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# The impact of Mobility as a Service concept to land use

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Abstract

Modern society is heavily dependent on mobility of people and the flow of goods. At the same time, the existing transport infrastructure can no longer comply with growing number of vehicles, causing social inequality and environmental challenges. Mobility is closely linked everyday life of people, who make several trips per day for business and leisure purposes, integrating land use system and mobility needs in one community structure. Thus the Land Use and Building Act, steers that land use plans must support the regional availability of services and traffic.

The cycle of land use and building new transport infrastructure is relatively long and thus exiting transport infrastructure does not necessary meet the changing needs of today's mobility, especially novel mobility concepts like "Mobility as a Service", in which a comprehensive range of mobility services (including public transport, private cars, cycles etc.) are provided to customers by the mobility operator. There is very little information on how new trends of mobility will evolve and how should be taken into account in land use. This study researches links between one MaaS and land use in Finland by examining the potential impacts of MaaS on land use.

The study begins whit the introduction to the subject. In Chapter 2, a relevant framework and legislation of land use in Finland is discussed, after which MaaS is scrutinized (Chapter 3). Chapter 5 presented the empirical evidences of interviews and the findings are discussed and conclusions drawn on chapter 6.

Land Use and Building Act is single most important framework of land use, governing both the use of land areas and building processes. The main goal of the Act, safe and comfortable living environment that fulfils society's needs, is very much linked to mobility environment (incl. environmental aspects, aging population, urbanization, digitalization, and shift in people's attitudes). Finland's total vehicle fleet is around 3 million vehicles and some decades ago, an ever-increasing use of private cars seemed inevitable. However, recent developments in ICT, urbanization, and improvements in public transport have initiated a trend among young adults not to get driver's license or to own a private car. This promotes new transport concepts like MaaS.

Based on theoretical study and expert interviews a set of potential impact factors, posed by MaaS to land use was identified: legislation aspects, changing transport infrastructure, more efficient transport system, increased attractiveness of public transport as a part of travel chain, sharing of transport assets, less private cars, changing hubs, regional aspects, increased mobility volume, new user services and automation of transport. The impacts of these factors were further discussed and suggestions on possible actions were made. All together it was widely agreed that cooperation is needed between branches in all levels of planning.

Keywords Mobility as a Service, MaaS, Land use, Transport System

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Tiivistelmä

Moderni yhteiskunta on pitkälti riippuvainen ihmisten ja tavaroiden liikkumisesta. Samaan aikaan kasvavat liikennemäärät aiheuttavat paineita liikennejärjestelmälle ja lisäävät sosiaalisia ja ympäristöllisiä ongelmia. Liikkuminen on vahvasti kytköksissä ihmisten jokapäiväiseen elämään ja näin ollen sillä on suora yhteys myös yhteiskuntarakenteeseen. Maankäyttö- ja rakennuslaki määrääkin, että maankäytön tulee tukea alueellisia palveluita ja liikennesuunnitelmia.

Maankäytön suunnittelun ja liikenneinfrastruktuurin rakentamissykli on verrattain pitkä, eikä tämänhetkinen infra välttämättä vastaakaan niitä tarpeita joita uudet liikkumiskonseptit kuten "Liikkuminen palveluna" (Mobility as a Service -MaaS) edellyttävät. MaaS yhdistää eri liikkumispalvelut (ml. julkinen liikenne, yksityisautoilu, kevyt liikenne jne.) yhdeltä palveluntarjoajalta hankittavaksi paketiksi. Saatavilla ei ole juurikaan tutkimustuloksia, kuinka nämä uudet palvelut tulevat kehittymään ja mikä niiden vaikutus maankäyttöön voi olla. Tutkimuksen tarkoituksena onkin selvittää, mitkä ovat MaaS-konseptin potentiaaliset vaikutuksen maankäyttöön Suomessa.

Maankäyttö- ja rakennuslaki, joka koskee alueiden käyttöä, suunnittelua ja rakentamista, on tärkein tämän tutkimuksen kontekstiin liittyvä lainsäädäntö. Maankäyttö- ja rakennuslain tavoite on turvallisen ja toimivan yhteiskunnan edistäminen. Tämä liittyy keskeisesti myös liikkumisympäristöön, jossa huomioon pitää ottaa ympäristölähtökohdat, ikääntyvä väestö, kaupungistuminen, digitalisaatio ja ihmisten asenteiden muuttuminen. Suomen autokanta on kasvanut voimakkaasti viimeisten vuosikymmenien aikana ollen tällä hetkellä n. 3 miljoonaa ajoneuvoa. Viime aikoina tietotekniikan kehittyminen, kaupungistuminen ja joukkoliikenteen kehittyminen ovat kuitenkin vähentäneet nuorten innokkuutta oman auton tai ajokortin hankintaa. Tämä kehitys tukee myös uusia liikennepalveluita.

Työssä käydään läpi aiheen taustaa, relevantti lainsäädäntökehys (Luku 2), MaaS konseptin kehitys (Luku 3). Luvussa 5 käydään keskustelua liikenteen ja maankäytön asiantuntijahaastatteluissa esille nousseista uusien liikennepalveluiden vaikutuksista maan käyttöön Suomessa. Johtopäätökset ja toimenpide-ehdotukset esitellään luvussa 6.

Kirjallisuuskatsauksen ja haastatteluiden perusteella MaaS palveluiden kehitys saattaa vaikuttaa maankäytön suunnitteluun seuraavien asioiden kautta: lainsäädäntö, liikenneinfrastruktuuri, liikennejärjestelmän tehostuminen, julkisen liikenteen houkuttelevuuden kasvaminen osana matkaketjua, jakamistalous, yksityisautojen määrän vähentyminen, muuttuvat liikenteen solmukohdat, lisääntynyt liikennesuorite, uudet palvelut ja automaatio. Työssä on analysoitu näitä mahdollisia vaikutuksia ja tehty toimenpide-ehdotuksia. Keskeistä on yhteistyö eri toimijoiden välillä kaikilla suunnittelun tasoilla.

Avainsanat Liikkuminen palveluna, Mobility as a Service, maankäytön suunnittelu, aluesuunnittelu, liikennejärjestelmä, MaaS

# Preface and acknowledgements

The subject of the thesis – as well as the research plan - was drafted in September 2014 while waiting for the boarding at Detroit Metropolitan Wayne County Airport. The city hosted 21st World Congress of Intelligent Transport System, where, among other things, new mobility services were presented. Those who know the history of city are aware of major changes in the structure of society during the last decades. This change cannot be passed while walking in the downtown of the Motor City, which once was the booming birthplace of American automotive industry. Vacant houses, empty plots and properties fostered the idea of studying the relationship of evolving transport concepts, land use, and shift of mobility paradigm. This thesis is the result of this process.

This research would have not been possible without various people and organizations. First I'd like to express my thanks to D.Sc. Saija Toivonen, and Professor Kauko Viitanen for their expertise and guidance. I had a privilege to interview several experts of land use and transport from related ministries, agencies, and other organizations. Without the input of these people it would not have been possible to cover such a complicated phenomenon in relatively short period of time. The work done for this research was also closely related to TransSmart spearhead programme of VTT Technical Research Centre of Finland Ltd. Thus, I'd like to express my deepest gratitude to Nils-Olof Nylund, Raine Hautala, and Harri Airaksinen, among other colleagues, for their contribution to the work.

Finally, the support and encouragement of family, parents, and friends cannot be overemphasized. The research process was, without any doubts, heavy for some close people as well. The future will show whether this was the final "thesis battle" for me or not…

Tapiola, 3.3.2015

Karri Rantasila

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# Acronyms

ELY Centres - The Centres for Economic Development, Transport and the Environment

EU - European Union

FTA - The Finnish Transport Agency

GDP – Gross Domestic Product

GHG - greenhouse gas

HRT – Helsinki Regional Transport

ICT - information and communications technology

IoT - Internet of Things

ITS – Intelligent Transport Systems

ITS Finland - Intelligent Transport Systems Finland

LSP - logistics service provider

MaaS - Mobility as a Service

MALPE - Land use, living, traffic, services, business –planning in Finland

PPP - Public Private Partnership

Trafi – Finnish Traffic Safety Agency

# Chapter 1 - Introduction

## 1.1 Background

Modern society is heavily dependent on mobility of people and flow of goods. At the same time, the existing transport infrastructure is no longer able to comply with ever-growing number of vehicles, further causing social inequality and environmental challenges. In addition, the inadequate infrastructure causes inefficiencies of transport system, such as congestions and low service level of public transport. Without exaggeration, it is fair to state that the modern society depends on mobility, which refers the ability to move or to be moved freely and easily. Since "the curbing of mobility is not an option", as it was stated in the EU Commission's White Paper on transport (2011), a better ways of ensuring mobility need to be developed. (European Commission 2011, 12.)

Mobility is closely linked everyday life of people, who make several trips per day for business and leisure purposes. The need for trips arises from the people's need to be in different places at certain time. Hence there is a direct link between land use system, defined in Land Use and Building Act, and mobility. As the act defines principles of land use and community structure, by providing a general plan that steers the local authorities' more detailed planning, it also generates the need for mobility. Land Use and Building Act also steers government authorities' land use that includes transport network and other infrastructure. According the Section 54 of the Land Use and Building Act, land use plans must support the regional availability of services and traffic. This lays down the foundation for the need of close cooperation between land use and mobility.

Whereas land use is a long and complicated process, the planning and building transport infrastructure is equally time-consuming and far-reaching function. This is why current transport infra, built many decades ago, does not necessary meet the changing needs of today's mobility, especially novel mobility concepts like "Mobility as a Service". These concepts do not only pose new kind of requirements for land use and infrastructure, but also provides some serious potential to achieve the goals of land use. Also a link between zoning and mobility should be scrutinized as people's mobility needs originate to their respective life environment and travel patterns.

The cycle of land use and building new transport infrastructure is relatively long. For example in Norway, it has been stated that it takes on average about 10 years from the start of planning to commencement of construction in major road and rail projects. (Norwegian Ministry of Transport and Communications 2013, 23.) This

requires forward-thinking foresights of mobility needs and future concepts in next ten to twenty years, which is a perspective of regional land use plans. Even longer foresights should be developed for basis of regional development strategies. One of the most promising and radical concepts of new mobility is called as “Mobility as a Service” or MaaS. MaaS is a system, in which a comprehensive range of mobility services are provided to customers by mobility operator (Heikkilä 2014, 65). This concept, originated in Finland, has gained lot of popularity in global scale as well. Mobility services based on MaaS are not restricted to certain mode of transport or do not distinguish private and public transport. MaaS is a paradigm change in transport as it promotes new way of providing and consuming transport services for all stakeholders. In distributed model all users’ major transport needs are offered by a services provider, which bundles all required services for easy to use package. The services are based on utilization of ICT which enables more efficient use of existing transport capacity in a smarted way and promotes user-centric, nomad mobile services. MaaS ecosystem consists of transport infra, mobility services, transport information, and payment solutions. For user this is a one stop shop that handles combining transport modes and practical transactions between providers and users. It must be stressed that MaaS is on a conceptual level and no empirical evidences or previous research results, validating the evolution of MaaS are available. Neither there is extant research available on how MaaS is related to land use or land use.

Digitalization and services related to this development will most likely have impact on everyday life of people. There is a clear interface between mobility and other essential aspects of society, namely housing, working and leisure time. From the land use perspective the some possible benefits of MaaS foreseen include efficient allocation of resources, improved traffic management, more reliable transport system, and vitality of society. At the same time MaaS facilitates collection of information for decision making and planning purposes. Studying and validating these are in the centre of interest in this research.

## 1.2 Objectives of the study and research question

This thesis studies links between one evolving and promising transport concept, MaaS, and land use in Finland. The main goal is to study potential impacts of MaaS concept on land use. Therefore, the research questions of this study are formulated as:

- **How MaaS is related to land use?**
- **What are the plausible impacts of MaaS on land use?**

## 1.3Research process

Research questions presented in previous chapter are successive and partly parallel. However, as the phenomenon is new, the problems must be advanced from different perspectives. The main phases of the research process is illustrated in Figure 1 with corresponding chapter numbers.

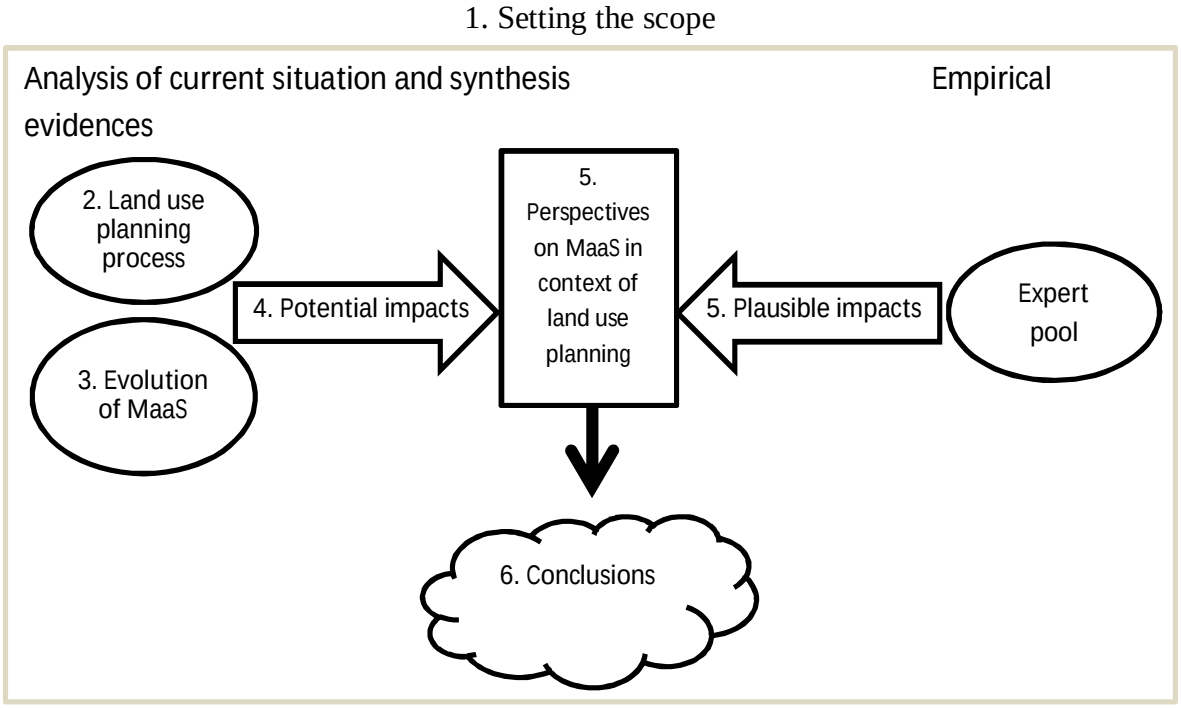


Figure 1 Research process

As depicted above the first objective is to analyze the evolution of MaaS concept and discuss the land use process in Finland (theoretical part of the study). This analysis, conducted in chapters 1 (setting the scene), 2 (land use), and 3 (MaaS), serves as a basis for revealing possible impacts of MaaS on land use (in chapter 4). Secondly, in empirical part of the study, selected experts of MaaS and land use are interviewed in order to draw a picture how plausible impacts are perceived from different perspectives (chapter 5). Finally, the results are discussed and conclusions are drawn with suggestions of actions.

## 1.4 Study design

### 1.4.1 Research methodology

Research methods guide the process of creating knowledge. In order to be effective, methods should fit to the problem, as well as to the presumptions, as these guide choosing of techniques and tools. (Arbnor & Bjerke 2009, 8-9.) Two main categories of research methods are commonly identified: quantitative and qualitative. Whereas qualitative research is often defined as "soft" research, quantitative studies is considered as "hard-nosed" and data-driven (Yin 2012, 178). Even though, it is not necessary to make a strict line between these two categories, this research is qualitative in nature as it focuses on meaning in context and requires sensitive data collection instruments (interviews). Qualitative approach is justified by the novel and multi-perspective aspects of the MaaS concept. Further, no extant research has been identified in this issue, which makes it complicated to build a formal framework for research. As MaaS phenomena, studied in context of land use, it is expected that no comprehensive theory is ready but rather needs to be built during the research process by means of literature review.

Classification on research methodologies is provided by Arbnor and Bjerke. Authors divide methodologies between analytical approach, system approach, and actors approach. This study includes elements from analytical approach and systems approach. The goal of analytical approach is to generate pictures of objective reality. With cyclical nature, connecting the theoretical and empirical world, in analytical approach the theories are formed through inductive reasoning based on facts in the empirical world. It is also characteristic for analytical approach that created theories are deductively compared with the facts (validation). Systemic approach creates new knowledge from explanatory perspective and attempts to understand real world from holistic perspective. The main difference from analytical approach is that systemic approach does not only study the parts of the whole phenomena, but rather also tries to include the relationship between individual parts. (Arbnor & Bjerke 2009, 183.) In this research, especially the relationship between two studied aspects is in interest of this study, which also favors the systemic approach.

This research can be divided between two main parts: theoretical and empirical. These are further presented in following sub-chapters. Whereas the theoretical part lies in identified extant sources, the empirical part utilizes future study techniques. These techniques, and especially future wheel (see 1.4.4), are in great importance in guiding interviews.

### 1.4.2 Theoretical part of research

Building the theoretical base for research is mainly findings of the review of identified extant research, legislation and other guidelines. This literature review forms a backbone of the theoretical part of this research. An adequate background for expert interviews is built in this phase. As mentioned, the main sources for theoretical part consist on relevant literature, identified extant research publications, and relevant legislation and guidelines. These are presented more detailed in Table 1.

Table 1 Sources of theoretical part of the study

| Perspective | Source | Main tools (description) |
|---|---|---|
| MaaS | Articles and literature | NELLI (The National Electronic Library Interface is a tool for retrieving information from electronic resources, used by Finnish universities) |
| | Other research findings | Summon (Web-based service enabling search of content found in library collections (incl. books, videos, e-resources such as articles)<br><br>Google scholar (web-based search, indexing the full text of scholarly literature) |
| Land use | Articles and literature | NELLI (The National Electronic Library Interface is a tool for retrieving information from electronic resources, used by Finnish universities) |
| | Relevant guidelines | Guidelines and publications of relevant ministries and agencies (e.g. Ministry of Environment) |
| | Legislation | FINLEX (Finnish legislation database) |

Based on the review of identified extant literature, research publications, and other relevant sources, the possible impact of MaaS to land use is created. The findings of the theoretical part are utilized as a starting point of open interview (empirical part).

### 1.4.3 Empirical part of the study

In empirical part, the same possible impacts of MaaS on land use are studied by interviewing relevant experts. Interviews utilize future wheel technique. The sphere of interviewed experts cover organizations working with MaaS or/and land use. The total number of interviewed organizations was eight, and two of interviews were conducted as group interviews. The list with organizational roles is presented below (See also Annex 1).

Table 2 Interviewed organizations

| Organization (number of people interviewed) | Expertise | Primarily perspective |
|---|---|---|
| Ministry of Environment (1) | Responsible for developing steering instruments for land use and enacts the related legislation. | Land use |
| The Finnish Environment Institute (2) | Examines the spatial structure and dynamics of communities, as well as their relation to the surrounding nature. | Land use |
| Ministry of Transport and Communications (1) | National transport policy and steering of acengies | MaaS |
| Finnish Transport Agency (3) | Responsible of Finland's transport network | MaaS / Land use |
| Centre for Economic Development, Transport and the Environment (1) | Promoting regional competitiveness, well-being and sustainable development and curbing climate change | Land use |
| Finnish Traffic Safety Agency (1) | Develops the safety of the transport system, promotes environmentally friendly transport solutions and is responsible for transport system regulatory duties. | MaaS |
| ITS Finland (1) | Forum of Intelligent Transport Systems in Finland representing the industry, public sector and research community. | MaaS |
| Tekes – the Finnish Funding Agency for Innovation (1) | Tekes is the most important publicly funded expert organisation for financing research, development and innovation in Finland. Tekes boosts a wide-range of innovation activities in research communities, industry and service sectors. | MaaS |

The information of experts is acquired in interviews. Main categories of face-to-face interviews are interviewers as participant-observer, unstructured interview, élite interview, group interview, semi-structured interview, structured interview, video interview, and interview as an qualitative experiment (Gillham 2005, 94). Without going into specific details, it can be stated that the control of interviewer to interviewee is loosest in unstructured interview, whereas the strongest control exist in structured interviews. In addition, unstructured interview is more of an observation, while structured interview is closer to questionnaire. Semi-structured

interview lies in-between these two extremes. In this research interview is relatively unstructured as control was only utilized if considered necessary by interviewer. This way interviewer may guide the course of discussion is justified by the novelty of studied phenomena. It is expected that MaaS concept needs to be explained to land use experts and vice versa. By controlling the interview it can be guaranteed that the course of discussion is within studied phenomena and their relationship. Furthermore, it might be assumed that some steering and focusing will be done during the interview process.

In practice the interviews were conducted between October-December 2014 with anonymity among identified experts in various organizations. The organization of interviewed person with general description of his/her duties is presented in Chapter 5 . All interviews were conducted either in VTT's or interviewees' premises with approximate duration varying from one hour to two hour. At the beginning of the interview experts were briefly briefed about the research and it's subject, as well as the concept of MaaS was clarified if needed. Furthermore, it was explained that future wheel technique will be utilized and interviewees have a chance to review the outcome after the interview.

### 1.4.4 Future wheel

Future-oriented technique called future wheel is utilized in cases where impact of uncertain phenomena, events, circumstances, or issues are analysed. The technique facilitates identifying all possible outcomes in a structured way (and could be categorized as a structured brainstorming). Some examples of potential applications in literature include forecasting potential future scenarios, future trends, possible effects from a trend, analysing potential patterns, forecasting implications for alternative circumstances, or collecting data on a group's perspectives. As the list shows, future wheel is very suitable technique for this research as the impacts of phenomena are uncertain and the best way of studying these is by consolidating experts' opinions from various perspectives. (Watkins et al. 2012, p. 228; Alcamo 2009, p.188-189.)

As in all research methods and techniques, it is important to understand the shortages and benefits of the used tool, in this case the future wheel. One of the main advantage of the future wheel technique is its' easiness to use as it is time-efficient and does not require heavy settings or arrangements. Future wheel can be also applied in many different contexts (like business, industry, human-related) which is important especially in this research where subject can be approached from great variety of perspectives. Finally, the pros of future wheel include its' applicability to complex relationships between causes and consequences, as well as to the problems where links between subdivisions are unclear. On the other hand it is important to

identify potential challenges of utilized research technique as this facilitates smoother and more reliable findings. In the context of this research the main challenges of the future wheel are related to tool's sequential structure that may in extreme cases result ignoring some contributing factors. The second potential pitfall for this research is related to causality of the effects as some times individuals may believe there is a causal relationship between effects even there is only correlation. Finally, when participants are engaged to future wheel, there is a possibility that opinions are presented as a facts, while in future these are merely "best guesses". (Watkins et al. 2012, p. 228-230.) Many of the challenges of using future wheel can be, however, tackled by careful preparation and well-planned structure of interviews.

Watkins et al. (2012, p. 230-233) have identified four main stages of the future wheel process. These are presented below at a glance:

- **Preparation.** In this phase the scope of future wheel is determined and participants are selected (preferred number of participants is 8 to 12 individuals). In addition the background study to the subject is conducted with practical arrangements. In context of this research this is mainly done in theoretical part of the study.
- **Implementation.** This phase consists of preparing participants (explaining the activity and approach), creating the future wheel (writing down key topics, identifying effects and implications, and finding a consensus between these.
- **Discussing and interpreting the future wheel.** After completing the future wheel, the findings are iterated among participants once more to synthetize information and to present detailed questions.

The phases described above are one possible process to follow. However, some alternative approaches to using future wheels exist. One of alternative approached is "expert panel future wheel", which is applicable especially when phenomena may have variety of impacts on several of themes. This is partially applied as well wheels are iterated with interviewees after drawing the first version. Future wheel activity can also be utilized in forecasting future of alternative solutions and scenarios. (Watkins et al. 2012, p. 234.)

In this study, a future wheel is employed as a visual tool to facilitate studying the consequences of a particular trend and change, namely MaaS in context of land use. In practise the evolution of a future wheel has four steps (partly adapted Knoke 2012):

1. Identifying the change / trend (in the context of this study MaaS)
2. Finding primary impacts (on land use)
3. Finding secondary impacts (on land use)
4. Concluding effects and implications (on land use)

MaaS, as a trend is a self-evident choice for change in the centre of the future wheel (step 1). The second step is to find primary (i.e. most direct impacts) of MaaS on land use. This step is followed by finding the secondary impacts that are direct consequence of first level impact (step 3). In step 4 the concluding effects and implications are found. Step four reveals the last impacts that can be traced back to phenomena in question This process is illustrated in context of this research below (only indicative example).


Figure 2 Example of future wheel

The figure presented above is only illustrative, yet some examples of steps are presented. Step one (red in the figure), identifying the trend, which in the context of this study is MaaS and its possible effects on land use, is studied in the theoretical

part of the study. This trend is placed in the centre of the future wheel. Steps two, identifying primary impacts of MaaS on the land use, are illustrated in dark blue circles (one possible effect could be less private cars), followed by identification of secondary impacts (e.g. less money required for road infra – step three, light blue circles). Finally, the implications of MaaS to land use (step four) are determined based on previous effects (e.g. resources available for public transport). As discussed in above these are last impacts that can be linked to phenomena. In practice, as mentioned earlier, the information is collected via expert interviews. Based on these face-to-face interviews the future wheels are developed. These are also utilized to illustrate the results of the research. Finally the experts validate the outcome.

## 1.5 Research limitations

Some limitations need to be stated. As theoretical part of the study is based on literature study (see Table 1) and MaaS is young concept it is possible that not all potential aspects are included to databases reviewed. Further, as MaaS is global phenomena no geographical limitations in review of identified extant research of MaaS concept are justified. However, as synthesis of relevance of MaaS in context of land use is made, the applicability to Finnish environment is considered. As land use is directly linked to national guidelines and regulations, only relevant Finnish research, legislation, and other sources are utilized in literature review. This also implies limitations for generalizability of the findings of review of relevant legislastion and guidelines, as this should not be done beyond Finnish context. Also in empirical part, the interviewed professionals pose an expertise in national scale, which limits the applicability of these findings to Finnish context.

## 1.6 Structure of the thesis

The thesis is divided into two main parts: a literature review (Chapters 2-4) and an empirical part (Chapter 5). Chapter 1 introduces the subject, presents study methodology and research process, as well as research implications and limitations. Chapters 2-3 form the theoretical phase that covers the two studied perspectives, planning and land use (Chapter 2), and MaaS (Chapter 3). Synthesis on literature review (possible impacts) is presented in Chapter 4 that bridges theoretical and empirical part of research. Chapter 5 provides an empirical evidences (plausible impacts) on theory created in previous chapters. Finally the findings are discussed and conclusions drawn on chapter 6. See also Figure 1 (in page 3) for chapters and research process.

# Chapter 2 — Planning and land use in legislation

This chapter presents the main aspects of land use in Finland. Relevant legislation and guidelines are described in order to provide an overview on juridical perspectives on the issue. Finally, the planning process is discussed with national objectives and different levels of planning.

## 2.1 Overview of land use in Finland

In a nutshell, the land use plan defines the use of the region including restrictions, and building guidelines (e.g. location, size and function of the buildings). The magnitude of land use varies from individual properties to whole neighbourhoods. Legislation on land use and building is based on several instructions and laws that regulate the domain. The most crucial piece of legislation that controls the land use, spatial planning and construction in Finland is the Land Use and Building Act (132/1999). The Act, which came into force in 2000, governs both, the use of land areas, and building processes conducted on them. It aims creating a healthy, safe and comfortable living environment that fulfils society's needs. More specific regulations on land use and building are presented in the Land Use and Building Decree (895/1999). In addition to the Act and Decree, Finland´s National Building Code provides complementing regulations and guidelines for Land Use and Building Act. Finally some detailed instructions are given in order to preserve built heritage and cultural landscapes in the Land Use and Building Act, the Building Protection Act and the Nature Conservation Act (1096/1996), as well as statutes established in other administrative sectors (including the Church Act). These regulations related to heritage and cultural landscapes are limited out of this study as no direct link to MaaS can be foreseen. (YM 2014a.) Acts and instructions are discussed below only from those perspectives that are relevant in context of this study.

## 2.2 Land Use and Building Act

In Finland regional land use is governed by the Land Use and Building Act (132/1999), which defines principles of land use and community structure, as well as defines areas reserved for regional development. The legislation can be considered as general plan, steering the local authorities' own and more detailed planning. This detailed planning include local master plans, local detailed plans. Also government authorities' land use, which includes also transport network and other infrastructure, are steered by Land Use and Building Act. (Land Use and Building Act 132/1999, 1.)

Some chapters of Land Use and Building Act have more impact on evolving of novel transport services. National land use process, guided by Land Use and Building Act is presented in chapter 2.5. In addition to planning process also Chapter 12 of Land Use and Building Act that governs streets and other public areas is relevant to transport. This chapter includes guidelines for street management (e.g. planning, building, maintenance etc.), which is a responsibility of the local authority, as well as street construction (plans approved by the local authority). (Land Use and Building Act 132/1999, 21-22.)

### 2.2.1 The purpose of the Land Use and Building Act

The Land Use and Building Act steers all the planning, building development and use of land and water areas, unless otherwise prescribed, meaning that it must be applied unless otherwise stated. Several main functions of Land Use and Building act can be identified. The law steers organizing the use of land areas and building activities conducted on them in such a way that creates the preconditions for a favorable living environment. The main goals that the Act is promoting are (Land Use and Building Act 132/1999, 2.):

1. "a safe, healthy, pleasant, socially functional living and working environment which provides for the needs of various population groups, such as children, the elderly and the handicapped;
2. economical community structure and land use;
3. protection of the beauty of the built environment and of cultural values;
4. biological diversity and other natural values;
5. environmental protection and prevention of environmental hazards;
6. provident use of natural resources;
7. functionality of communities and good building;
8. economical community building;
9. favourable business conditions;
10. availability of services;
11. an appropriate traffic system and, especially, public transport and non-motorized traffic."

Above presented objectives are designed to enhance healthy, safe and socially functioning living environments, respecting the needs of different groups. In the scope of this study, especially the last goal, promoting appropriate traffic system and, especially, public transport and non-motorized traffic, is in center of an interest. In order to achieve these goals, the Land Use and Building Act, as well as Building Act and Decree (see chapter 2.2.2) include provisions to (Ministry of Environment 2014a):

- Town planning
- Municipal building ordinances
- Planning and building with regard to shore areas
- Plot division
- Expropriation of land in relation to community structure
- General requirements on building
- Building permits and other supervision by authorities

### 2.2.2 Competent authorities

As a rule of thumb, the competent ministry related to land use and buildingis the Ministry of the Environment, unless this is otherwise prescribed in decree. The responsibilities of the Ministry by the Act include the general development and guidance of land use and building activities. Furthermore, the ministry promotes, steers and monitors regional planning. (Land Use and Building Act 132/1999, 4.)

In practice, the Ministry of the Environment has several authorities to help it with its duties. The regional environment centres (as defined in the Act on the Environmental Administration (55/1995)) promote and steer organizing the land use and building activities in the areas covered by a local authority by ensuring that national land use and building objectives, as well as other goals are met. Other relevant authorities are presented in Table 3. (Land Use and Building Act 132/1999, 5-6.)

Table 3 Roles of authorities according Land Use and Building Act (Land Use and Building Act 132/1999, 5-6)

| Authority | Responsibility |
|---|---|
| Regional council | Regional planning |
| Local authority | Land use and building planning in a local level |
| Local building control authority | Statutory functions, building guidance and control (building inspection) |

## 2.3Land Use and Building Decree

Land Use and Building Decree was issued in 1999 and is closely linked to the Land Use and Building Act (132/1999). Land Use and Building Act also defines the general provisions of Land Use and Building Decree, as well as identifies the legal power of the Decree. These occurrences are presented below.

First of the Land Use and Building Decree's implementation subjects is related to investigation of land use plan's impact. The Decree states that "when a land use plan's impact is investigated, it is necessary to provide data for assessing the impact of the plan's implementation on the following (Land Use and Building Decree 1999, 1):

1. people's living conditions and environment;
2. soil and bedrock, water, air and climate;
3. plants and animals, biodiversity and natural resources;
4. regional and community structure, community and energy economy and traffic;
5. townscape, landscape, cultural heritage and the built environment.

In the second section of Land Use and Building Decree the monitoring of land use is defined. According the Decree the Ministry of the Environment is responsible of organizing the monitoring of the state and development of land use and the built environment. This also covers the maintenance of a respective database. In connection to monitoring the land use, also regional environment centres, regional councils, and local authorities all have a responsibility to participate on promoting and steering the organization of monitoring. Planners' qualifications (e.g. appropriate university degree) are defined in section 3, followed by the responsibilities of the local building supervision authority in section 4. (Land Use and Building Decree 1999, 2-3.)

Land Use and Building Decree also takes a stand on preparation of national land use objectives as defined in the Decrees's section 7. According the section, the preparation of national land-use objectives should be lined the way they allow public debate and interaction. Further, the environmental and other impact needs to be adequately investigated and assessed, while preparing national land use objectives. Concerning the national land use, assessment of objectives must be requested from the following parties (Land Use and Building Decree 1999, 3-5):

- ministries, regional environment centres, regional councils and other authorities that the matter concerns;
- the local authorities especially concerned;
- nationwide organizations that are important in terms of the proposal

On interesting chapter in Land Use and Building Decree from transport perspective is Chapter 9, which cover the decrees related to streets, parks and other public areas. According it's section 41, which governs street plans in more detail, a street plan indicates how the street area will be used for various purposes, how the street fits in with its surroundings and its impact on the environment. This also includes indicating the principles of arranging traffic, among other things. Furthermore, it is

notable that Decree advocates the interaction when drawing up street plans by imposing a need for possibility to contribute to the preparation of a street plan, as well as making plan proposals available in public (for least 14). Finally the Decree regulates possession of street areas and equipment in these. (Land Use and Building Decree 1999, 22-24.)

## 2.4 Finland´s National Building Code

Complementary to Land Use and Building Act, the National Building Code provides regulations and guidelines for building. These are not obligatory but regulations must be followed, yet other solutions can be utilized if compulsory ones are observed. Building Code concern the construction of new buildings. (Ministry of Environment 2014b; Land Use and Building Act 132/1999, 3; Land Use and Building Decree 1999, 3.)

The National Building Code of Finland includes both technical regulations and instructions. In the code these are divided into seven sections (Table 4).

Table 4 National Building Code sections (Ministry of Environment 2014c)

| Section | Description |
|---|---|
| General section | Supervision of construction work |
| | Building designers and plans |
| | Maintenance manual for the care and use of buildings |
| | Plan notations |
| | Supervision of construction work |
| | Building designers and plans (pdf, unofficial translation) |
| The strength of structures | Structural safety and loads |
| | Loadbearing structures |
| | Foundations |
| | Concrete structures |
| | Structures of lightweight concrete blocks |
| | Light gauge steel structures |
| | Steel structures |
| | Brick structures |
| | Structures of concrete blocks |
| Insulation | Sound insulation and noise abatement in building |
| | Moisture |
| | Thermal insulation in a building |
| | Thermal insulation |
| Hepac and energy management | Water supply and drainage installations for buildings |
| | Indoor climate and ventilation of buildings |
| | Energy management in buildings |
| | HEPAC drawings |
| | Calculation of power and energy needs for heating of buildings |
| | Efficiency requirements for boilers |
| Stuctural fire safety | Stuctural fire safety in buildings |
| | Fire safety of production and warehouse buildings |
| | Small chimneys |
| | Fire safety of garages |
| | Fire safety of ventilation installations |
| | Masonry fireplaces |
| | Fire safety of boiler rooms and fuel stores |
| General building planning | Barrier-free building |
| | Safety in use buildings |
| Housing planning and building | Housing design |

It's relatively easy to see that there is no direct link between National Building Code and novel transport concepts. Some of the sub-sections like fire safety of garages can be loosely linked to MaaS but in general these are presented just for a brief.

## 2.5 National land use guidelines and planning process

This chapter discusses the national land use guidelines and planning process in a context of this study. Therefore the guidelines are discussed only from those parts that can anticipated to have link to evolving transport concepts like MaaS. Guidelines

are mainly based on Land Use and Building Act, Land Use and Building Decree and Finland's national Building Code that were presented in the first parts of this chapter.

### 2.5.1 Steering guidelines at a glance

Land use process contains several stages, depending on the nature and importance of the respective plan. As discussed above, the main legislation is in the Land Use and Building Act (132/1999), which sets objectives for the land use (see 2.5.2). The responsibility of drafting and approving local master plans (see 2.5.4) and local detailed plans (see 2.5.5) belongs to municipalities, while regional land use plans (see 2.5.3) are drafted and approved by regional councils. (YM2014d.)

Planning guidelines follow the levels of planning, from national level objectives to regional planning and local plans (this sub-chapter follows the same structure). The Council of State defines national objectives concerning land use and regional structure, while regional plans sets a general plan for land use for the entire region. (Land Use and Building Act 132/1999 1-2.)

As described above, the responsibility of actual planning belongs to municipalities and regional councils. The development of land use, however, is the responsibility environmental administration parties. In Finland these parties are the Ministry of the Environment and the Centres for Economic Development, Transport and the Environment. In addition, the Finnish Environmental Institute carries out the specific function of environmental research (incl. collection of national data on the the environment and planning). (YM2014a.)

Interaction and transparency of the planning process are crucial issues. This is why planning process should involve all those persons whose circumstances or benefits the plan could affect. For this reason authorities provide planning information on their websites, in newspapers and in planning reviews. The protocol ensures that all relevant parties are able to influence the planning process. Finally, concerned parties have possibility to appeal against authorities' approved land use plan. In case of appeals drafted by more than one municipality against regional land use plans or joint local master plans, these should be directed to the Ministry of the Environment, while further appeals are directed to the Supreme Administrative Court. (YM2014d.)

### 2.5.2 National land use objectives

National land use objectives are initiated by the Council of State, and concern subjects that could have (Land Use and Building Act 132/1999, 6):

1) international or more extensive than regional bearing on local structure, land use, or the transport or power network;
2) a significant impact on national cultural or natural heritage;
3) nationally significant impact on ecological sustainability, the economy of the local structure, or avoidance of environmental hazards.

Again, in the context of this study, the transport network is explicitly mentioned as a national-level priority, and thus steered by the Council of State. As a competent ministry, the Ministry of Environment, in collaboration with the other ministries and other competent authorities, is in charge of drafting national land use objectives. These need to be taken into account in regional and national level land use and promote their implementation. (Land Use and Building Act 132/1999, 6.)

### 2.5.3 Regional planning

The regional plan adopts the national land use objectives (see also 2.2.1) with respect of land reservation needs and environmental protection requirements. The section 25 in the Land Use and Building Act defines the regional scheme, the regional plan, and the regional development programme. The regional scheme includes the regional development goals and principles of land use. The core of planning focuses on regional land reservation and infrastructure, people, environment, buildings, society, transport, energy and sustainable development. These are considered from both national and EU perspectives. (Association of Finnish Local and Regional Authorities: Regional land use; Land Use and Building Act 132/1999, 7.)

The main purpose of regional land use is to facilitate the implementation of national and regional land use goals in the local level. Finland has divided into 18 regions that are covered by a regional land use plan with medium and long-term objectives. (YM2014b.)

Responsibility of making proposals for regional land use plans belongs to regional councils and citizens as well as other relevant organisations can participate in the process. Regional plans are also approved by regional councils, which then communicate these to Ministry of the Environment for pre-ratification assessment. Regional land use plan defines a framework for more detailed planning and should give attention to following (Land Use and Building Act 132/1999, 7):

1. appropriate regional and community structure of the region,
2. ecological sustainability of land use,
3. environmentally and economically sustainable arrangement of transport and technical services,
4. sustainable use of water and extractable land resources,

5. operating conditions for the region's businesses,
6. protection of landscape, natural values, and cultural heritage
7. sufficient availability of areas suitable for recreation.

As stated in legislation, regional land use plans are legally binding, but at the same time these leave plenty of room for the municipalities for deciding local land use and development aspects. Regional plans are evaluated and updated in regular basis based on the changing conditions. (YM2014b, Land Use and Building Act 132/1999, 7.)

The presentation mode of regional plan, drafted by council, is on map with explanations of symbols and written regulations. After presenting the plan, the next step is approval (party responsible: regional council's highest decision-making body) and ratification (party responsible: competent ministry for ratification) of the plan. The ratification must be done within a year from approval. (Land Use and Building Act 132/1999, 7-8.)

When approved, the plan is to be used as a guideline for local master plans and local detailed plans. These are presented in following sub-chapters.

### 2.5.4 Local master plans

According the hierarchy of land use the local master plans steers and coordinates local detailed plans, and serves as a general land use plans of municipalities. Generic steering on land use (including traffic infra) and development in municipalities is outlined in local detailed plans. (Land Use and Building Act 132/1999, 9; YM2014c.)

Coverage of local master plans, presented in a map, appended with notations and regulations, is entire municipalities or parts of them. In latter case, plans are referred as partial master plans. A joint planning between two or more municipalities is possible. In practice, local master plans are executed by municipalities, and later approved by cities or municipal councils. In case of joint planning, the plan needs to be approved by a joint municipal organ and the Ministry of the Environment. (YM 2014c; Land Use and Building Act 132/1999, 9.)

In general, local master plans are flexible with respect of varying precision, depending on the case in question. As stated above, the overall “purpose of the plan is to provide general guidance regarding the community structure and land use of a municipality or a part thereof, and to integrate functions”. (Land Use and Building Act 132/1999, 9.)

From the perspective of transport, the requirements of a local master plan in are in the center of interest. Section 39 of the Land Use and Building Act defines that following requirements must be taken into account when a local master plan is drafted (Land Use and Building Act 132/1999, 10):

1. the functionality, economy and ecological sustainability of the community structure;
2. utilization of the existing community structure;
3. housing needs and availability of services;
4. opportunities to organize traffic, especially public transport and non-motorized traffic, energy, water supply and drainage, and energy and waste management in an appropriate manner which is sustainable in terms of the environment, natural resources and economy;
5. opportunities for a safe and healthy living environment which takes different population groups into equal consideration;
6. business conditions within the municipality;
7. reduction of environmental hazards;
8. protection of the built environment, landscape and natural values; and
9. sufficient number of areas suitable for recreation.

Particularly requirements regarding the opportunities to organize traffic, especially public transport and non-motorized traffic, has a direct interface to new transport service concepts like MaaS.

### 2.5.5 Local detailed plans

Local detailed plans guide the land use, building and development. Local detailed plan has several purposes. Plan aims to designate areas for different purposes and to guide land use according to local conditions, townscape and landscape, good building practice. While municipalities define master plans, the local detailed plan is primarily a responsibility of local council. (Land Use and Building Act 132/1999, 13.)

Section 54 of Land Use and Building Act defines the required content of local detailed plan. The main object of the plan is to support healthy, safe and pleasant living environment, locally available services and the organization of traffic. Emphasis is also put on local living environment like recreational areas etc. Correspondingly to local master plan, also local detailed plan is be presented on a map (with key symbols and written regulations) indicating the following (Land Use and Building Act 132/1999, 13-14):

1. the boundaries of the area covered by the local detailed plan (local detailed plan area);
2. the boundaries of the various areas included in the local detailed plan;
3. the public and private uses intended for land and water areas;
4. the volume of building;
5. the principles governing the siting of buildings and, when necessary, the type of construction.

Even though local detailed plans a more related to building than transport infrastructure, a link between local detailed plans and transport exists, as mobility of people originates from local habitations.

### 2.5.6 Principles of the planning process

Planning process ensures that all parties to whom the plan may have impact, can participate in preparing the plan and impact evaluation, as well as they may state their opinion on the plan. The principle of participation also covers the interaction procedures and time-related aspects (i.e. plans must be available in a good time). (Land Use and Building Act 132/1999, 16.)

At the beginning of the planning process the plans are publicized so relevant parties have access to information on planning and assessment procedures. The proposal of the plan is public, and must be publicized in an appropriate way concerning the purpose and significance of the plan. At this phase, the inhabitants of municipality and other interested parties have an opportunity to express their opinion. During the drafting of the regional plan also competent ministries and regional environment centres are involved in order to ensure that plan meets national objectives. Finally, when the plan is decided to approve, all relevant parties must be informed without a delay. (Land Use and Building Act 132/1999, 16-17.)

# Chapter 3 — Mobility as a Service

The idea behind Intelligent Transport System (ITS) and service concepts like MaaS is relatively simple. Transport services are provided to user in an easy way and by utilizing ICT. At the same time, new ways of working are sought by public sector, for example related to infrastructure maintenance. This chapter discusses the evolving concept of MaaS, first introducing the Finnish transport sector, global aspects, then presenting the drivers of novel mobility services, finally ending the actual MaaS concept.

## 3.1 Finnish transport scheme

Finland's total vehicle feet is around 3 million vehicles with relatively old average age of cars, almost 12 years. To compare, the EU average is only 8.3 years. Average Finn make 5.2 billion domestic trips per year and travels 74 billion kilometres annually. On average day, a Finn spends around 66 minutes travelling with 41 km in distance. (Hautala, Karvonen, Laitinen, Laurikko, Nylund, Pihlatie, Rantasila, Tuominen 2014, 19.)

When considering energy consumption in Finland, transport accounted for 16 % of energy consumption in 2013. This is below EU average, mainly due to the Finland's energy-intensive industries (e.g. paper industry). Some other characteristics of Finnish transport scheme include the northern location (above latitude 60°), large size (a country with long distances), and four seasons. During the winter times, the transport systems must be capable of operating in cold conditions, with an average snowfall of 20 cm. (Hautala et al. 2014, 19.)

Finland has progressive biofuel production with strong ICT competence and intelligent transport systems. Share of public transport ridership has increased steadily during the recent years and about 1 million people, live in the capital region with access to public transport system based on trains, metro, trams, buses and even a couple of ferries governed by Helsinki Region Transport (HRT). (Hautala et al. 2014, 20.)

## 3.2 Shift of paradigm

Transport sector is not isolation function but rather a part of the environment that surrounds it. Thus, it is affected by international trends, which also contribute to increased demand for more intelligent transport systems and services. The grand challenges, discussed here, include environmental aspects/climate change, aging population, urbanization, digitalization, and shift in people attitude. (Towards a new

transport policy: Intelligence in transport and wisdom in mobility. Finland's second generation intelligent strategy for transport 2013, 11.)

### 3.2.1 Environmental awareness

The emphasis on environmental issues is especially valid in transport, which utilizes scarce natural resources and effects on climate change. Traffic emissions in 2012, counted 25 per cent of all greenhouse gas (GHG) emissions in Europe. This made transport second biggest contributor of GHG emissions. (Towards a new transport policy: Intelligence in transport and wisdom in mobility. Finland's second generation intelligent strategy for transport 2013, 11) Oil is still dominating transport energy source as 95% of total energy consumption is generated by oil-based fuels. At the world level transport is responsible for a quarter of all energy consumption. In EU the corresponding figure is even higher, 33%. (Hautala et al. 2014, 16-17.)

From ITS and new mobility service concept perspective, it should be addressed that a considerable proportion emissions of vehicles is caused by inefficient driving (e.g. driving around for a free parking lot). EU’s goal is to significantly reduce GHG emissions within coming decades and energy efficient transport, with sophisticated ITS solutions, will play a key role in this process. (Hautala et al. 2014, 16-17.)

### 3.2.2 Demographic changes

In so-called developed countries population is ageing while population growth is mainly taking place in developing countries (Figure 3). As the population in the world is expected to continue to grow in the future, and in developed countries the demography is changing due to ageing population, these trends has also an impact on development of transport and new mobility solutions.

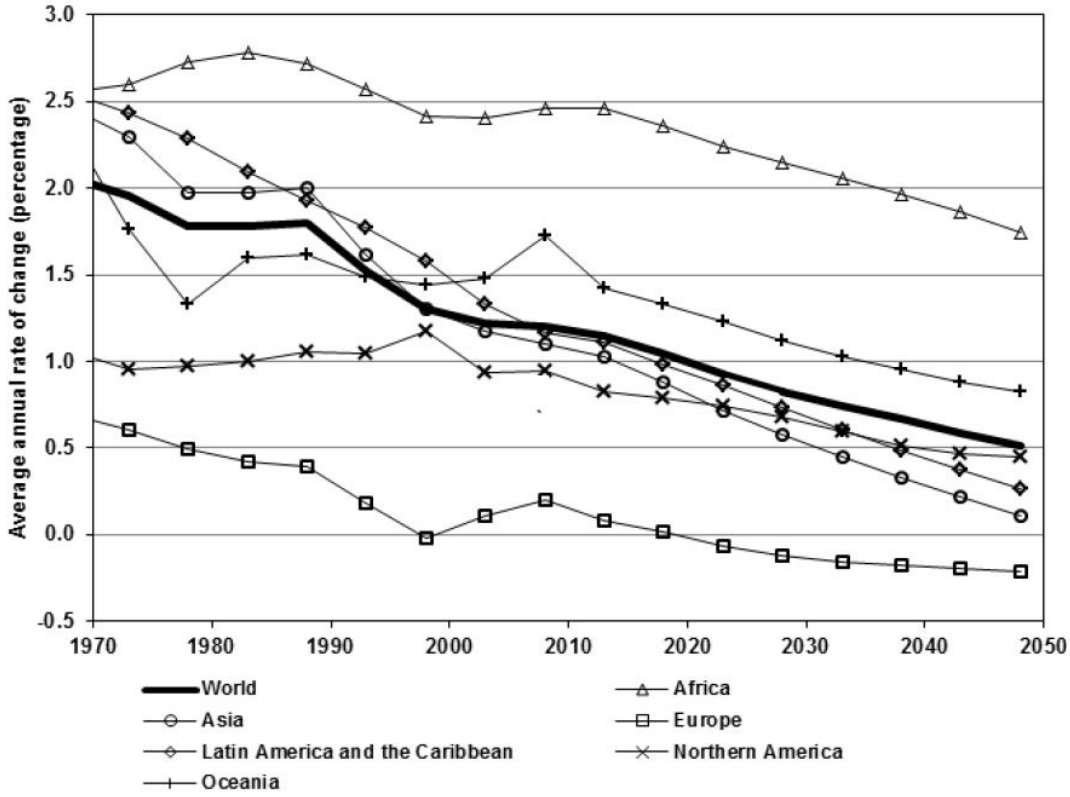


Figure 3 World population growth 1970-2050 (UN 20142014, 4)

As illustrated in figure about the annual growth rate of world's total population is declining but still be 0.5% in 2050 (at the moment the rate is little over 1%). The growth is mainly generated by African and Oceania countries, while developed countries show slower growth or prospect even negative growth in future (Europe). This growth projection means that by 2050 there are 9.5 milliard people in earth (UN 20142014, 3.)

Tomorrows' transport services and technology must meet people's changing needs. In addition to ageing population, also concentration of people in certain areas (i.e. urbanization) all over the world pose some challenges but also opportunities to transport sector. Future's mobility needs should be met by creating an intelligent transport system, which incorporates private cars with sufficient public transport services supported by intelligent feeder traffic and parking solutions. (Hautala et al. 2014, 17.)

### 3.2.3 Private cars

Some decades ago, ever-increasing use of private cars seemed inevitable. Recent developments in online ICT (e.g. virtual presence capabilities) and information services, urbanization, and improvements in public transport services have initiated a

trend among young adults not to get driver's license or to own a private car. (Hautala et al. 2014, 18.)

Declining trend of getting new drivers' licences has been identified in many countries. There are of course regional differences in this development and in Finland it's more common to get driver's license right after turning 18 in rural areas. In fact 75% of 18-year old people hold a driver's licence in rural areas, while in same ratio on cities was 56%. On average, 60% of Finnish people turning 18 acquire a driving license. (Traffic Safety Agency 2014a.)

There are of course also differences between cities and in Helsinki only 33% of 18-year old people took driver's license exam in 2012. Sometimes this is referred as "Stockholm-phenomena" as Sweden's capital was one of the first cities in Europe to witness this kind of development. It is understandable that this kind of development is realized first in urban areas, where incentives like availability of public transport and general atmosphere is more favourable for not having a driver's license or own car. At the same time green values and the cost of driver's license has encouraged especially young people who have a choice to not to drive themselves to refrain from acquiring the license. (Traffic Safety Agency 2014a.)

Even the number of new driver's licences is showing some signs of regression, the number of passenger cars has been steadily increasing through 21st century in Finland. From 1990 to early 2000 the number of passenger cars remained in roughly 2 000 000 cars. Since then the number has reached the line of 3 000 000 cars, meaning that there are approximately 5.5 Finns for 3 three cars. The development is illustrated in Figure 4.

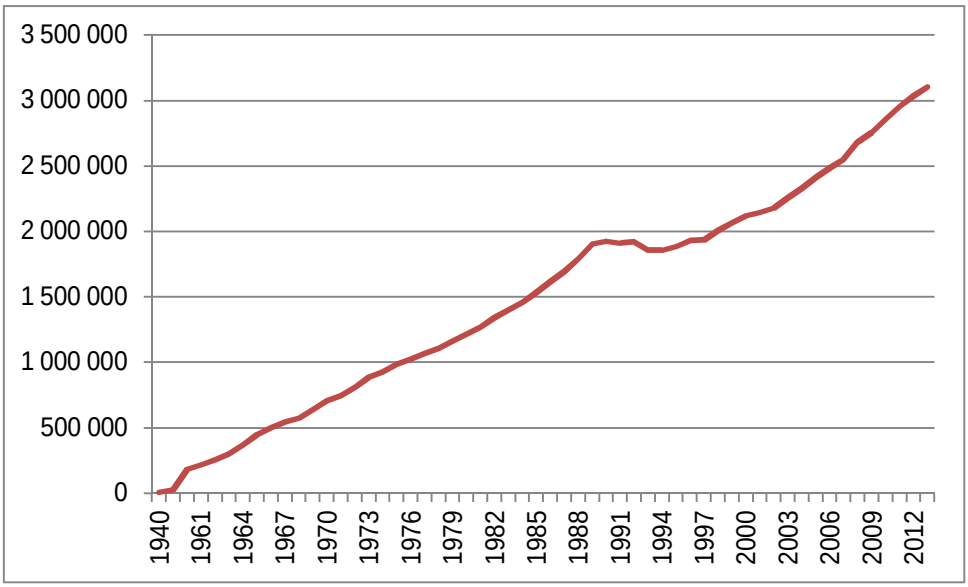


Figure 4 Number of passenger cars in Finland 1940-2012 (Finnish Information Centre of Automobile Sector)

From land use and planning perspective the interesting aspect is the adequate development of road infrastructure. While number of passenger cars has tripled within last three decades but the question remain whether road infra can keep up with this or not. It is evident that rapid increased in number of cars create huge pressures to infra especially in urban areas.

### 3.2.4 Public transport

Many stakeholders like cities and communes have put a lot of effort to make public transport more attractive. However, the statistics of Finland shows that private transport has a major share of all passenger transport. There is obviously huge variation between cities. Market shares of passenger kilometres show that 84.1% of all travelled passenger kilometres was made with passenger cars in 2011. Corresponding shares of buses were 6.6%, followed by railways (5.4%), air (1.8%), taxi (1.5%), metro (0.5%) and tram (0.2%). When measured by the number of trips commuter transport (tram, underground, and buses) increase their relative share. (Public Transport Performance Statistics 2011, 8.) The market shares per passenger kilometre and market shares per journeys are illustrated below.

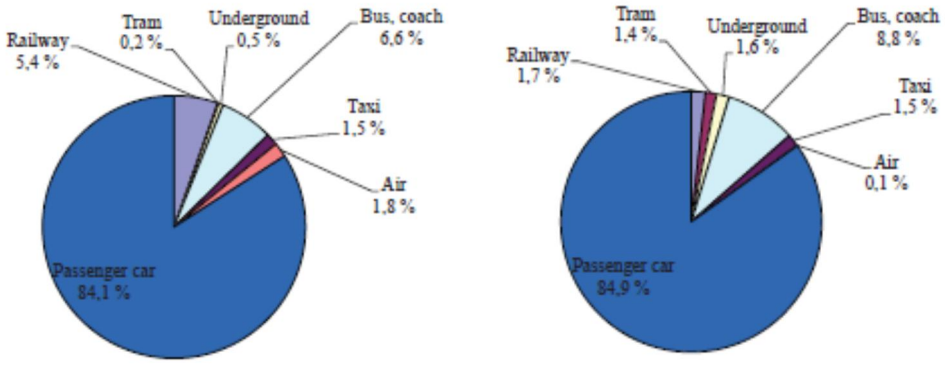


Figure 5 Market shares of passenger transport 2011 of passenger kilometres (left hand side) and of passenger numbers (right hand side) (Public Transport Performance Statistics 2011, 8)

When scrutinizing the development of absolute volume of public transport from 1997 (Figure 6), it's obvious that the number of journeys made by public transport has increased steadily. Passenger kilometres by bus and tram has remained in relatively same level, but output of underground, railway and taxi have experienced an increase of 20% or more. Air travel is different in its nature (mainly cross-border trips) and thus no conclusions should be drawn from that.

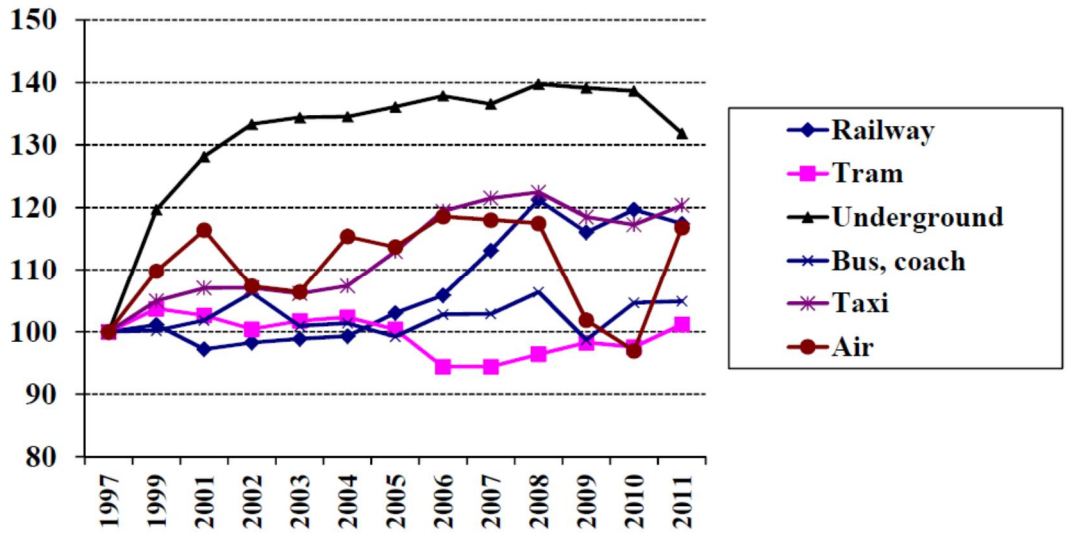


Figure 6 Passenger kilometres of public transport, index 100=1997 (Public Transport Performance Statistics 2011, appendix 5)

From the above mentioned transport means underground and tram are only available in the capital region. Railway transport is mainly inter-city traffic, but bus transport is organized in both urban and rural area. Considering the regional differences of bus transport, it must be stated that out of the 67.8 million yearly bus passengers in Finland, 55.7 are travelling with Helsinki Regional Transport (HRT) 2011. From 2009, the number of passenger with HRT has increased by 5.6 million, while average journey length has remained in 10 kilometres. Other areas, worth mentioning, are Pirkanmaa (Tampere) with 2.9million bus journeys and Southwest Finland (Turku) 3.7 million bus journeys in 2011 (Public Transport Performance Statistics 2011, 15.).

| HSL, ELY centre | 2011 | | | 2009 | | |
|---|---|---|---|---|---|---|
| | Passengers, million | Average journey length, km | Passenger km, million | Passengers, million | Average journey length, km | Passenger km, million |
| HSL (2009: YTV), regional | 55,7 | 10 | 562 | 50,1 | 10 | 506 |
| South Ostrobothnia | 0,1 | 10 | 1 | 0,1 | 10 | 1 |
| Southeast Finland | 0,4 | 25 | 10 | 0,5 | 25 | 14 |
| Central Finland | 0,6 | 10 | 6 | 0,6 | 10 | 6 |
| Lapland | 0,2 | 27 | 6 | 0,3 | 27 | 7 |
| Pirkanmaa | 2,9 | 10 | 29 | 2,8 | 10 | 28 |
| North Ostrobothnia | 0,6 | 22 | 13 | 0,7 | 22 | 15 |
| North Savo | 0,9 | 29 | 27 | 1,0 | 29 | 30 |
| Uusimaa | 2,7 | 25 | 67 | 3,2 | 25 | 80 |
| Southwest Finland | 3,7 | 10 | 37 | 3,6 | 10 | 36 |
| TOTAL | 67,8 | 11 | 758 | 62,9 | 11 | 723 |

Figure 7 Regional bus transport data in Finland 2011/2009 (Public Transport Performance Statistics 2011, 15)

Finally, it is interesting to see how private and public transport utilization has developed in Helsinki region. As depicted in Figure 8 it can be seen that in 1960 and 1970 decades public transport was more popular than private cars but since the private car journeys have surpassed the public transport journeys. From 2008, it however seems that public transport has increased its journeys more rapidly compared to private car journeys. From 2012 to 2013 the number of journeys with HRT increased by 3 per cent and share of public transport in Helsinki region was 43%. (Helsinki Regional Traffic 2013, 14) In 2013, HRT collected 278MEUR in ticket incomes (Helsinki Regional Traffic 2013, 27). In comparison, the average price of single journey ticket in medium-sized Finnish cities in 2004 was 2.4EUR (Rosenberg & Räsänen 2005, 28.).

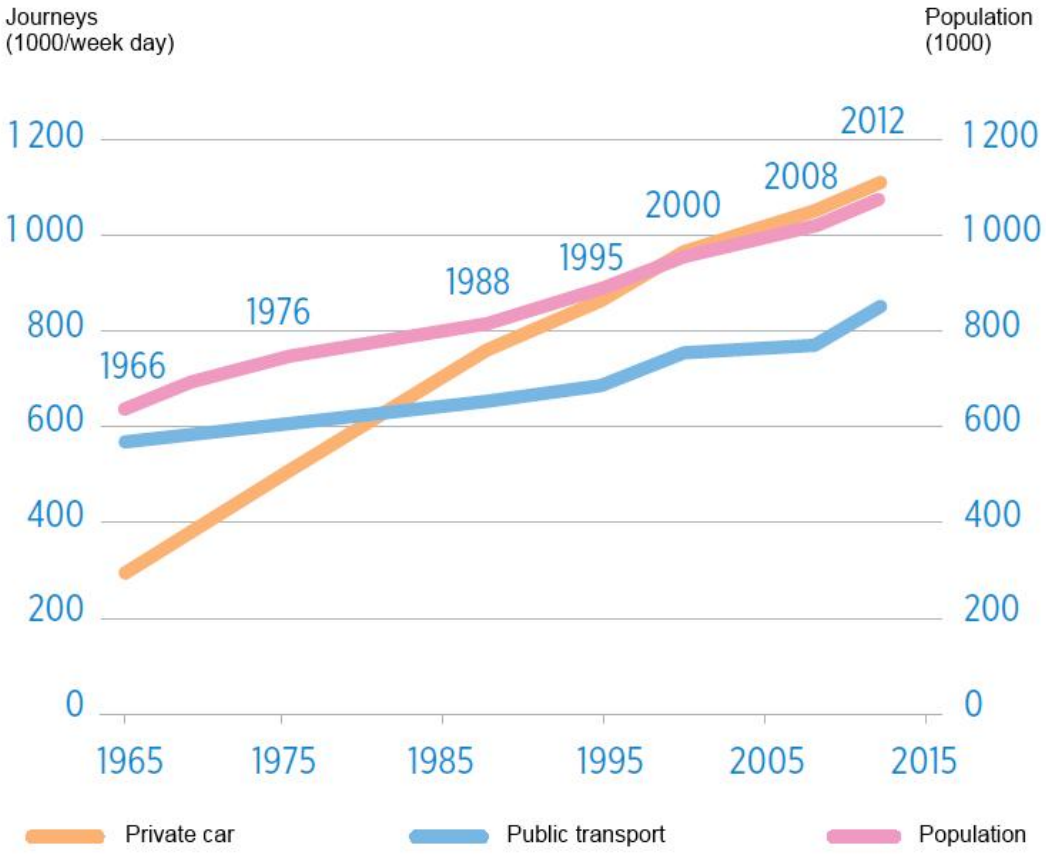


Figure 8 Private and public transport in Helsinki region (HRT Annual Report 2013, 14)

According to studies, the attitude towards public transport (at least in Helsinki region) has become more positive. Customer satisfaction towards HRT services hit the record high (4.07/5) in 2013 and Helsinki's public transport system was selected as the best in European for the fourth time in a row. 80% of people living in Helsinki had HRT travel card and over 1300 Helsinki region-based companies provide their

employees public transport as a benefit. (Helsinki Regional Traffic 2013, 15-21.) This indicates that people are changing their consumption towards mobility.

## 3.3 Demand for novel mobility solutions

The need for MaaS and other novel transport solutions can be justified with many issues. In Finland, the need for substitute of constructing new transport infrastructure has identified in national transport strategies, of which goal is to facilitate new solutions with pilots and other actions. This chapter discusses the transport infrastructure in Finnish context as well as briefly describes two pilots concerning new transport innovations.

### 3.3.1 Transport infrastructure

Provision of transport infrastructure is based on legislation. The main pieces of relevant legislation include Private roads Act (358/1962), Highways Act (503/2005) and the Rail tracks act (110/2007). This juridical foundation provide also forms the basic rules for the planning, construction and maintenance of the transport infrastructure. In sparsely populated country like Finland, transport network creates prerequisites for well-being of people and competitiveness of business. The ministry responsible of transport network, Ministry of Transport and Communications, ensures safe and effective travel and goods transport. Simultaneously, the effort is made to minimise emissions and other adverse effects. (Ministry of Transport and Communications 2014a.) There is somewhat political consensus that transport infra is backbone of Finnish society and investments to this benefit both industry and people. The direct consequence of new infra projects is work for people and this usually stimulates economic activity as well. On the other hand these projects are usually relatively expensive and directing the budget is hard.

Alongside of mobility of people, the transport network is crucial for many businesses and especially export-oriented sectors like pulp and wood. Logistics costs of Finnish companies are in higher level compared to other European countries. Although these are not directly comparable some studies suggest that on global logistics costs are around 5% compared to GDP. Logistics costs can be divided into six main cost components: transportation, warehousing, inventory carrying, transport packaging, and other logistics costs. The largest individual cost component for Finnish manufacturing and trading companies is transportation costs (4.6% of turnover in 2011), followed by inventory-carrying costs (3.0%) and warehousing costs (2.6%) Logistics administration cost were 1.2% and other logistics costs 0.7% of turnover on average. Historical development is illustrated in Figure 9.

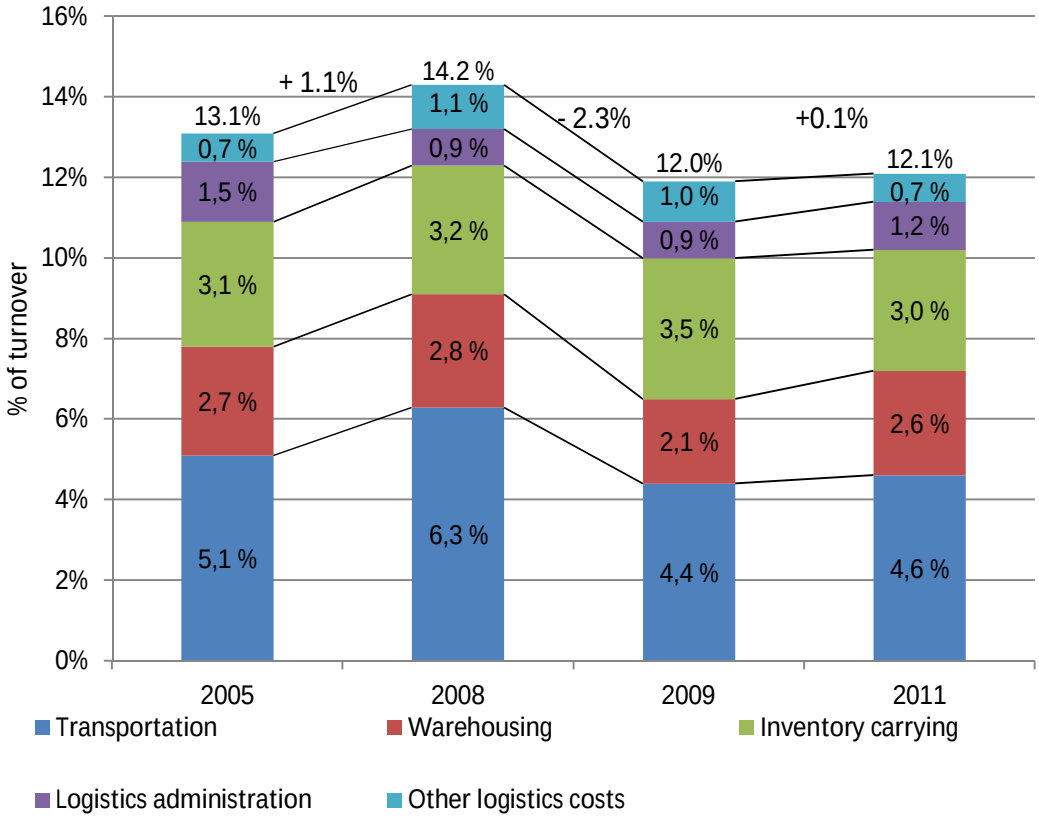


Figure 9 Logistics costs in Finnish manufacturing and trading enterprises as a % of turnover in 2005, 2008, 2009, 2011 (Rantasila 2013, 176)

The transport infrastructure of Finland consists of all roads and streets, private roads, railways, maritime and inland waterways, and the metro and tram systems. Under the direction of the Ministry of Transport and Communications, The Finnish Transport Agency, is a party responsible for the maintenance and development of the core network. Other responsible parties maintaining the infrastructure are Finavia Corporation (state-owned limited liability company is in charge of airports), and municipal authorities (responsible for the street network in their own area). Also most ports are owned by municipalities, or companies directly under their influence. Finally, in sparsely populated country, private roads, maintained by maintenance associations, landowners, and other different kinds of communities or companies, are a life line of many people and for example forest industry. (Ministry of Transport and Communications 2014a.)

As mentioned above, the transport network of Finland (Figure 10) consists of roads, rails, and waterways. The total length of public roads is around 78,000 kilometres, of which 13,300 kilometres is considered as main roads (class I and II main roads). Around two-third of all roads are paved and 765 kilometres are covered by motorways. Total rail network length is roughly 5,900 kilometres and little over half of this is electrified. Around 90 per cent is covered with single-track lines. Ports have

always been in great importance for Finnish society, and maritime and inland waterways cover approximately 16,200 kilometres (4,000 km of this is considered as merchant shipping routes). (Ministry of Transport and Communications 2014a; Finnish Transport Agency 2014a)

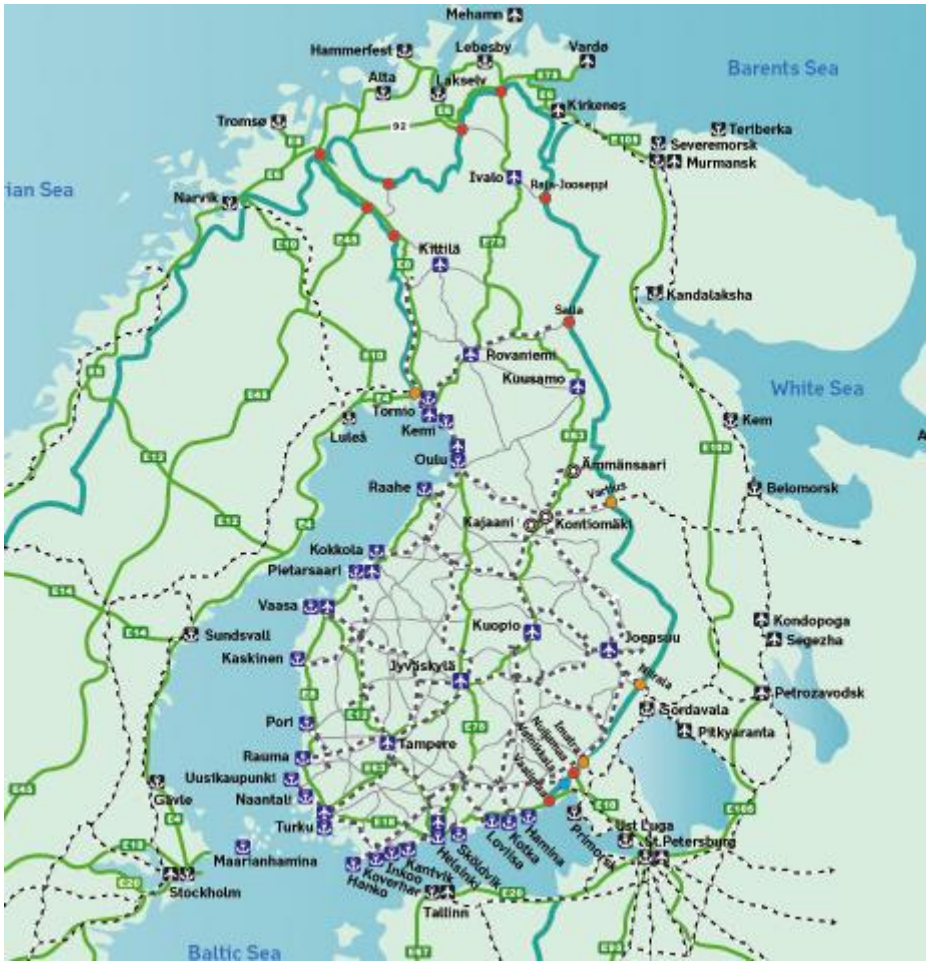


Figure 10 Finnish transport network (Finnish Transport Network 2015)

It has been evaluated that the value of all transport infrastructure and terminals in is approximately EUR 30 billion (of which the state's share is some EUR 19 billion) (Ministry of Transport and Communications 2014a). When comparing this to yearly budget of Finland, which is roughly 54 billion euro in 2004, it is easy to see that maintaining and developing transport infrastructure is a huge national issue (Finnish Government: State Budget 2014). The situation has forced ministries and authorities to find some new ways of ensuring mobility for people with less money. Thus, the Ministry's has announced that it goal is to boost the efficiency of infrastructure development by seeking new forms of cooperation with various fields and by making use of intelligent transport services (Ministry of Transport and Communications 2014a.).

### 3.3.2 National Intelligent Transport System strategy

Intelligent transport system, or ITS, simply means the utilization of ICT to improve traffic flow, enhance safety and make it more environmentally friendly. ITS solutions aim at making travelling more user-friendly, efficient, easier, and more predictable for travellers whether they choose to use their own cars or public transportation. From land use and planning perspective the contribution of intelligent transport is to shift the focus of transport policy from the construction and maintenance of transport network infrastructure to the effective functioning of travel and transportation. ITS can be scrutinized from several different perspectives but main characteristics of intelligent transport system includes (Ministry of Transport and Communications 2014b):

- Intelligent transport constitutes sustainable development
- Intelligent transport treats everyone equally
- Easy and affordable services
- Respect for privacy
- Utilisation of familiar solutions
- Interoperability of services
- Strong network cooperation

Finland was the first country (in 2009) to include ITS strategy in the Government Programme and thus underlined to importance of intelligent transport solutions and services. According the first National Strategy for Intelligent Transport the Government commits on promoting new intelligent transport services, financial steering, and innovations. The first National Strategy for Intelligent Transport was refined in 2013 with the second generation intelligent strategy for transport. The second generation intelligent strategy further emphasises ITS as part of all other forms of transport and Finnish transport policy with the following main themes (Towards a new transport policy: Intelligence in transport and wisdom in mobility. Finland's second generation intelligent strategy for transport 2013, 6; Towards a new transport policy: Intelligence in transport and wisdom in mobility. Finland's second generation intelligent strategy for transport 2013, 15-16.):

- Customer-oriented improvement in the level of service for mobility, transport and information services
- Furthering the implementation of a new transport policy
- Fulfilling the objectives set by the EU’s White Paper on Transport and the ITS Directive
- Exploiting the opportunities provided by the rapid development of information and communications

As defined above, in ITS strategy ICT plays a key role in in the reform of transport policy, growing the service capacity of the transport system, increasing the productivity of the infrastructure maintenance, enhancing traffic safety, increasing the use of public transport, promoting cycling and walking, and to facilitating the objectives of climate and environmental policy (EU White Paper on Transportation goals). The bold vision for ITS in 2020 in Finland states that the Finnish transport system will be one of the most advanced in the world. This includes, among other things better transport services, environmental friendliness, safety, more efficient use of infrastructure (the transport policy will address the mobility problems instead of just building infrastructure – from bitumen to bytes). This vision should place Finland as a one of the major player in the global markets for intelligent transport. Furthermore, the strategy emphasises the cooperation between public sector (enabler) and private sector (business). (Ministry of Transport and Communications 2014b; Towards a new transport policy: Intelligence in transport and wisdom in mobility. Finland's second generation intelligent strategy for transport 2013, 14-15.)

For the implementation, the Strategy has identified following key projects for implementation (Towards a new transport policy: Intelligence in transport and wisdom in mobility. Finland's second generation intelligent strategy for transport 2013, 7):

- Intelligent transport system reference architecture
- Real-time situation picture of transport system status and operation
- Integrated public transport system
- Intelligent traffic control
- Reactive and proactive safety systems
- Multi-service model for transport
- Intelligent logistics
- Smarter and more eco-friendly mobility
- Innovation and piloting programmes

Several of above-mentioned key projects promote new kind of services. The architecture enables new service ecosystems, while integrated public transport system and multi-service models and smarter mobility are building block for MaaS.

### 3.3.3 New intelligent mobility services are currently under piloting

According Finland’s Second Generation Intelligent Strategy for Transport (2013), the emphasis is on development of necessary test facilities and pilot projects. In addition it has pointed out that as a young industry, the ITS industry has focused on research and development pilots and test projects. (Towards a new transport policy: Intelligence in transport and wisdom in mobility, Finland's second generation

intelligent strategy for transport 2013, 5-6.) Two flagship projects of developing new intelligent transport services in Finland are briefly described here in order to give practical example how new service concepts are evolving. These projects are Helsinki-St.Petersburg Smart Transport Corridor, and Traffic Lab.

Helsinki–St. Petersburg Smart Transport Corridor project aims at promoting smoother traffic flows, enhanced traffic safety, environment friendliness in transport, and improved mobility services in Helsinki-St. Petersburg corridor. It also further facilitates provision on cooperative transport services for border-crossing passenger. As the volume of road traffic between Finland and Russia has been growing in recent years, with total number of crossings 12 million in 2012, new transport services also create some promising business opportunities (Rantasila, Mantsinen, Casey, Hautala, Lankinen 2014, 4.). Currently services are introduced for cross-border train passengers, car drivers, and public transport users. New traffic service portfolio, introduced in first phase, consists of following services (Rantasila & Lankinen 2014, 2-4):

- weather and road condition service
- road assistance
- border queue information
- traffic incident information service
- traveller services in real-time
- public transport information
- hotspots in trains and border-crossing points
- translation services

Another example of piloting novel transport services can be found from Finland. A project called Traffic Lab is an experimental project launched by the Finnish Ministry of Transport and Communications. It aims at promoting ITS market in a partnership between public and private actors (PPP – public private partnership). The project that runs until the end of 2015 encourages companies to apply funding to support their ITS product and service development, as well as it is technology neutral and is based on open interfaces. The driver behind the experimental project is the prospects of transport services for both public and private sector. (Traffic Lab: Building Blocks for Mobility as a Service; Traffic Lab 2014a.)

Also public transport has developed and ICT is more and more employed to increase its' attractiveness and to create new services. A Finnish state-of-the-art example is demand-based public transport service called KutsuPlus, which offers seamless stop to stop travel with minibuses. Kutsuplus, provided by HRT, operates in greater Helsinki area within Ring Road I. The backbone of service is software and mobile application that allows people going in the same direction at the same time travel

together. Rides can be booked via online or via text message and are paid with mobile wallet. (HRT KutsuPlus) Globally, probably the most well-know new transport service is Uber, “taxi-app” that enables anyone with car to offer travel service via application. The service was launched in Finland at the end of 2014, making Helsinki one of 230 cities where service is available. Uber operates two services, of which Uber Black is more high-end product, while Uber POP is aimed for price conscious customers. As taxi services are relatively regulated in Finland (and in some other European countries as well) also the legality of Uber services has been questioned. (Saarinen 2014) In March 2014 Suomen Taksiliitto (Finnish Taxi union) demanded law enforcers to intervene illegal taxi services (Uber was not addressed by name). (Suomen Taksiliiton lausunto 18.3.2015)

## 3.4 Mobility as a Service

This subchapter discusses the MaaS as a solution for above-mentioned challenges. The concept is presented with examples, as well as market opportunities are considered.

### 3.4.1 The concept

The concept of MaaS is relatively simple, yet revolutionary: bundling different transport means, public and private, into one easy-to-use package for customer. The service is provided to customer via mobile applications and also payment, as well as sharing the costs, are handled via digital wallet. Heikkilä (2014) defined MaaS as a system, in which, a comprehensive range of mobility services are provided to customers by mobility operators. These mobility operators are companies that buy mobility services (i.e. transport like public transport, taxi, car sharing, bicycle etc.) from service providers, and combine them for customer services. (Heikkilä 2014, 8.) However, MaaS is not just an app, it’s a shift towards consuming mobility as a service, which breaks traditional paradigms of owning a car, or buying trips with traditional point-to-point way.

The development of mobility as a service has been fostered by a new way of thinking. According this trend, traffic and mobility are not anymore considered as isolated functions but these have become more and more linked to society, services, and economy. At the same time, the world is modernizing along with technological developments, as well as phenomena called servicizing. Servicizing as a phenomena refers situation where end-users and customers receive the outcome of certain action instead of organizing it. In other worlds this mean that people are buying more services rather than producing actions themselves. Some examples of this include for

example home cleaning services (instead of cleaning yourself) and restaurants (instead of preparing the food yourself). (Heikkilä 2014, 10-11; Hietanen 2014, 2.)

A good example of new services can be found also in transport sector. Freight transport or logistics has experienced servicizing many years ago. Many of logistics companies refer themselves as Logistics Service Provider (LSP), meaning that their main business is to sell comprehensive freight transport services to customers, not necessarily by producing these themselves but by combining the services of transport companies. In global scale the market of logistics services are a huge business. It was estimated that in Europe only, the annual total expenses on logistics services in 2010 was 930 billion euros. (Rantasila 2013, 69) In Finland, the logistics costs of companies totaled 33.1 billion euros in 2011, which was 12.1 % of their turnover (Rantasila 2013, 176).

MaaS is also based on more efficient utilization of resources. Great examples of this include car sharing, ride sharing and bicycle sharing activities. Currently, these, as well as public transportation, are isolated functions, which has had impact on their success. (Heikkilä 2014, 11.) MaaS operator is tackling this problem by providing a service that handles individual mobility requirements with high service quality without owning a private car (Hietanen 2014, 2).

The most important enablers of MaaS are digitalization and ICT. The wave of digitalization has not yet to hit transport industry but is soon to do that. One domain where digitalization has already realized in field of transport is aviation where passenger can seamlessly combine different routes and options for the journey. Yet the land surface transport to airport must be bought separately. Other domain where digitalization has resulted huge changes is telecommunication sector where different operators cooperate in order to provide seamless user experience and services in different countries in an easy-to-use and standardized way. As a part of digitalization development, also a technology and especially ICT has taken giant leaps in recent years. Development of telecommunication and mobile devices has started also a march of new applications. Mobile devices allow people to access information anywhere, and among other, the real time traffic information has been introduced to handhold devices. Internet has changed the way information is shared and has facilitated the improvement of processes. Initiatives like Internet of Things (Iot) enables all to connect and communicate with each other objects, (ten Hompel 2014) while in field of transport autonomous driving is gaining ground. (Hietanen 2014, 2-4; Heikkilä 2014, 31-32.)

The same way the digitalization and servicizing is changing our world, the MaaS provides a mobility distribution model that meets customer’s transportation needs with a common interface. The services can be bundled into a mobility packages that can be compared to telecom and internet use packages. MaaS vision sees the whole

transport sector as a cooperative and interconnected system that fulfils customer's mobility needs by new kind of ecosystem of mobility operators and service providers. Benefits for the user include developed, personalized transport information and payment services, with respect user's needs and seamless solutions. (Hietanen 2014, 3-4.) Next subchapter will present a concrete example how MaaS could work in practice.

### 3.4.2 Example of MaaS

This subchapter provides a concrete example of MaaS concept. It must be stated that examples discussed are fictional and are only one potential way of realizing the concept. However, the idea background the MaaS concept is meet the user's mobility needs in a new way. Figure 11 presents four different "MaaS packages that are designed to different customer segments.


Figure 11 Example of MaaS service package (Traffic Lab: Building Blocks for Mobility as a Service)

The package presented in upper left corner, Urban commuter package, is designed for people who mainly commuter in the home city area but also need taxi and rental car once in a while to go beyond areas served by public transport. Some domestic public transport is also included to package to make inter-city journeys. A typical user of this kind of package would be person who is living in urban are with good connections and not necessarily have a large family.

Second package, a 15-minutes package, is for person who appreciates short response time of taxis and also travels abroad some times per month. The core of transportation in the home city is public transport, as well as domestic journeys are included. However, the person want's one on a wild be served by taxi.

Business world package is for those people who travel a lot, want flexibility, and can't be served by public transport timetables. Free taxi in home city, with taxi roaming globally and a possibility for a lease car is included to package.

Finally the family package is for those families that require a car but also unlimited public transport within home town for all, topped up with limited domestic public transport. Also a taxi service is included to package.

### 3.4.3 Benefits of MaaS

The potential benefits of ITS and MaaS can be scrutinized from different perspectives. Usually cost benefits and savings are mentioned first. Even though the increased efficiency and cost savings are important to different stakeholders, ITS and MaaS should also be seen as an opportunity and enabler, not only as a cost or a function with a value of its own. (VTT 2014.)

Whereas public sector should be able to find provide improved services with less money, individual transport users experience value of better services and more user-friendly services. From users' perspective benefit of MaaS include developed, personalized, and improved mobility services that provide improved user-experience (e.g. seamless, easiness to use). For a public sector some of the potential benefits include full utilization of ITS systems, increased efficiency of transport system (including infrastructure and services) and thus better allocation of services. Well-functioning transport system also promotes better living environment and new business. Finally, companies can find new markets and business opportunities with transport service markets (Hietanen 2014, 3.)

The magnitude of potential business at ITS products and services has been recognised and many results indicate significant growth projections for the ITS markets and transport service sector as a whole. Not many figures on these markets are yet available but some studies have reported that Finnish ITS industry had around 1700 employees with markets of approximately € 300 million in 2010. Tre trend has indicated that it has been characteristic for the markets that rapidly growing firms have been doing well whereas the weakest performers seem to have experienced a declining trend. (Rantasila, Hautala, Lankinen, Lankinen 2014, 4.)

# Chapter 4 — Perspectives on MaaS in the context of land use

Based on the review of identified extant research on MaaS and land use, this chapter provides main suggestions of interfaces between MaaS and land use and maps the possible impacts of MaaS on land use. First, the links between these concepts is scrutinized in order to enhance understanding on what could be the main subjects where impacts can be presumed to exists. Furthermore these impacts are discussed in second sub chapter.

## 4.1 The interfaces of MaaS and land use

The concept of Maas is currently evolving and it is rather uncertain how the development will continue and in what time window. On the other hand, the timespan is relatively long considering the land use as well as processes are well-established. The latter one is also due to strong legislative background.

The interfaces between these two can be divided between two main categories: 1) macro scale policy goals and 2) operative level planning. First one, the policy objectives are related to national level planning, grand challenges and legislation work. Operative level includes practical actions in land use processes and development of MaaS (in context of technological, social, and business aspects).

Land use sets the guidelines to the use of the particular area including restrictions, and building guidelines. Also transport sector is relatively heavily regulated in Finland, especially in context of passenger transport. The goals of legislation are grounded to meta-goals of society in a broader scale (e.g. Land Use and Building Act (132/1999) aims creating a healthy, safe and comfortable living environment that fulfils society's needs, while transport related legislation promotes safe and efficient transport system). There is a clear interface between the MaaS and land use in preparation of legislation in ministerial cooperation. This interface covers, in addition to legislation work, the whole set of cooperation in different practical initiatives. For example if Ministry of Transport wants to promote MaaS they need to make sure that this is in line with work of Ministry of Environment.

Also megatrends like growing population and aging are promoting new transport services. Urbanization and population growth should provide needed mass to achieve economies of scale for new transport services. This further emphasizes the need for discussion between land use planning and providers of mobility as concentration or scarcity of population may cause possibilities or pressures for service providers. On

the other hand aging of population supplies new users for services, among which also MaaS can be.

In operational level these interfaces can be found from crass root work. Developing transport system requires experts from both sides, like for example transport infrastructure is heavily related to land use but also more and more to steering transport flows, creating new services, and enabling people mobility in general. People, private sector, public sector are all in a key role on developing transport system and better mobility. This is why the system must be developed as a whole and jointly.

## 4.2 Possible impacts of MaaS on land use

Starting from the top, it can be expected that need for cooperation between ministries and authorities should remain closely, in order to transport system to cope with new concepts like MaaS. Evolution of MaaS could also provide more options for steering land use with respect of meta-goals of the Ministry.

From environmental perspective it can be assumed that MaaS contributes to greener transport as vehicles are used more efficiently and also investments to new technology can be made (e.g. automated vehicles and newer cars). Also public transport and better utilization of greener transport modes contribute to green transport.

From infrastructure perspective MaaS may help reducing resources needed to maintain and development of the transport infrastructure. This is mainly due to the more efficient transport services and utilization of different transport modes in combination. MaaS does not necessary decrease the traffic volume but this can be organized the way it does not wear out that much infra.

MaaS could have impact on land use in both urban and rural areas, although these impacts may have some difference. While in urban areas MaaS may improve the quality and efficiency of transport system, in rural areas it may facilitate the possibilities of people to have more responsive transport services and thus contribute the livelihood of these areas with less cost.

Also public transport could increase its attractiveness as a results of introduction of MaaS. This creates more options but also increases the need for cooperation between land use planners and transport planners. Public transport steers people flows and generates hubs. These hubs, like stations etc., attracts services and thus the successful development of these nodal points require cooperation between local and regional

planning authorities. In large scale, these hubs can change people flows and thus have impact on planning land use concerning both residential and industrial zones.

It can be assumed that, new service like MaaS will increase the efficiency of current transport system, as well as introduction of sharing economy, should decrease on number of private cars, which currently is less than 3 million in Finland. This together with automation of transport could facilitate avoiding congestion in urban areas and thus promote better society as a whole. The need for less parking spaces and infrastructure in general has also impact on land use as it frees space for other things. This vacant space must be utilized in new functions, which has direct link to land use.

Above mentioned impacts of MaaS on land use are some possible examples but the list is not exhaustive. In following chapter, the impacts are studied by interviewing the experts of MaaS and land use. Interviews are conducted as open interviews, meaning that these assumed impacts are not discussed in beforehand.

# Chapter 5 — Experts' view on plausible impacts of MaaS on land use

This chapter presents the outcomes of expert interviews (empirical evidences). As discussed earlier, the technique known as future wheel is utilized in interviews. Also the results are illustrated here with future wheels, first in context of land use experts and then in context of MaaS experts. As persons are interviewed anonymously, no names or titles are disclosed, yet a general description of organization and experts' background are provided.

In general, all interviewees considerate discussion like interview suitable for studying the phenomena. In addition it was stated that the interview was useful themselves to see new links between phenomena outside their own expertise. According some interviewees the interview also facilitated their work from outside box perspective.

## 5.1 Land use perspectives

### 5.1.1 Ministry of the Environment

The responsibility of the Ministry of the Environment is to prepare matters for legislation process concerning communities, the built environment, housing, biodiversity, sustainable use of natural resources and environmental protection. Further it aims securing sustainable development, create a good living environment and promote biodiversity and sustainability. The Ministry of the Environment is steered by the Minister of the Environment and the Minister of Housing and Communications. Ministry's responsibilities include, within its administrative sector, strategic planning, steering and resources, drafting legislation, and internationality and cooperation. (Ministry of Environment 2014d.)

The interview took place in October 2014 with a senior expert, specialized in built environment and land use. This expert also had some background in the field of transport but concept of MaaS was explained at the beginning of the interview.

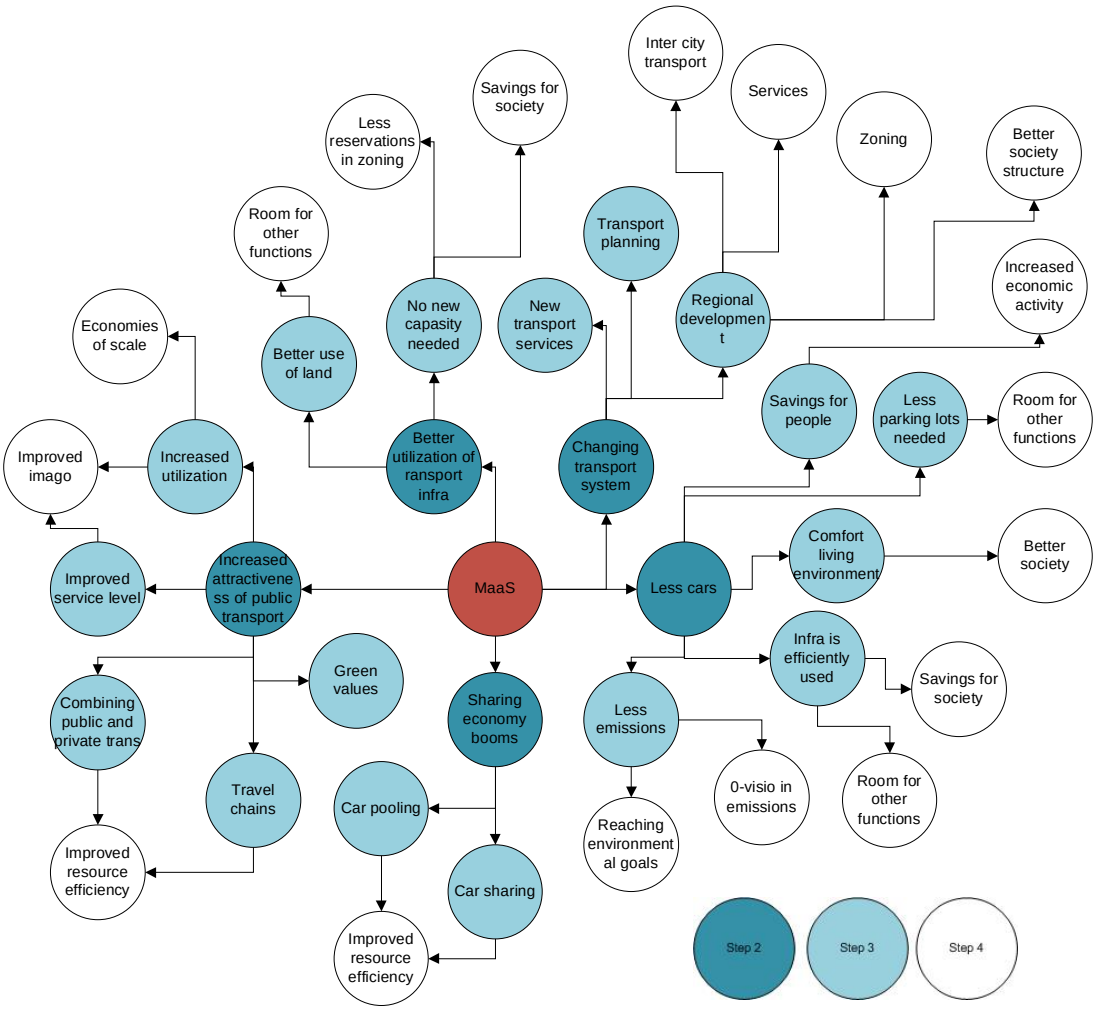


Figure 12 Plausible impacts of MaaS on land use (Ministry of Environment)

First level impacts of MaaS in context of land use are related to built environment (i.e. transport infrastructure), impacts on transport system (including the system as a whole, as well as to private and public transport), and the sharing of assets.

From the perspective of infrastructure, the Ministry addressed the impacts on more efficient land use and adequacy of current capacity. From Ministry's point of view the impact of less needed infra is contributing their land use steering as more land will be available to other activities and less reservations are needed for transport infrastructure.

In regional development level MaaS may contribute not only zoning but also broader aspects like structure of society and availability services. On the other hand, the transport system must secure adequate services for all and people must be able to commuter between jobs and home. Facilitating public transport is in high priority in Ministry's agenda and MaaS can support these actions. The interface of MaaS and public transport is important for increased utilization rates, efficiency and better

service level. The goals can also be achieved by combining public and private transport to more resilient supply chains, which again improves the efficiency and attractiveness (including imago) of more ecological transport.

Highly relevant to MaaS, the movement towards sharing economy was also brought up by in the interview. The impact of land use comes from more efficient use of resources, like car sharing (many users for one car) and car pools (many people in same car) in this case.

Finally, the decreasing number of private cars due to the MaaS was discussed. Less cars has direct link to money used for transport, which further frees more money to other consumption and investments. From land use perspective it is particularly interesting if the number of cars decrease and thus also less parking spaces are need (direct impact on land use/zoning). This vacant space can be used to other functions. It is also evident that less cars means less emissions and hence MaaS facilitates meeting the environmental goals. The impact of decreased number of cars also decreases the pressure for infra investments and maintenance and thus makes more resources available for other things. As the comfort living environment is one of the goals of Ministry of Environment, concepts like MaaS provide interesting option to achieve these goals.

To conclude, it was addressed in interview that the increased resource efficiency facilitates the goals of the Ministry of Environment in land use. Novel transport concepts like MaaS can have direct impact on increased efficiency and better society. Transport system must be seen as a whole, starting from the needs of people to move, which can be fulfilled with public and private transport means. Especially in case of infra and private cars, MaaS can provide some savings and efficiency improvements that enable more liberties to land use as well. Finally evolving MaaS may support the environmental friendly options in together with enhanced land use choices.

### 5.1.2 Finnish Transport Agency

The Finnish Transport Agency (FTA) is in charge of enabling smooth, efficient and safe travel and transport. From its establishment the agency has been responsible for roads, railways and waterways and for the overall development of transport system in Finland. The goal is to promote effective transport system, traffic safety and a sustainable development of the regions. In this context the agency is working closely with land use from traffic perspective. The agency operates under the jurisdiction of the Ministry of Transport and Communications with varying tasks from operative traffic control to administration. The main responsibilities are (Finnish Transport Agency 2014b):

- to maintain and develop the traffic system jointly with the other actors in the field;
- to maintain the government's road and rail networks as well as the waterways under our control and to consolidate measures directed at them and directing and supervising waterways maintenance all over the country;
- to implement vital road projects and to plan, design, maintain and construct railroads and waterways;
- to direct the road maintenance operations of the regional centres for economic development, transport and the environment;
- to participate in reconciling traffic and land use;
- to control and develop traffic management in the government's traffic lanes and in the waterways;
- to ensure winter navigation;
- to develop and promote transport services and the functioning of the markets for them;
- to improve the performance of transport infrastructure management;
- to develop the operational preconditions for public transport and to grant maritime subsidies and subsidies for the other transport modes;
- to update and develop hydrography;
- to safeguard that the transport system is working also under abnormal conditions and in exceptional situations under normal conditions.

As the agency employs over 600 experts, there is a broad knowledge in field of MaaS and land use. Thus, the interview was conducted as a group interview with two specialists of intelligent transport systems and one expert of land use (architect). The interview took place on November 2014 and included a brief by interviewer to both MaaS and land use in Finland.

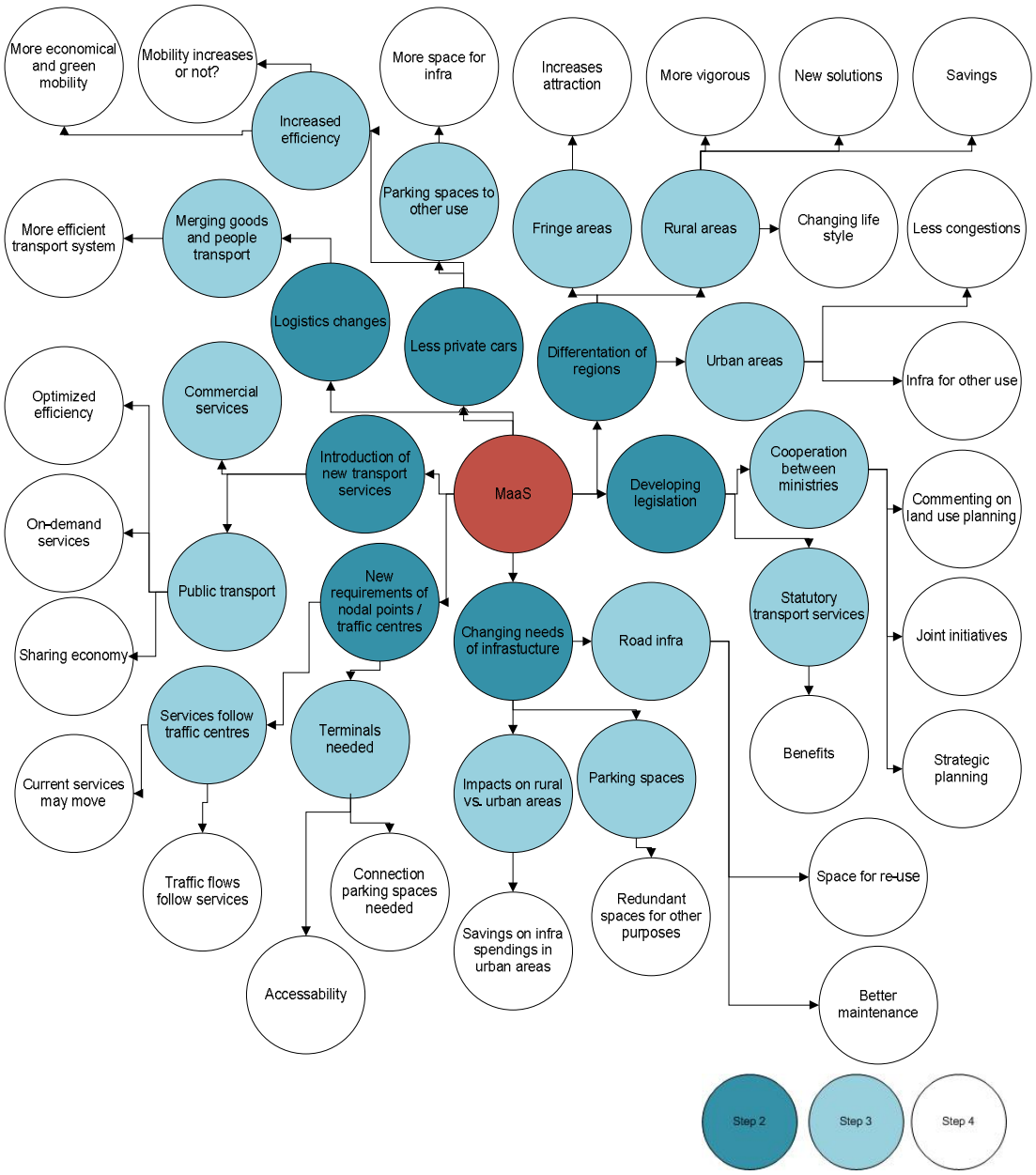


Figure 13 Plausible impacts of MaaS on land use (Finnish Transport Agency)

During the interview of Finnish Transport Agency (FTA) experts, several aspects from both regional planning and transport system point of view were discussed. From regional perspective, the impact of MaaS is related to urban areas, where MaaS can contribute to less congestions and more efficient use of transport infrastructure. In case of fringe areas, novel transport concepts can increase the attractiveness of area, whereas in rural areas can become more vigorous with better transport solutions.

Also the impact of MaaS on number of private cars and thus to land use was pointed out. For example the unnecessary parking spaces can be used for other purposes like

infra or buildings, while increased efficiency contributes the environmental friendliness. It was also pointed out that mobility does not necessarily decrease but may also be increased as a result of better services.

MaaS as a initiator of new transport services may result more options in both public and private transport services. Especially in case of public services, it can be presumed that on-demand based services will increase in future with boost of sharing economy. In case of land use, traffic and people flows meet in nodal points of traffic. It needs to be taken into account that services follow these flows and concentrate on these nodal points, which may cause the changes in current service structure in some areas. This again has an impact on land use. Furthermore, when it comes to nodal points of transport, new services may require terminals and other facilities that must be fitted to other land use purposes.

When it comes to actual infrastructure it should be kept in mind that road infrastructure is not the only one in which MaaS may have impact from land use perspective but also for example parking spaces could have some re-use if more efficiency is achieved. Also the differences between the impacts on rural and urban infra are assumed to be different and at the first place these will be realized in urban areas.

Both transport system and land use are heavily linked to legislation. Hence the cooperation of ministries (namely the Ministry of Transport and Communications and the Ministry of Environment) is playing a major part in this equation. From FTA's perspective the major tool in this legislation work is possibility to comment on land use legislation from transport system's point of view and vice versa. These ministries also cooperate in joint-initiatives and strategic planning, which also involves FTA's expertise.

Finally, plausible impacts on logistics was addressed as a one vital part of transport system. Emerging services in people and goods transport can increase the efficiency of the transport system as a whole significantly. Concepts like MaaS could open new ways of combining these flows and thus improve well-being especially in rural areas.

As an conclusion, it was stated that the impacts of MaaS from land use perspective differ between areas (urban, rural, fringe), and at the first place the impacts and possibilities are realized in urban area. On the other hand MaaS might increase the attractiveness of rural areas. Less cars does not necessarily equal less traffic volume, yet this does not necessarily have significant impact on main road infra as this is more related to external circumstances (vice versa in cities). In case there will be a significant decrease in number of private vehicles, this can free current road infra and parking spaces for other uses. Public transport, sharing economy, new and combined services, as well as nodal points of transport should give serious consideration from

planning purposes, keeping in mind these new services. In general, the time aspect must be considered as technology develops significantly more rapidly compared to timespan of land use. One of the questions remain as it is not clear whether MaaS decrease the mobility or increase it, and in which scale. However, it was agreed that MaaS is one of the key factors in making rural areas transport systems efficient and this has certainly some reflections to land use that should already be considered in cooperation between different authorities.

### 5.1.3 Centre for Economic Development, Transport and the Environment

The responsibility of Centres for Economic Development, Transport and the Environment (ELY Centres) covers the regional implementation and development aspects. These 15 ELY Centres in Finland are steered by the central government, under the administrative branch of the Ministry of Employment and the Economy. ELY Centres are dealing with tasks coming under the various administrative branches of the Ministry of the Environment, Ministry of Transport and Communications, Ministry of Agriculture and Forestry, Ministry of Education and Culture and Ministry of the Interior. The purpose of ELY Centres is to support and promote regional competitiveness, well-being and sustainable development and curbing climate change. One of the three areas of responsibility is related to transport and infrastructure, others being business and industry, labour force, competence and cultural activities, environment and natural resources.

The interview took place in December 2014 with expert of ELY Centre Uusimaa, located in Helsinki. This particular ELY Centre deal with all three areas of responsibility mentioned above. The interviewed person was expert in transport system but the concept of MaaS was quickly revised with land use guidelines in Finland.

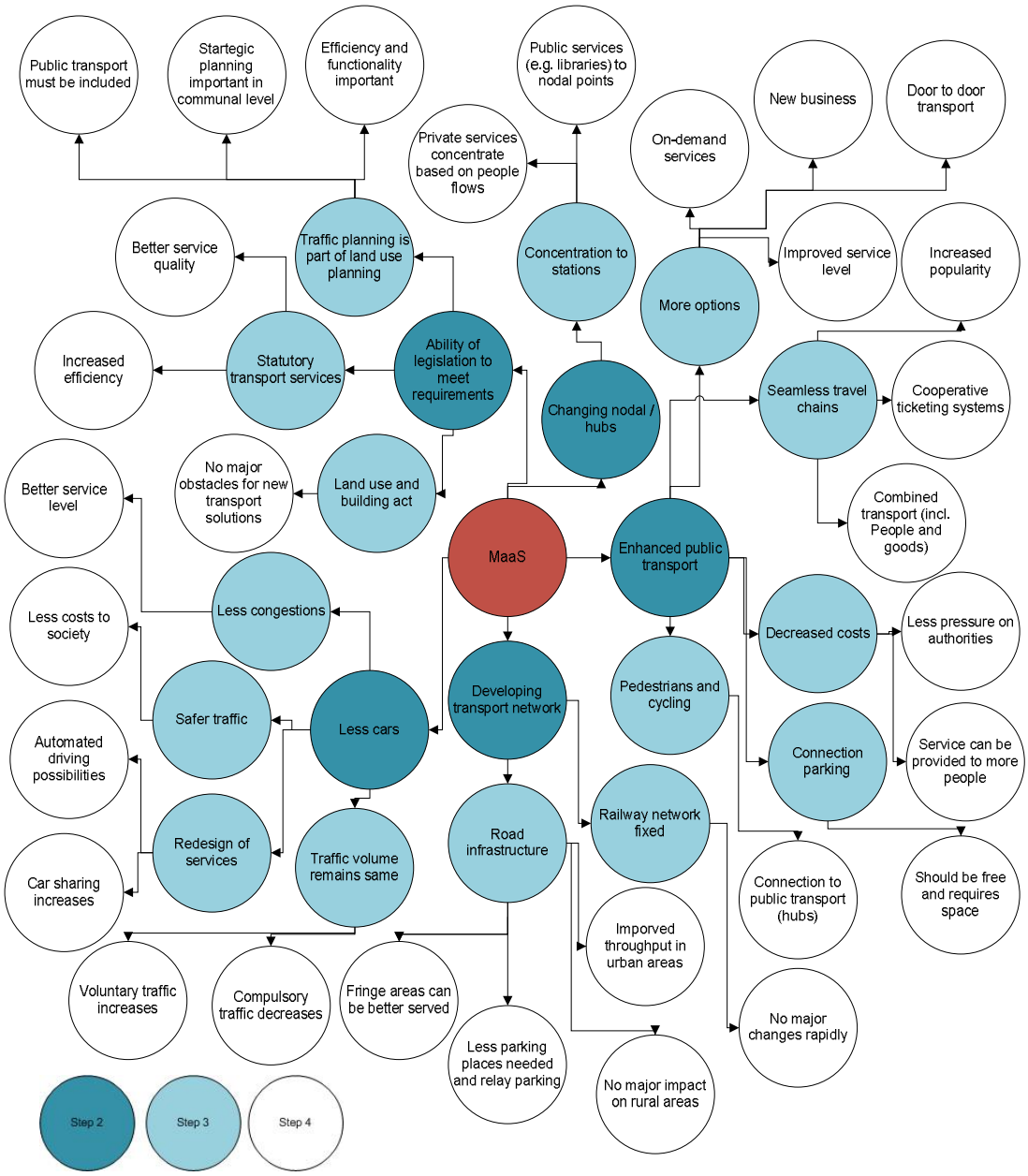


Figure 14 Plausible impacts of MaaS on land use (Centre for Economic Development, Transport and the Environment)

First level impacts identified by the interviewee of ELY Centre were related to enhanced public transport, transport network, changing hubs/nodal points, legislation issues, and declining number of private cars. These were generally in line with other experts.

As public transport is one of major responsibilities for ELY Centres, it was foreseen that new transport concepts like MaaS could bring more options to people, which further can generate improved services, new business, and new service concepts like door-to-door and on-demand. From land use perspective this development improves the living environment especially in rural areas and thus provides more tools for land

use planners. As costs are a major concern for ELYs, enhanced public transport can help on decreasing these, relieving the pressure of authorities in this field, yet making services available to more people in different areas. Public transport is not only mass transit but also cycling and pedestrians must be considered, as well as connection-parking facilities must be established. These must be considered in land use as they should be planned as integral part of transport system and must be linked to each other.

When considering transport network as a whole from land use perspective, it must be identified that there are at least two main types of networks: fixed (rail) and evolving (road). This should not be understood the way that road network is not relatively fixed but there are little bit more room for alternatives compared to rails. MaaS can provide better road service level in fringe areas, as well as it may increase the network throughput in urban areas. Considering the railway network, not rapid developments are foreseen, but this must be taken into account in land use via hubs etc. It was also pointed out that hubs and other traffic nodal points are subject to change. From land use perspective, it already have to be considered that services and traffic will be more and more concentrating to these nodal points (e.g. stations). Interestingly, the interviewee pointed out that public services should be also relocated to stations, alongside with private services, as the latter ones cannot alone guarantee the attractiveness.

It was also identified that development of MaaS may result the decrease in number of private cars. The history has shown, however, that traffic volumes should remaine the same, even the compulsory traffic decreases as voluntary traffic should increase. Less cars also result redesign of services. Some examples of this also exists as car sharing has evolved. In future also automated vehicles must be taken into account in land use as these pose some requirements for transport infrastructure and built environment (e.g. terminals). Less cars also contributes to safer traffic (which further cuts the society's expenses), as well as it reduces congestions. This provides some possibilities for land use as transport system can better cope with volumes.

Finally the legislation aspects of MaaS on land use were discussed. Land Use and Building Act, as the most important piece of legislation in this context, was not considered to pose any major obstacles to fully employ the possibilities of MaaS. Land use is very much related to the vitality of areas, the aspects of statutory transport services were addressed. These are defined in legislation and could benefit on MaaS in context of better efficiency (less costs) yet improved quality. The major thing is also how transport planning and land use cooperate. According the interviewee the main thing is to include public transport to land use, to have strategic planning in communal level, and to cooperate between different branches in order to ensure the efficiency and functionality of services.

In general the plausible impacts identified by the interviewee were related to public transport, transport network, legislation issues, and declining number of private cars. For public transport MaaS could bring more options to people and authorities, facilitating services, new business, and new service concepts with greater efficiency. Impacts on transport network must be seen as a whole, covering changing needs of hubs, people and different areas. The decrease in number of private cars not necessarily decrease traffic volumes, posing some challenges on land use system to cope with. Finally it was stated that the Land Use and Building Act, does not pose any major obstacles to fully employ the possibilities of MaaS, yet the cooperation between different branches is required.

### 5.1.4 Finnish Environment Institute

The Finnish Environment Institute (SYKE) is serving as a research organization and a centre for environmental expertise. SYKE is part of Finland's national environmental administration, operating under the auspices of the Ministry of the Environment. SYKE currently employs more than 700 professionals, of which around 500 of them in research and expert operations. SYKE’s expertise and extensive cooperation provide valuable new information on sustainable development questions in the local and global scale. (SYKE 2014)

Interview took place in December 2014 with expert of land use. As the expert was not familiar with current transport developments, the MaaS was explained in the beginning of the interview.

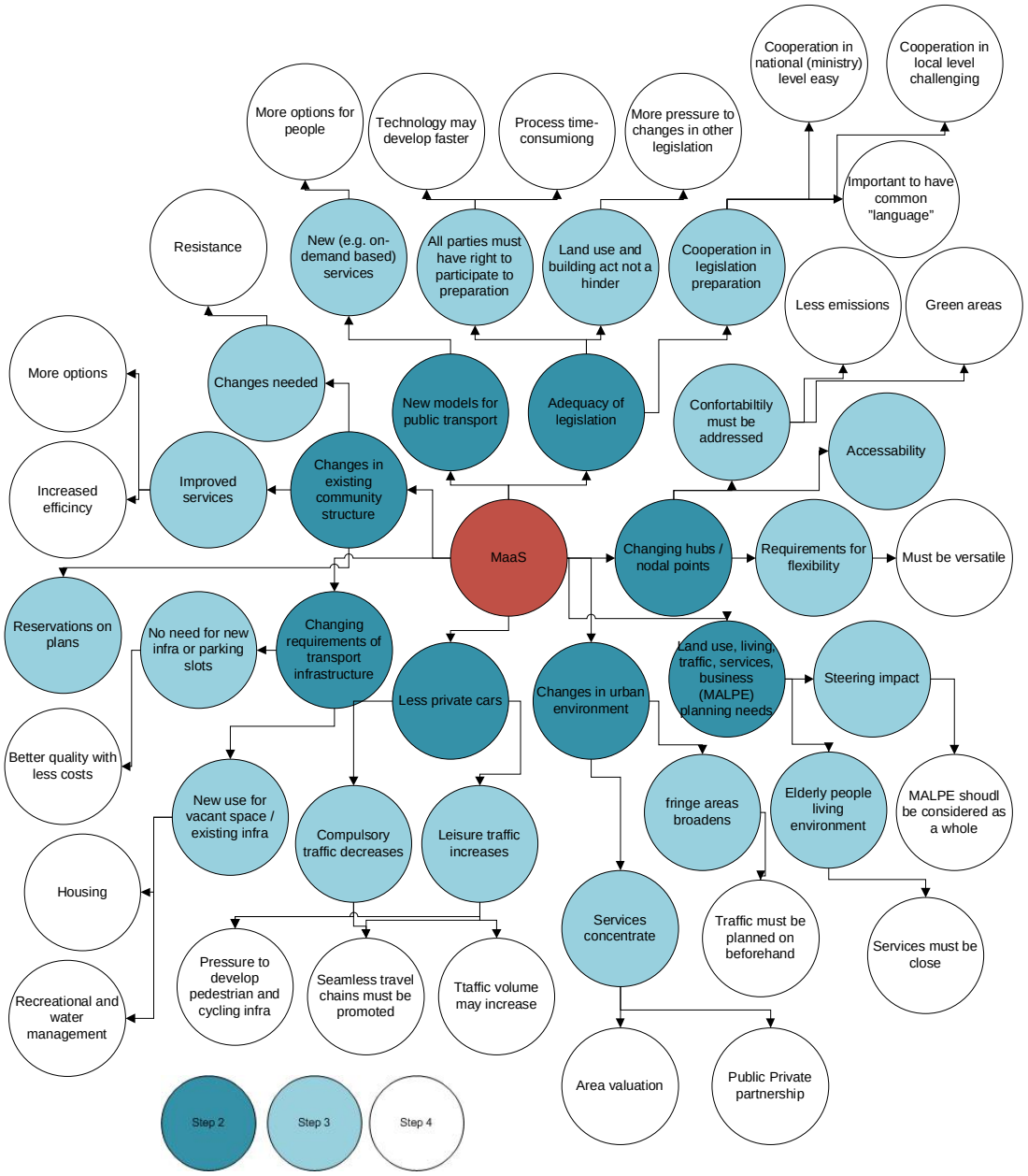


Figure 15 Plausible impacts of MaaS on land use (Finnish Environmental Institute)

The first plausible impacts identified by representative of SYKE were changing transport hubs, transport infrastructure and urban environment, impacts on MALPE (Land use, living, traffic, services, business) planning, decreasing number of private cars, and public transport systems. In addition, the existing community structure and legislation were subjects of potential change.

Changing hubs / nodal points and community structure should be taken into account to land use from several perspectives. Communities are changing as needs to people change and services are improving. This generates more possibilities and increases efficiency. In future transport hubs / nodal points require better flexibility and are more versatile. Accessibility is increasingly important and should be addressed in

land use with increased comfort of areas (e.g. green areas and less emission). In this development, MaaS can help and should be utilized as one mean of achieving these goals. It should be also kept in mind that some resistance may evolve.

MALPE planning was addressed as a one essential tool for steer land adaptation of new transport concepts in land use. This promotes the consideration of transport and planning system as a whole. One specific case is increasing number of senior people that have different requirements for their living environment and services. In this picture MaaS can have major contribution.

When considering MaaS and urban environment, the change of areal diversification and services must be identified. Fringe areas may broaden as a result of new transport concepts as people have more options. At the same time it can be assumed that services concentrate, that has impact for example on area valuations. Since the transport system is maintained by public sector and services are mainly produced by private sector, a public private partnership (PPP) is key for efficient society.

One of the recognized plausible impacts of MaaS was decreasing number of private cars. The mobility was divide between leisure and compulsory movement, of which the first one should increase, while latter one was predicted to decrease as a result of MaaS. In general, the total traffic volume may eventually increase and demand for travel chain (door-to-door transport) approach increases. This trend of increasing traffic volumes must be identified in land use on beforehand. Also the fact, that people reduce their compulsory traffic, but increase their voluntary traffic, can change the traffic patterns and flows.

The plausible impact of MaaS also includes changes for transport infrastructure. It can be assumed that some infra becomes vacant and available for new use. New use could include housing and recreational functions but has also links to the water management aspects.

Public transport has and legislation direct links to MaaS and land use. The main goal of public transport is to serve people in efficient manner, and thus new concepts like on-demand transport can provide more alternatives and tools for land use as well. When considering the legislation perspectives, the cooperation between different branches must be close. According to interviewee, the national level (ministry level) cooperation is close but in communal level, some improvements could be fruitful. Land Use and Building act was not considered as major obstacle for new transport concepts, yet it must be realized that time-spans of these two are different and thus both aspects should continuously reviewed.

To conclude, plausible major impacts were seen number of cars, transport infrastructure, hubs, legislation and public transport. From legislation and planning

perspectives the cooperation was considered very important. The total traffic volume was expected to even increase, and as time-spans of development between land use and technology are significantly different, changing needs in hubs and communes must be already considered. Decreasing number of private cars frees some space for other functions that must be considered from areal perspective.

## 5.2MaaS perspectives

### 5.2.1 Traffic Safety Agency

Finnish Traffic Safety Agency  Trafi develops the safety of the transport system covering all modes of transport from surface transport to aviation. Trafi also promotes environmentally friendly transport solutions and is responsible for transport system regulatory duties. In practice Trafi issues traffic permits, prepares legal rules for transport sector, takes care of sector's taxation and registration, oversees the transport market, and facilitates opportunities for the development of ITS. Finally, Trafi informs the public of transport-related choices. (Trafi – about) Trafi has several duties related to development of new transport concepts from enabling and regulating perspectives. As Trafi is steered by the Ministry of Transport and Communication, it has also direct relationship with legislation. (Traffic 2014)

Interview was conducted in November 2014 with person working in an expert in the field of intelligent transport systems. Interviewed person was not an expert of land use but ITS and owns several years of experience in transport systems and services development. Finnish land use process was introduced at a glance in the beginning of the interview.


Figure 16 Plausible impacts of MaaS on land use (Traffic Safety Agency)

In the interview of Traffic Safety Agency legislation issues were on of the first level impacts that was discussed. MaaS, as a novel concept, may have some impact on legislation and vice versa. The cooperation between ministries and thus to land use was addressed. Also it was stated that legislation should be enabling not preventing.

MaaS definitely has impact on national transport system in context of infrastructure (current and future), transport flows (commuter traffic etc.), as well as business opportunities. These are also the kind of things, which pose some requirements and possibilities to land use. The same goes to automation and decreasing number of vehicles, which free some space for other activities but at the same time require some new facilities like terminals for shared and automated cars.

Public transport is one of the key enablers of MaaS and in this context it should seamlessly combine all transport modes. These new service could include such as depots, park-and-ride, new transport hubs. All of these new services require designated areas and thus land use should take these into account in long medium and long term plans.

One of the key features of Finnish transport planning are piloting projects that bring these new concepts to real environment. Interesting enough, these can have some real contribution on land use as these provide lot of vital information in existing and new areas that can be developed accordingly the needs of new transport concepts. At the same time different land use and zoning possibilities can be tested in real environment.

Overall, when people are more satisfied with services it can be assumed that mobility activity will grow and that has impact on whole society. Land use does not change directly due to the MaaS but rather new needs and increased mobility have created a need for MaaS. At the same time new phenomena like automated vehicles and improved public transport make new transport concepts more attractive. These all change the patterns of mobility that should be considered in land use the way all activities support each other.

### 5.2.2 Tekes – the Finnish Funding Agency for Innovation

Tekes, the Finnish Funding Agency for Innovation, is expert organisation that finances research, development and innovation in Finland with public funding-base. The goal of Tekes is to boost wide-ranging innovation activities in research communities, industry and service sectors in field of technological breakthroughs, as well as service-related, design, business, and social innovations. Each year Tekes finances around 1 500 business R&D projects plus, in addition which almost 600 public research projects get funding. (Tekes 2014a) Tekes also has “Mobility as a Service -joint programme” which aims at enabling free, seamless and efficient flow of information, goods and people. Tekes’ role is especially to activate companies (start-ups and existing ones) to develope new kind of products and services for traffic and logistics, and also be a catalyst for international companies to base Finland to develop and test their solutions. (Tekes 2014b)

Interview with Tekes expert took place on November 2014. The expert in question has outstanding experience in enabling new services and strategic innovations in context of transport, smart cities and ecosystems. At the beginning of the interview the scope of Finnish land use process was briefly introduced in the scope of the research.


Figure 17 Plausible impacts of MaaS on land use (Tekes)

As a first impacts of MaaS that may generate changes in the operating environment of land use include increased use of public transport and digital services, changes in mobility patterns, increased fluency of transport, less number of private cars, as well as level of automation in transport. Increased use of public transport further creates better mobility for all people regardless the ownership of car, as well as it promotes new operational models, which finally removes the silos between modes and creates demand for on-demand based transport services. In addition, increased door-to-door type of services should grow in future. These all should be considered in land use as they may have significant impact on mobility of people and thus to the structure of society.

Digitalization is major enabler of new services and seamless transport chains. Information enables more options for people and make services (instead of owning) the car more attractive. This also enables better mobility in rural areas. Digitalization also facilitates utilization of home delivery of services that increases their availability outside urban areas as well. On the other hand, when mobility services are more efficient, people have more time for other things that may eventually increase mobility volumes. Land use should consider the impacts of changing people and goods flows to people choises to living place etc.

MaaS and even current public transport system is based on hubs and nodal points. This development makes also services to follow traffic flows and to concentrate on hubs. This may cause the declined service level in some current active areas, as well as current transport infra may experience pressure to cope with changes (re-engineering). This is not necessary a problem but should be identified and prepared to already in land use.

It was also pointed out that it is expected that the number of private cars may reduce as an impact of MaaS. This contributes to current infra and may also free some areas (e.g. parking places) vacant for other uses in land use. However, as if sharing economy starts to boom, vehicles still need terminals and it's the task of land use to make this reality.

When considering MaaS, it is not only about new services but rather a change in current mobility paradigm. This causes changes in mobility patterns of people and provides better mobility for all people. As a results a mobility activeness may increase but also rural areas become more attractive. In addition, goods and people transport should experience more cooperation, making the system more efficient in all areas. This should be taken into account when land use is considered from people mobility patterns perspective.

Automated driving is one evolving technology solution that is also linked to MaaS. This creates more efficient use of resources but it also should be considered that this infrastructure also need terminals etc. that should be included to land use. Automated driving also enables sharing of cars, which would decrease the number of cars, and thus have impact on needed infrastructure.

To conclude, a broader view to MaaS was discussed from perspectives of changing mobility patterns of people and possibilities of digitalization. These both enable new ways of providing better services with more efficiently way. From land use perspective this development should be considered as one of the drivers of tomorrows traffic flows and peoples' decisions concerning living environment. At the same time, MaaS facilitates mobility in both rural and urban areas, and as a matter a fact should increase the mobility. Seamless travel chains, covering all modes

of transport, will dissemble the silo-like structure between different transport modes and automation makes mobility even more resilient. Finally, MaaS may also change the traffic flows, addressing the importance of land use related to needed terminals and transport nodal points that attract services. In addition, it seems evident that new use needs to be designed for those areas that will not more needed for transport infrastructure as number of private cars decline.

### 5.2.3 Ministry of transport and communication

Ministry of transport and communication has in charge of effective transport and communications systems in Finland. In field of transport, Ministry's main responsibilities cover transport systems and networks, transport of people and goods, traffic safety, as well as issues relating to climate and the environment. The main tool of the Ministry is transport and policy which goal is to provide people with opportunities for safe and smooth everyday travel, to maintain the competitiveness of businesses and to mitigate climate change by reducing emissions. Ministry is also the legislative authority in the transport sector with responsibilities of cooperation within European Union (EU) and internationally. Finally, the Ministry is in charge of guiding and supervising its administrative sector, including Finnish Transport Authority and Traffic Safety Authority. (Ministry of Transport and Communications)

The person interviewed for this research on November 2014 works as a senior expert in the Ministry. This person has extended experience in transport policy, new transport services and transport pilot projects in Finland. As Finnish land use process and legislation was not familiar, these were briefly introduced in the beginning of the interview.


Figure 18 Plausible impacts of MaaS on land use (Ministry of Transport and Communications)

As a first level impacts, also Ministry of Transport and Communications brought up the increased digitalization, which enables new mobility applications, new way of bundle services (“mobility packages”), and internet of mobility that all improve the quality and efficiency of transport system and provide more options to people. One of these options is that people does not strictly retain their living in places based on traditional transport options. In addition, virtual reality, which is one outcome of digitalization, can provide ways to eliminate some mobility needs. In a large scale, like land use, this change the way people mobility patterns should be foreseen.

One forms of new mobility services like MaaS is introduction of sharing economy. This further requires the number of vehicles needed and thus saves space for other functions. Obviously, this should be considered in land use already at this stage.

One of the main duties of the Ministry is to develop transport system. The plausible impacts of MaaS to transport system include less private cars and thus less congestions and less parking space needed. This should be taken in account when land use is conducted, especially from infrastructure point of view. In general the infra is also used more efficiently with the help of novel transport services, which increases the throughput of current infra and relieves pressures of expending it. MaaS can also be seen as one tool to reach the goals of transport policy and thus has steering effect (as also land use has), as well as it improved the efficiency of system and enables better services for rural areas.

As MaaS have impact on new and current services, also public services and travel chain, combining different transport modes, can flourish after with current and new service concepts. This again promotes more options to land use, as transport system does not anymore pose a bottleneck to land use.

On particular topic related to MaaS and land use discussed was automation of mobility. Main impacts include the need for fewer vehicles, impacts on vehicle fleet and required infra. Autonomous driving can greatly improve the utilization of vehicles, which further reduce the need for transport infra (e.g. parking spaces). However, at the same time, adequate terminal facilities must be included to land use as these are vital for the system. Other impact is related to environment as autonomous driving will reduce the average age of cars and thus cut the emissions.

Finally, as ministry is also responsible on juridical issues, the impacts of MaaS were discussed. It was stated that new transport concept should need some deregulation activities, yet there is no clear obstacles of proposing these. When it comes to regulatory issues, the need for cooperation between ministries (in this case between Ministry of Transport and Communications and Ministry of Environment) plays a key role in matching the needs and wishes between transport and land use regulatory actions.

Key issues addressed in the interview were mostly in line with other interviews. Issues like digitalization, new mobility services, and the impact of these for more efficient and higher quality services were predicted. It was further assumed that impacts on infrastructure will generate some free resources for other purposes but the transport system as a whole (automated driving as one of the future phenomenas) should be experience some re-engineering including also public transport system and legislation. Decreasing number of private vehicles facilitates curbs infra maintenance and extension as well as more detailed information facilitates focusing of these measures. However, even the compulsory mobility decreases, yet leisure mobility may increase but in general less private cars should have positive impact on congestions and environment.

### 5.2.4 ITS Finland

A is a non-profit association, Intelligent Transport Systems Finland (ITS Finland 2014), promotes the development and deployment of transport and logistic telematic services and improves the awareness of ITS expertise in Finland. The association aims to increase the safety, security and the efficiency of transport systems and helps to create more traffic free zones in cities. The members of ITS Finland include private companies, public agencies, and research institutions involved in the research, development and design of ITS solutions that enhance safety, increase mobility and sustain the environment. (ITS Finland 2014)

The interview of ITS Finland expert took a place in December 2014. The expert was very much aware of MaaS but land use legislation or process was not familiar to the expert. Thus, the latters were explained at the beginning.

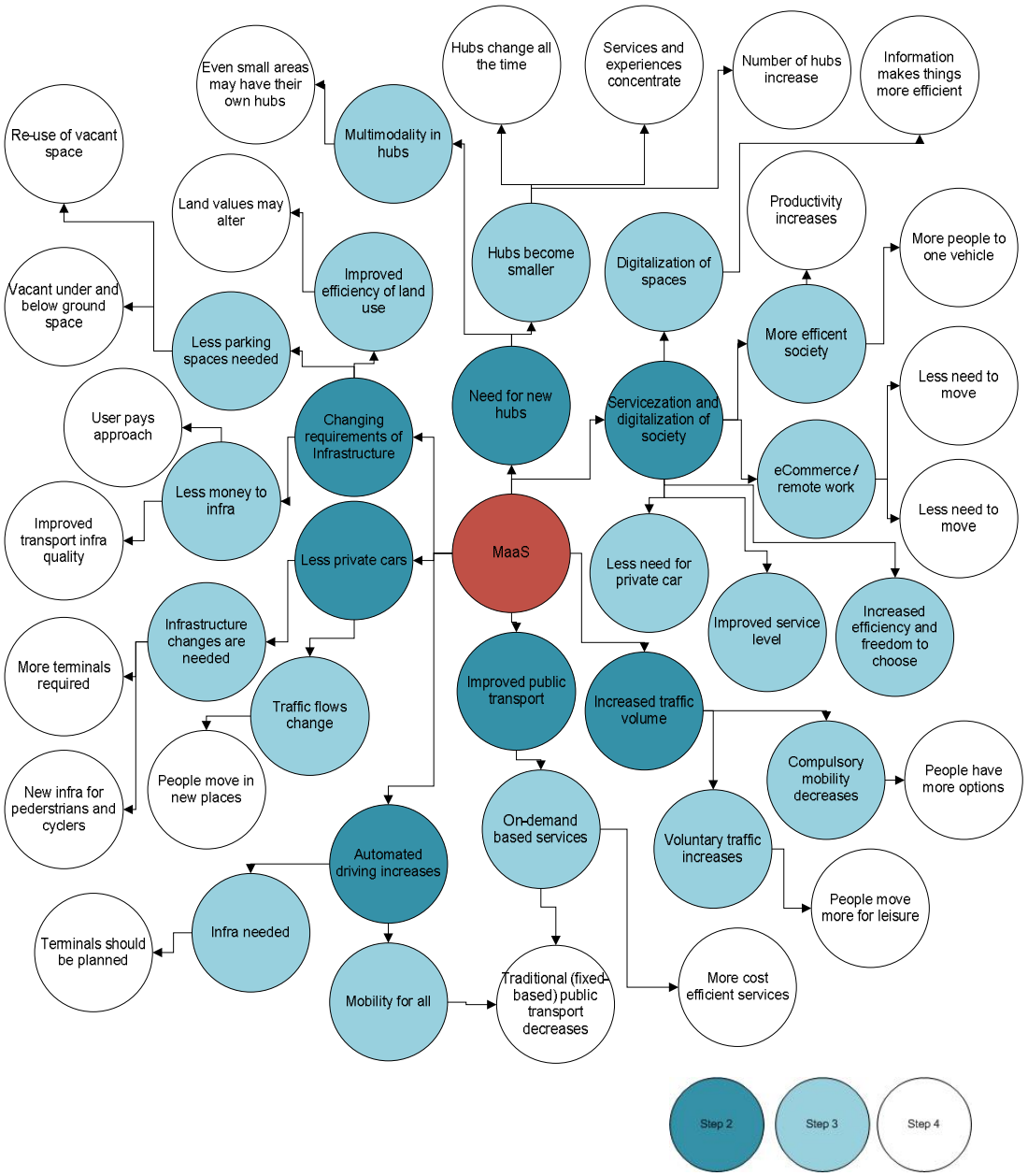


Figure 19 Plausible impacts of MaaS on land use (ITS Finland)

The major first level impacts identified in interview were similar with other interviewed MaaS experts. Improved public transport, need for new transport hubs, more efficient use of transport infrastructure, less private cars, and automated driving are kind of phenomena that should be taken into account in land use. In addition, the role of services and digitalization was also predicted to change the society.

As society employs the potential the digitalization, many of traditional needs behind mobility are lifted. More people can work from home and ICT makes whole space to digitalize. Because of this, people have less need to own a private car or move, as

well as mobility options increase. As mobility is provided as a service, the efficiency will be increased and equal opportunities will be provided to all despite of place of living or possibility to own a private car. Even the compulsory mobility decreases, it can be expected that mobility volumes can go up as a result of increased leisure traffic.

Automated driving is also one particular evolving phenomena that has impact on mobility and land use. This requires a new kind of planning of infrastructure regarding terminals and physical infrastructure (including ICT and energy grid). As automation of transport should enable better and more efficient mobility for all it also changes the paradigm of current transport system where for example public transport is mainly based on fixed lines. It is predicted that on-demand based public transport solutions (e.g. KutsuPlus by HRT) will gain more and more popularity in future, making these more efficient and responsive in urban and rural areas as well.

As MaaS most likely has impact on number of private cars, this should change the traffic flows and requirements for transport infrastructure. Some new investments like terminals and infra for pedestrian and cyclers are needed but at the same time the overall costs of infra should decrease. Further the current investments to infra can be used for improving the quality, and in best-case scenario these could be funded from pay as you drive mode. Vacant infra (e.g. underground parking spaces) can be re-used for other purposes. This development may also has impact on land values as people has traditionally valued transport connections as one criteria in housing decisions. If traditional criteria, like proximity of train- or metro station does not has that significant value in future, the valuation of areas can alter.

Finally, the transport hubs can change due to the MaaS. Multimodality becomes increasingly important, covering all modes from private cars, to public transport and cycling. It is also possible that current hubs will become smaller, and there will be greater number of these. Services are still concentrating on these hubs but in future we can see a phenomena where transport hubs are changing over the time more rapidly. This also has a direct link to digitalization of society where also services and mobility should be understand broadly.

Main things addressed in the interview were similar to ones brought up by other transport experts. Digitalization of society as a base of new mobility services, and diminishing number of private cars, as well as the impact on these to transport infra costs and quality were addressed during the interview. It was very much agreed that concepts like MaaS can greatly facilitate mobility for all and still increase the efficiency of transport system. Automated driving and seamless multimodality were also strongly underlined and these should be taken into account in land use already from required infra point of view. Interestingly enough, the possible impact of MaaS

to land valuation was mentioned as well as possible trend of changing hubs in the future. These are issues that should be already included when land use is conducted.

# Chapter 6 — Discussion and conclusions

The last chapter brings together the main findings of literature review and concludes the outcomes of interviews based on future wheel technique. The bridge between empirical and theoretical world was built in Chapter 4 where possible impacts of MaaS on land use were mapped based on theoretical part of the research. This Chapter answers the research questions:

- **How MaaS is related to land use**
- **What are the plausible impacts of MaaS on land use**

## 6.1 Operational environment of transport sector and land use

Modern society is heavily dependent on mobility. Yet, the existing transport infrastructure is no longer able to comply with ever-growing number of vehicles, further causing social inequality and environmental challenges. Digitalization of society and services has impact on everyday life of people. This sprawls over all essential aspects of society, including housing, working, leisure time, and mobility. MaaS is one of potential new concepts that evolve in transport scene, even though at the moment it is only possible to predict the development.

As mobility needs arise from everyday life of people, a direct link between land use and transport is easy to see. Finnish Land Use and Building Act, as a fundamental piece of legislation guiding land use, defines principles of land use and community structure, by providing a general plan that steers the local authorities' more detailed planning. As a matter a fact, the Act also includes transport network and other infrastructure; according the Section 54 of the Land Use and Building Act, land use plans must support the regional availability of services and traffic.

In Finland, the land use plans define the use of the region including restrictions and building guidelines. Legislation on land use and building as a whole is based on several instructions and laws that regulate the domain. The fundamental piece of legislation that steers and controls the land use, spatial planning and construction in Finland is the Land Use and Building Act (132/1999), which came into force in 2000. The Act governs the use of land areas, and building processes conducted on them, by aiming on creating healthy, safe and comfortable living environment that fulfils society’s needs. Specific regulations are presented in the Land Use and Building Decree (895/1999). In addition to the Act and Decree, Finland´s National Building Code provides complementing regulations and guidelines for Land Use and Building Act. In addition to mentioned ones, some detailed instructions are given in

the Building Protection Act and the Nature Conservation Act (1096/1996). Yet no direct link between latter ones and MaaS can was identified.

Whereas land use is a long and complicated process, the planning and building transport infrastructure is equally time-consuming and far-reaching function. For example current transport infra, built many decades ago, does not necessary meet the changing needs of today's mobility (this applies especially novel mobility concepts like MaaS). New transport solutions pose new kinds of requirements for land use and infrastructure, but also increase the variety of options to achieve the goals of land use.

Even the transport is usually seen from traditional (and conservative) perspective, ICT and ITS has facilitated new service concepts like on-demand public transport and intelligent traffic infrastructure. It must be kept in mind that even in Finland, the transport is a huge business. The total vehicle fleet consists of some three million vehicles, an average Finn makes 5.2 billion domestic trips per year (travelling 74 billion kilometres annually), transport accounts for 16 % of final energy consumption, and Finns made 67.8 million yearly bus journeys (of which 55.7 are travelling within Helsinki Regional Transport area.

As mobility is not isolation function but rather a part of the environment that surrounds it, the need and business opportunity for novel transport solutions like MaaS has increased. Especially in Finland, the need for substitute of constructing new transport infrastructure has identified in national transport strategies, of which goal is to facilitate new solutions with pilots and other actions. Nevertheless, the provision of transport infrastructure is defined in legislation, including the basic guidelines for the planning, construction and maintenance. In sparsely populated country like Finland, transport network (with estimated value of 30 billion EUR) creates prerequisites for well-being of people and competitiveness of business.

The need for mobility has a link to megatrends like urbanization, growth and ageing population. Thus these services must meet the changing demands of people. There are, of course, relatively big differences between countries in this context. As this study employs the perspectives of Finnish legislation and experts it must be kept in mind that the results may vary in other countries. Growth of population, urbanization etc. megatrends has not yet be seen as immediate problems in Finland. This was also to be seen in interview results as the issue was not brought up by interviewees.

First in the world, Finland published national Intelligent Transport System strategy, aiming at making travelling more user-friendly, efficient, easier, and more predictable for travellers whether they choose to use their own cars or public transportation. From land use and planning perspective the contribution of ITS is to shift the focus of transport policy from the construction and maintenance of transport

network infrastructure to the effective functioning of travel and transportation. The strategy includes spearhead project, many of which promoting new kind of mobility services like MaaS.

The concept of MaaS is relatively simple, yet revolutionary: bundling different transport means, public and private, into one easy-to-use package for customer. In other words, a comprehensive set of mobility services are provided to customers by mobility operators that buy mobility services (i.e. transport like public transport, taxi, car sharing, bicycle etc.) from service providers, and combine them for customer services. The development of mobility as a service has been fostered by a new way of thinking according which the mobility is servicizing (people are buying services instead of producing actions themselves). MaaS also facilitates efficient utilization of resources, which can mean for example car sharing.

It must be stated that the concept of Maas is currently evolving and it is rather uncertain how the development will continue and in what time window. On the other hand, the timespan of land use is relatively long considering the as well as processes are well established. The main interfaces between land use and new mobility concepts were identified to exist in two main categories:

1) Macro scale policy goals (national level planning, grand challenges and legislation work)

2) Operative level planning (practical actions in land use processes and development of MaaS (in context of technological, social, and business aspects)

There is a clear interface between the MaaS and land use in preparation of legislation in ministerial cooperation. This interface covers, in addition to legislation work, the whole set of cooperation in different practical initiatives. For example if Ministry of Transport wants to promote MaaS they need to make sure that this is in line with work of Ministry of Environment. Operational level interfaces can be found from crass root work. Developing transport system requires experts from both sides. For example, transport infrastructure is heavily related to land use but also more and more to steering transport flows, creating new services, and enabling people mobility in general. People, private sector, public sector are all in a key role on developing transport system and better mobility. Thus the system must be developed as a whole and jointly.

## 6.2 Major potential impact of MaaS on land use

Based on the theoretical part of the research, some possible impacts of MaaS on land use were mapped. Considering the ministerial level (including authorities) actions, the need for close cooperation can be expected to increase, in order to transport system to cope with new concepts like MaaS. Evolution of MaaS should also provide more options for steering land use with respect of meta-goals of the both ministries. From environmental perspective, it can be assumed that MaaS contributes to greener transport including vehicles with improved efficiency, increased use of public transport, and new technology (e.g. automated vehicles). Considering the infrastructure, MaaS should help reducing resources needed to maintain and develop the transport infrastructure, as well improved quality and efficiency of transport system as a whole. One of the possible impacts is also the increased attractiveness of public transport as MaaS creates more options for travel chain. Transport hubs, like stations etc., can change as a result of MaaS and thus have impact on planning land use concerning both residential and industrial zones. Finally, based on desk research, it was assumed that MaaS will increase the efficiency of current transport system, as well as introduction of sharing economy, should decrease on number of private cars, facilitates the automation of transport, reduces needed parking spaces (and transport infrastructure in general). These possible impacts are also presented in Table 5.

Table 5 Possible impacts of MaaS on land use based on theoretical part of the research

| |
|---|
| Increased cooperation in the ministerial level (including authorities) to make transport system to cope with new concepts. |
| Greener transport including vehicles |
| Improved efficiency of transport system, |
| Increased use of public transport, |
| Boots to new technology (e.g. automated vehicles). |
| More efficient use of transport infrastructure (including maintenance and improved quality) |
| Changes in transport hubs (e.g. stations, terminals etc.) |
| Facilitates introduction of the sharing economy in transport |
| Decrease in number of private cars |
| Reduces needed parking spaces and transport infrastructure in general (frees space for other functions like complementary construction) |

Above mentioned impacts of MaaS on land use are some possible examples which was then accompanied by outcome of eight open expert interviews. The conclusions concerning the outcome of these interviews are discussed next.

As illustrated in utilized research tool, the Future Wheel, the possible possible impacts, perceived by land use experts, are presented. The impacts presented here are

mainly first level ones but most common second, third and fourth level impacts are given as examples.

Table 6 Plausible impacts of MaaS on land use – land use experts' perspective

| 1st level impacts | Most common ones of further impacts |
|---|---|
| Legislation aspects | Increased cooperation between ministries (in legislation preparation), statutory transport services are organized more efficiently (and in increased service level), joint-projects to find optimal solutions, traffic planning to be integrated to land use, major obstacles for MaaS in other than LUBA, MALPE as a steering tool |
| Changing transport infrastructure | Current capacity adequate, re-use of vacant road infra, redundant parking spaces for other means (e.g. complementary construction), savings on infra spending, fringe areas better served, main changes in road infra (rail infra fixed), no new reservations on planning |
| More efficient transport system | New mobility services, tools for transport planning |
| Increased attractiveness of public transport as a part of travel chain | Improved utilization, better service, on-demand public transport, more options to organizer, pedestrians and cyclers must be considered as part of public transport |
| Sharing of transport assets | Better utilization via sharing, sharing economy more common |
| Less cars | Less emissions, less congestions in urban areas, less parking spaces needed, increased utilization of infra, safer traffic, |
| Changing hubs, nodal points and centres | Terminals are needed, connection parking must be organized, services concentrate on hubs, traffic flows change hubs, smaller hubs than today, accessibility must be addressed |
| Mobility volume increases or remains | Leisure mobility increases, compulsory mobility decreases, remote work becomes more popular |
| Regional aspects | Rural areas more vigorous, fringe areas increase attractiveness, urban areas more functional |
| New services for users | More options, on-demand services, optimized efficiency, travel chains are served, services needs to be re-engineered |

Plausible impacts, identified by mobility (MaaS) experts are discussed below in Table 7. Again, the results are presented according the Future Wheel levels.

Table 7 Plausible impacts of MaaS on land use – MaaS experts' perspective

| 1st level impacts | Most common ones of further impacts |
|---|---|
| Legislation aspects | Cooperation between legislation branches, enabling (not preventing) legislation must be developed, piloting of new services as a first step, cooperation within EU and internationally, goal to deregulate |
| Changing transport infrastructure | New requirements for infra quality, current road infra capacity adequate, maintenance must be ensured, infra steers land use, more efficient use of current (adequate) infra, quality over quantity, re-use of vacant road infra, redundant parking spaces for other means, savings on infra spending, fringe areas better served |
| More efficient transport system | Transport flows become more fluent and commuter traffic increases, mobility for all, land value between areas may alter, leisure mobility increases – compulsory decreases |
| Increased use of public transport as a part of travel chain | Seamless integration of all transport modes, responsive services, connection parking facilities, improved service level, on-demand services, door-to-door transport, traditional line transport diminishes |
| Less cars | Sharing economy increases, less parking spaces needed, re-use of infra, less congestions, pedestrians and cycling increases |
| Hubs and nodal points change | Services concentrate on hubs (decreased services in other areas), hubs needs to be re-engineered for MaaS, multimodality important, |
| Mobility volume increases or remains | Leisure mobility increases, compulsory mobility decreases, remote work becomes more popular |
| New transport services for users | Increased satisfaction and mobility, new business opportunities, more options in rural and urban areas, home delivery increases, mobility increases, digitalization bundles services, new applications, internet of mobility, more options, virtual reality changes mobility (eCommerce/eWork), new service concepts |
| Automation of transport | Increased mobility, new requirements for infrastructure, resources in more efficient use, freedom to choose place of living, terminals need space, autonomous driving, cleaner traffic |

As presented in tables above, the impacts perceived by experts pool were somewhat in line with each other. Naturally, the emphases had some differences. The empirical evidences (plausible impacts) are compared with possible impacts based on theoretical part of the research in Table 8.

Table 8 Comparison of impacts identified in theoretical research and empirical interviews

| 1st level impacts | Identified by land use experts | Identified by MaaS experts | Identified in theoretical research |
|---|---|---|---|
| Legislation aspects | X | X | X |
| Changing transport infrastructure | X | X | X |
| More efficient transport system | X | X | X |
| Increased attractiveness of public transport as a part of travel chain | X | X | X |
| Sharing of transport assets | X | X | X |
| Less cars | X | X | X |
| Changing hubs, nodal points and centres | X | X | X |
| Regional aspects | X | | |
| Mobility volume increases or remains | X | X | |
| New services for users | X | X | X |
| Automation of transport | | X | X |
| Greener transport | | | X |

As depicted in table above, many of the first level impacts were identified by both expert groups and in theoretical research as well. Naturally, regional planning aspects was underlined by land use experts, while transport automation was addressed by MaaS experts. The increase of mobility volume was not identified based on theoretical research but on the other hand environmental aspects were not perceived as first level impacts by experts (however greener transport were seen as major consequence of MaaS by experts as well). One of the potential impacts that was not explicitly brought out by any of the interviewees could be the impact on land values. As land value tend to follow the service level of (public) transport or proximity of main roads, MaaS has a potential to be a game changer in this context. Naturally this should be studied more for further conclusions.

The main impacts, identified by experts in interviews, are further analyzed with regard of both perspectives in next sub-chapter (excluding the impacts identified in previous research). In addition, some actions for future are proposed.

## 6.3Proposal for actions

Based on impacts discussed in previous chapter, these are drawn together. Additionally, some potential actions are proposed by author.

First of potential impacts identified by experts were legislation aspects. Cooperation between ministries in legislation preparation and piloting was underlined. Also the cooperation must be implemented in regional level. Whereas MaaS experts were giving more weight on piloting and international cooperation, land use experts were unanimous that land use legislation does not pose any obstacles for MaaS. On the other hand, the will to deregulate transport related legislation was addressed.

➔ Suggestion: increasing horizontal and vertical cooperation especially between regional authorities. Land use legislation was not seen as a major obstacle by interviewees, thus the possible changes must be taken place elsewhere. Pilots should be employed as a relevant tool to assess new services and to get feedback.

It was widely agreed by experts that MaaS can have major impacts on land use when it comes to current and future infrastructure. As it was discussed earlier, the time-spans of infra planning and technology/service development are significantly different (yet it should be underlined again that there is no certainty of development of technologies and in case of some technologies the ramp-up has taken decades). At the same time the money designated for infra is reducing. As an impact of MaaS, current road capacity should be adequate in future, yet there is need for plan a re-use for existing infra (e.g. parking lots etc.). At the same time the quality of infrastructure becomes increasingly important and savings generated by more efficient use of infra should be used for improving the quality and other requirements.

➔ Suggestion: road infrastructure planning should already take into consideration the requirements of new transport concept like MaaS. Same time a throughout mapping of potential re-use of current spaces should be conducted. No new reservations for road infra were foreseen to be needed but current infra should be maintained in future.

A consensus by experts was also found in the context of MaaS making the transport system more efficient. As new services evolve, traffic flows may alter, and total transport volume may even increase. Mobility becomes available for all areas.

➔ Suggestion: land use planners should have more tools to help predicting changes caused by new services. Traffic flows, as a basis of land use, must be forecasted from new attributes that take MaaS into consideration.

Most of the experts considered the increased use and attractiveness of public transport as one of the first level impacts of MaaS on land use. It was also addressed that also land use is affected by a development that combines different transport modes into a seamless travel chains. It was also strongly agreed that current operational model of public transport will develop towards on-demand and door to door services. This development increases the services level, and thus attractiveness of public transport in future transport is promoted. Finally it was addressed that connection parking, as well as a needs of pedestrians and cyclers should be included already in land use phase.

- ➔ Suggestion: new models of public transport, like on-demand based, should be included to land use, as traditional fixed line-based public transport is not that flexible than new services. Multimodality becomes increasingly important and this must be taken into account when hubs and nodal points are planned. Connection parking facilities must be zoned to ensure interoperability of private and public transport. Finally land use should consider more and more pedestrians and cycles, as well as their accessibility to public transport.

Sharing of transport assets must also be considered in land use. As people become increasingly familiar with the opportunities of sharing-economy, also lot of transport assets can be shared. As this increases the efficiency of current private vehicles, also need for some of facilities and infrastructure diminishes.

- ➔ Suggestion: foresights of development of sharing economy (e.g. number of private cars in next ten years) must be produced and these should be used as a basis in land use and making regulations (e.g. when zoning parking lots).

Partly related to sharing economy, it was also predicted that the number of private cars will decrease in future. Besides the impact on infrastructure requirements and needed parking spaces, the development should give more freedom to land use as the dominance of traffic safety and capacity challenges (e.g. congestions) aspects diminishes. In addition, current transport infra can be used for other pusposes.

- ➔ Suggestion: decreasing number of private vehicles must already considered as a basis of land use plans. In addition, the planning of re-use of current transport infra and facilities should be initiated. Corresponding adjustments must be also included to relevant legislation if needed.

Hubs, terminals and nodal points of traffic are vital points for transport system. Due to the introduction of MaaS, it was anticipated that one of the potential impacts should be changes in hubs. As hubs follow traffic flows (that may change because of MaaS) the possibility of changing locations should be considered in land use. Accordingly, the services follow hubs. In addition, it was considered that in future

hubs may change more often and also smaller hubs born. This possibility should be also considered in land use plans that should ensure the services and connectivity of different areas. Some particular issues also include connection parking in hubs, requirements of multimodality, and accessibility.

➔ Suggestion: traffic planning, as a basis of land use, will involve scenarios of changing hubs (location, services, sizes etc.) that include MaaS. Aspects of multimodality are included increasingly to land use with hub design that allows re-engineering.

It was relatively unanimously agreed that the volume of mobility will increase (or at least remain in the current level) in future. As it was predicted that compulsory mobility (e.g. commuting) is going to decrease but leisure (voluntary) mobility increases, this should be taken into account in land use plans as it may change the traffic flows. Traffic patterns, that are currently based on need of commuting may change towards ones that emphasize more leisure time routes. For example, Finns have 500000 summer cottages, where most people go by car.

➔ Suggestion: alternative scenarios that include increased voluntary mobility and decreased commuting are also considered as a basis for land use.

Regional aspects were also discusses. MaaS was considered to have impacts on attractiveness and mobility service level of rural and fringe areas, which is why it also gives more options to land use. In urban areas, the efficiency of transport increases and thus should be included to planning of build environment (including transport infra, services and housing).

➔ Suggestion: the impacts of MaaS, mentioned above, must be included to land use process.

Most of the interviewees considered that one of the impacts of MaaS, also in context of land use, is availability of new services. This covers new operational models like on-demand services, travel chain approach, door-to-door transport, and general digitalization of transport. In addition to increased quality, new services also enable optimized efficiency of transport system. As services must be re-engineered, this also brings more options of organizing transport in rural and fringe areas, while virtual presence (e.g. e-work and e-commerce) changes the fundaments of mobility.

➔ Suggestion: new transport service concepts should be piloted in limited areas. When more data (e.g. on user acceptance etc.) for policy making has been acquired, this is linked to land use process. Further, new transport concepts should be scrutinized from legislation revision perspective, as they may make

some of current guidelines (e.g. parking lots, statutory transport services) unnecessary.

Finally, the automation of transport was addressed. As it has become increasingly clear that automation will come to transport system as well, this should be taken into account within the land use time span already. Automated transport poses new requirements for infrastructure, including the quality of roads, hubs and new terminals. From land use perspective, especially the fact that automation will provide mobility to all, despite of person and place of living, this may mean a major change to areas where people are living and moving. On the other hand automation should contribute to better use of resources, cleaner traffic and less congestions that all may increase the quality of living in urban areas as well.

➔ Suggestion: impacts of automation of transport from perspectives of areas, people and transport flows must be further researched. Based on these results, new guidelines for land use should be made, and possible new requirements of infra etc. must already be included to land use reservations.

To conclude, many of the impacts and following proposed actions in context of land use, are closely linked to new needs and possibilities in different areas and for different people. It is evident that transport flows will alter based on people's needs and actions of public and private sector. The cycle of land use is relatively long and thus these changing needs must already be included to land use process. However, it is wise to collect as much real data to support policy making as possible. Thus, piloting new services like MaaS in some areas with participation of both land use professionals, traffic planning experts, research, and people already, is suggested way to proceed. Cooperation between all branches and stakeholders is the way forward!

## 6.4 Reliability and validity of the research

In research work, several issues including reliability and validity are in major concern (Merriam 2009, 234). Even though every researcher does best to avoid mistakes, the reliability and validity varies based on the nature of the study and therefore should are discussed here.

As a concept, reliability of the research is defined as repeatability of results, referring the research's ability to generate non-random results. In case of reliable research, results should be same without regarding the time or the researcher conducting the research (McNeill and Chapman 2005, 9). Hence, the concept of reliability can also be described as an accuracy of the results. (Heikkilä 2000, 30, 187; Hirsjärvi et al. 1997, 216.) Reliability of this research is mainly concern in the empirical part of the

study as research is based on interviews. According Reis and Judd (2000, 299) three main sources of unreliability can be identified in interviews. These are poorly conducted interviews, a poorly constructed coding, and poorly trained coders. (Reis et al. 200, 299) To overcome these challenges, the interviews were controlled by interviewer if necessary. Furthermore, the future wheel technique facilitates the subject-oriented approach, guiding the actual interview session. The preparation for interviews is conducted by testing the future wheel approach with several experts in the field of futures research.

In addition to reliability, the concept of validity of the research must be discussed. Whereas reliability has to do with repeatability of results, validity rather refers the ability of chosen meters, techniques and methods to create a truthful picture of studied phenomena (i.e. research's ability to measure the issues it is meant to measure). (McNeil & Chapman 2005, 9; Saunders et al. 2009 157.) Validity can be sub-divided between internal and external validity. The first one, internal validity refers to the credibility of causal relationship between theories (findings of the literature review) and empirical results (interview results). External validity, respectively, reflects the generalizability of findings to other relevant contexts. The latter one is often described as a similarity of interpretations between original researcher and others. (Heikkilä 1998, 29, 186; Merriam 2009, 234, 186; Saunders et al. 2009, 592.) From the perspective of this research, both internal and external validity are in interest, yet due to the "green field" nature of the study subject, the internal validity is perhaps more important. This refers the interphase of theoretical and empirical part. The selection of sample and collection of data (interviews) play are crucial role in internal validity. For this reason the theoretical part should be conducted as comprehensively as possible, as well as interviews should be carefully structured (especially when it comes to external validity). To increase validity, the future wheel technique is also trained beforehand with future research experts.

## 6.5 Research implications

Implications of the research can be roughly divided between theoretical and managerial implications. The first category provides the base theory of impacts and relationship between MaaS and land use. Empirical part creates managerial implications that provides state of the art expert opinions for land use planners.

Theoretical implication in the context of this study are improved understanding on development of two related activities: land use and transport. This improved understanding can facilitate the future research as no theoretical base for studying links between these two issues was established. In addition, the concept of MaaS was only studied with limited coverage, without any attention to land use context.

Main managerial implication can identified as increased understanding of those impacts that should already be included to both land use and transport developments. It was further evident that these two cannot be considered as isolated functions and cooperation and improved understanding on close connection between these two must be established.

Considering the above said, study met the goals set at the beginning of the work. In practise it was also valuable for experts to start considering these issues from each other's' perspectives. The subject of the thesis was relatively challenging as no previous research was available and especially MaaS is still evolving concept. This addresses the necessity of the output of the work.

## 6.6 Suggestions for further research

As described in previous chapter, more research is needed to quantify the impacts and thus provide more detailed information on relationships between attributes. As the development of MaaS is relatively uncertain, the research must also be updated regularly to meet the current phases of development. As one of the main frameworks of land use is legislative, also possible changes needed to this one must be evaluated prior broader actions.

As development of society, built environment and transport system is complex and multi-dimensional task with many aspects and stakeholders, it would be justified to proceed with pilots that are properly evaluated. These limited pilots would provide decision makers needed information on magnitude and links between impacts. As users are in the core of transport developments, their opinions must be included to future research.

Finally, this research was studying the potential impacts of MaaS on national and areal level. It was evident that many of the potential impacts also effect on city/municipality level, where decisions of for example zoning are made. Thus it would be crucial to deepen the research besides the limitations of this study in near future.

# Bibliography

Alcamo, J. (2009) “Environmental Futures: The Practice of Environmental Scenario Analysis”, Amsterdam, Nederland.

Arbnor, I. and Bjerke, B. (2009) “Creating Business Knowledge”, 3rd Edition, Thousand Oaks, CA, US.

Association of Finnish Local and Regional Authorities: Regional land use, available at: http://www.localfinland.fi/en/authorities/regional-councils/regional-land-use-planning/Pages/default.aspx , accessed 13.10.2014

European Commission (2011) “European Commission’s White Paper 2011: Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system”, available at: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52011DC0144&from=EN , accessed 6.10.2014

ELY Centres, available at: < http://www.ely-keskus.fi/en/web/ely-en/>, accessed 3.12.2014

Finnish Government: State Budget (2014), available at: <http://valtioneuvosto.fi/toiminta/talousarvio/2014/fi.jsp>, accessed 23.10.2014

Finnish Information Centre of Automobile Sector, Long-term statistics, available at: <http://www.autoalantiedotuskeskus.fi/en/statistics/vehicles_in_register>, accessed 17.10.2014

Finnish Transport Agency 2014a: Väylät numeroina, available at: <http://portal.liikennevirasto.fi/sivu/www/f/liikennevirasto/tilastot/vaylatilastot >, accessed 23.10.2014

Finnish Transport Agency 2014b, available at: < http://portal.liikennevirasto.fi/sivu/www/e/fta >, accessed 24.11.2014

Finnish Transport Network 2015, available at: < http://portal.liikennevirasto.fi/sivu/www/e/transport_network>, accessed 3.3.2015

Gillham, B. (2005) ”Research Interviewing: The Range of Techniques”, Maidenhead, U.K

Hautala, R., Karvonen, V., Laitinen, J., Laurikko, J., Nylund, N-O., Pihlatie, M., Rantasila, K. and Tuominen, A. (2014) “Smart sustainable mobility. A user-friendly

transport system is a combination of intelligence, low carbon energy, and adaptable services", Nylund, N-O and Belloni, K (eds.), Kuopio, Finland (ISBN: 2242-1157)

Heikkilä, S, (2014) "Mobility as a Service – A Proposal for Action for the Public Administration", Master's Thesis in Aalto University,School of Engineering , Espoo, Finland.

Heikkilä, T. (2005) "Tilastollinen tutkimus". Helsinki, Finland.

Hietanen, S. (2014) "Mobility as a Service" – The new transport model?, Eurotransport, Vol. 12, No. 2

Hirsjärvi, S., Remes, P. and Sajavaara, P (2003) "Tutki ja kirjoita". Helsinki, Finland.

Helsinki Regional Traffic (2013), Annual Report available at: < https://www.hsl.fi/sites/default/files/uploads/hsl_vuosikertomus_2013.pdf >, accessed 23.10.2014

HRT KutsuPlus (2015), available at: < https://kutsuplus.fi/tour>, accessed 28.3.2015

ITS Finland (2014), available at: < http://www.its-finland.fi/index.php/en/ >, accessed 3.12.2014

Knoke, W. (2012) "A four-step example of a future wheel", lecture exercise available at: < http://www.knoke.org/lectures/futureswheel.htm>, accessed 11.10.2014

Land Use and Building Decree (895/1999), available at: < http://www.finlex.fi/en/laki/kaannokset/1999/en19990895 >, accessed 21.10.2014

Land Use and Building Act (132/1999) [amendment 222/2003 included], available at: http://www.finlex.fi/fi/laki/kaannokset/1999/en19990132.pdf , accessed 12.10.2014

McNeill, P. and Chapman, S. (2005) "Research methods", 3rd edition, Oxon, England.

Ministry of Environment 2014a, available at: http://www.ym.fi/en-us/Land_use_and_building/Legislation_and_instructions/The_Land_Use_and_Building_Act , accessed 13.10.2014

Ministry of Environment 2014b, available at: < http://www.ym.fi/en-US/Land_use_and_building/Legislation_and_instructions >, accessed 14.10.2014

Ministry of Environment 2014c, available at: < http://www.ym.fi/fi-FI/Maankaytto_ja_rakentaminen/Lainsaadanto_ja_ohjeet/Rakentamismaarayskokoelma/The_National_Building_Code_of_Finland%2810420%29 >, accessed 14.10.2014

Ministry of Environment 2014d, available at: http://www.ym.fi/en-US/The_Ministry, accessed 14.11.2014

Ministry of Transport and Communications, available at: < http://www.lvm.fi/en/ministry >, accessed 17.11.2014

Ministry of Transport and Communications 2014a, available at: < http://www.lvm.fi/en/transport_infrastructure >, accessed 23.10.2014

Ministry of Transport and Communications 2014b, available at: < http://www.lvm.fi/en/intelligent_transport>, accessed 23.10.2014

Merriam, S. (2009) "Qualitative research: a guide to design and implementation", San Francisco, CA, US.

Norwegian Ministry of Transport and Communications (2013) "National Transport Plan 2014-2023", Meld.St.26 (2012-2013) Report to the Storting (White Paper)

Public Transport Performance Statistics (2011), Statistics of the Finnish Transport Agency, 2/2013.

Rantasila, K. (2013) "Measuring logistics costs - designing a generic model for assessing macro logistics costs in a global context with empirical evidence from the manufacturing and trading industries", doctoral dissertation, Turku School of Economics at University of Turku A-8:2013, ISBN: 978-952-249-319-4, Turku, Finland

Rantasila, K., Hautala, R., Lankinen, M. and Lankinen, L. (2014) "*Deploying ITS Services: Case Finland-Russia Smart Transport Corridor*" Technical paper on 21th ITS World Congress, 6–11 September2014, Detroit, United States.

Rantasila, K. and Lankinen, M. (2014) "Flow mechanics", Thinking Highways, Vol.9, No.2, pp: 2-5

Rantasila, K., Mantsinen, H., Casey, T., Hautala, R. and Lankinen, M. (2014) "*Development of ITS multi-service from idea to deployment*", technical paper on 10th ITS European Congress, 16–19 June 2014, Helsinki, Finland.

Reis, H. and Judd, C. (2000) "Handbook of Research Methods in Social and Personality Psychology", Cambridge, New York, US.

Rosenberg, M., Räsänen, J. (2005) "Joukkoliikenne keskisuurissa kaupungeissa: vertailu ja yhteistaloudellisia vaikutuksia, Liikenne ja viestintäministeriön julkaisuja 2/2005, Helsinki, Finland.

Saarinen, J. (2014) "*Taksiyhtiö Uber aloittaa Helsingissä – kaikilla kuljettajilla ei ole taksilupaa*", Helsingin Sanomat 19.11.2014.

Saunders, M., Lewis, P. and Thornhill, A. (2009) "Research Methods for Business Students", 5th edition, Essex, England.

Suomen Taksiliiton lausunto 18.3.2015, available at: http://www.taksiliitto.fi/ajankohtaista/taksiliiton_lausunnot/, accessed 28.3.2015

SYKE 2014, available at: < http://www.syke.fi/en-US/SYKE_Info >, accessed 6.12.2014

Tekes 2014a, available at: < http://www.tekes.fi/en/tekes/>, accessed 17.11.2014

Tekes 2014b, available at: < http://www.tekes.fi/en/programmes-and-services/tekes-programmes/mobility-as-a-service/> , accessed 17.11.2014

ten Hompel, M. (2014) "Internet of Things", presentation in 7th ECITL conference, Dortmund, Germany, 5-7.11.2014

Towards a new transport policy: Intelligence in transport and wisdom in mobility. Finland's second generation intelligent strategy for transport (2013), Publications of Ministry of Transport and Communications 2/2013

Traffic Lab 2014a, available at: < http://trafficlab.fi/what-is-traffic-lab/>, accessed 5.11.2014

Traffic Lab 2014b, available at: < http://liikennelabra.fi/wp/wp-content/uploads/2014/09/TrafficLab.pdf >, accessed 5.11.2014

Traffic Safety Agency 2014a, "Maaseudulla kolme neljästä hankkii ajokortin heti", available at: < http://www.trafi.fi/tietoa_trafista/ajankohtaista/2250/maaseudulla_kolme_neljasta_hankkii_ajokortin_heti >, accessed 17.10.2014

Traffic 2014b, available at: http://www.trafi.fi/en/about_trafi, accessed 14.11.2014

UN (2014), Concise Report on the World Population Situation report of United Nations, Department of Economic and Social Affairs, Population Division, ST/ESA/SER.A/354

VTT (2014) Blog: Älykästä ja oikeudenmukaista liikennettä, kiitos?, available at: <blog.vtt.fi>, accessed 7.11.2014

Watkins, R., West, M., Maurya, V. and & Yusra, L. (2012) A Guide to Assessing Needs : Essential Tools for Collecting Information, Making Decisions, and Achieving Development Results, available at: https://openknowledge.worldbank.org/handle/10986/2231, accessed 11.10.2014

Yin, R. (2012) "Applications of Case Study Research", 3rd Edition, Thousand Oaks, CA, US.

YM 2014a, Environment.fi - a joint website of Finnish environment authorities: Land use system, available at: http://www.ymparisto.fi/en-us/Living_environment_and_planning/Land_use_planning_system/Regional_land_use_planning , accessed 13.10.2014

YM 2014b, Environment.fi - a joint website of Finnish environment authorities: Land use system/Regional planning, available at: http://www.ymparisto.fi/en-US/Living_environment_and_planning/Land_use_planning_system/Regional_land_use_planning , accessed 13.10.2014

YM 2014c, Environment.fi - a joint website of Finnish environment authorities: Land use system/Local master plan, available at: http://www.ymparisto.fi/en-US/Living_environment_and_planning/Land_use_planning_system/Local_master_plans_coordinate_and_direct_local_detailed_plans, accessed 13.10.2014

YM 2014d, Environment.fi - a joint website of Finnish environment authorities: The planning process, available at: http://www.ymparisto.fi/en-US/Living_environment_and_planning/The_planning_process, accessed 13.10.2014

# Annexes

Annex 1 Detailed information on interviews

| Organization (number of people interviewed) | Expertise | Primarily perspective | Location Interview | Month, duration |
|---|---|---|---|---|
| Ministry of Environment (1) | Responsible for developing steering instruments for land use and enacts the related legislation. | Land use | Otaniemi , Espoo | 10/2014 , 60 min |
| The Finnish Environment Institute (2) | Examines the spatial structure and dynamics of communities, as well as their relation to the surrounding nature. | Land use | Töölö, Helsinki | 12/2014 , 90min |
| Ministry of Transport and Communications (1) | National transport policy and steering of acengies | MaaS | Kaartinka upunki, Helsinki | 11/2014 ,60min |
| Finnish Transport Agency (3) | Responsible of Finland's transport network | MaaS / Land use | Pasila, Helsinki | 11/2014 , 90min |
| Centre for Economic Development, Transport and the Environment | Promoting regional competitiveness, well-being and sustainable development and curbing climate change | Land use | Pasila, Helsinki | 12/2014 , 70min |
| Finnish Traffic Safety Agency (1) | Develops the safety of the transport system, promotes environmentally friendly transport solutions and is responsible for transport system regulatory duties. | MaaS | Vallila, Helsinki | 11/2014 , 60min |
| ITS Finland (1) | Forum of Intelligent Transport Systems in Finland representing the industry, public sector and research community. | MaaS | Kamppi, Helsinki | 12/2014 , 75min |
| Tekes – the Finnish Funding Agency for Innovation (1) | Most important publicly funded expert organisation for financing research, development and innovation in Finland. Tekes boosts a wide-range of innovation activities in research communities, industry and service sectors. | MaaS | Pasila, Helsinki | 11/2014 , 60min |