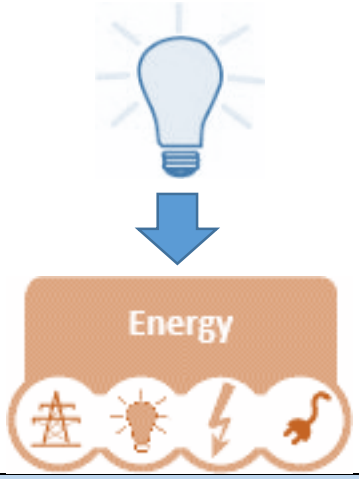
Sector	Impacts	KPI	Forecast
ITS innovations for Freight and Logistics 	⇪ Optimization of capacities with demand will reduce energy consumption of F&L. ⇪ Also, from inclusion of all transport modes for deliveries.	🗝 **KPI-026:** kWh for energy consumption per vehicle km travelled.	✚ ✚ ✚ ↘

Table 29: Impacts of ITS innovations for Freight and Logistics to Energy Sector related to Mobility

9.4.4 Impacts of ITS Innovations in Freight & Logistics to the Environment Sector

Sector	Impacts	KPI	Forecast
ITS innovations for Freight and Logistics 	⇪ Reduced amount of trips reduce emissions. ⇪ Electrification of vehicles reduce noise.	🗝 **KPI-027:** Vehicle emissions CO2 per vehicle km	✚ ✚ ✚ ↘

Table 30: Impacts of ITS innovations for Freight and Logistics to Environment Sector related to Mobility

9.4.5 Impacts of ITS Innovations in Freight & Logistics to the Safety and Health Sector

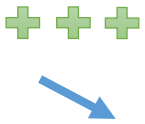
Sector	Impacts	KPI	Forecast
ITS innovations for Freight and Logistics 	⇪ Consequently, reduced amount of emissions have positive impacts in health. ⇪ In future Robot Trucks will reduce human based mistakes during driving (similar to light vehicles).	🗝 **KPI-029:** Number of accidents per year (reduction)	

Table 31: Impacts of ITS innovations for Freight and Logistics to Safety and Health Sector related to Mobility

9.4.6 Impacts of ITS Innovations in Freight & Logistics to the ICT Sector

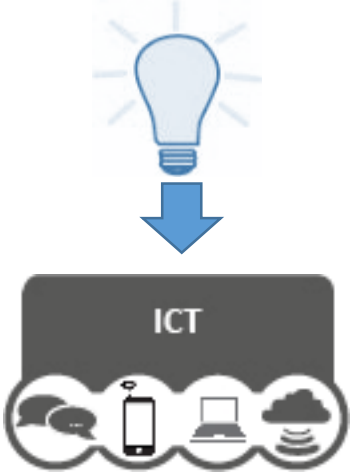
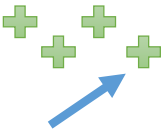
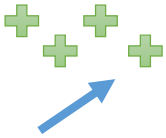
Sector	Impacts	KPI	Forecast
ITS innovations for Freight and Logistics 	⇪ ICT sector will give important support to increase the efficiency of F&L via digitalization of processes, or interconnection of the supply chain. ⇪ New services can be created. ⇪ ICT solutions for SME's (small hauliers with only 1-2 trucks) required.	🗝 **KPI-037:** Amount of APIs in transport sector	
		🗝 **KPI-039:** Use of Cloud Services	

Table 32: Impacts of ITS innovations for Freight and Logistics to ICT Sector related to Mobility

9.4.7 Impacts of ITS Innovations in Freight & Logistics to the Economy

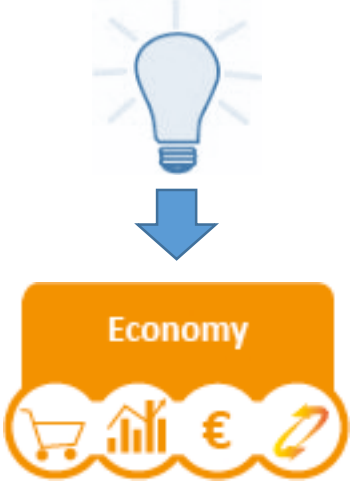
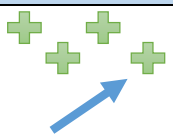
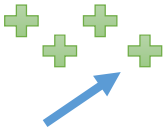
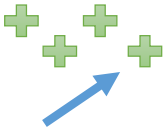
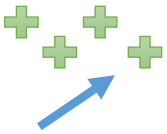
Sector	Impacts	KPI	Forecast
ITS innovations for Freight and Logistics 	⇪ The sector will also benefit mainly from reduction of congestion, increase of capacity with same equipment, better efficiency. ⇪ Mobility Pricing will stop disadvantage of Finnish Hauliers. ⇪ Better cost transparency,	🗝 **KPI-033:** GDP	
		🗝 **KPI-034:** Value of time	
		🗝 **KPI-051:** Employees in Finnish ITS industry	
		🗝 **KPI-052:** Size of Finnish ITS market	

Table 33: Impacts of ITS innovations for Freight and Logistics to Economy Sector related to Mobility

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9.5 SWOT for ITS Innovations in Freight & Logistics

The following illustration shows the SWOT-Analysis with the strength, weaknesses, opportunities and threats related to ITS Innovations in Freight and Logistics.

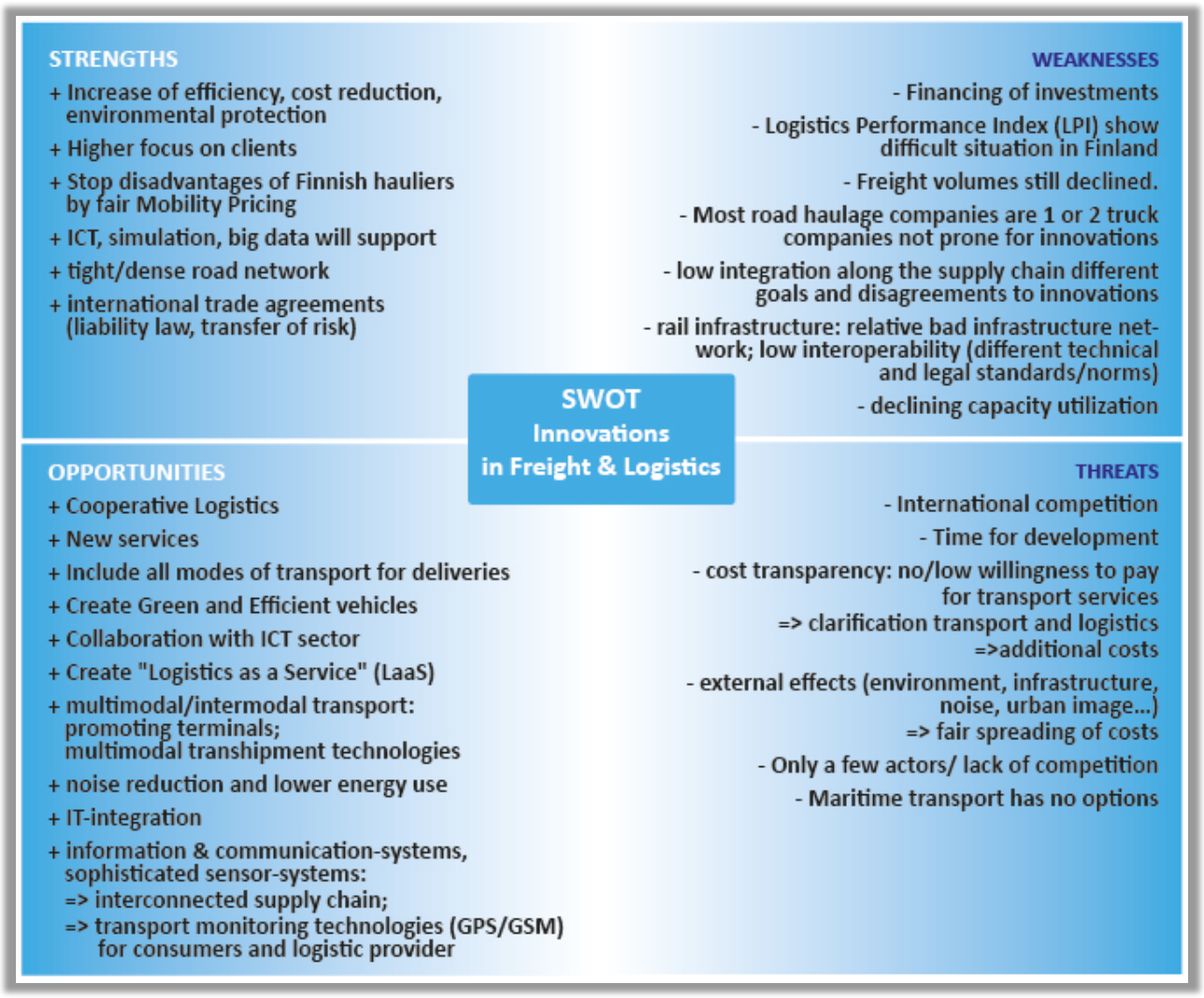

Figure 31: SWOT- analysis for ITS Innovations in Freight & Logistics

9.6 Policy Recommendations for Innovations in Freight and Logistics

1. Develop actions and associated KPIs to define and monitor main factors to improve the LPI Index in Finland. As part of this, a detailed analysis of the present situation is recommended, and a strategy with proper actions are to be set, in order to increase cargo and freight volumes for the Finnish logistics industry. This might need more international cooperation.
2. MaaS shall be also applied to Freight & Logistics ("MaaS for Goods") with two pillars:
   (a) for urban logistics, and
   (b) for long distance and international services.
   Note: Finland would be also a frontrunner in this!
3. Consider best practices and experiences from European projects explained in projects like BESTFACT, CITILOG, CO-GISTICS, or STRAIGHTSOL.

4. Introduce “Twin-City or Twin-Regions” Logistics models within Finland, or between Helsinki with Tallinn and Stockholm.
5. Introduce Mobility Pricing to foster sustainability in logistics, and to stop disadvantage of the Finnish Industry against international hauliers and freight forwarders in order to receive road usage payments, since usually gas is not purchased in Finland on their trip through the country.
6. Creation of an “Innovations for Freight & Logistics” task force or workgroup, to discuss system upgrades, cooperation, restructuring, required funding, and pilot projects.

9.7 Strategic Summary for ITS Innovations in Freight and Logistics

1. Finland needs an upgrade of the Freight and Logistics sector. For this, many ITS solutions and best practices exist, in order to increase efficiency, foster a better position against (international) competition, supporting and modernizing the Finnish Hauliers industry, ports, and logistics transport service providers.
2. ITS will support the sector to expand to more adaptable and flexible logistics networks, increase the efficiency, improve last mile deliveries, increase customer orientation, improve competitiveness, and contribute to the environmental goals.
3. Mobility as a Service principles and business models shall be also applied to Freight & Logistics.
4. Mobility Pricing will generate better cost transparency, increase fairness, foster less energy consumption, and result in more sustainability.
5. Innovations from automation (e.g. drones), shared services, and best practices

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10 Summary of the Study

10.1 Answers by the HERMES Study to the initial Six Questions asked by MINTC

Initially, the following six questions have been asked by MINTC, here are the answers:

10.1.1 Answer to question 1: Policy and Structure of a new Pricing Model for Mobility?

How this needs to be designed and structured to support the successful deployment of MaaS, as well as to foster sustainability, inter-modality and full cost aspects.

Mobility Pricing is an efficient (pricing based) tool to create and ensure sustainable mobility for people and goods. It considers all internal and external costs associated with mobility, is transparent and applicable for all transport modes. It includes also Policy measures in regard of national, regional, or local considerations.

Mobility Pricing should be communicated in a way to get acceptance by the users. Critical elements are cost increases, data protection, or privacy.

Mobility Pricing shall become a core element of transport Policy to maintain Sustainability in financing, efficiency, environment, and safety.

Mobility Pricing supports sustainability in ITS applications or innovations such as Robot Cars, MaaS, and in Freight & Logistics.

Mobility Pricing has to be combined also with other accompanying measures in the society, e.g. more flexible working times and home office use, differentiation of school starting or shop opening times.

If Mobility Pricing is part of an overall tax reform, other transport taxes could be removed or reduced and replaced by Mobility Pricing.

Mobility Pricing ensures sustainable financing of investments and operations. This includes also sustainable funding for road maintenance (winter, rural areas, etc.)

Mobility Pricing improves inter-modality, reduces congestion, fosters public transport, and reduces emissions.

10.1.2 Answer to question 2: What effects of MaaS are to be expected?

MaaS will offer a better service for mobility, especially in city areas. Efficiency will be increased because of enlargement of transport network. MaaS supports the movement of people and goods and reduces the need to own or use a private car. The results are environmental protection (also reduction of energy consumption) and an efficient utilization of the existing infrastructure, which lowers maintenance. Since MaaS supports Public Transport, also accident rates will be reduced.

MaaS is also a pre-condition for automation of transport. i.e. to manage the use of Robot Cars.

Increase of interchange points will be needed to allow better and easier intermodal trips with different transport providers (e.g. park & ride, metro & cycling, train/bus/metro & shared taxis.

Digitalization, communication broadband, widespread dissemination of smartphones, or big data, are acting as enablers of MaaS.

MaaS will increase the cooperation (needs) between the different transport service providers.

MaaS increases affordability and accessibility of users to public transport, especially in rural areas.

10.1.3 Answer to question 3: What impacts and tendencies will the Convergence of Transportation have on major Key Performance Indicators (KPI) in related sectors Finland?

In the Annex you can find the list the Key Performance Indicators of the afore handled ITS Innovations in a matrix, showing also their relevance to the seven Sectors in Finland: Infrastructure, Energy, Environment, Road Safety and Health, Information and ICT and the Economy.

The findings of the Study are applied to the relevant KPIs as a "first projection".

In order to find out the monetary impacts of a single ITS Innovation or a combination of ITS Innovations on the selected Sectors, the development of a **Dynamic Mobility Simulation (DNS-M) Model** is suggested.

In this context it should be mentioned, that new European key performance indicators standards exist. They should be integrated or combined with Finnish statistics for better standardization and comparability between European states.

10.1.4 Answer to question 4: What major impacts shall the future Transport Eco-System have on Finland's Financing, Safety, Mobility, Congestion, Energy, and Inter-Modality?

The future Transport Eco-System, being based on MaaS, Robot Cars, upgraded Freight & Logistics, and the "Sustainability Management System" offered by Mobility Pricing will foster efficiency, financing, energy use and road-safety by reducing the accident rate with all consequences. It also will improve traffic flow and reduce congestions. Due to automated driving systems based on sustainable use of automation, energy consumption and CO2 emissions of vehicles will be also reduced.

To support implementation of the future Transport Eco-System in Finland, strong partnerships and cooperation, both public and private, need to be developed. Communication and cooperation are also main key points to improve Mobility and Inter-Modality.

10.1.5 Answer to question 5: How will the future Transport Eco-System support businesses and competitiveness in Finland?

Transport is no longer seen as a value in its own right but rather as an enabler for the mobility of people and goods. This shift of paradigm opens great possibilities for society and businesses. Competitiveness of the Finnish businesses will be increased securing the international position of the Country.

The Finnish ITS industry counts about 1.700 employees, with a market of approximately 300 million EUR (in 2010). ITS Innovations handled in this study will create new businesses and jobs. A quantification needs to be done. The ITS Innovations are also a main pillar of the success of "Digitalization of Transport" in Finland, where 20.000 new jobs are being projected.

As explained in detail by the Study, the ITS Innovations will give strong support to the seven Sectors in Finland, with many positive economic aspects.

10.1.6 Answers to question 6: Develop a structure for an argumentation toolbox including Projections of monetary impacts

As inputs, relevant Key Performance Indicators (KPI's), the desired Policy measures, and the local infrastructure and traffic data shall be used. The KPIs shall represent all relevant sectors and the ITS-enablers involved. The DNS model shall allow to define and analyze the impacts, and to develop appropriate final Policies. MINTC shall find a suitable partner for this.

10.2 Finland has a great potential

Finland is a leading Country with huge potentials[84] in many aspects, please see table below. This needs to be utilized in regard of the findings of this Study to support the deployment of the ITS Innovations.

A few examples of Finland's rankings in 2010–2012	
Comparison	**Finland's rank**
Best mathematical skills (OECD's PISA)	6
The least corrupted countries (Transparency Int.)	2
The most competitive countries (WEF)	4
The most innovative countries (R. Florida)	1
Best business environments (Forbes)	13
The most networked countries (WEF)	3
Countries with the best online services (UN)	19
The best digital economies (Economist Intelligence Unit)	3
The ICT environment (BSA)	2
The best countries (Newsweek)	1

Table 34: Ranking of Finland in the World

10.3 Convergence of Mobility needs Strong Action

Thus, we have arrived at a time point with the need for a convergence towards more Sustainable Mobility and Transport for people and goods. Now, it is time to declare Policy Actions with the following points:

1. Foster solutions **only** which foster sustainable mobility.
2. Follow a pragmatic approach with priorities how to change in a short time or in steps from the todays schemes to the new schemes which include the new ITS Innovations.
3. Create smart and connected transport services to make traveling seamless and efficient.
4. Involve travelers in decision making for sustainable use of their personal mobility. And give them reliable, real-time information. Include social media, data analytics, and big data for this.
5. Align the existing infrastructure capacities with the demand.
6. Brake down the silos between the different transport modes.
7. Deliver tailored mobility solutions to the various social groups.

[84] Federation of Finnish Technology Industries. Ranked Finland - Education, expertise, labour force, economy, and ICT in international comparison Source: http://teknologiateollisuus.fi/sites/default/files/file_attachments/tt_rankedfinland_32012.pdf, 24.0.2016

8. Increase the role of public and users.

10.4 Public Sector as an Enabler

The Public sector has a dominant role to foster the deployment of the aforementioned Innovations: This includes:

- Include these ITS Innovations in National Transport Policy.
- Create the Policy for a "Mobility Management Office".
- Remove legal barriers, and update the legal framework.
- Support of open data structures, powerful communication backbones, and ICT infrastructure.
- Support a framework for testing and pilot projects.
- Foster public and private partnerships.
- Foster inter disciplinary research and education in the ITS and Transport sector.
- Create a pro-active communication platform to inform and include the opinions of all involved Stakeholders, both public and private, the industry, associations and user groups, the media, and research and education.

10.5 Next Steps

The Study shall be selectively presented and discussed in an open process.

- Interested or affected Ministries (Transport, Finance, Labor, Economy, …)
- Stakeholders involved mobility and transport
- Public and private sectors;
- Users and Interest Groups;
- ITS-Finland and its members;
- Media

This will create better understanding of the benefits of the new technologies, solutions and services of the mentioned ITS Innovations.

The suggested DNS Model and statistical information with KPIs identified will allow to perform detailed research and study on the numerical effects to the related sectors in Finland.

The KPIs need to be updated to reflect the developments on EU level. Also new KPIs are required, to cover pilot projects like for MaaS, AURORA, or Helsinki-Hämeenlinna-Tampere.

It is suggested to further support the deployment of aforementioned ITS Innovations in Finland in creating task forces or workgroups for:

1. Policy Development
2. Communication (stakeholders, media)
3. KPI (standardization, internationalization, update)
4. DNS Model (allows to perform detailed research and study on the numerical effects to the related sectors in Finland)

The Methodology of the Study can be applied also to other ITS Innovations.

Moving Forward Consulting would also like to support MINTC in the future in this or another field for the deployment of ITS Innovations in Finland.

The Author appreciates any comments and feedback.

This space is left free intentionally.

11 The Author of the Study, Memberships

The Author of the Study, Josef A. Czako, is a globally experienced Consultancy, Policy, Management, and Business Development professional in the fields Road Transport, Mobility, ITS, Road Pricing and Road Finance, and Road Safety.

Josef Czako has a proven record of successful flagship projects in ITS, tolling, ticketing, and automation worldwide. At present, Josef Czako is President & CEO of Moving Forward Consulting. He also covered many management positions with global ITS leaders, such as Kapsch TrafficCom, Cubic Transportation Systems, Buscom, INIT, Robert Bosch, Leybold Heraeus, or Potter Instruments. Mr. Czako holds a degree in Telecommunication (M.Sc. Eng.) from Vienna Technology Institute HTL, Austria.

Josef Czako is a frequent speaker at many international Conferences, and is supporting international Transport and Traffic Associations like ASECAP, ERF, ERTICO ITS-Europe, IBTTA, IRF, ITF, IRU, POLIS, or UNECE, as well as many National ITS Associations worldwide.

Josef Czako is the Chair of Policy Committee on ITS of the International Road Federation (IRF) in Geneva.

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- Prof. Georg Hauger, TU VIENNA, Head of Institute for Transportation Planning, Department of Spatial Planning at Vienna Technical University, Vienna, Austria
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18 Annex: Matrix of KPIs

KPI	Name (21.2.16)	Description	Applicable Sector	Robot Cars relevance to KPI	MaaS relevance to KPI	Mobility Pricing relevance to KPI	Innovations in Freight & Logistics relevance to KPI	KPI relevance to Transport	KPI relevance to Infra-structure	KPI relevance to Energy	KPI relevance to Environ-ment	KPI relevance to Safety & Health	KPI relevance to ICT	KPI relevance to Economy
KPI-001	Amount of connected vehicles	vehicles	Transport											
KPI-002	Passenger kilometres P.T.		Transport											
KPI-003	Mobility pricing + value adding services business market		Transport		+	+								++
KPI-004	Quality of logistics (MaaS/LaaS)	Logistics performance index	Logistics			+		+						
KPI-005	Maintenance and upkeep	Funds/year for m&u for transport INF	Infrastructure											
KPI-006	Capacity utilisation: passenger kilometres / passenger seat kilometres		Transport											
KPI-007	Congestion level of Helsinki according to TomTom traffic index	Ranking in World	Transport	+				+						
KPI-008	Traffic density	Vehicles per hour	Transport	+		+		++						
KPI-009	Average travel speed	km/h	Transport	+		+		++						
KPI-010	Energy consumption	Energy/year in transport system (Lipasto)	Energy	+	+	+								++++
KPI-011	Total number of passengers in public transport	million passengers	Transport											
KPI-012	Other emissions	Pm, NOx	Environment											
KPI-013	Level of Service	%	Transport		+			+						
KPI-014	CO2 emissions	CO2 emissions/year of transport system	Environment											
KPI-015	Accidents: Amount of people killed per year in road transport	persons	Safety	+		+						++		
KPI-016	Amount of people seriously injured per year in road transport	persons	Safety	+		+						++		
KPI-017	Amount of people injured per year in road transport	persons	Safety	+		+						++		
KPI-018	Amount of people died per year in road transport	persons	Safety											
KPI-019	Noise	Amount of people living in areas with transport noise (> 55 dB)	Environment											
KPI-020	Citizen satisfaction with transport system	% of very satisfied + satisfied transport system users	Transport		+			+						
KPI-021	Transport service turnover	€	Transport		+			+						
KPI-022	Average scrapping age of passenger vehicles	years	Transport			+		+				+		
KPI-023	Sustainability of transport	index	Transport		+++	+				+	+			++
KPI-024	Hours of congestion per year	hours	Transport	+		+		++						+
KPI-025	Road width	meters	Transport											
KPI-026	Vehicle Energy consumption per km	kWh/vehicle/km	Energy	+		+	+			+++				+
KPI-027	Vehicle CO2 emissions per km	g CO2/vehicle*km	Environment	+		+	+				+++			
KPI-028	Amount of persons/vehicle	persons	Transport	+	+			+			+			
KPI-029	Number of accidents per year in road transport	accidents	Safety	+		+	+					+++		
KPI-030	Available road capacity	cars per lane?	Transport	+					+					
KPI-031	Cost of health care system to cover injuries from road transport	new	Safety	+		+						++		
KPI-032	Amount of users of public space	persons	Transport	+					+					
KPI-033	GDP Finland	EUR per year	Economy	+	+	+	+							++++
KPI-034	Value of time Finland	EUR per hour	Economy	+	+	+	+							++++
KPI-035	Freight transport volume	Billion tonne-kilometres	Logistics											
KPI-036	Volume of freight transport relative to GDP	Index (2000 = 100)	Logistics											
KPI-037	Amount of API:s in transport sector		ICT	+	+	+	+						++++	
KPI-038	Digibarometer index ranking	Index	ICT	+		+							+++	
KPI-039	Use of cloud services	Index	ICT	+	+	+	+						++++	
KPI-040	User % of fast (2 Mb+) internet connection	Subscribers/population (%)	ICT											
KPI-041	Active users of mobile internet	% of population	ICT											

KPI-042	Amount of mobile health care apps	Amount of apps / 100 000 people	ICT											
KPI-043	Amount of transport apps	Amount of apps / 100 000 people	ICT											
KPI-044	Online sales		ICT											
KPI-045	Producer prices for transport services	Index 2010=100	Logistics											
KPI-046	Deployment of Electric Vehicles		Transport	+										+
KPI-047	Passenger car performance	million vehicle kilometres	Transport	-		+		+		-				
KPI-048	Capacity investments	Funds/year for capacity investment in transport system	Infrastructure	+	+				++					
KPI-049	Household spending in transport	% of household income	Transport		+									+
KPI-050	Deployment of Robot Cars		Transport	+										+
KPI-051	Employees in Finnish ITS Industry	employees	Economy	+	+	+	+							++++
KPI-052	Size of Finnish ITS market	m€	Economy	+	+	+	+							++++
KPI-053	Incomes from Gas Tax	m€	Finance			+			+					
KPI-054	Tax Spending on Road Infrastructure Investment		Finance			+			+					
KPI-055	Tax Subsidies for Public Transport		Finance			++			=					+
KPI-056	Tax Spending on Road Infrastructure Maintenance		Finance			+								+
KPI-057	Construction for Freight & Logistics		Infrastructure				+		+					

19 ANNEX: List of KPIs

KPI	Name	Source
KPI-001	Amount of connected vehicles	N/A
KPI-002	Passenger kilometres P.T.	http://www2.liikennevirasto.fi/julkaisut/pdf8/lti_2015-03_public_transport_web.pdf
KPI-003	Mobility pricing + value adding services business market	N/A
KPI-004	Quality of logistics (MaaS/LaaS)	http://lpi.worldbank.org/international/scorecard/radar/254/C/FIN/2014#chartarea
KPI-005	Maintenance and upkeep	http://www.trafi.fi/tietopalvelut/analyysitoiminta/indikaattorit/ymparistoindikaattorit
KPI-006	Capacity utilisation: passenger kilometres / passenger seat kilometres	http://www2.liikennevirasto.fi/julkaisut/pdf8/lti_2015-03_public_transport_web.pdf
KPI-007	Congestion level of Helsinki according to TomTom traffic index	https://www.tomtom.com/en_gb/trafficindex/#/list
KPI-008	Traffic density	
KPI-009	Average travel speed	
KPI-010	Energy consumption	http://www.trafi.fi/tietopalvelut/analyysitoiminta/indikaattorit/ymparistoindikaattorit
KPI-011	Total number of passengers in public transport	http://www2.liikennevirasto.fi/julkaisut/pdf8/lti_2015-03_public_transport_web.pdf
KPI-012	Other emissions	http://www.trafi.fi/tietopalvelut/analyysitoiminta/indikaattorit/ymparistoindikaattorit/liikenteen_paastot_ilmaan
KPI-013	Level of Service	
KPI-014	CO2 emissions	http://www.trafi.fi/tietopalvelut/analyysitoiminta/indikaattorit/ymparistoindikaattorit
KPI-015	Accidents: Amount of people killed per year in road transport	http://liikennejarjestelma.fi/turvallisuus/tieliikenteen-turvallisuus/kuolleet-ja-loukkaantuneet/

KPI-016	Amount of people seriously injured per year in road transport	
KPI-017	Amount of people injured per year in road transport	
KPI-018	Amount of people died per year in road transport	
KPI-019	Noise	http://www.trafi.fi/tietopalvelut/analyysitoiminta/indikaattorit/ymparistoindikaattorit
KPI-020	Citizen satisfaction with transport system	http://liikennejarjestelma.fi/palvelutaso/tyytyvaisyys/kansalaisten-tyytyvaisyys-liikennejarjestelmaan/
KPI-021	Transport service turnover	
KPI-022	Average scrapping age of passenger vehicles	(www.autoalantiedotuskeskus.fi) The more mileage we can generate with MaaS-services and shared use, the faster vehicles will be scrapped
KPI-023	Sustainability of transport	http://ec.europa.eu/eurostat/web/sdi/indicators/sustainable-transport
KPI-024	Hours of congestion per year	
KPI-025	Road width	
KPI-026	Vehicle Energy consumption per km	
KPI-027	Vehicle CO2 emissions per km	
KPI-028	Amount of persons/vehicle	
KPI-029	Number of accidents per year in road transport	
KPI-030	Available road capacity	
KPI-031	Cost of health care system to cover injuries from road transport	
KPI-032	Amount of users of public space	
KPI-033	GDP Finland	
KPI-034	Value of time Finland	
KPI-035	Freight transport volume	http://www.stat.fi/til/kttav/2014/kttav_2014_2015-05-13_tie_001_en.html
KPI-036	Volume of freight transport relative to GDP	http://ec.europa.eu/eurostat/tgm/table.do?tab=table&plugin=1&language=en&pcode=tsdtr230
KPI-037	Amount of API:s in transport sector	
KPI-038	Digibarometer index ranking	http://digi.fi/files/2015/03/Digibarometri-2015.pdf
KPI-039	Use of cloud services	http://digi.fi/files/2015/03/Digibarometri-2015.pdf
KPI-040	User % of fast (2 Mb+) internet connection	http://digi.fi/files/2015/03/Digibarometri-2015.pdf
KPI-041	Active users of mobile internet	http://digi.fi/files/2015/03/Digibarometri-2015.pdf
KPI-042	Amount of mobile health care apps	http://digi.fi/files/2015/03/Digibarometri-2015.pdf
KPI-043	Amount of transport apps	N/A

KPI-044	Online sales	
KPI-045	Producer prices for transport services	http://www.stat.fi/til/pthi/2015/03/pthi_2015_03_2015-10-26_tie_001_en.html
KPI-046	Deployment of Electric Vehicles	
KPI-047	Passenger car performance	http://www2.liikennevirasto.fi/julkaisut/pdf8/lti_2015-03_public_transport_web.pdf
KPI-048	Capacity investments	Liikennevirasto, HLJ
KPI-049	Household spending in transport	
KPI-050	Deployment of Robot Cars	
KPI-051	Employees in Finnish ITS Industry	VTT
KPI-052	Size of Finnish ITS market	VTT
KPI-053	Incomes from Gas Tax	
KPI-054	Tax Spending on Road Infrastructu	
KPI-055	Tax Subsidies for Public Transport	
KPI-056	Tax Spending on Road Infrastructu	
KPI-057	Construction for Freight & Logistics	

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