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Smart Mobility Market Analysis

Case FABULOS

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Master of Business Administration

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Thesis

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This thesis focuses on conducting a Smart Mobility market analysis report for the FABULOS project. Smart Mobility is an alternative and smarter way of transportation. FABULOS project is an EU level plan focused on autonomous vehicles as part of public transportation.

During the project, a consortium was formed, and pre-commercial procurement was done. From this pre-commercial procurement, FABULOS has chosen the preferred partners for the project. Metropolia University of Applied Sciences was chosen as a technical partner. EU funds the FABULOS project, and this thesis provides a required deliverable, namely the market analysis of the Smart Mobility industry done by Metropolia of Applied Sciences. Metropolia University of Applied Sciences funds this research.

The research's scope is to produce the market analysis for the FABULOS project, focusing on European participants. The FABULOS project has acquired data on the Smart Mobility industry in the previous stages of the project. The researcher analysed these data and based samples on them. The data collection method was a web-based Google Forms survey.

The results of the market analysis in this Master's thesis revealed that the Smart Mobility industry is quite challenging to research. The outcome of this thesis is the survey results put together and analysed in a report. From the report, the FABULOS project gets insights into the current market status. The current status is that markets are close to the pre-mature stage, with many start-ups on the supply-side. The market consensus is that supply -and demand-side are willing to invest and develop Smart Mobility rapidly further.

The knowledge gained from this research can be used as a foundation for continuous market analyses of Smart Mobility.

Keywords	Smart Mobility, Market analysis survey, FABULOS project

Contents

1 Introduction

News from the world is inevitably illustrating terrible conditions as global warming is consuming the earth. Transportation is on the brink of a change. Transportation is seeking solutions, and Smart Mobility is going to change the way we move around. Smart Mobility promises to use available resources better and more efficiently, enhancing the quality of life (All roads lead to smart mobility 2020.)

The thesis subject is related to the FABULOS (Future Automated Bus Urban Level Operation Systems) project. FABULOS project simplified is a project that aims for automated buses to operate in city bus lines. The market analysis focuses on the Euro-pean level, but it has some global aspects because some of the market participants are located outside the E.U.

This thesis focuses on market analysis within the Smart Mobility industry and related to the FABULOS project. The FABULOS project received funding from the European Union's Horizon 2020 research and innovation program. Metropolia University of Applied Sciences, as a partner of FABULOS, is sponsoring this thesis.

Market analysis is conducted as a part of a deliverable agreed-upon grant agreement's policy between E.U. and FABULOS. From the grant agreement, the deliverable has been phrased as "Analysis on the market's defragmentation and potential elaboration of standards for public procurement in this domain." With the project steering team's help, we decided to design this deliverable as a market analysis. At the end of this thesis is the attached report for the FABULOS project.

1.1 About FABULOS

The FABULOS (Future Automated Bus Urban Level Operation Systems) project aims to acquire an autonomous bus line operation. Autonomous minibusses have been tested on several occasions in a technical demonstration. The concept is not yet available that

autonomous buses are operated along with public transport regulations (FABULOS 2020.)

Driving automation needs to be further developed. A presentation of the solution's economic, technical, social, and legal maturity is needed. The solution should be implemented in a real environment by integrating automated minibusses into the public transport ecosystem (FABULOS 2020.)

FABULOS partners assimilate this by procuring research and development to prototype and test smart systems that can operate a self-driving minibusses fleet in urban environments. These solutions should include these components: software, hardware, fleet, and services. Partners have a significant part in combining their efforts supporting the market to develop this kind of system. Such an intelligent transportation system (ITS) and integrated transportation approach is key to facilitating the sustainable development of public transportation and cities to become car-free in the foreseeable future (FABULOS 2020.)

2 Research design

This section examines the research question, research approach, research design, data collection, and analysis methods. Deliverable to FABULOS project was "Analysis on the market's defragmentation and potential elaboration of standards for public procurement in this domain", which is transferred to market analysis within the Smart Mobility industry.

2.1 Research Questions

In this thesis, research questions are in two-part. First is the supplier side, which is operating autonomous buses and or related software. The other is the demand side, which consists of public transport operators involved in the FABULOS project. Research questions are:

-Supplier side, what kind of players are in the automated bus industry? FABULOS already has the suppliers' information, but data should be verified, and their view of Smart Mobility enhanced.

-What are the demand side's expectations/requests that the demand side has set for the supplier side? Market analysis needs another point of view, and the researcher wants to enhance the demand side's view of the suppliers.

2.2 Research Approach

According to Kananen (2014, 20) there is always a problem statement solved with different research methods. Problem statements in research could be developing processes or accomplish change. Research produces information to gain knowledge and supports decision making. Solving a research problem is called a research approach. The research approach contains information gathering, analyzing, and interpretation methods. The nature of the research problem defines the research approach.

A research approach is a common form for different methods that can be utilized in the thesis. The fundamental division of the study form is qualitative and quantitative. There are also other forms of divisions, but they are subject to contradiction. Different research approaches can be combined with blended research methods, often called study strategies (Kananen 2014, 21.)

Research can be seen as a model, which has four main features: research questions frames the research, what data is needed to answer those research questions, how to design research that collects and analyses that data, and how to transform data to answer the questions (Punch 2003, 7.)

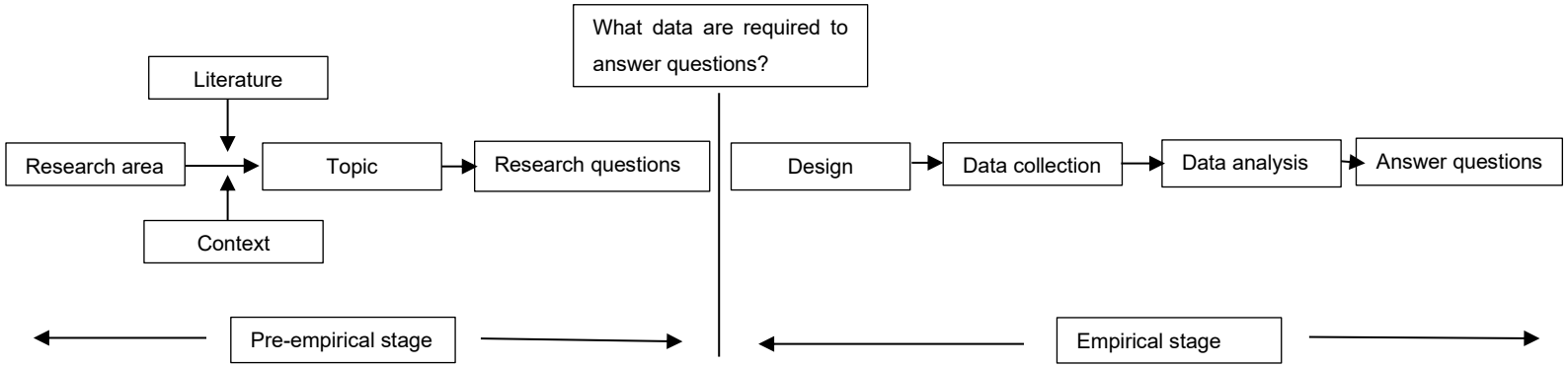

Figure 1. A simplified model of research (Punch 2003, 7).

According to Tuomi (2018, 78-80), there is a new and useful perspective for the research approach called mixed methods. Mixed methods are defined as combining quantitative and qualitative research approaches. Combining these methods brings a better understanding of the research problem than separate. The key finding is that mixed-methods fixes those flaws that both methods contain, and mixed methods can be used when neither method works. The mixed-method does not remove bifurcation, but it abandons confrontation and perspective that either one is somehow "better." The mixed-method is convenient and committed to pragmatism. Researchers should solve research problems best possible, and in the everyday world, people strive to solve problems with words and figures.

2.3 Data Collection and Analysis

The data collection method affects follow-up. The next step in interview research is to create a survey form and decide the research method and sample count. After testing, the survey form starts the fieldwork. The researcher picks interviewers, and they are guided to their tasks. After fieldwork, interviews are controlled and reported. Web-interview fieldwork consists of sending the surveys and reminding answerers or resending surveys. During the data collection and after that, the material is validated, coded, and tabulated. After this researcher conducts analysis, graphics, and summary of the results (Lotti 2001, 121-122.

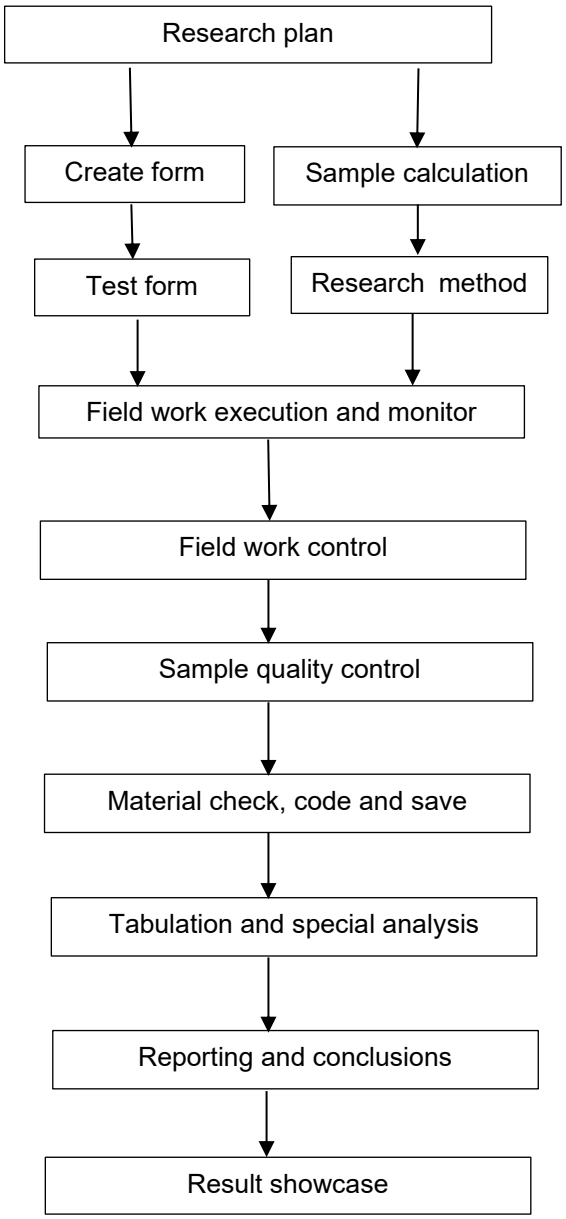

Figure 2. Survey-based research data collection process (Lotti 2001, 121).

The difference between interviews and surveys on a concept level is that when the informant is personally filling the form, it is an interview. When the answerer is filling the form, it is a survey. The difference is in the data collection phase and how the informant acts. There is one exception, email interview. In the email interview, the informant emails questions to the answerer, and the answerer answers them and sends them back. After that, the informant can specify questions (Tuomi 2018, 85.)

According to Fowler (Fowler 2002, 75), it is evident that mode choice is a complicated decision and relies much on the particular study situation. The survey design approach is essential when selecting the mode of data collection. A smaller sample with personal interviews could produce more useful data than a larger sample of telephone interviews. Methodological objectives and thorough consideration of all the design issues affecting data quality are needed before deciding how to collect data.

Punch suggests that (Punch 2003) data could be analyzed by applying the logical and straightforward three-part framework. First is the summarizing and reducing the data; this process leads to creating the variable. The second is showing the distribution of the variables across the sample. The third part is analyzing relationships between the variables. The researcher finds it useful to use tables. They organize the analysis and gives structure to the presentation of results. Primarily focus is to answer the surveys' research questions (Punch 2003, 63-65.)

2.4 Survey Research Design

With structured interviews, semi-structured interviews, and in-depth interviews can study different phenomena and seek different problems. The technical difference between these is how structured these interviews are (Tuomi 2018, 87-88.)

A structured interview is often used in quantitative research. With a structured interview, researchers can test hypotheses, and collected samples can be easily quantitated. The interview's objective is to get answers to all of the questions within given options in the researcher determined order. A structured interview is not often used in qualitative research, but it is possible to use it if the respondent can be categorized qualitatively (Tuomi 2018, 87-88.)

A semi-structured interview is closer to an in-depth interview. It is also called a theme interview. In a semi-structured interview, the researcher proceeds with specific chosen themes and questions related to them. One of the benefits is that researcher can deepen and specify questions based on answers. Interviews are implemented almost open interview style to a structured form. It is impossible to ask anything in a theme interview and intend to find meaningful answers related to the research purpose and problem setting or research question. The chosen themes are chosen in advance at the primary level, and they are based on the research's theoretical framework (Tuomi 2018, 87-88.)

An in-depth interview is entirely unstructured. It is phrased as an open interview, clinical interview, customer-centric interview, and conversation like an interview. Open questions are used in in-depth interviews; only the phenomenon which is chosen is predetermined. Open questions do not qualify for an in-depth interview; the objective is that research deepens answerers answers, thus building an extension for an interview based on collected answers. An in-depth interview phenomenon is emphasized as openly as possible, which means that there are only a few answerers, possibly only one, and the same interviewee might get interviewed several times (Tuomi 2018, 87-88.)

Market analysis is based on the metering. When using interviews and survey research methods, single or multiple questions are meters. These meters determine the reliability of the research. The survey form's integrity is made up of questions. It is good to start with exciting and easy questions, which do not contain multiple answer choices. It is essential to get the answerer involved, as every answer is valuable. The survey is not a competition. More delicate questions should be at the end of the survey. Surveys and interviews should progress logically, one subject at a time. When changing the subject, a few words as an introduction would be good. The question sequence should be revised and transform from one question to another is correct. A good question is short, clear, unequivocal, and contains only one question. There should be answering choices to help to answer and prevent monotonously. Open-ended questions bring pace and variation to the survey. The researcher should avoid leaving open-ended questions till the end. Researchers should bear in mind that answerer answers are based on their values, not researchers. If the subject and questions are interested or the answerer feels like a professional among the subject, a positive vibe immediately exists. The target audience is not just a passive reporter. If the survey form does not require influence or feels complex for answerer fault, it is probably in the researcher (Lotti 2001, 159-160.)

These questions get answers with an email survey that the researcher sends to the provided contact list. The survey form consists of quantitative and qualitative questions, so data is in both forms to analyze. The thesis's scope has been modified from the FABULOS point of view. A necessity deliverable related to this project and deliverable has been decided in the grant agreement's policy and to meet that deliverable.

For the survey, Google Forms is used because it is free and easy to use and does not require any previous knowledge. Google Form is a cloud-based survey generating tool (Google). Metropolia accounts have been linked with Google, so the researcher got official visual materials and email in use.

Samples are given from the FABULOS project, and they are seen in appendix 1. Participants are involved in the FABULOS project. The demand side is represented with a possible of 10 answerers, and the supply side has 13. Sample count totaling 23. Demand-side participants are located in Europe, and they are operating public transport in European cities. The Supply-side is represented with a significant share in Europe. Two participants are located outside Europe (the USA and New Zealand).

3 Smart Mobility

What is Smart Mobility? There is no one absolute answer, and the researcher defines it as a smarter way of moving people and things around. The researcher has collected other researchers' views on Smart Mobility.

Here is one of the newest definitions (Ydersbond & Auvinen & Tuominen & Fearnley & Aarhaug 2020). They sum it up as "zero emissions, zero accidents, and zero ownerships for a better quality of life, emphasizing technology as a means for sustainability."

According to Noy & Givoni (2018), the "Smart City" paradigm is the concept and methodological origin of Smart Mobility. Various governmental bodies worldwide have adopted the smart city concept and definition. Smart City can be used as a mechanism for prosperity. Smart Mobility is an abstract designed to transform digital change in transport and mobility systems.

Šurdonja (Šurdonja & Giuffrè & Deluka-Tibljaša 2019) states that actions such as improving the efficiency, effectiveness, and environmental sustainability of cities are part of Smart Mobility. The use of IT defines an unlimited number of proposals that Smart Mobility can consist of. Smart Mobility eases people's movement and wares; it could provide six benefits: reduced traffic, reduced travel time, reduced travel costs, reduced pollution, reduced noise pollution, and improved safety during the trip.

Connectivity is a crucial aspect of Smart Mobility. It means open and big data. Data can be transferred to all traffic in real-time. Dynamic management can be done via public administrators. Mobile app users are immediately notified as mobility information can frequently change. This data contains the change in parking spaces, bus delays, accidents, train or traffic conditions. The terms "open data" and "big data" does not mean the same. The process that involves traditional database and software techniques and extensive data is usually difficult to process; the information generated by millions of journeys is recorded daily as "open data." Change in the demand for transport will happen as new transport systems and services will lead to it (Šurdonja et al. 2019.)

Van Oers states that (van Oers & de Hoop & Jolivet & Marvin & Späth & Raven 2020), the "big data myth" generally states that big data technologies produce information that can be improved. Recent efforts at the center of Smart Mobility surround the familiar undeniable assumption that agile management of data and outcomes will improve cheaper, secure, and sustainable cities. The hallmark of Smart Mobility is its ability to contribute to identifying the municipality through measurements and unrealized technologies to redefine urban transport systems towards significant efficiency and sustainability. Data storage, computation, and analysis are essential to these combined capabilities for assuming intelligent mobility applications. Urban actors see these three processes as demanding in order to prosecute mobility infrastructures in different ways. Inappropriate promises of faster or even real-time management - where users, who are also data producers, provide users with data-driven feedback to bring about change, are mobilized to encourage claims about optimizing or modifying data, performance, and use mobility networks.

According to Sjöman (Sjöman & Ringenson & Kramers 2020),

> "there is a broad consensus among researchers, industry, and governmental actors that digitalization and other technological advances can enable a changed transport system. The changed transport system is often referred to as "Smart Mobility"."

As stated in the introduction, the Smart Mobility industry is relatively new and developing fast. Helsinki is leading the way in Smart Mobility, and Helsinki Business Hub has made a terrific picture of how young these projects are. Within five years, there have been started multiple projects. FABULOS is one of the projects started in the Helsinki area. Other started projects similar to FABULOS are Sohjoa and Robobusline (Smart Mobility business opportunities in Greater Helsinki.)

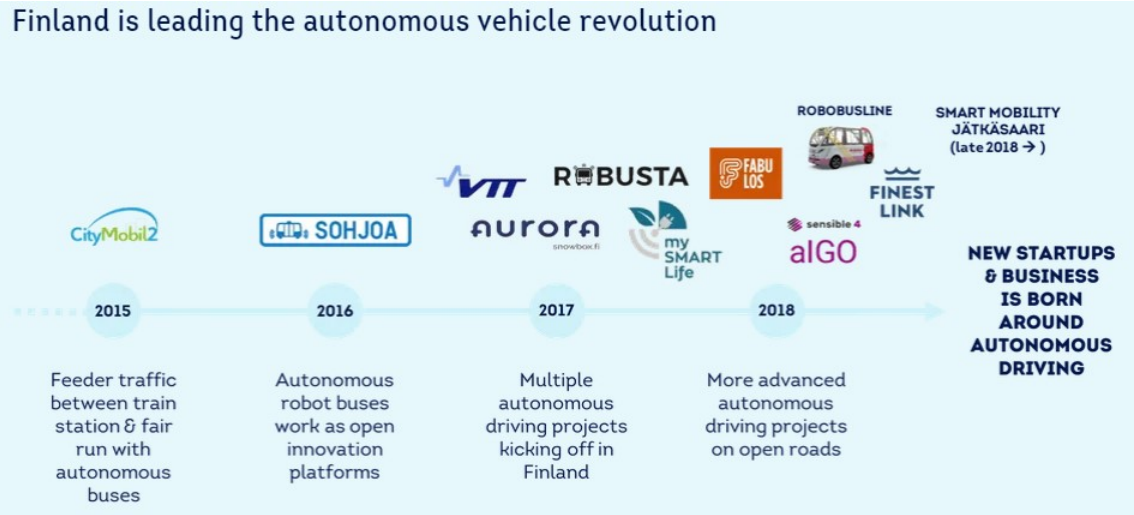

Figure 3. Finland is leading the autonomous vehicle revolution (Smart Mobility business opportunities in Greater Helsinki).

Consulting company Deloitte made a study in 2015 about Smart Mobility (Deloitte 2015.) This report states that Finland has announced a brave objective for the year 2025; Helsinki city's purpose is

> "to make it unnecessary for any city resident to own a private car. The goal is an on-demand mobility system that would allow customers to choose among public and private transport providers and assemble the fastest or cheapest way of getting anywhere they need to go at any time."

Something needs to be done to achieve this goal, so Smart Mobility projects such as FABULOS have started in recent years.

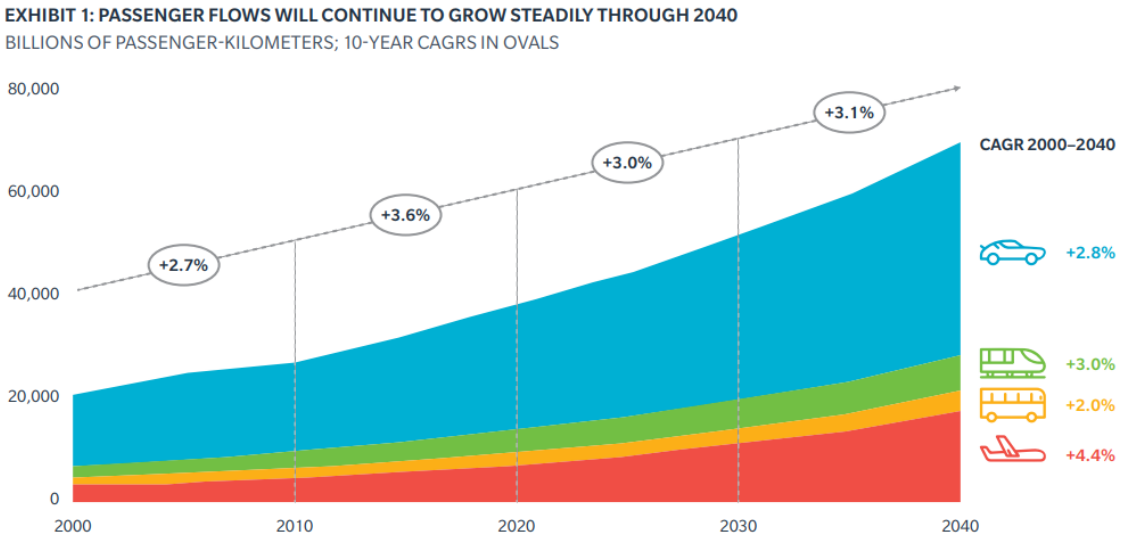

Figure 4. Passenger flows will continue to grow steadily through 2040 (Oliver Wyman 2018).

Wyman has also surveyed 7500 global consumers about Smart Mobility. They wanted to gain a deeper understanding of Smart Mobility from the passenger point of view. The survey questions these themes: the attractiveness of Smart Mobility to different traveler groups, their willingness to pay, impacts on modal shifts, and observation of companies in the Smart Mobility industry.

Consulting company Olive Wyman has researched Mobility in 2040, and as we can see in figure 4. It is forecasted that passenger flows will continue to grow steadily through 2040. That is one of the significant reasons why Smart Mobility will be needed. Traveler's preferences are shifting towards personalized and flexible end-to-end solutions such as autonomous vehicles. According to Wyman, mobility start-ups accumulated over 40$billion in investments between 2011 to 2016, and these investments are forecasted to be doubled year over year (Mobility 2040 2018).

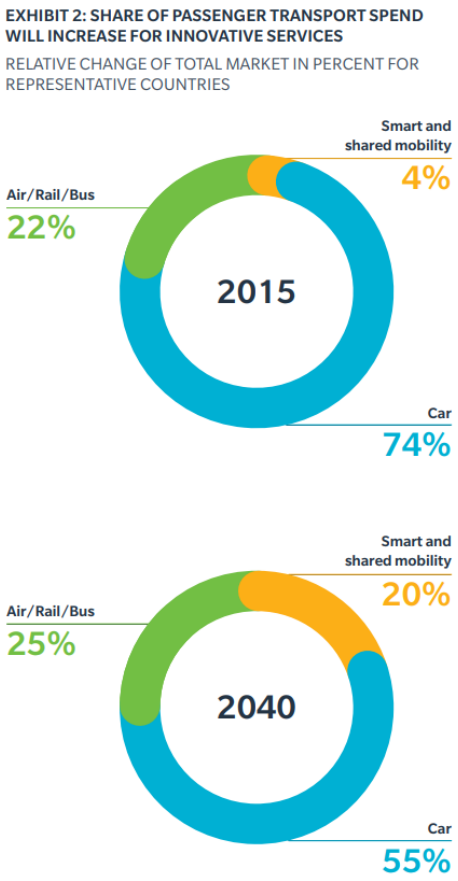

Figure 5. Share of passenger transport spend will increase for innovative services (Mobility 2040 2018).

3.1 Smart Mobility conceptual framework

Based on the academic literature presented above, the researcher has summarized the key themes in a conceptual framework. These themes are linked to the survey that is going to be conducted. The researcher has chosen four main aspects of Smart Mobility based on academic literature: technological aspect, environmental aspect, societal aspect, and economic aspect. The conceptual framework (figure 7.) is done via a cloud-based Internet app.

According to Romero & López (2014), developing transport systems has gradually expanded its objectives to include optimization of economic supply, efficiency in energy usage, environmental issues, safety, regional and social equality, and living standards. The transport sector's importance and its impact on the environment are vital to achieving

energy efficiency targets. In the future, mobility will increase as economic development continues, increasing emissions and energy consumption in the mobility sector.

For the technological aspect, Noy & Givoni (2018) mentions these solutions:

> "automated and autonomous features and vehicles, integrated and connected vehicles vehicle to vehicle (V2V) and vehicle infrastructure (V2I), user applications for car sharing, co-preparation, riding, ticketing, parking, navigation, data and intelligent transport System (ITS)."

Ydersbond states that (Ydersbond & et al. 2020) firstly, ownership will be changed so that users of the mobility system will have less ownership of personal means of transport. Second, the mobility market's definition is being changed as "the traditional business model for sharing public and private tasks throughout the mobility system is evolving". Thirdly, the transition from a "modal-centric" system to a "user-centric" system, in which user demand is given priority over different modes of transport. Fourthly, travelers will have a new role. The traveler is increasingly a "source and recipient of information and services. They are one of the many actors that feed information into the mobility system."

Intelligent Transport Systems (ITS) reduce traffic congestion and pollution by optimizing Smart Mobility, affordability, safety, and fuel efficiency. The benefits from the Intelligent transport systems is that it can solve traffic congestion and make air quality better. ITS include software solutions and various technologies for transportation. These include highway and event management systems, electronic toll collection, and advanced traffic management systems. It could provide advanced information systems, dynamic signaling, real-time navigationing and advanced public transport systems for passengers. (Šurdonja et al. 2019.)

Sjöman states that (Sjöman et al. 2020) Mobility as a service (MaaS) is frequently cited as an integral element of Smart Mobility. Mobility as a service is characterized as a concept that uses a modern approach to provide options for transportation and services. It allows using a different kind of transport options. This approach combines certain types of mobility interface plans for different modes of transport. These different modes provide an option for owning a car. Smart mobility gives the opportunity to distribute prosperity and reduce pollution and shorten time delays identified in privately owned cars.

Transforming Smart Mobility requires prudent and knowledgeable politics to achieve sustainable transport and the aimed impact on communities. If there is no governance,

digitized mobility such as MaaS might end up to old mobile practice based on private-owned cars, thus increasing pollution and congestion. Removing private owned cars from the standard alternative of transport, particularly communal transport, cycling, and increased pedestrian movement, is essential to dwindle pollution. Challenge is to design public modes of transport that are as agile and convenient as services built for privately owned cars. Thanks to a smooth and convenient promise, MaaS can be seen as a clear plan to replace a single car (Sjöman et al. 2019.)

Prosperous mobility alternatives like Uber are private vehicle-based and primarily take over walking, cycling, and communal transport. The planned new mobility services will be challenging to compete with private cars, mainly due to public transport's unique destinations not accessible. It is suggested that coercive measures are needed to move from car-based transport. Coercive measures must achieve these if they are politically achievable. Financial incentives and governance to support cars' transition from society can be politically challenging to appoint without adequate mobility options. MaaS can potentially be reflected in dwindling greenhouse gases by encouraging people to change from private cars to different modes of transport (Sjöman et al. 2020.)

The expected capacity of smart mobile applications is seen as an exceptional concept for making the decision. Calculations are essential to managing mobility systems to meet goals and expectations like reliability, security, and optimization. This report on Smart Mobility has begun to provide futuristic thinking on transport systems in European policy and practice. The diversity of opportunities for Smart Mobility is described from the proposed change in ownership to use. These proposals include: reducing CO2 emissions and fuel substitution in the mobility system, optimizing demand, intermodality, and increased connectivity (van Oers et al. 2020.)

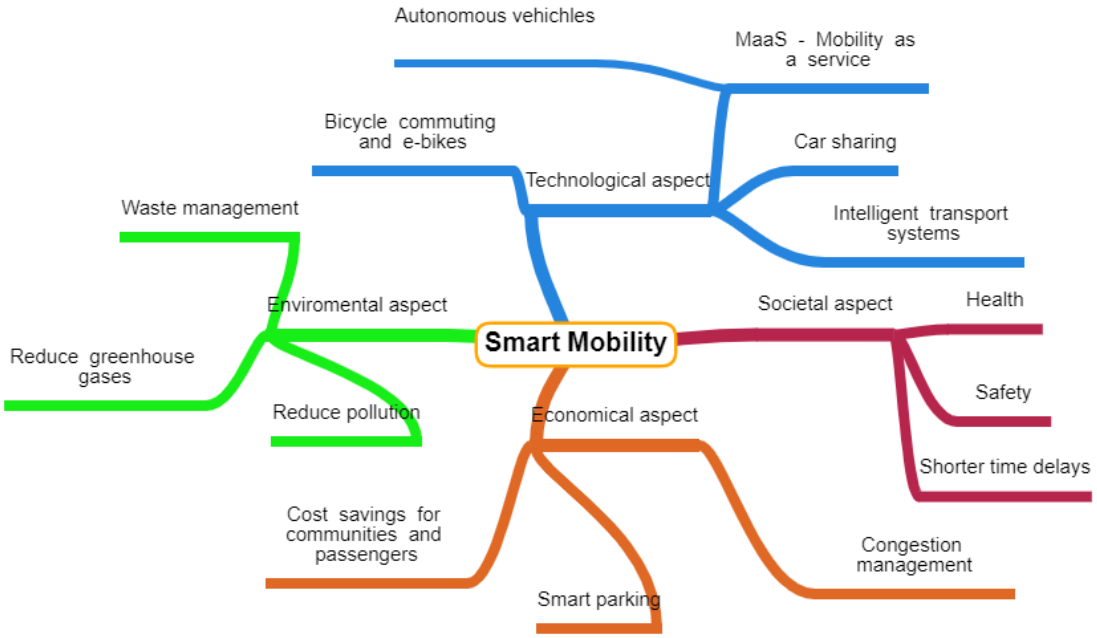

Figure 7. Conceptual framework of Smart Mobility.

From these sources, the researcher has made a conceptual framework of Smart Mobility, seen in figure 7. In this research, the researcher wanted to obtain information from the Smart Mobility demand-side and the supply-side. The researcher divided Smart Mobility into four different aspects and collected propositions for each of them. These propositions were the most appeared in the source materials. In order to enhance both survey participants' views, their propositions were taken into the survey. From these propositions, the researcher could analyze both participant groups' views on different subjects.

4 Market Analysis

Data and informatics are needed in order to achieve knowledge. Knowledge is needed to make decisions. Successful decisions are the basics for successful and profitable operations in the markets. Market analysis's objective is to gain knowledge that assists in decision making. Market analysis is based on indicators and statistics produced regularly and systematically (Lotti 2001, 26.)

According to Aaker (2014: 55-59), market analysis has two primary objectives: determine the market's attractiveness to current and potential participants and understand the market dynamics. Market attractiveness is seen as the market's profit potential measured by its participants' long-term return on investment. The market dynamics include identifying several factors, such as emerging submarkets, critical success factors, trends, threats, opportunities, and strategic uncertainties. Aaker also suggests that the starting point of the market analysis is market size, measured as total sales level in most cases. It is often useful to consider the market's potential size too, and after the potential market size has been estimated, forecast the market's growth.

Materials for Market analysis are not always ready for the researcher. Still, indicators, meters, and statistics can be collected gradually, start from some point, and complete as a whole. Market analysis is usually based on a continuous or repeatable metering process. One of the repeatable processes is the overall market and market share study. If the study is performed only once, it does not need to consider relative timing or regional differences. Repeatable study implies that the information is taken from the same group regularly, for example, yearly. The critical point is that information is comparable so that the variety is measurable. Another criterion is the exactness of the needed information. Research methods are: explorative, descriptive, and interpretive (Lotti 2001, 105-108.)

The explorative research method is informal. It is based on existing statistics, the Internet, trade association, and perhaps a couple of specialist interviews. It is often described as desk research. In a descriptive study, information is gathered systematically with different interviews and selected target group sampling. Information is gathered from opinions, attitudes, values, customer relationships, satisfaction, brands, and image. These studies are repeatable, and the target is to know what has changed. The interpretive

research method is the most demanding; it measures which effects on what and how. It clarifies several factors and their effect on each other. Interpretive research can also be made experimental in the laboratory (Lotti 2001, 105-108.)

The market analysis may contain a more in-depth market profitability analysis if possible. Michael Porter has developed a five-factor market profitability model based on market attractiveness by the long-term return on investment. The average firm depends on five factors that influence profitability, shown in figure 8. (Aaker 2014, 62.)

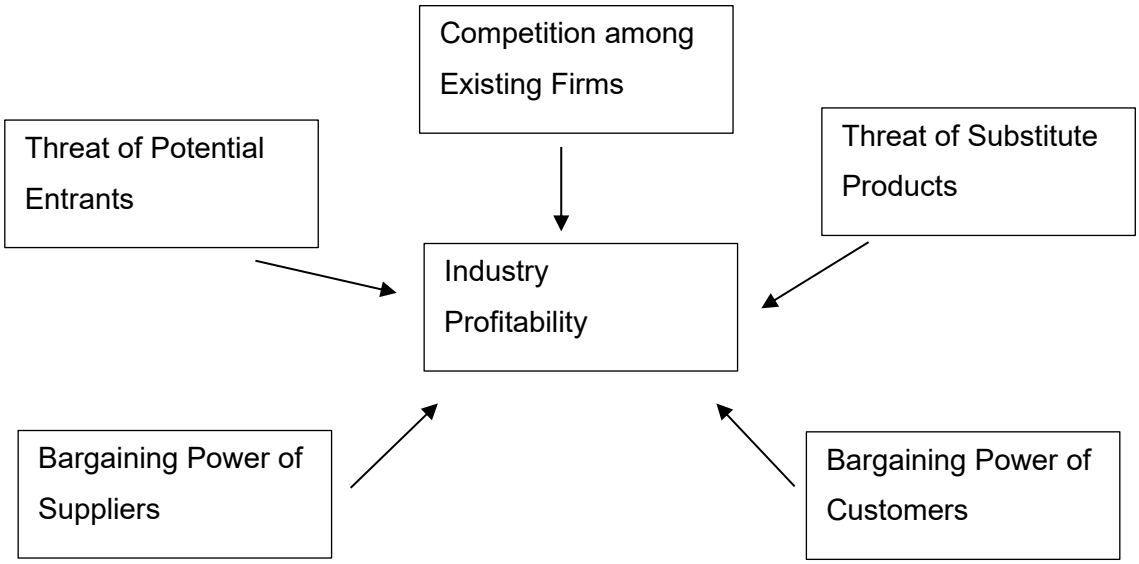

Figure 8. Porter's Five-Factor Model of Market Profitability (Aaker 2014, 62).

4.1 Market analysis survey

The survey aims to acquire knowledge from the supply side (vehicle/software provider) and demand (public transport operator) side of the Smart Mobility industry. Samples are given from the FABULOS project, and they are seen in appendix 1. Participants are involved in the FABULOS project. The demand side is represented with a possible of 10 answerers, and the supply side has 13. Sample count totaling 23.

It is essential to get answerers to answer the survey. In order to get answers, the researcher should mind this simple guide: make answerer feel important, explain why this

survey is conducted and how data is going to be used, tell them how long it is going to take to fill the survey, and try to keep it short and ask direct and short questions (Lotti 2001, 159-160.)

First is the introduction part, which is a sort of invitation to answer the survey. This text is located in the email that Google Forms is sending to recipients. It is phrased like this: "Dear Sir/Madam, as a representative of Metropolia University of Applied Sciences, I am inviting you to fill a market analysis survey for the FABULOS project. Answering will not take longer than 5 minutes. Your answers are anonymous, email addresses are only collected for follow-up. These answers are used for my master thesis, and a public report is conducted for the FABULOS project. Your answer is highly appreciated. Br, Eero Tuulainen"

The first question is related to which party the answerer is representing, either the demand or supply side of the Smart Mobility industry. The survey is divided into two parts, and questions are designed for each side.

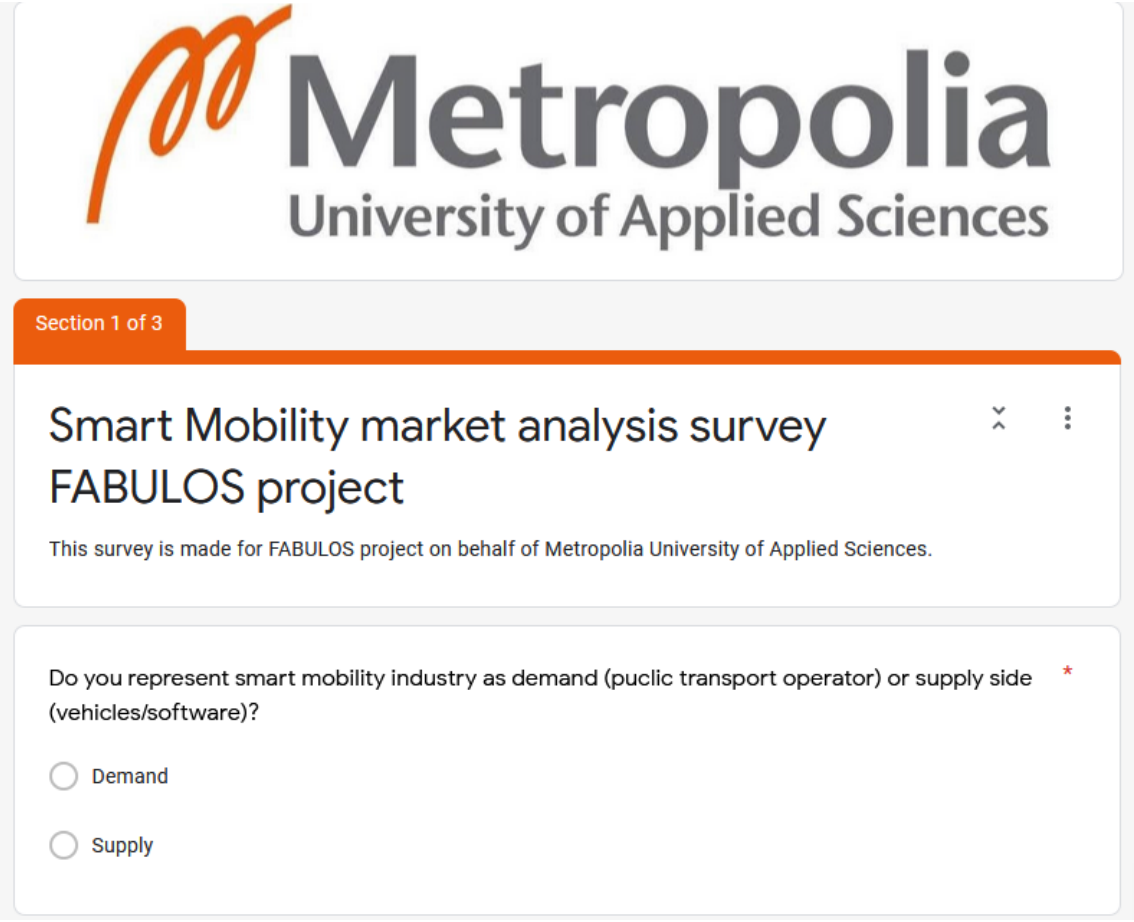

Figure 9. Smart Mobility market analysis survey header and question number 1.

The front survey page is formal, looking with the official Metropolia logo and visuals.

The second question is the basic knowledge of the answerer. It is not required to get detailed information on the answerer, so only the location is needed. A drop-down selection for this and answer choices are these: Denmark, Estonia, Finland, France, Germany, Netherlands, New Zealand, Norway, Portugal, Sweden, Switzerland, USA, and Other. This question is the same for both groups.

The third question is related to market size. From the supply side, how much revenue companies generate within the Smart Mobility industry, and the demand-side, how much they are spending on projects within the Smart Mobility industry (million euros). Choices are for supply-side: below 0,1, 0,1-0,5, 0,5-1, 1-5 and over 5 million. The demand side choices are: below 0,5, 1-2, 2-5 and more than 5 million.

The fourth question is also related to the market size and maturity of the industry. Both groups answer the same question, "How mature Smart Mobility industry is?" and choices are on a linear scale: one is pre-mature, only start-ups, and five is well matured, all the major participants are involved.

The fifth question is about the future of the Smart Mobility industry from the answerer point of view. The question for the supply-side is: "In 5 years perspective to the future, how is your business going to develop within Smart Mobility?". Multiple answering choices: none or smaller than now, steady stable as it is now, medium growth with more R&D, fast growth with more focus on Smart Mobility, and super-growth with full steam ahead. For the demand-side: "Are you going to increase or decrease the budget for Smart Mobility projects in the future?" Answer choices with linear scale one is yes, increase by more than 25%, and five is no, decrease by more than 25%.

The sixth question is open-ended, and it is about Smart Mobility at the general level for both groups. It is "What Smart Mobility means to your company/organization?" The researcher is assuming to get versatile written answers and find something interesting.

Questions from seven to ten are related to the conceptual framework as a whole. Questions are the same for both groups. The seventh question is "which one of these propositions is the most important?" and answering choices are cost savings for communities and passengers, smart parking, or congestion management. The eight question is

"Smart Mobility from the technological perspective, which one of these propositions is the most important?" and answering choices are autonomous vehicles, Mobility as service, or Intelligent Transport Systems. The ninth question is "Smart Mobility from the environmental perspective, which one of these propositions is the most important?" and answering choices are reducing pollution, reducing greenhouse gases, or waste management. The tenth question is "Smart Mobility from the societal perspective, which one of these propositions is the most important?" and answering choices are health, safety, or shorter time delays.

The eleventh question is open-ended and wants to determine the expectations both groups have for each other. There is a chance to get diverse answers, which are interesting for the research—hoping to get more insight into how they feel.

The last question is number twelve, and it is the same for both groups. It is about how supply and demand sides monitor the Smart Mobility market and information about new market participants on the supply side. The question is, "Have you noticed a change in Smart Mobility suppliers?" and answer choices are: yes, new players have entered the market, no situation remains stable, and maybe, I do not follow the market situation.

For this thesis, the survey's role is essential. The researcher has put much effort into creating a survey that will be the best possible option. The survey is the primary source of obtaining information for market analysis. The survey must answer research questions correctly, and the researcher can collect data and analyze them.

5 Results

A Smart Mobility market analysis survey was carried out during 30.11.2020 – 6.11.2020. The survey answering time and the survey were relatively short—that way, the researcher wanted to achieve a relatively good amount of answers. Questions were kept short and simple. One reminder was sent to participants in the middle of the survey period. The survey got eight responses, with the answer percentage being around 35%. One of the answerers has filled answers for both supply and demand side. It was unintentional. The researcher has not thought of that happening.

This pie chart shows participants' answers to the first question. It can be seen that three-quarters of the participants represent the demand side of the industry. From the sample count, the supply-side had 13 possible participants, and the demand had 10. The overall answer percentage is 35%, the supply side is 15%, and the demand side is 80%.

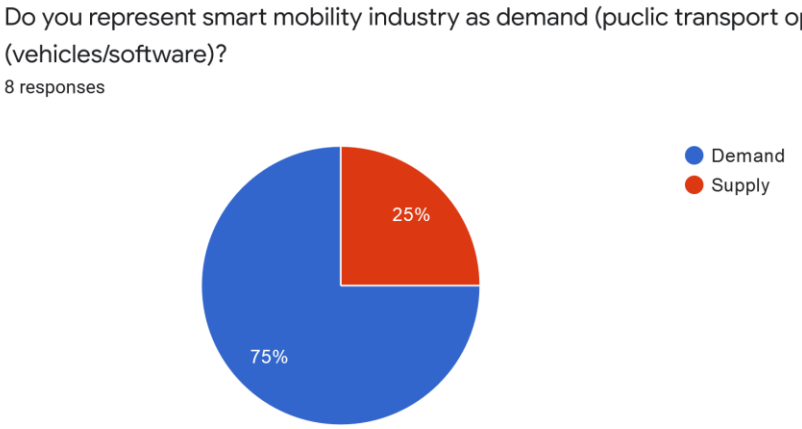

Figure 10. Survey participant's dividend.

5.1 Supply-side results

This pie chart shows supply-side participants' geographical business locations. One of the participants was from Estonia, and the other was from Norway.

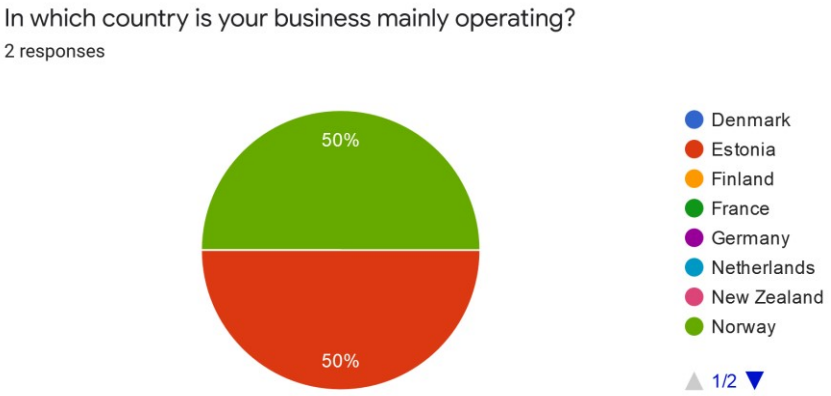

Figure 11. Supply-side business locations.

This graph shows the revenue generated from the Smart Mobility industry. Participants' companies represent the different sizes of companies. One is still a small one, and another has approximately ten times more revenue than smaller ones.

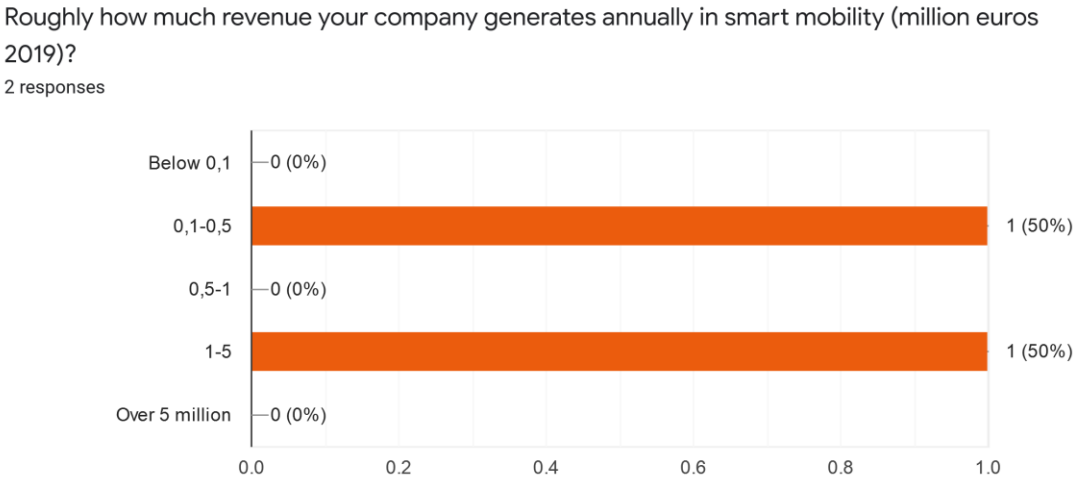

Figure 12. Supply-side revenue generated.

This graph shows a supply-side view of Smart Mobility state of maturity. The view was somewhat divided; one half stated that maturity is close to the pre-mature stage, and the other one states that the Smart Mobility industry is close to a well-matured state. It is an exciting finding, as this may reflect participants' business size.

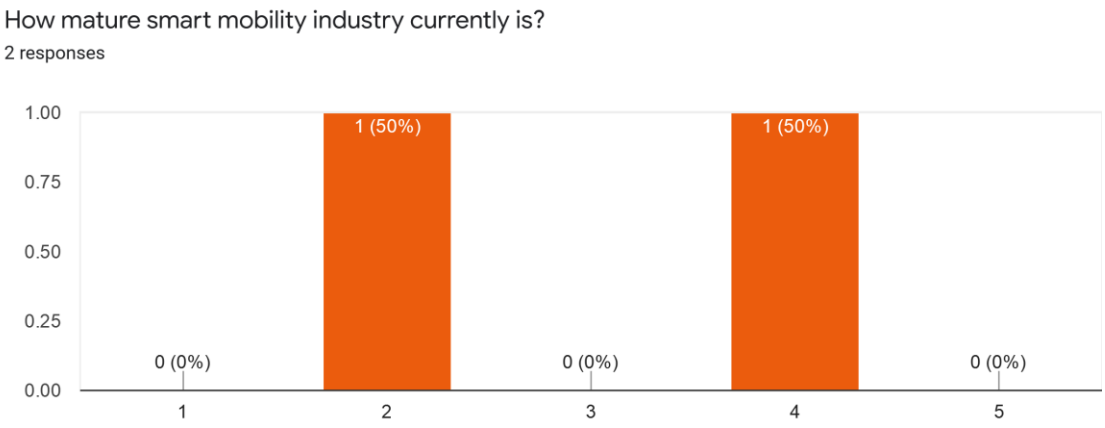

Figure 13. Supply-side view of Smart Mobility state of maturity.

This pie chart shows the supply-side participants' view of the future. It has only one clear statement, both of the supply side companies are stating that they will develop their business with increased efforts within the Smart Mobility industry.

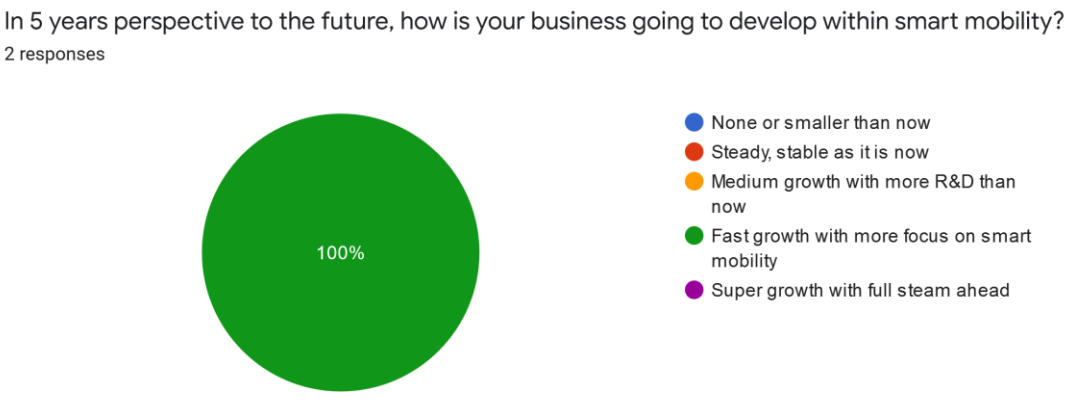

Figure 14. Supply-side future plans.

This pie chart shows the supply-side participants' view of Smart Mobility from an economic perspective. Answers were divided, half of the answerers went to cost savings and another half to congestion management. Smart parking did not get attention.

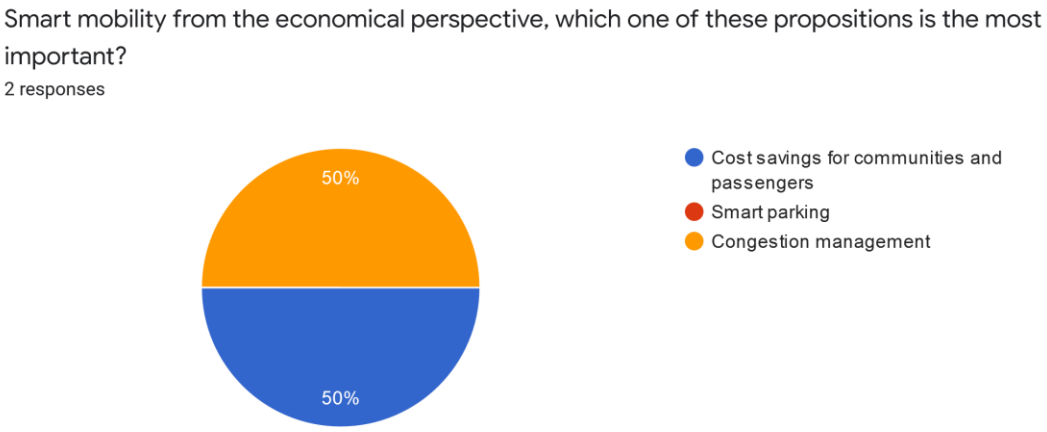

Figure 15. Supply-side view of Smart Mobility from an economic perspective.

This pie chart shows the supply-side participants' view of Smart Mobility from an environmental perspective. This one has clearly shown that both answers are focused on reducing pollution. Greenhouse gases are maybe associated with pollution, so that may reduce the answer to that. Waste management is not on the priority list for the supply-side.

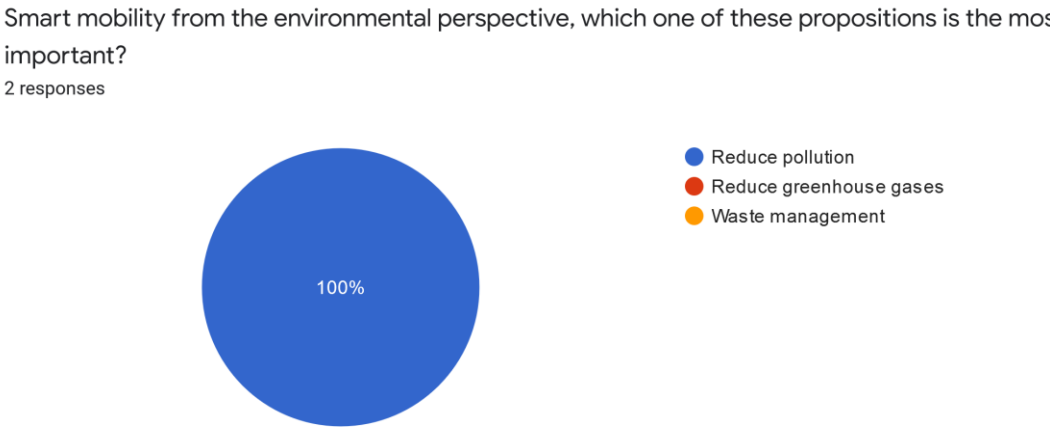

Figure 16. Supply-side view of Smart Mobility from an environmental perspective.

This pie chart shows the supply-side participants' view of Smart Mobility from a technological perspective. Autonomous vehicles and intelligent transport systems got attention from answerers. It might be related to participants' field of business, MaaS might not be their core business.

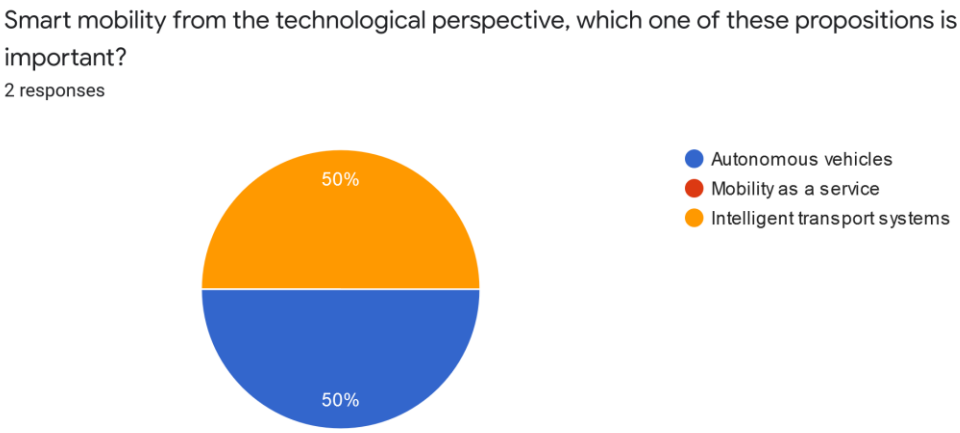

Figure 17. Supply-side view of Smart Mobility from a technological perspective.

This pie chart shows the supply-side participants' view of Smart Mobility from a societal perspective. Answers were divided between safety and shorter time delays. The researcher was astonished that health did not get attention from answerers.

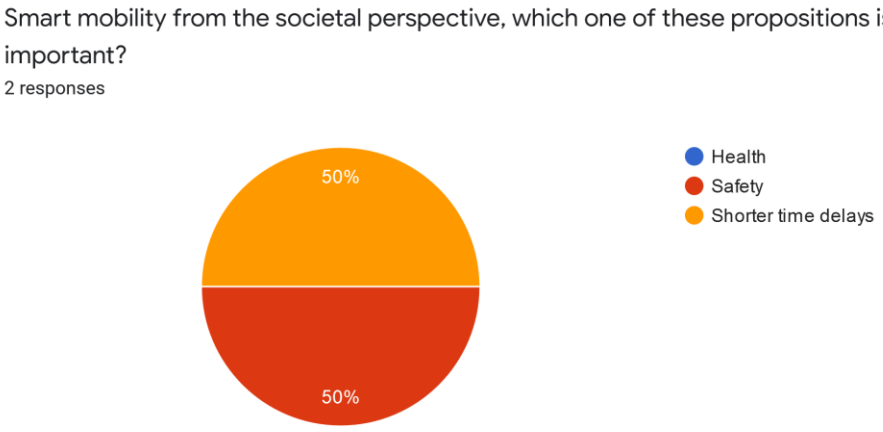

Figure 18. Supply-side view of Smart Mobility from a societal perspective.

This graph shows the supply-side of the Smart Mobility market changes. Participants have noticed a change in the market, and participants monitor the market at least with some level of attention.

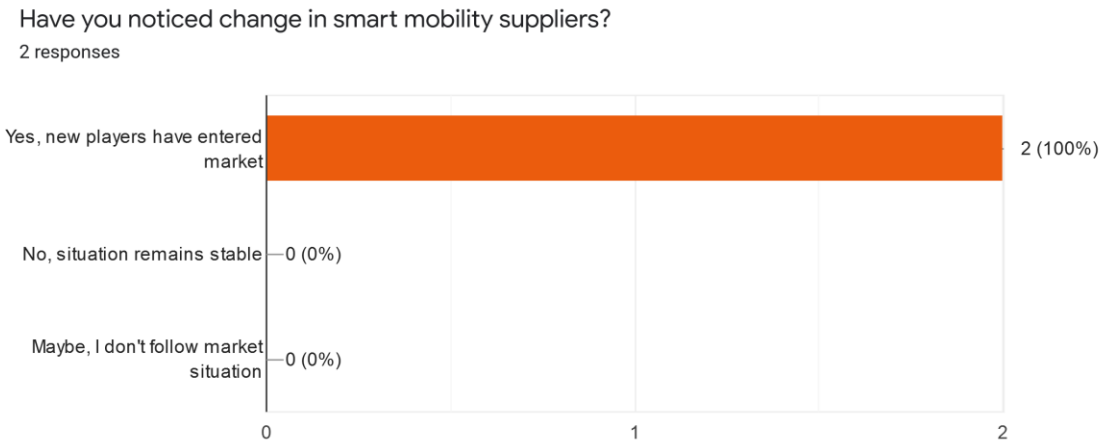

Figure 19. Supply-side view of Smart Mobility market changes.

For the open-ended questions, the supply-side answers are quoted here. The first open-ended question was "*What Smart Mobility means to your company?*" and the answers were:

"Smart Mobility system and smart cities. Autonomous vehicles, V2X systems, lot of data gathering etc.

Open solutions easy to integrate, Shared data, Predictably"

Another open-ended question was:

"What kind of expectations do you have towards demand side (public transport operators) of Smart Mobility?" and the answers were:

"Personal car free city centres only alternative transport (last mile shuttles), green cities etc."

"Early adopters takes a risk."

To first, supply-side open-ended question answers have a lot of detailed technological aspects such as autonomous vehicles. It seems that the business side is fond of the technical side of the Smart Mobility industry. To second question supply side is answering with an environmental and economic point of view.

5.2 Demand-side results

This pie chart shows the demand-side participants' geographical locations. Finland and Norway have two participants, Estonia, Denmark, Netherlands, and Portugal has one participant.

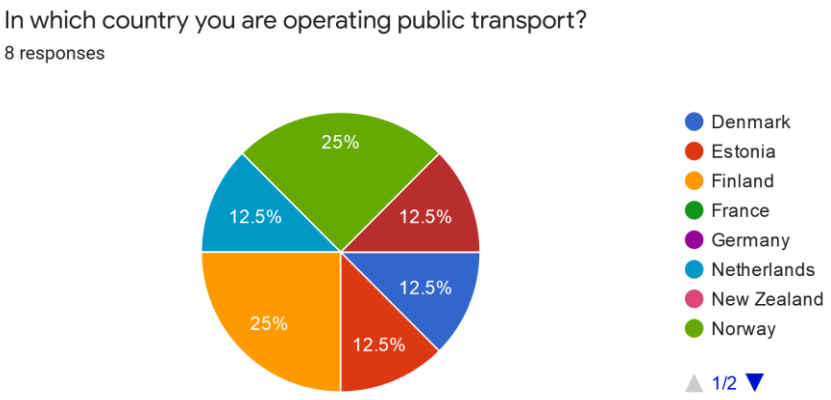

Figure 20. Demand-side public transportation locations.

This pie chart shows the demand-side participants budgeted projects within Smart Mobility in the year 2020. Budgets were divided into half, 50% of the budgets are over two million euros and 50% are below two million euros.

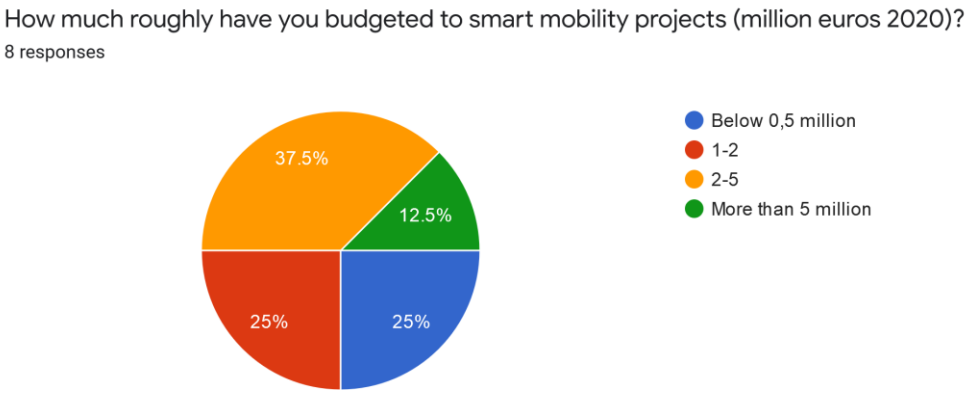

Figure 21. Demand-side project budget for Smart Mobility.

This graph shows a demand-side view of Smart Mobility state of maturity. The majority of the participants consider the Smart Mobility industry to be close to the pre-mature stage.

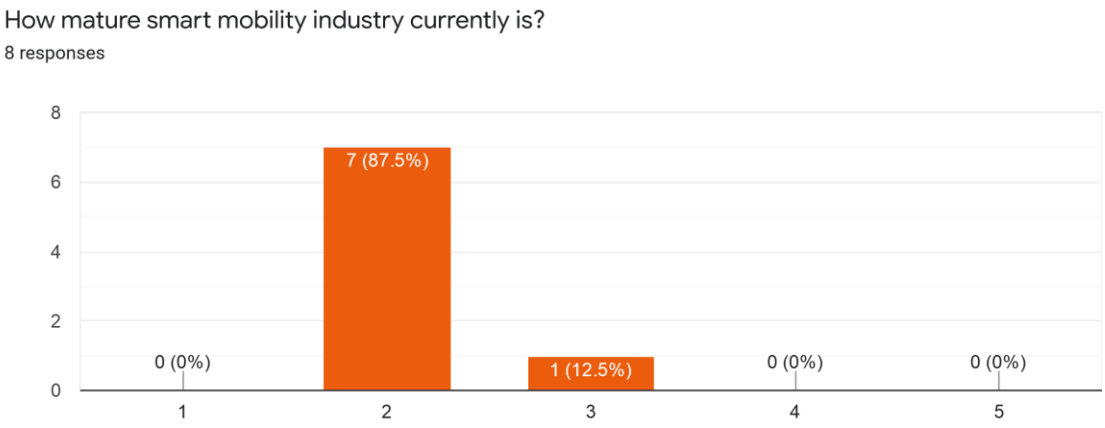

Figure 22. Demand-side view of Smart Mobility state of maturity.

This graph shows a demand-side view of willingness to invest in Smart Mobility projects in the future. Most of the participants will keep the budget at the same level as it used to be. Two of the participants are increasing the budget by more than 25%, and one participant will slightly decrease the budget in the future.

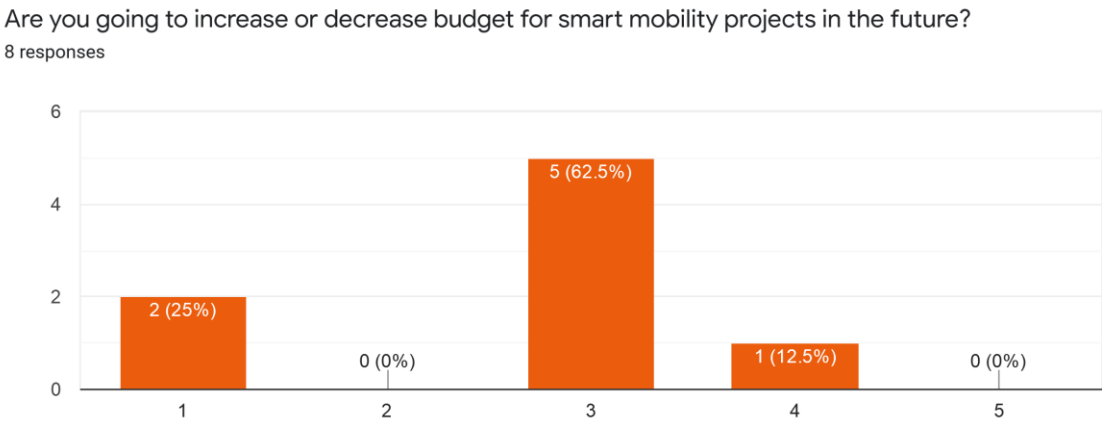

Figure 22. Demand-side future plans.

This pie chart shows the demand-side participants' view of Smart Mobility from an economic perspective. The majority of the participants state that cost savings are the most important, and congestion management was the two participants' top priority. Smart parking did not get any attention.

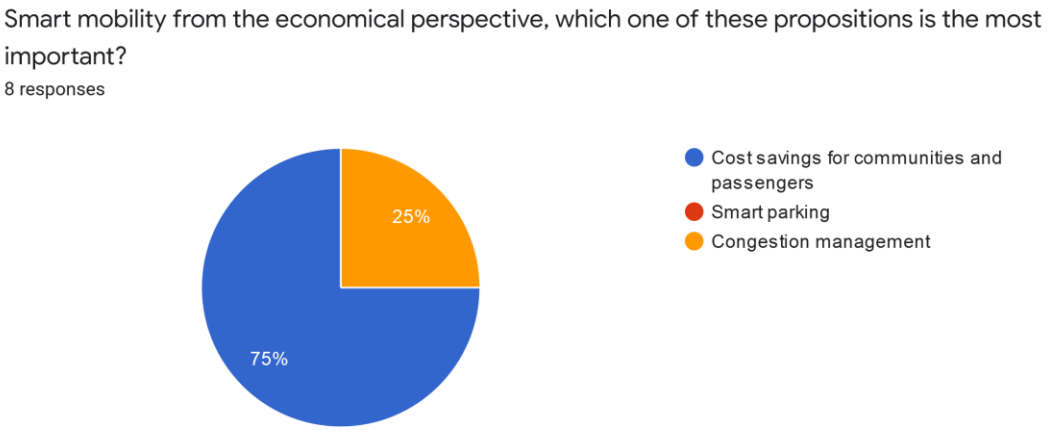

Figure 23. Demand-side view of Smart Mobility from an economic perspective.

This pie chart shows the demand-side participants' view of Smart Mobility from a technological perspective. Half of the participants favored intelligent transport systems, MaaS, and autonomous vehicles got the same 25% rating.

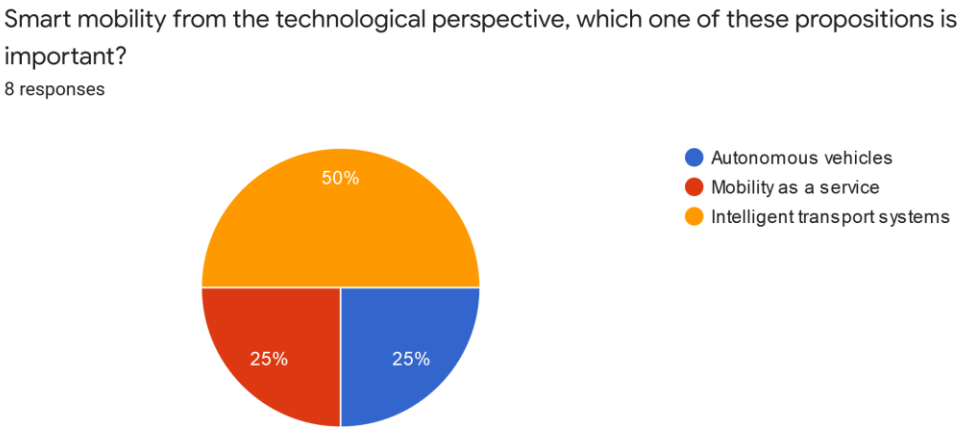

Figure 24. Demand-side view of Smart Mobility from a technological perspective.

This pie chart shows the demand-side participants' view of Smart Mobility from an environmental perspective. The majority of the participants stated that reducing pollution or greenhouse gases was the most critical environmental task. Waste management was not considered to be necessary.

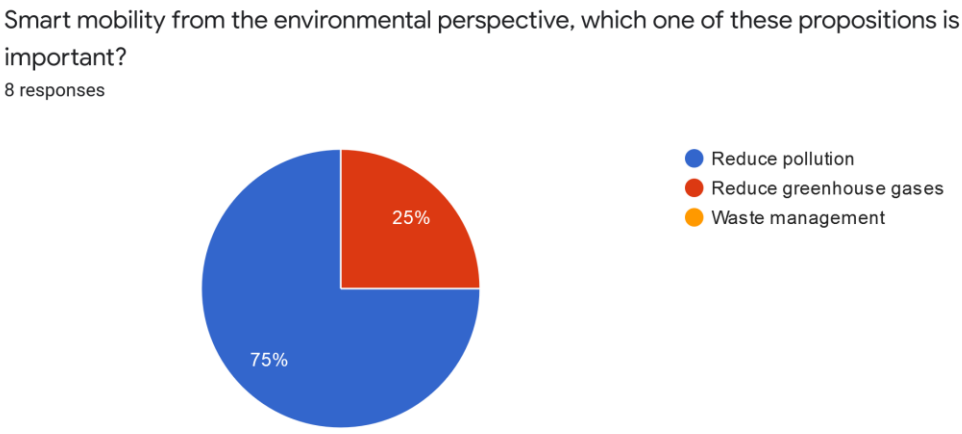

Figure 25. Demand-side view of Smart Mobility from an environmental perspective.

This pie chart shows the demand-side participants' view of Smart Mobility from a societal perspective. Half of the participants stated that health was the most important thing. Safety got 25% of the answers, and one answerer stated that shorter time delays were significant. One participant chose another and answered, *"In addition to health and safety, the freedom of choice and ease of travel are important. Can't really put them in order*".

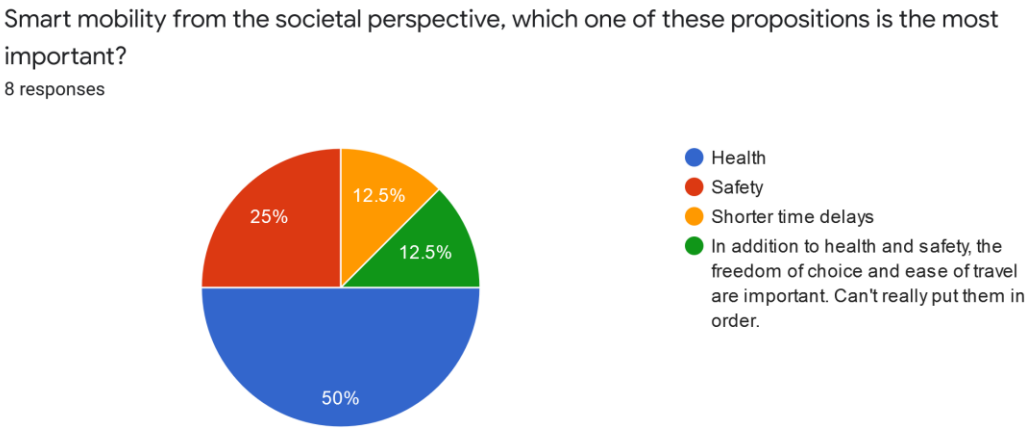

Figure 26. Demand-side view of Smart Mobility from a societal perspective.

This graph shows a demand-side view of market changes in Smart Mobility suppliers. Most participants have noticed a change in suppliers as new players have entered markets. A minor part of the demand side did not follow markets and could not tell are there any changes. One participant had noticed a change and not noticed a change simultaneously; this was unintentional.

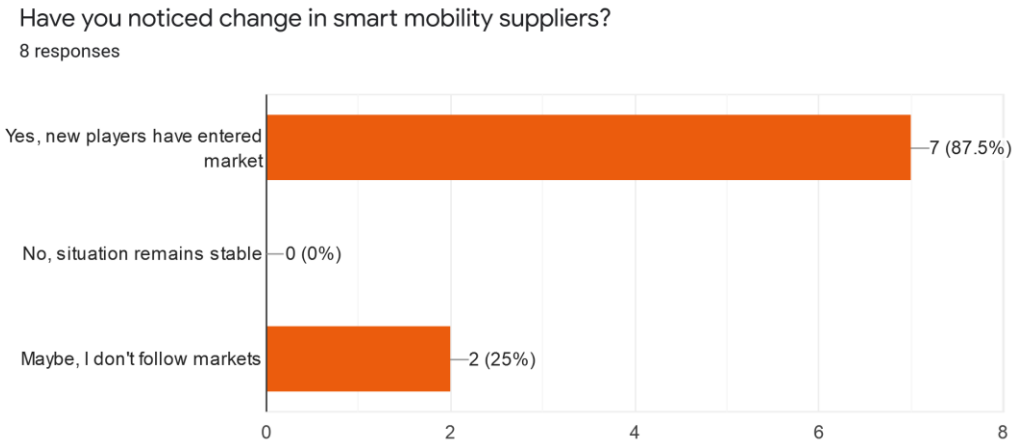

Figure 27. Demand-side view of Smart Mobility market changes.

For the open-ended questions, the demand side answered is quoted here. The first open-ended question was "*What Smart Mobility means to your organization?*" and the answers were:

"everything, our company is dedicated to Smart Mobility"

"Autonomous mobility"

"Using technology and services to provide sustainable mobility"

"an opportunity for the future"

"Many different modes of transport and ways of movement are connected, incl. taking advantage of the information and communication technology. The goal is efficiency, flexibility, security, accessibility, personality, need."

"Smart Mobility is a way of how we move in a cleaner, safer, more efficient and environmentally sustainable way."

"Much"

"Smart Mobility to us means flexible combining of various modes of transportation in ways that meet the needs of passengers."

It seems that the demand-side is not focusing solely on one subject. One participant's organization was entirely dedicated to Smart Mobility. Flexibility and sustainability were meaningful for the two participants. Three participants enhance the technological perspective of Smart Mobility. One participant's answer was just "much," maybe questioning was overwhelming.

Another open-ended question was:

"*What kind of expectations do you have towards supply side (vehicles/software providers) of Smart Mobility?"* and the answers were:

"Personal car free city hearts and green cities"

"That development of autonomous vehicles will accelerate in the coming years"

"Focus on factual benefits that can actually be implemented"

"I expect that the next 5 years we will see new developments on the field of smart mobility"

"Offering turnkey solutions. Flexibility."

"Expectations are high with regard to suppliers and the development and supply of new technologies"

"Big ones"

"Hoping for the supply side to enter the markets with functioning solutions. However, the demand side must most likely support and possibly also fund the projects of the supply side in the beginning for the solutions to be feasible."

The majority of demand-side answers were related to future wishes, such as rapid developments and flexible solutions from the Smart Mobility supply side. One participant doubt that demand-side might have to fund supply-side development projects. One participant's answer was just "Big ones," maybe questioning was overwhelming.

5.3 Results summary

Survey participants represented six different nations, and they were all located in Europe. Countries were: Denmark, Estonia, Finland, Netherlands, Norway, and Portugal. Supply participant's revenue within Smart Mobility ranged from 0,1 to five million, and demand-side project budgets ranged from below 0,5 to over five million. Participants are in very different Smart Mobility stages. It seems that dispersion is relatively high, based on how much money is involved.

Considering Smart Mobility maturity, most participants think that Smart Mobility is close to the pre-mature stage, and there are mainly start-ups operating markets. 80 % of the participants stated that markets are close to the start-up stage. The more developed market was seen as the only minority.

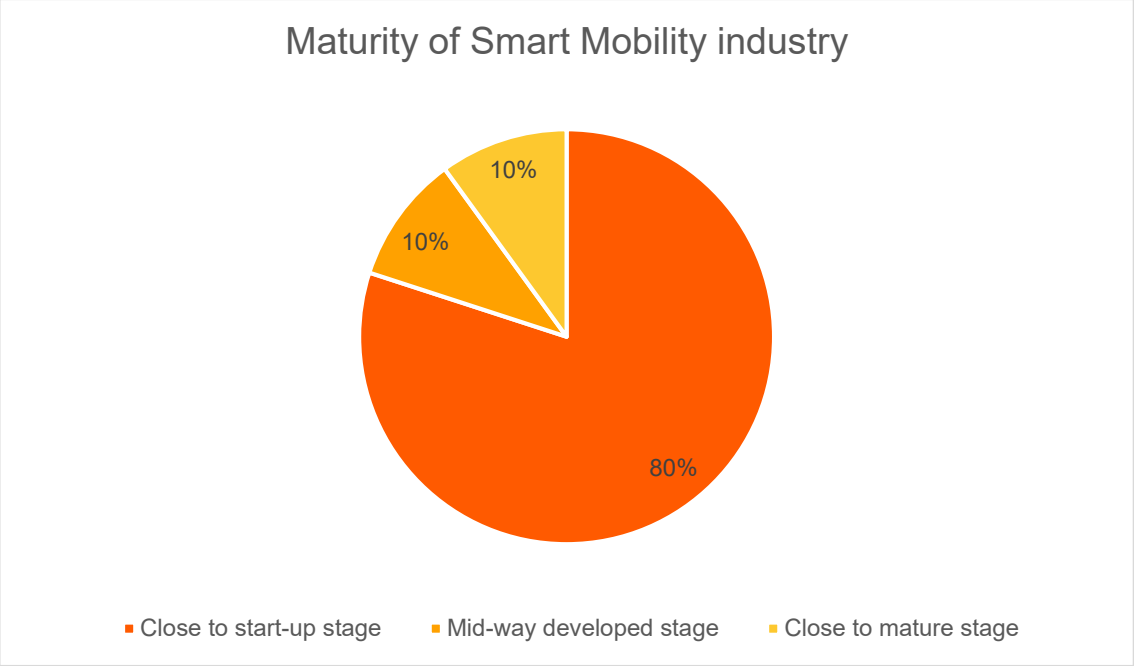

Figure 28. Maturity of Smart Mobility industry.

For future plans, the supply-side seems to be more optimistic towards Smart Mobility, they were anticipating fast growth. The demand-side was not that excited about the future; nevertheless, future budgeting was mostly neutral, as seen in figure 29. It seems promising that only a minority of the participants considered lowering Smart Mobility development or budgets in the future.

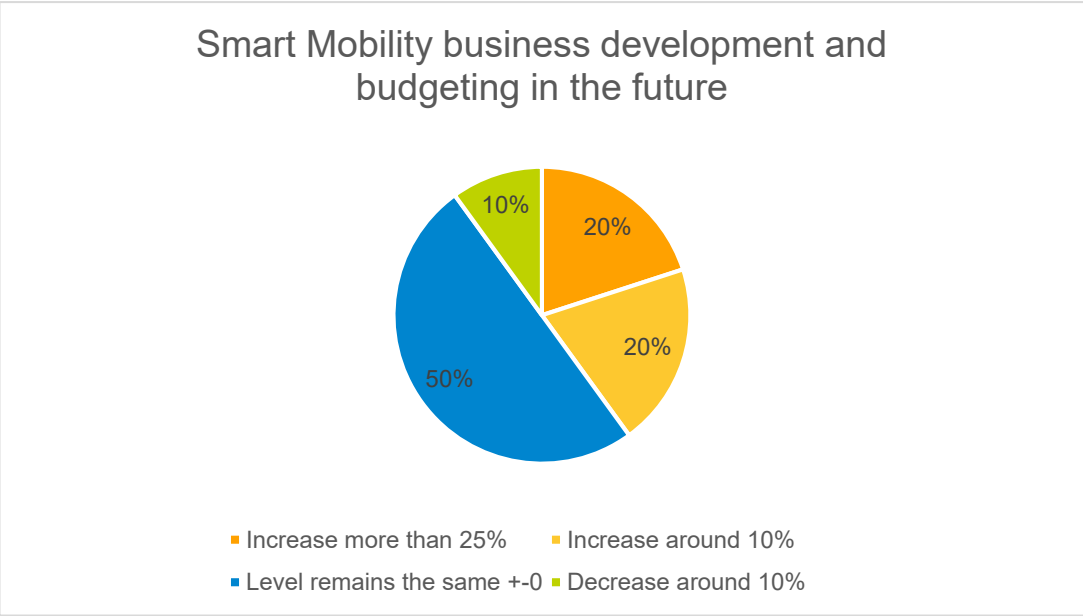

Figure 29. Smart Mobility business development and budgeting in the future.

The researcher wanted to test the conceptual framework related to Smart Mobility as apart of the market analysis, and participants answered four statements from economic, environmental, technological, and societal perspectives. The essential economic perspective was cost savings for communities, passengers, and the minority stated that congestion management was the most important. Smart parking did not receive any selections, so that is a clear signal that is not experienced essential. The technological perspective supply -and demand-side were on the same page, and Intelligent Transport Systems got majority preferences. Autonomous vehicles were second favorited, and MaaS was considered the least important. From an environmental perspective, reducing pollution was the most important thing for both supply and demand-side. Reducing greenhouse gases was also crucial for the minor of participants. Waste management did not fit either of the group's most crucial things list. The societal perspective was dividing these groups. For supply-side safety and shorter time delays were important, demand-side health was considered the most important thing. Safety was second, and the minority thought that shorter time delays and other things were the most important. It seems that public transport operators are emphasizing quality of life.

The researcher wanted to visualize the most important answers to demonstrate the analysis. The visualization shows that these words were among the highest incidences "Shorter Reducing Smart Transport Safety."

Figure 30. Word cloud related to survey results in the Smart Mobility contextual framework, created with Word Art.

As for open-ended questions, the researcher also used a word cloud to visualize all the given answers. For the open-ended question, "*What Smart Mobility means to your company/organization*?" visualization shows that these words were among the highest incidences; "Autonomous Smart Mobility System Data." These words were mostly used.

Figure 31. Word cloud related to survey results in Smart Mobility open-ended question, created with Word Art.

For the open-ended question, *"What kind of expectations do you have towards demand side (public transport operators) / supply-side (vehicles/software providers) of Smart Mobility?"* The visualization shows that these words were among the highest incidences; "Green Personal Development City New Solutions Car." Both groups had similar expectations towards each other, and these words were mostly used.

Figure 32. Word cloud related to survey results in Smart Mobility open-ended question, created with Word Art.

The last question for both participant groups was, "*Have you noticed change in Smart Mobility suppliers?"*. The researcher wanted to determine if supply -and demand-side are screening markets or awareness of suppliers' change. It is a strong signal that there are new suppliers entered the Smart Mobility market. A total of 80% of participants have noticed a change in suppliers.

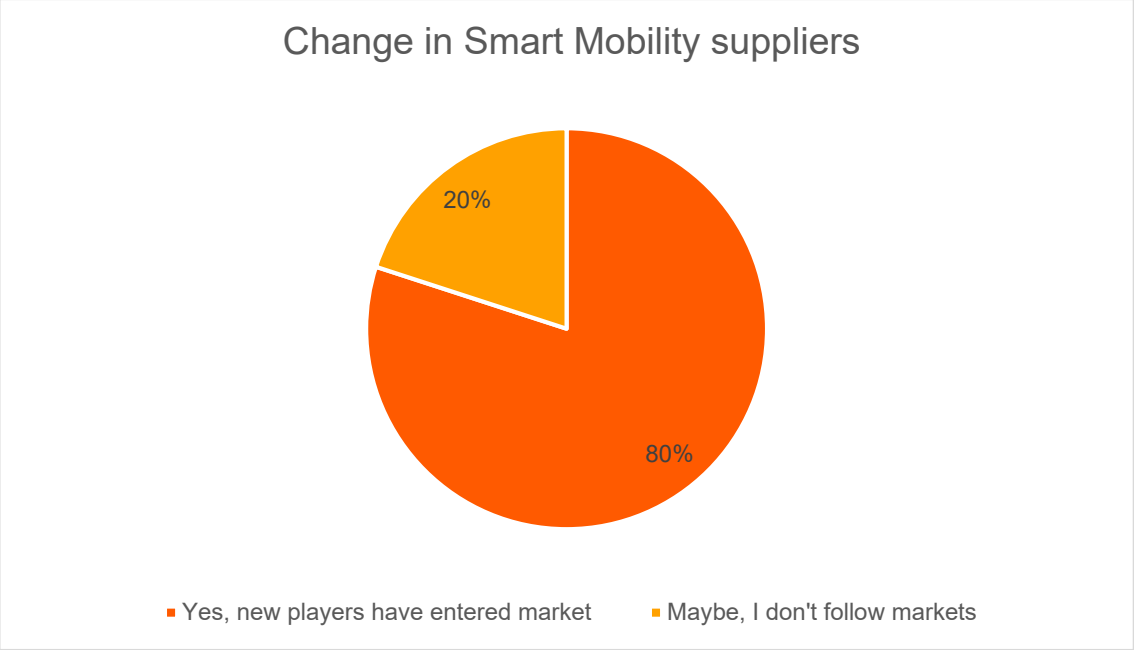

Figure 33. Change in Smart Mobility suppliers.

Overall conclusions based on the survey results are that Smart Mobility is a relatively small market based on revenues and project budgets. Survey results state that the Smart Mobility market is close to the pre-mature stage, with many young companies such as start-ups. Start-ups might not have big companies' resources and a limited amount of capital, supporting the view of a small market. It seems that change is coming in the future; the supply-side will increase development fast, and the demand-side is at least providing stable budgeting for the coming years and, that way, funding supply-side. Survey participants also stated that new suppliers are coming to the Smart Mobility market. The deduction is that Smart mobility markets are going to expand and more financial flow to the Smart Mobility market.

The researcher had made the framework based on the literature view of Smart Mobility (see figure 7.), and these assumptions were close to survey participants' answers. Participants considered cost savings for communities, Intelligent Transport Systems, reducing pollution, health, and safety as the most important aspects of Smart Mobility.

Open-ended questions provided some insights for the supply -and demand-side. The researcher wanted to know the foundation of Smart Mobility and formed a question for both participants, "*what does Smart Mobility mean to your company / organization?*" Smart Mobility seems to mean many things depended on the answerer's opinion. The researcher summarizes it as "Smart Mobility is a technological solution for various modes

of sustainable and flexible transportation". For another open-ended question, *"What kind of expectations do you have towards demand side (public transport opera-tors) / supply-side (vehicles/software providers) of Smart Mobility?"* Both participant groups wanted personal car-free cities with new technologic solutions. Participants were confident that the development of Smart Mobility solutions would be accelerated within the coming years. The supply-side was worried about the risk of early adopters. The demand-side was worried about suppliers' lack of funds, and the demand-side have to carry a financial burden.

6 Conclusions

This section provides an evaluation of the thesis and summarizes key findings.

6.1 Managerial implications and recommendations

This research has studied the Smart Mobility industry from two point-of-views; supply and demand-side. FABULOS project might already have some sort of information, but with this new information, the project got more useful knowledge about market participants. It is advised that the FABULOS project carry this information to new projects. FABULOS project is ending at the end of 2020, but new Smart Mobility projects will be started. This research might be useful for new projects, which require knowledge related to Smart Mobility markets.

For the supply-side, it is recommended to keep on investing in the Smart Mobility industry. Demand for Smart Mobility solutions is expected to be stable or increasing soon, based on demand-sides answers related to their investing willingness. The balance between parties' financial risks is one major issue to look at. For the supply-side public investors, such as public transport operators, it seems to be an attractive business partner as financial risk might be lower than the private sector's.

To achieve sustainable and flexible transportation solutions that demand-side desires, the public sector needs to invest in Smart Mobility projects. The private sector solely will not provide enough solutions for public transportation. Public transport operators should express their wishes and expectations to the supply-side as they both have similar views of Smart Mobility's future.

6.2 Thesis validity and reliability

For the thesis's trustworthiness, Tuomi (2018) suggest some guidelines. The researcher answers these arguments in the latter part. For the thesis subject and purpose, what the researcher is researching, and why. Researchers' commitment to this research and why this research is essential, and what kind of assumptions the researcher has made and changed during research. Data collected for the research, how data collection is made from the methodological point of view, possible problems, and other meaningful aspects. Researchers informants, why informants have been chosen, how they were contacted, and how many informants' researchers had. Researcher-informant-relationship, how the relationship worked, did the informants get a chance to see results before publication and reviewed their answers. Length of the research, what was the timeline for the research. Data analysis, how data was analyzed, and how results were achieved. Research reliability, the researcher must evaluate why research is ethically high-standards and why the thesis is reliable (Tuomi 2018, 163-165.)

The researcher switched working place twice during studies. Therefore it has been quite challenging to do a thesis for employing companies. I have been working in the energy industry for nine years now. The thesis subject came from Metropolia University of Applied Sciences because the researcher did not find suitable working life subjects. The researcher was supposed to study Smart Mobility market analysis. The exact subject is related to deliverable between the FABULOS project, and E.U. FABULOS gave the assignment of the study Metropolia University of Applied Sciences.

Researchers' commitment to the research was relatively high in the beginning. The steering group had two telecoms, which the researcher found useful. At some point, the thesis felt insurmountable. The researcher had decent clarity of what kind of study is going to be conducted. At first, the assumptions were that Smart Mobility is just autonomous vehicles, which the FABULOS project is mainly focused on, but after some research revealed, it is just a scratch of the surface.

As a practical way to collect data, an internet-survey made with Google Forms was selected. Data was in a qualitative and quantitative format. Survey questions were made in detail, and the researcher was delighted to them. The survey and questions were mostly

short and comprehensible; there was not much confusion. The problem was also found. One of the participants answered for both of the groups, and that confused researcher. The possibility that someone would fit both of the answer groups did not come to the researcher's mind.

The researcher got a sample list from the FABULOS steering group. The researcher did not contact any other possible informants. The main reason for not contacting other market participants was that the researcher believed that those involved with the FABULOS project would be more likely to answer the survey. It was the right assumption as the answer percentage was 35%. Contacting others might have increased sample count and, that way, the study's reliability, but on the other hand, the answer percentage might have fallen. Informants contacted via email that had a link to the internet-survey could view their answers after submitting the form.

The thesis started at the beginning of May and continued with the research proposal and the actual research process. As a part of the research, the proposal researcher conducted a directional timeline for the thesis. At that time timeline seemed to be adequate. After the summer, the thesis started slowly, and the researcher was rushing to get the thesis done.

Research phase	**Objectives**	**Deadline**
Research proposal	Approval of the thesis from Metropolia and viability for the FABULOS project.	19.6.2020
Starting phase	Obtain instructor for thesis from Metropolia	19.6.2020
Conduct a thesis	Actual research process	30.11.2020
Finalize report for FABULOS	Based on thesis, form report to FABULOS project	15.12.2020

Table 1. Research timeline from the research proposal.

Scheduling was made to imprecise and failed. The schedule should have been more precise to guide the researcher more.

Data were analyzed directly from graphs and text provided by Google Forms. Results are presented with each of the groups separately and then jointly. The researcher wanted

to present data this way as differences between groups are seen more precisely. Visualizations of different analyses provide a decent view of the subjects.

The research did not quite meet the research questions. It did not answer questions precisely, but it gave more insights into the Smart Mobility market as anticipated. Research validity suffers some points here, as stated before. Reliability is acceptable; if research had been done again with the same parameters, results would have been quite the same.

6.3 Suggestions for further studies

This thesis offers knowledge from the Smart Mobility market. The thesis could be used as a preliminary study of the Smart Mobility market. In order to gain more in-depth knowledge about Smart Mobility, further studies are required. Further studies could be described as continuous research. It might grant more measurable results in the long run.

References

All roads lead to smart mobility. (2020). Available at https://www.goodnewsfinland.com/feature/all-roads-lead-to-smart-mobility/ [accessed 20.11.2020]

Aaker, D. A. (2014). Strategic market management. Hoboken: Wiley.

FABULOS Project. (2020). Available at https://fabulos.eu/ [accessed 12.9.2020].

Fowler, F.J. (2002). Survey research methods. USA: Sage Publications Ltd.

Google. About Google Forms. Available at https://www.google.com/intl/fi_fi/forms/about/ [accessed 22.11.2020]

Kananen, J. (2014). Laadullinen tutkimus opinnäytetyönä. Miten kirjoitan kvalitatiivisen opinnäytetyön vaihe vaiheelta. Jyväskylä: Jyväskylän ammattikorkeakoulu.

Lotti, L. (2001). Tehokas markkina-analyysi. Juva: WS Bookwell.

Oliver Wyman. (2018). Mobility 2040 - The quest for Smart Mobility. Available at https://www.oliverwyman.com/content/dam/oliver-wyman/v2-de/publications/2018/Aug/Mobility2040_OliverWyman.pdf [accessed 3.10.2020]

Noy, K., Givoni, M. (2018). Is 'Smart Mobility' Sustainable? Examining the Views and Beliefs of Transport's Technological Entrepreneurs. Sustainability 2018, Vol.10 p.422. Available at https://search-proquest-com.ezproxy.metropolia.fi/docview/2014731359/?pq-origsite=primo [accessed 31.10.2020]

Punch, K.F. (2003). Survey research, The basics. Padstow: Sage Publications Ltd.

Romero, R.P, López, M.C. (2014). Smart Mobility for economic, energy and environmental assessment of measures and policies applied to the transport sector. Procedia - Social and Behavioral Sciences 162 p. 506 – 515. Available at https://www.sciencedirect.com/science/article/pii/S1877042814063332?via%3Dihub [accessed 31.10.2020]

Deloitte. (2015). Reducing congestion and fostering faster, greener, and cheaper transportation options. Available at https://www2.deloitte.com/content/dam/insights/us/articles/smart-mobility-trends/DUP_1027_Smart-Mobility_MASTER1.pdf [accessed 3.10.2020]

Smart Mobility business opportunities in Greater Helsinki. Available at https://www.helsinkibusinesshub.fi/smart-mobility/ [accessed 3.10.2020]

Šurdonja, S., Giuffrè, T., Deluka-Tibljaša, A. (2019). Smart Mobility solutions – necessary precondition for a well-functioning smart city. AIIT 2nd International Congress on Transport Infrastructure and Systems in a changing world. Available at https://www.sciencedirect.com/science/article/pii/S2352146520302131?via%3Dihub [accessed 31.10.2020]

Tuomi, J., Sarajärvi, S. (2018). Laadullinen tutkimus ja sisällönanalyysi. Helsinki: Tammi.

Ydersbond, I. M., Auvinen, H., Tuominen, A., Fearnley, N., Aarhaug, J. (2020). Nordic Experiences with Smart Mobility: Emerging Services and Regulatory Frameworks. Transportation Research Procedia 2020, Vol.49, p.130-144. Available at https://www.sciencedirect.com/science/article/pii/S235214652030733X?via%3Dihub [accessed 1.11.2020]

van Oers, L., de Hoop, E., Jolivet, E., Marvin, S., Späth, P., Raven, R. (2020). The politics of smart expectations: Interrogating the knowledge claims of Smart Mobility. Futures: the journal of policy, planning and futures studies September 2020, Vol.122. Available at https://www.sciencedirect.com/science/article/pii/S001632872030094X?via%3Dihub [accessed 1.11.2020]

Survey participants

Demand Side:

MOVIA - Greater Copenhagen PT	Denmark	PT Operator
Kolumbus	Norway	P.T. Operator
Horarios do Funchal (Madeira)	Portugal	P.T. Operator
Hermes Public Transport	Netherlands	P.T. Operator
Hamburger Hochbahn	Germany	P.T. Operator
Tallinna Linnatranspordi	Estonia	P.T. Operator
HSL - Helsinki Region Transport	Finland	PT Operator
Nobina	Sweden	PT Operator
STCP	Portugal	PT Operator
Ruter	Norway	P.T. Operator

Supply-side:

Navya	France	Vehicle providers/software stack
Easymile	France	Vehicle providers/software stack
2getthere	Netherlands	Vehicle providers/software stack
Transdev	France	Vehicle providers/software stack
Lohr	France	Vehicle providers/software stack
Local Motors	USA	Vehicle providers/software stack
Ohmio	New Zealand / Germany	Vehicle providers/software stack
Sensible4	Finland	Vehicle providers/software stack
AuVe Tech	Estonia	Vehicle providers/software stack
Roboride	Finland	Vehicle providers/software stack
Bestmile	Switzerland	Operator / solution provider
Holo	Denmark	Operator
Applied Autonomy	Norway	Operator / solution provider

Smart Mobility Market Analysis

Author: Eero Tuuliainen, Metropolia University of Applied Sciences

Contents

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no °287609.

Introduction

This report focuses on market analysis within the Smart Mobility industry. The report is related to FABULOS (Future Automated Bus Urban Level Operation Systems) project. FABULOS is funded by the E.U. Metropolia University of Applied Sciences as a partner of FABULOS is conducting and funding this thesis.

Market analysis conducts as a part of a deliverable agreed-upon grant agreement's policy between E.U. and FABULOS. From the grant agreement, the deliverable has been phrased as "Analysis on the market's defragmentation and potential elaboration of standards for public procurement in this domain." With the project steering team, the researcher decided to design this deliverable as a market analysis.

Research methodology

Research questions are in two-part. First is the supplier side, which is operating autonomous buses and or related software. The other is the demand side, which consists of public transport operators involved in the FABULOS project. Research questions are:

-supplier-side, what kind of players are in the automated bus industry? FABULOS already has the suppliers' information, but data should be verified, and their view of Smart Mobility enhanced.

-what are the demand side's expectations/requests that the demand side has set for the supplier side?

The data collection method is an internet-survey. For the survey, Google Forms is used because it is free to use, and Metropolia accounts have been linked with Google. Google Form is also easy to use and does not require any previous knowledge. The survey aims to acquire knowledge from the supply side (vehicle/software provider) and demand (public transport operator) side of the Smart Mobility industry. Samples are given from the FABULOS project. Participants are involved in the FABULOS project. The demand side is represented with a possible of 10 answerers, and the supply side has 13. Sample count totaling 23.

Data were analyzed directly from graphs and text provided by Google Forms. Results are presented with each of the groups separately and then jointly. The researcher wanted to present data this way as differences between groups are seen more precisely. Visualizations of different analyses provide a decent view of the subjects. Data was in a qualitative and quantitative format. Survey questions were made in detail, and the survey and questions were mostly short and comprehensible; there was not much confusion.

The researcher had made a conceptual framework based on the literature view of Smart Mobility. The researcher has chosen four main themes of smart Mobility: technological aspect, environmental aspect, societal aspect, and economic aspect. From these aspects, the researcher created statements and tested how survey participants valued them. The conceptual framework is done via the cloud-based mind-maps.app.

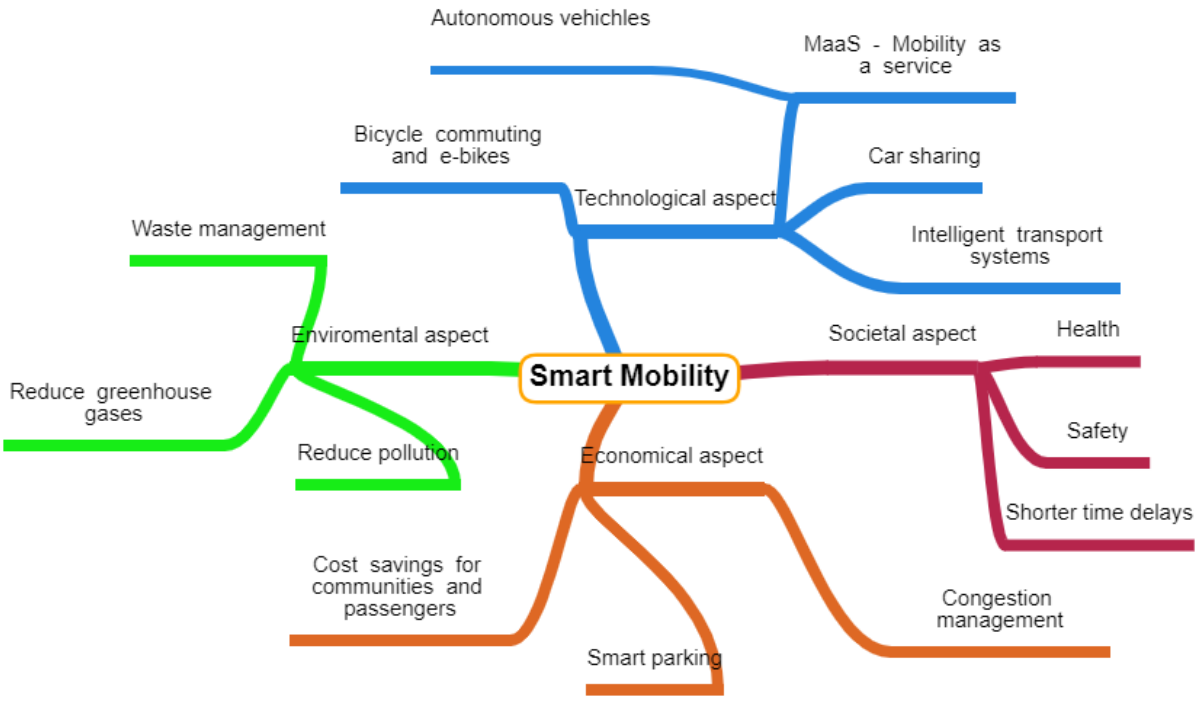

Figure 1. Conceptual framework of Smart Mobility.

From these sources, the researcher has made a conceptual framework of Smart Mobility, seen in figure 1. In this research, the researcher wanted to obtain information from the Smart Mobility demand-side and the supply-side. The researcher divided Smart Mobility into four different aspects and collected propositions for each of them. These propositions were the most appeared in the source materials. In order to enhance both survey participants' views, their propositions were taken into the survey. From these propositions, the researcher could analyze both participant groups' views on different subjects.

Market analysis survey

It is essential to get answerers to answer the survey. In order to get answers, the researcher should mind these simple guides: make the answerer feel important, explain why this survey is conducted and how data is going to be used, tell them how long it is going to take to fill the survey, and try to keep it short and ask direct and short questions.

First is the introduction part, which is a sort of invitation to answer the survey. This text is located in the email that Google Forms is sending to recipients. It is phrased like this: "Dear Sir/Madam, as a representative of Metropolia University of Applied Sciences, I am inviting you to fill a market analysis survey for the FABULOS project. Answering will not take longer than 5 minutes. Your answers are anonymous, email addresses are only collected for follow-up. These answers are used for my master thesis, and a public report is conducted for the FABULOS project. Your answer is highly appreciated. Br, Eero Tuulainen"

The first question is related to which party the answerer is representing, either the demand or supply side of the Smart Mobility industry. The survey is divided into two parts, and questions are designed for each side.

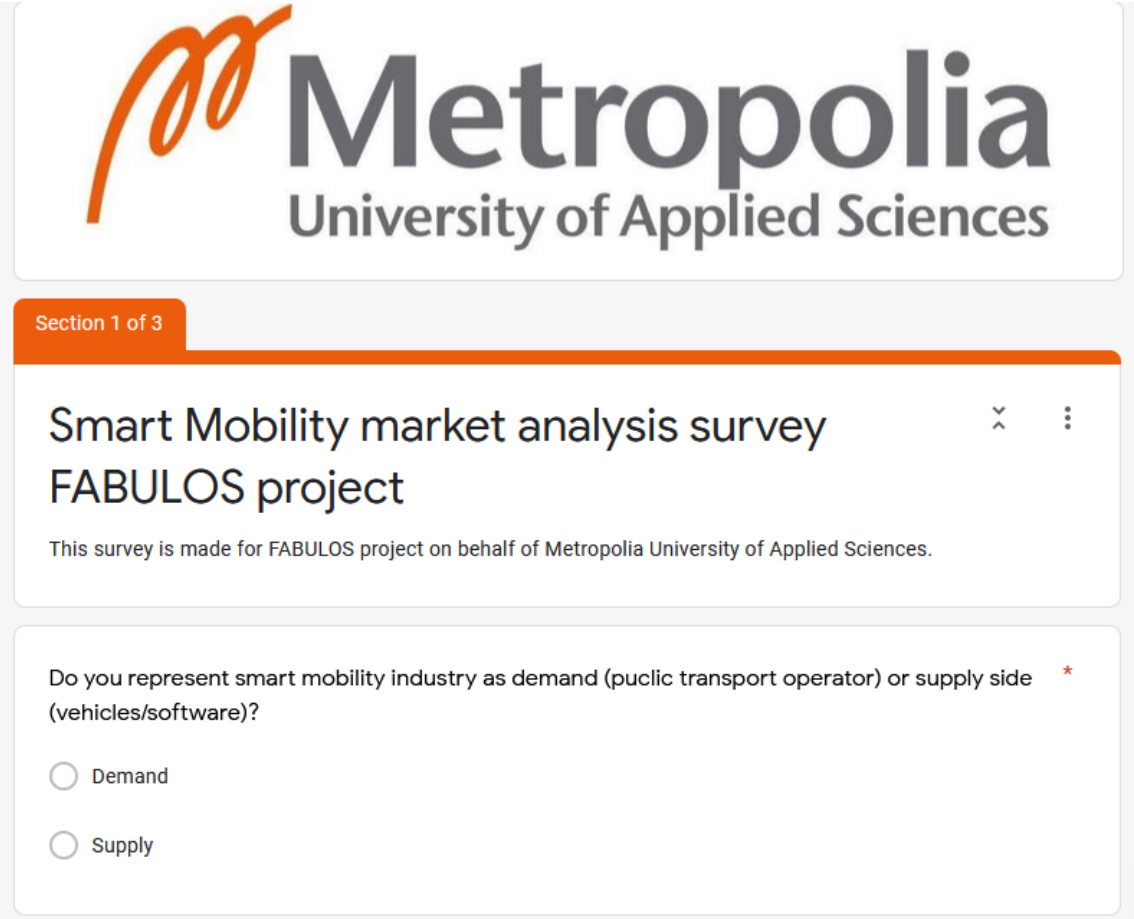

Figure 2. Smart Mobility market analysis survey header and question number 1.

The front survey page is formal, looking with the official Metropolia logo and visuals.

The second question is the basic knowledge of the answerer. It is not required to get detailed information on the answerer, so only the location is needed. A drop-down selection for this and answer choices are these: Denmark, Estonia, Finland, France, Germany, Netherlands, New Zealand, Norway, Portugal, Sweden, Switzerland, USA, and Other. This question is the same for both groups.

The third question is related to market size. The supply side, how much revenue companies generate within the Smart Mobility industry, and the demand-side, how much they are spending on projects within the Smart Mobility industry (million euros). Choices are for supply-side: below 0,1, 0,1-0,5, 0,5-1, 1-5 and over 5 million. The demand side choices are: below 0,5, 1-2, 2-5, and more than 5 million.

The fourth question is also related to the market size and maturity of the industry. Both groups answer the same question, "How mature the Smart Mobility industry is?" and choices are on a linear scale: one is pre-mature, only start-ups, and five is well matured, all the major participants are involved.

The fifth question is about the future of the Smart Mobility industry from the answerer point of view. The question for the supply side is: "In 5 years perspective to the future, how is your business going to develop within Smart Mobility?". Multiple answering choices: none or smaller than now, steady stable as it is now, medium growth with more R&D, fast growth with more focus on Smart Mobility, and super-growth with full steam ahead. For the demand side: "Are you going to increase or decrease the budget for Smart Mobility projects in the future?" Answer choices with linear scale one is yes, increase by more than 25%, and five is no, decrease by more than 25%.

The sixth question is open-ended, and it is about Smart Mobility at the general level for both groups. It is "What Smart Mobility means to your company/organization?" The researcher is assuming to get versatile written answers and find something interesting.

Questions from seven to ten are related to the conceptual framework. Questions are the same for both groups. The seventh question is "which one of these propositions is the most important?" and answering choices are cost savings for communities and passengers, smart parking, or congestion management. The eight-question is "Smart Mobility from the technological perspective, which one of these propositions is the most important?" and answering choices are autonomous vehicles, Mobility as service, or Intelligent Transport Systems. The ninth question is "Smart Mobility from the environmental perspective, which one of these propositions is the most important?" and answering choices are reducing pollution, reducing greenhouse gases, or waste management. The tenth question is "Smart Mobility from the societal perspective, which one of these propositions is the most important?" and answering choices are health, safety, or shorter time delays.

The eleventh question is open-ended and wants to determine the expectations both groups have for each other. There is a chance to get diverse answers, which are interesting for the research—hoping to get more insight into how they feel.

The last question is number twelve, and it is the same for both groups. It is about how supply and demand sides monitor the Smart Mobility market and information about new market participants on the supply side. The question is, "Have you noticed a change in Smart Mobility suppliers?" and answer choices are: yes, new players have entered the market, no situation remains stable, and maybe, I do not follow the market situation.

Market analysis results

A smart Mobility market analysis survey was carried out during 30.11.2020 – 6.11.2020. The survey answering time and the survey were relatively short—that way, the researcher wanted to achieve a relatively right amount of answers. Questions were kept short and simple. One reminder was sent to participants in the middle of the survey period. The survey got eight responses, with the answer percentage being around 35%. One of the answerers has filled answers for both supply and demand side. It was unintentional. The researcher has not thought of that happening. Nevertheless, the answers are still valid.

Google Forms provide answers with distinguished style. The researcher has divided the answers into two sections; both answering groups have their own.

This pie chart shows participants' answers to the first question. It can be seen that three-quarters of the participants represent the demand side of the industry. From the sample count, the supply-side had 13 possible participants, and the demand had 10. The overall answer percentage is 35%, the supply side is 15%, and the demand side is 80%.

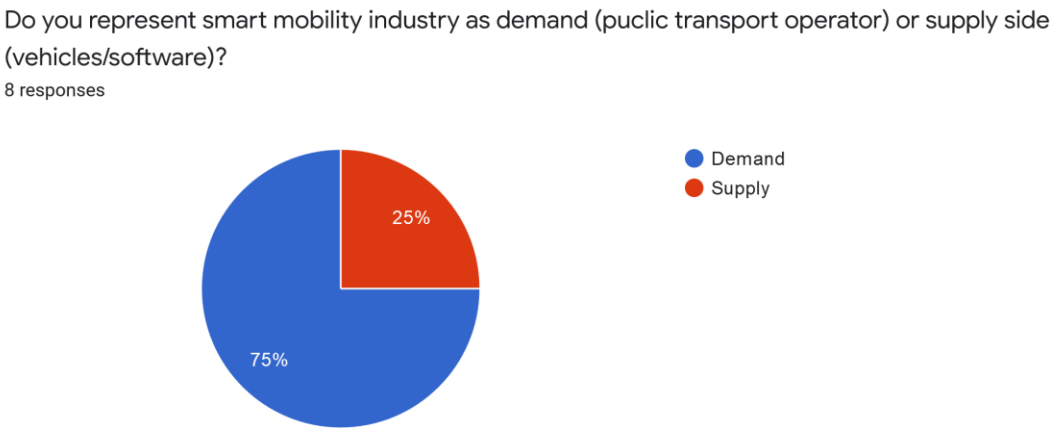

Figure 3. Survey participant's dividend.

Supply-side results

This pie chart shows supply-side participants' geographical business locations. One of the participants was from Estonia, and the other was from Norway.

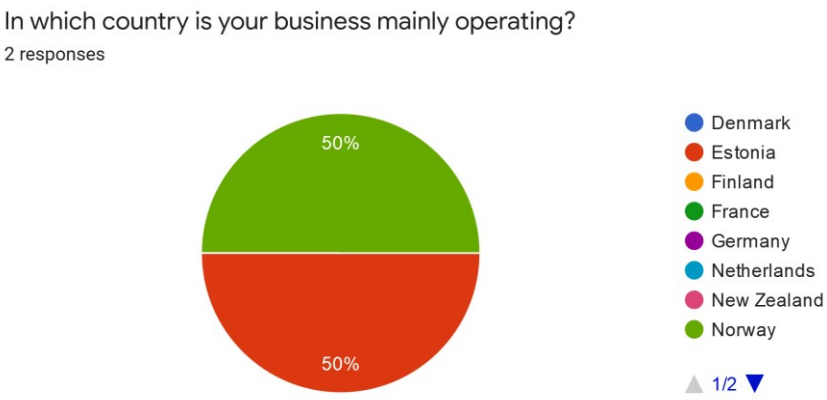

Figure 4. Supply-side business locations.

This graph shows the revenue generated from the smart mobility industry. Participants' companies represent the different sizes of companies. One is still a small one, and another has approximately ten times more revenue than smaller ones.

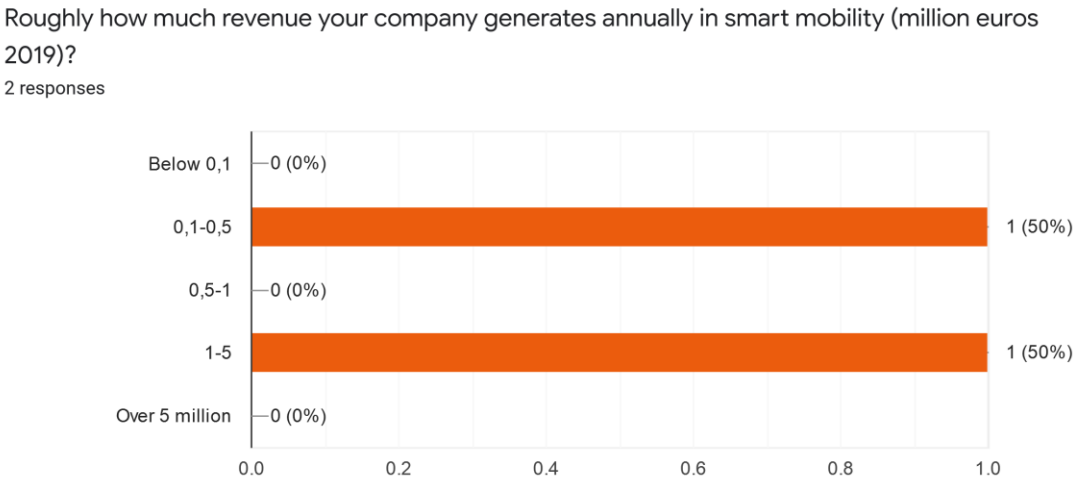

Figure 5. Supply-side revenue generated.

This graph shows a supply-side view of Smart Mobility state of maturity. The view was somewhat divided; one half stated that maturity is close to the pre-mature stage, and the other one states that the Smart Mobility industry is close to a well-matured state. It is an exciting finding, as this may reflect participants' business size.

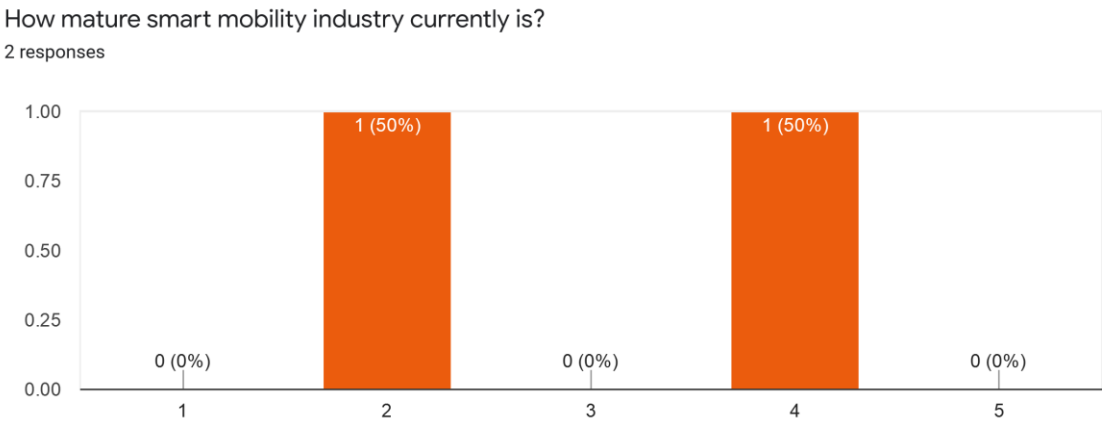

Figure 6. Supply-side view of Smart Mobility state of maturity.

This pie chart shows the supply-side participants' view of the future. It has only one clear statement, both of the supply side companies are stating that they will develop their business with increased efforts within the Smart Mobility industry.

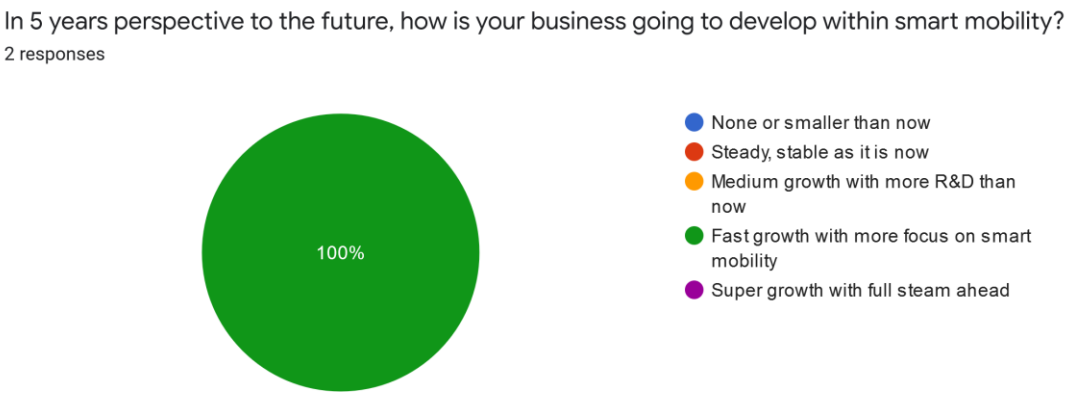

Figure 7. Supply-side future plans.

This pie chart shows the supply-side participants' view of Smart Mobility from an economic perspective. Answers were divided; half of the answerers went to cost savings and another half to congestion management. Smart parking did not get attention.

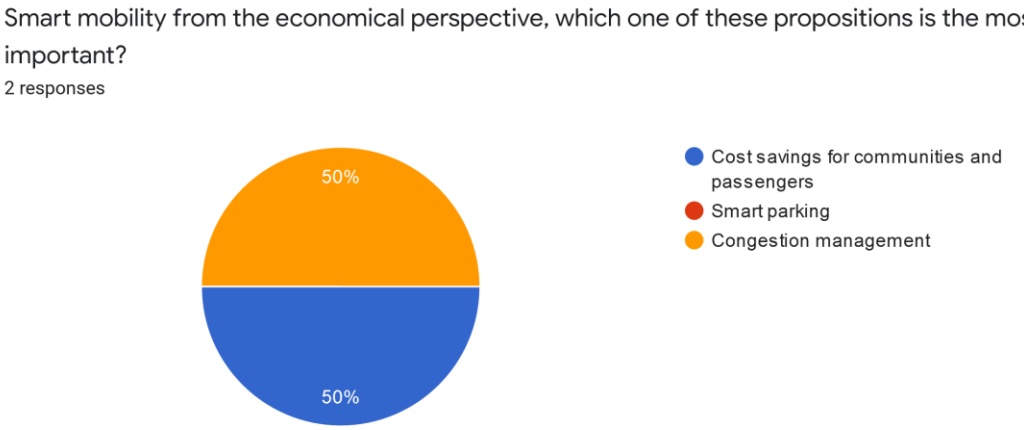

Figure 8. Supply-side view of Smart Mobility from an economic perspective.

This pie chart shows the supply-side participants' view of Smart Mobility from an environmental perspective. This one has clearly shown that both answers are focused on reducing pollution. Greenhouse gases are maybe associated with pollution, so that may reduce the answer to that. Waste management is not on the priority list for the supply-side.

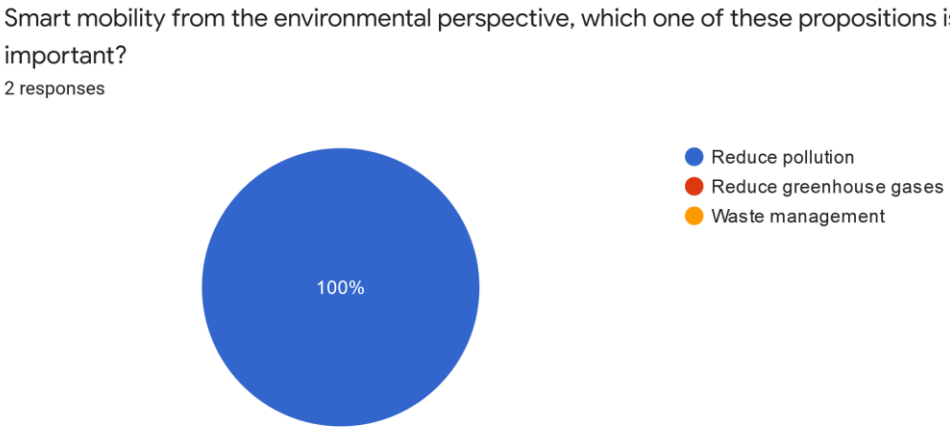

Figure 9. Supply-side view of Smart Mobility from an environmental perspective.

This pie chart shows the supply-side participants' view of Smart Mobility from a technological perspective. Autonomous vehicles and intelligent transport systems got attention from answerers. It might be related to participants' field of business, MaaS might not be their core business.

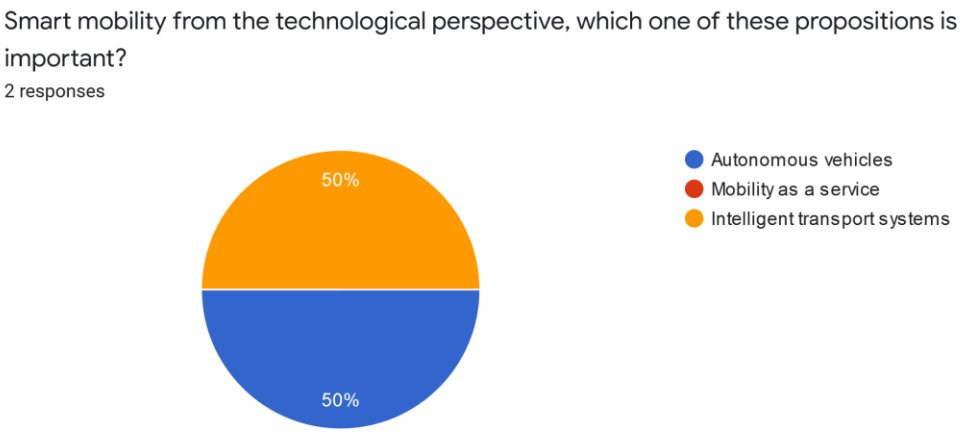

Figure 10. Supply-side view of Smart Mobility from a technological perspective.

This pie chart shows the supply-side participants' view of Smart Mobility from a societal perspective. Answers were divided between safety and shorter time delays. The researcher was astonished that health did not get attention from answerers.

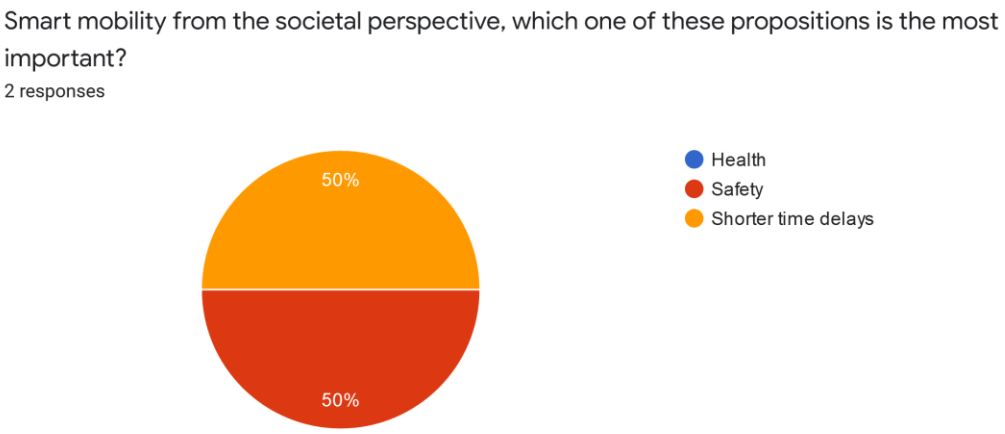

Figure 11. Supply-side view of Smart Mobility from a societal perspective.

This graph shows the supply-side of the Smart Mobility market changes. Participants have noticed a change in the market, and participants monitor the market at least with some level of attention.

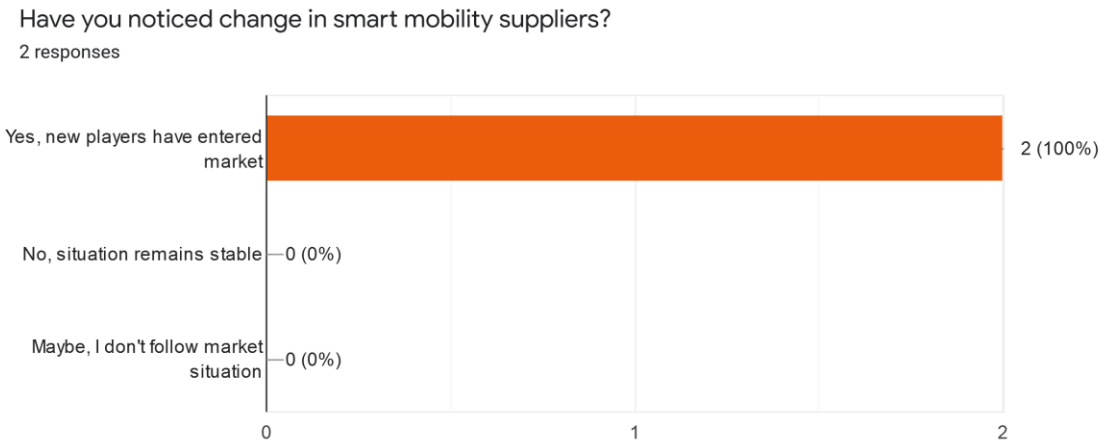

Figure 12. Supply-side view of Smart Mobility market changes.

For the open-ended questions, the supply-side answers are quoted here. The first open-ended question was "*What smart mobility means to your company?*" and the answers were:

"Smart mobility system and smart cities. Autonomous vehicles, V2X systems, lot of data gathering etc.

Open solutions easy to integrate, Shared data, Predictably"

Another open-ended question was

"What kind of expectations do you have towards demand side (public transport operators) of smart mobility?" and the answers were:

"Personal car free city centres only alternative transport (last mile shuttles), green cities etc."

"Early adopters takes a risk."

To first, supply-side open-ended question answers have a lot of detailed technological aspects such as autonomous vehicles. It seems that the business side is fond of the technical side of the smart mobility industry. To second question supply side is answering with an environmental and economic point of view.

Demand-side results

This pie chart shows the demand-side participants' geographical locations. Finland and Norway have two participants, Estonia, Denmark, Netherlands, and Portugal has one participant.

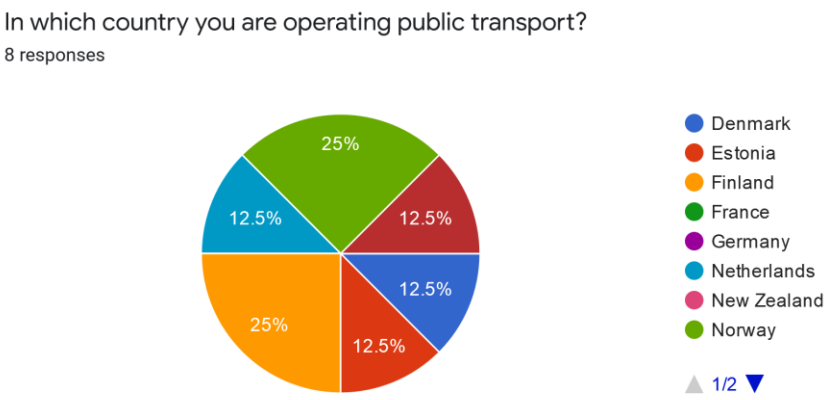

Figure 13. Demand-side public transportation locations.

This pie chart shows the demand-side participants budgeted projects within Smart Mobility in the year 2020. Budgets were divided into half, 50% of the budgets are over two million euros and 50% are below two million euros.

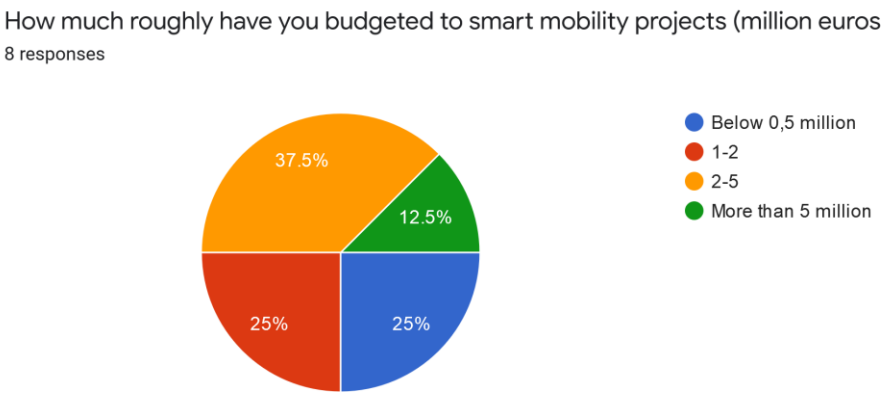

Figure 14. Demand-side project budget for Smart Mobility.

This graph shows a demand-side view of Smart Mobility state of maturity. The majority of the participants consider the Smart Mobility industry to be close to the pre-mature stage.

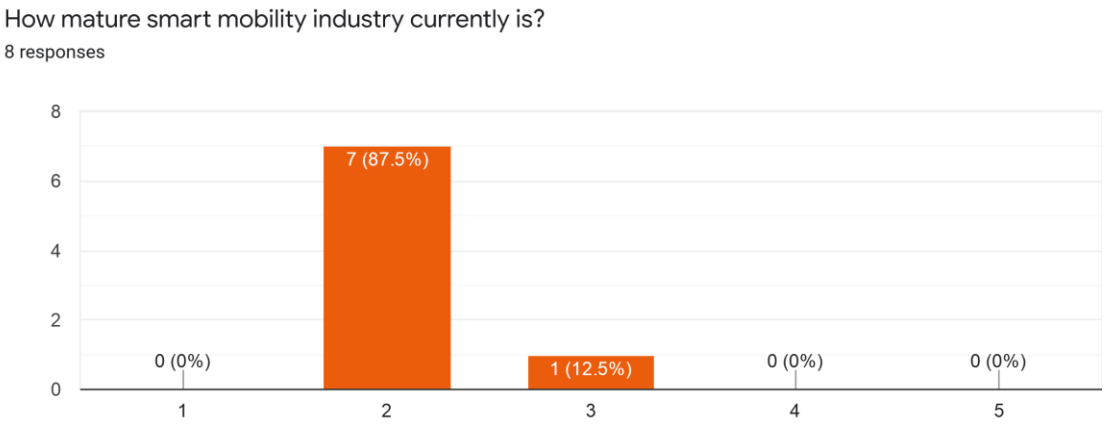

Figure 15. Demand-side view of Smart Mobility state of maturity.

This graph shows a demand-side view of willingness to invest in Smart Mobility projects in the future. Most of the participants will keep the budget at the same level as it used to be. Two of the participants are increasing the budget by more than 25%, and one participant will slightly decrease the budget in the future.

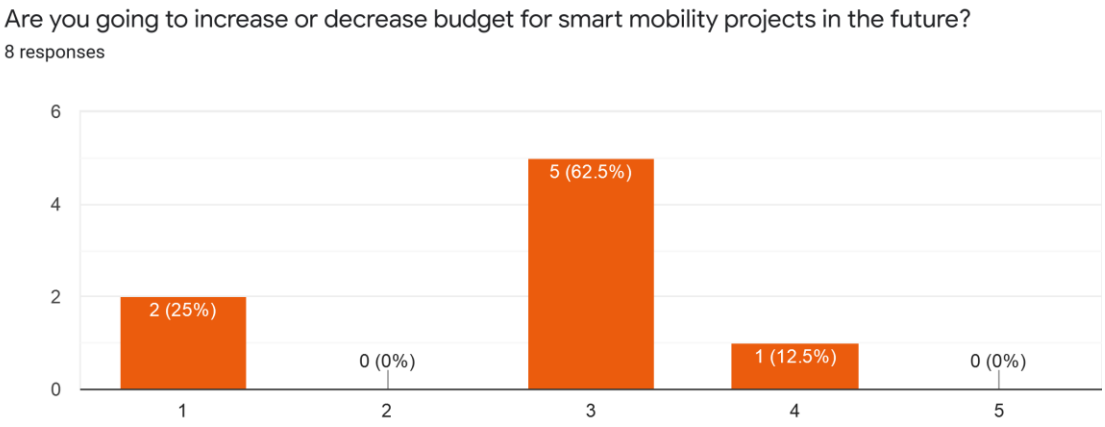

Figure 16. Demand-side future plans.

This pie chart shows the demand-side participants' view of Smart Mobility from an economic perspective. The majority of the participants state that cost savings are the most important, and congestion management was the two participants' top priority. Smart parking did not get any attention.

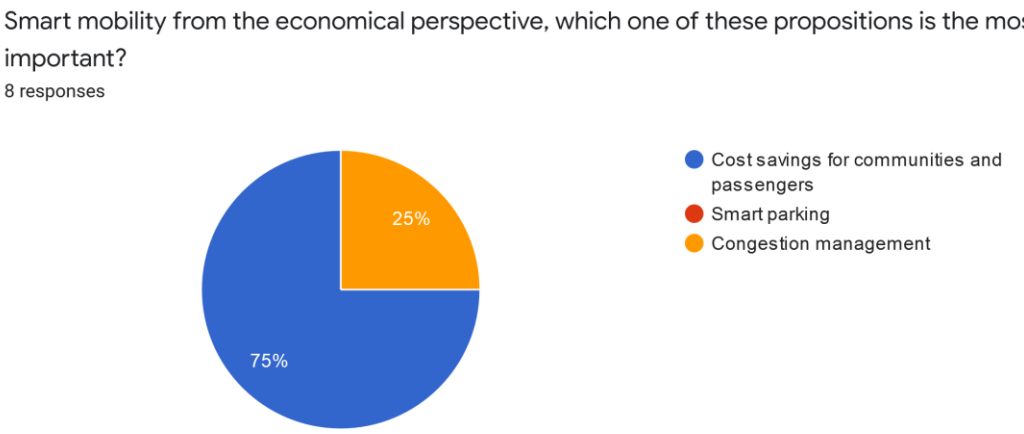

Figure 17. Demand-side view of Smart Mobility from an economic perspective.

This pie chart shows the demand-side participants' view of Smart Mobility from a technological perspective. Half of the participants favored intelligent transport systems, MaaS, and autonomous vehicles got the same 25% rating.

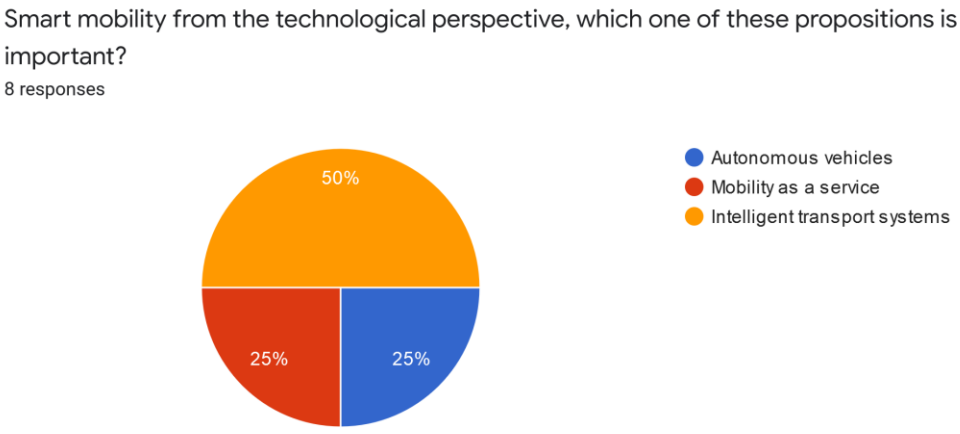

Figure 18. Demand-side view of Smart Mobility from a technological perspective.

This pie chart shows the demand-side participants' view of Smart Mobility from an environmental perspective. The majority of the participants stated that reducing pollution or greenhouse gases was the most critical environmental task. Waste management was not considered to be necessary.

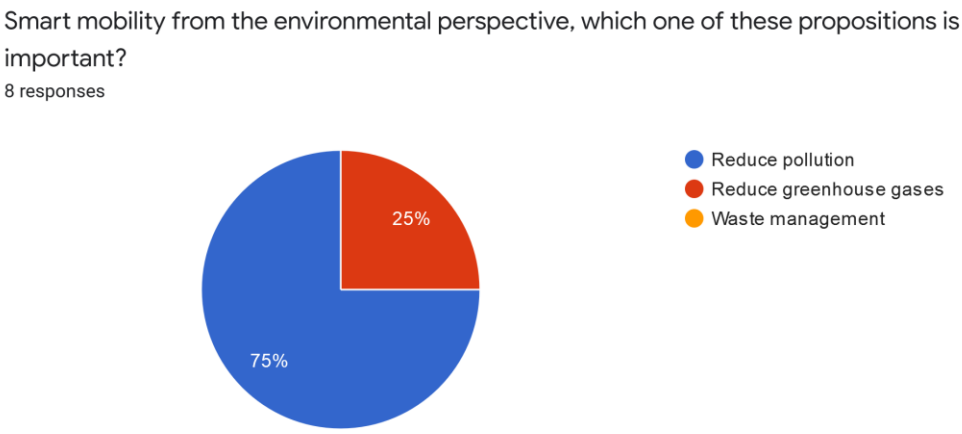

Figure 19. Demand-side view of Smart Mobility from an environmental perspective.

This pie chart shows the demand-side participants' view of Smart Mobility from a societal perspective. Half of the participants stated that health was the most important thing. Safety got 25% of the answers, and one answerer stated that shorter time delays were significant. One participant chose another and answered, *"In addition to health and safety, the freedom of choice and ease of travel are important. Can't really put them in order*".

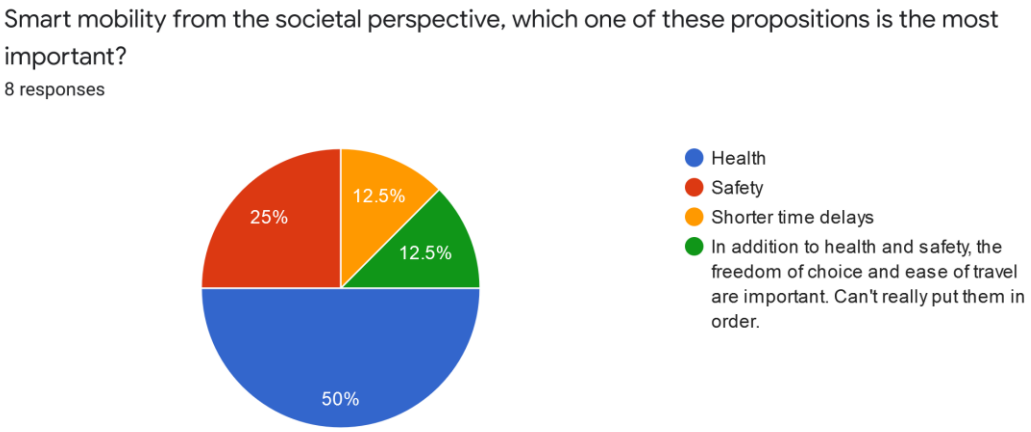

Figure 20. Demand-side view of Smart Mobility from a societal perspective.

This graph shows a demand-side view of market changes in Smart Mobility suppliers. Most participants have noticed a change in suppliers as new players have entered markets. A minor part of the demand side did not follow markets and could not tell are there any changes. One participant had noticed a change and not noticed a change simultaneously; this was unintentional.

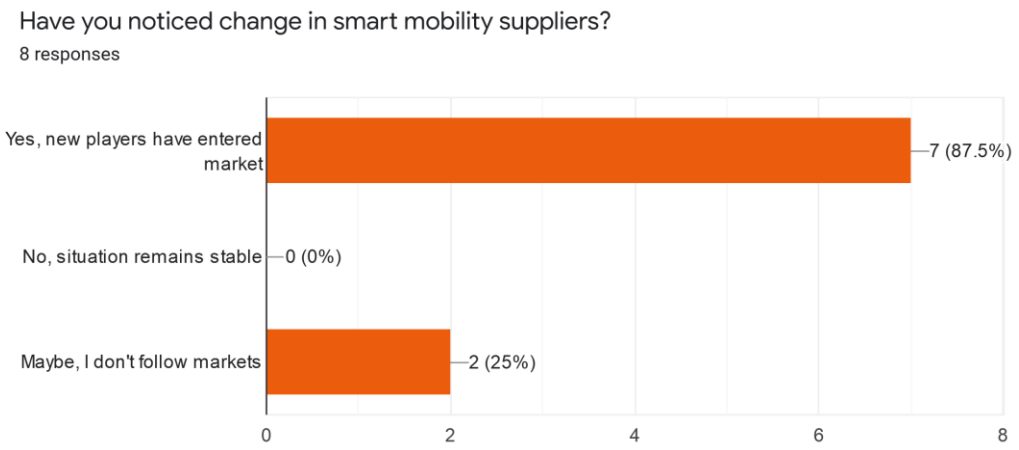

Figure 21. Demand-side view of Smart Mobility market changes.

For the open-ended questions, the demand side answered is quoted here. The first open-ended question was "*What smart mobility means to your organization?*" and the answers were:

"everything, our company is dedicated to smart mobility"

"Autonomous mobility"

"Using technology and services to provide sustainable mobility"

"an opportunity for the future"

"Many different modes of transport and ways of movement are connected, incl. taking advantage of the information and communication technology. The goal is efficiency, flexibility, security, accessibility, personality, need."

"Smart mobility is a way of how we move in a cleaner, safer, more efficient and environmentally sustainable way."

"Much"

"Smart mobility to us means flexible combining of various modes of transportation in ways that meet the needs of passengers."

It seems that the demand-side is not focusing solely on one subject. One participant's organization was entirely dedicated to Smart Mobility. Flexibility and sustainability were meaningful for the two participants. Three participants enhance the technological perspective of Smart Mobility. One participant's answer was just "much," maybe questioning was overwhelming.

Another open-ended question was:

"*What kind of expectations do you have towards supply side (vehicles/software providers) of smart mobility?"* and the answers were:

"Personal car free city hearts and green cities"

"That development of autonomous vehicles will accelerate in the coming years"

"Focus on factual benefits that can actually be implemented"

"I expect that the next 5 years we will see new developments on the field of smart mobility"

"Offering turnkey solutions. Flexibility."

"Expectations are high with regard to suppliers and the development and supply of new technologies"

"Big ones"

"Hoping for the supply side to enter the markets with functioning solutions. However, the demand side must most likely support and possibly also fund the projects of the supply side in the beginning for the solutions to be feasible."

The majority of demand-side answers were related to future wishes, such as rapid developments and flexible solutions from the Smart Mobility supply side. One participant doubt that demand-side might have to fund supply-side development projects. One participant's answer was just "Big ones," maybe questioning was overwhelming.

Results summary

Survey participants represented six different nations, and they were all located in Europe. Countries were: Denmark, Estonia, Finland, Netherlands, Norway, and Portugal. Supply participant's revenue within Smart Mobility ranged from 0,1 to five million, and demand-side project budgets ranged from below 0,5 to over five million. Participants are in very different Smart Mobility stages. It seems that dispersion is relatively high, based on how much money is involved.

Considering Smart Mobility maturity, most participants think that Smart Mobility is close to the pre-mature stage, and there are mainly start-ups operating markets. 80 % of the participants stated that markets are close to the start-up stage. The more developed market was seen as the only minority.

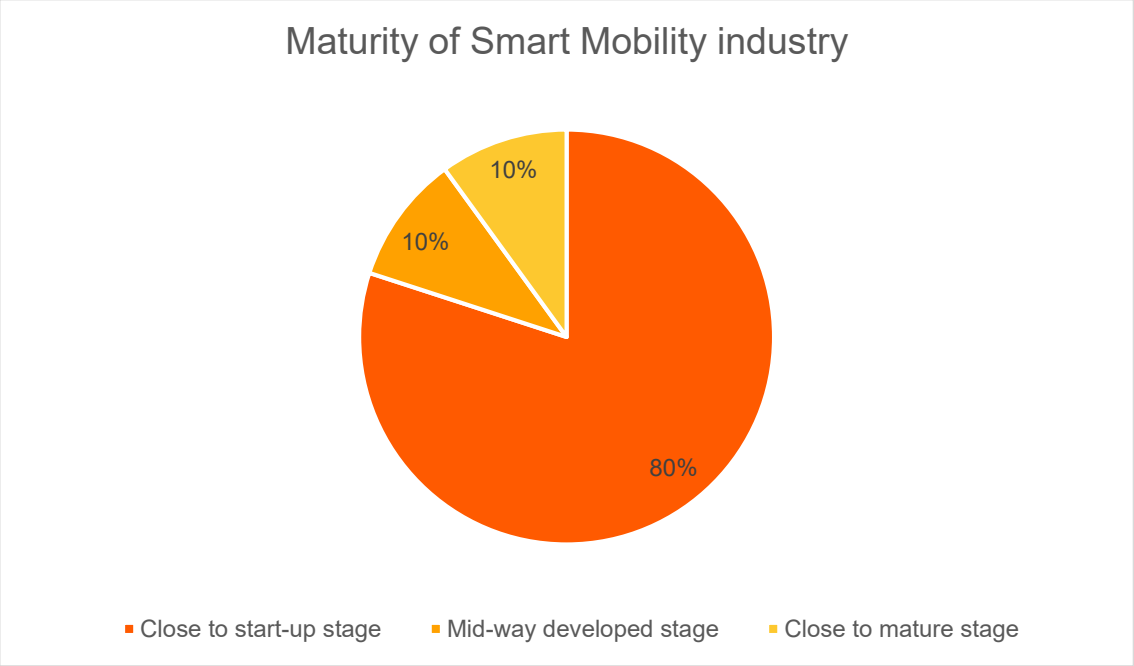

Figure 22. Maturity of Smart Mobility industry.

For future plans, the supply-side seems to be more optimistic towards Smart Mobility. They were anticipating fast growth. The demand-side was not that excited about the future; nevertheless, future budgeting was mostly neutral, as seen in figure 23. It seems promising that only a minority of the participants considered lowering Smart Mobility development or budgets in the future.

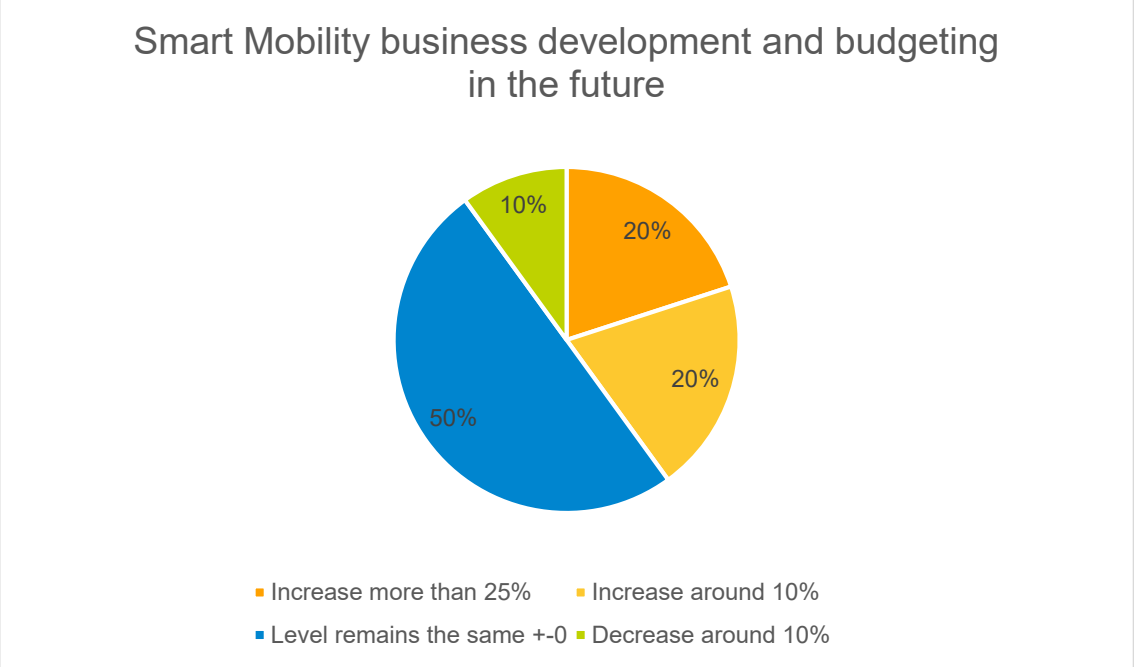

Figure 23. Smart Mobility business development and budgeting in the future.

The researcher wanted to test the conceptual framework related to Smart Mobility, and participants answered four statements from economic, environmental, technological, and societal perspectives. The essential economic perspective was cost savings for communities, passengers, and the minority stated that congestion management was the most important. Smart parking did not receive any selections, so that is a clear signal that is not experienced essential. The technological perspective supply -and demand-side were on the same page, and Intelligent Transport Systems got majority preferences. Autonomous vehicles were second favorited, and MaaS was considered the least important. From an environmental perspective, reducing pollution was the most important thing for both supply and demand-side. Reducing greenhouse gases was also crucial for the minor of participants. Waste management did not fit either of the group's most crucial things list. The societal perspective was dividing these groups. For supply-side safety and shorter time delays were important, demand-side health was considered the most important thing. Safety was second, and the minority thought that shorter time delays and other things were the most important. It seems that public transport operators are emphasizing quality of life.

The researcher wanted to visualize the most important answers to demonstrate the analysis. The visualization shows that these words were among the highest incidences "Shorter Reducing Smart Transport Safety."

Figure 24. Word cloud related to survey results in the Smart Mobility contextual framework, created with Word Art.

As for open-ended questions, the researcher also used a word cloud to visualize all the given answers. For the open-ended question, "*What smart mobility means to your company/organization*?" visualization shows that these words were among the highest incidences; "Autonomous Smart Mobility System Data." These words were mostly used.

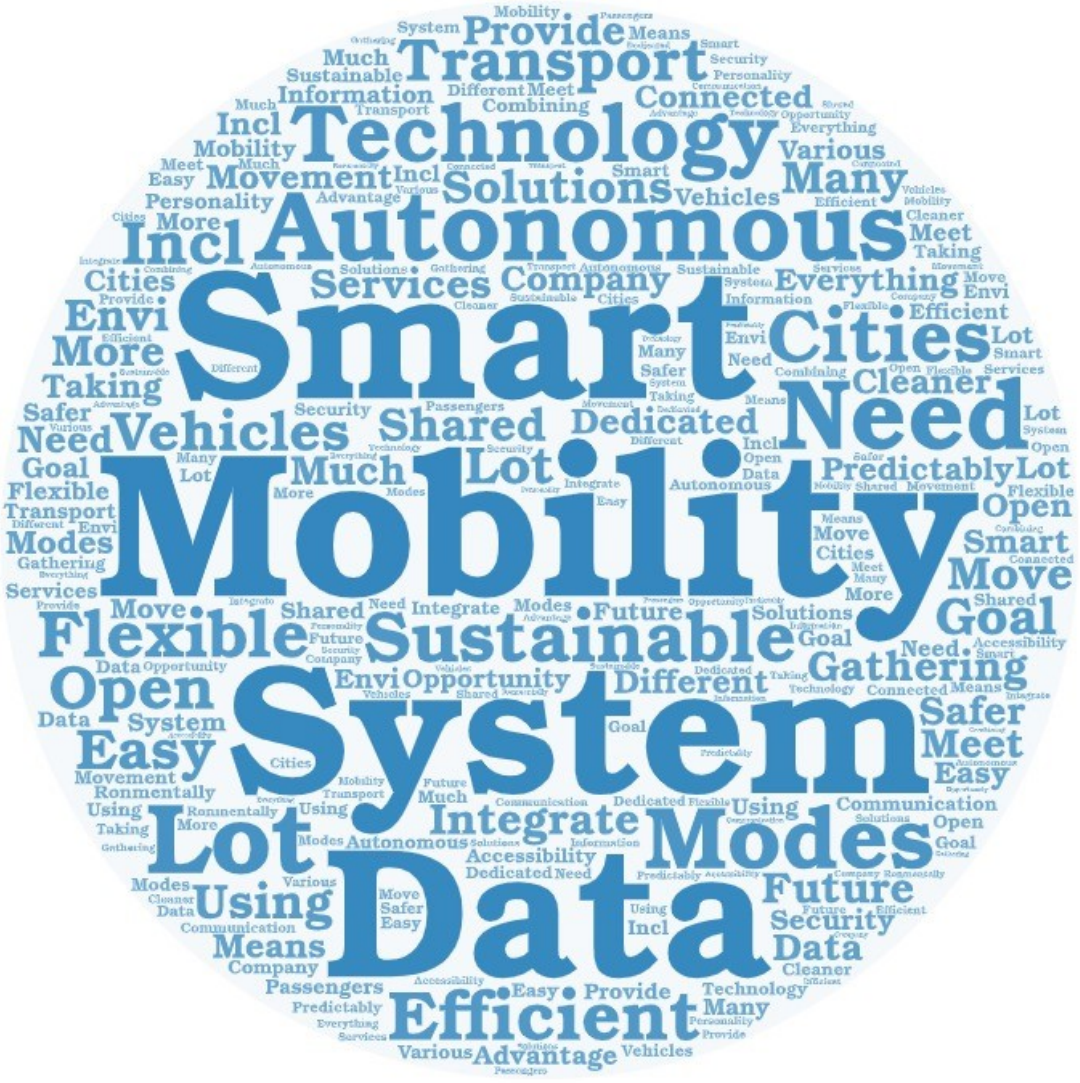

Figure 25. Word cloud related to survey results in Smart Mobility open-ended question, created with Word Art.

For the open-ended question, *"What kind of expectations do you have towards demand side (public transport operators) / supply-side (vehicles/software providers) of smart*

mobility?" The visualization shows that these words were among the highest incidences; "Green Personal Development City New Solutions Car." Both groups had similar expectations towards each other, and these words were mostly used.

Figure 26. Word cloud related to survey results in Smart Mobility open-ended question, created with Word Art.

The last question for both participant groups was, "*Have you noticed change in smart mobility suppliers?"*. The researcher wanted to determine if supply -and demand-side are screening markets or awareness of suppliers' change. It is a strong signal that there are new suppliers entered the Smart Mobility market. A total of 80% of participants have noticed a change in suppliers.

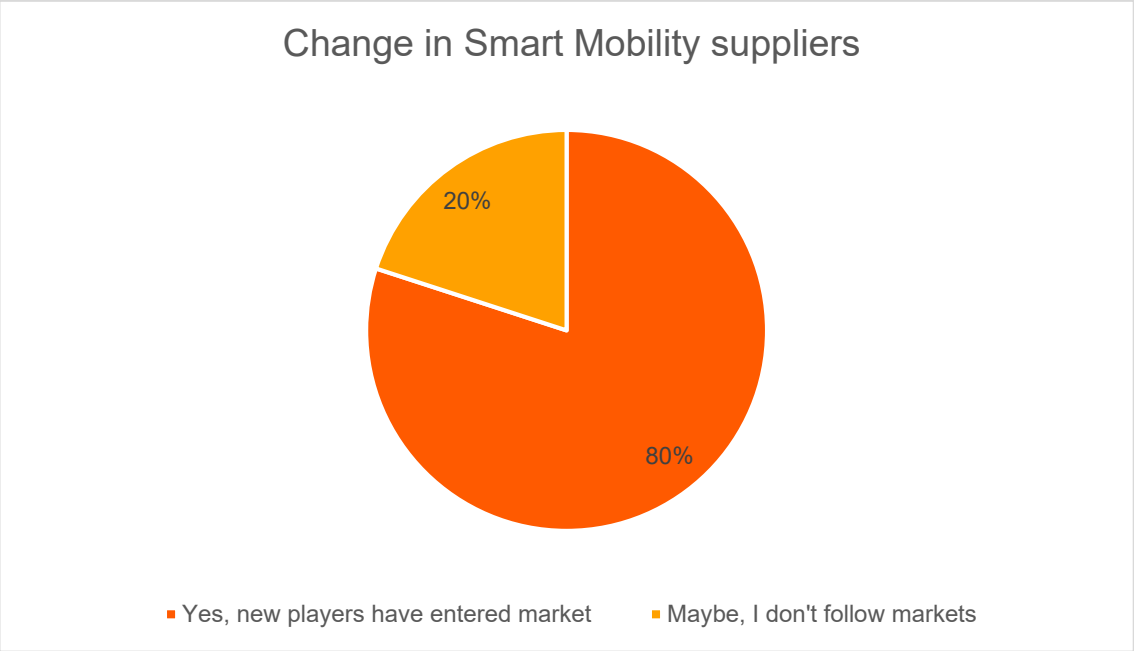

Figure 27. Change in Smart Mobility suppliers.

Managerial implications and recommendations

Overall conclusions based on the survey are that Smart Mobility is a relatively small market based on revenues and project budgets. The smart Mobility market is close to the pre-mature stage, with many young companies such as start-ups. Start-ups might not have big companies' resources and a limited amount of capital, supporting the view of a small market. It seems that change is coming in the future; the supply-side will increase development fast, and the demand-side is at least providing stable budgeting for the coming years and, that way, funding supply-side. Survey participants also stated that new suppliers are coming to the Smart Mobility market. The deduction is that Smart mobility markets are going to expand and more financial flow to the Smart Mobility market.

For the conceptual framework, results are quite hard to express. The researcher had made the framework based on the literature view of Smart Mobility (see figure 1.), and these assumptions were close to survey participants' answers. Participants considered

cost savings for communities, Intelligent Transport Systems, reducing pollution, health, and safety as the most important aspects of Smart Mobility.

Open-ended questions provided some insights for the supply -and demand-side. The researcher wanted to know the foundation of Smart Mobility and formed a question for both participants, "*what does Smart Mobility mean to your company / organization?"* Smart Mobility seems to mean many things depended on the answerer's opinion. The researcher summarizes it as "Smart Mobility is a technological solution for various modes of sustainable and flexible transportation." For another open-ended question, *"What kind of expectations do you have towards demand side (public transport opera-tors) / supply-side (vehicles/software providers) of smart mobility?"* Both participant groups wanted personal car-free cities with new technologic solutions. Participants were confident that the development of Smart Mobility solutions would be accelerated within the coming years. The supply-side was worried about the risk of early adopters. The demand-side was worried about suppliers' lack of funds, and the demand-side have to carry a financial burden.

This research has studied the Smart Mobility industry from two point-of-views; supply and demand-side. FABULOS project might already have some sort of information, but with this new information, the project got more useful knowledge about market participants. It is advised that the FABULOS project carry this information to new projects. FABULOS project is ending at the end of 2020, but new Smart Mobility projects will be started. This research might be useful for new projects, which require knowledge related to Smart Mobility markets.

For the supply-side, it is recommended to keep on investing in the Smart Mobility industry. Demand for Smart Mobility solutions is expected to be stable or increasing soon, based on demand-sides answers related to their investing willingness. The balance between parties' financial risks are one major issue to look at. For the supply-side public investors, such as public transport operators, it seems to be an attractive business partner as financial risk might be lower than the private sector's.

To achieve sustainable and flexible transportation solutions that demand-side desires, the public sector needs to invest in Smart Mobility projects. The private sector solely will not provide enough solutions for public transportation. Public transport operators should express their wishes and expectations to the supply-side as they both have similar views of Smart Mobility's future.