Sohjoa Baltic

The Roadmap to Automated Electric Shuttles in Public Transport

Procurement Challenges

Credits

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This publication has been made in the Sohjoa Baltic project (2017-2020) funded by Interreg Baltic Sea Region Programme. The aim of the project was to bring knowledge and competence on organizing environmentally friendly and smart automated public transport, provides guidelines on legal and organizational setup needed for running such a service in an efficient way.

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Foreword

The upcoming years are crucial to the development of automated driving in Europe. The technology has great potential to serve the public interest by improving the environmental sustainability of traffic and making transit safer and more enjoyable for everyone. Cities are finding solutions for more sustainable and cost effective mobility in the public transportation sector. If the demand for autonomous, electric vehicles suitable for public transport rises, is there enough supply to satisfy the need?

The vehicles currently operated are still in their demo mode. In Europe, the markets have been mainly shared for years by two French startups, Navya and Easymile. Though competitive products are developed also elsewhere, for instance by startups in Finland by Sensible 4; in Estonia by Auve Tech but the start-ups are both disruptors and fragile in the markets, ruled by big automotive companies aiming to provide similar products themselves.

This volume is intended to provide views on the topic added with real-life procurement barriers and enablers from Sohjoa Baltic (Interreg Baltic Sea Region) project's robot bus pilots from Norway, Poland, Finland, Estonia and Latvia. The lessons learned are compiled into recommendations of what should happen for this type of mobility service succeed. This publication identifies the main requirements that must be fulfilled for an automated vehicle to run on public roads. Examples from practice illustrate the explanations.

The Sohjoa Baltic Roadmap to Automated Electric Shuttles in Public Transport volume **The Procurement Challenges** provides an overview of the procurement issues that arise when implementing automated buses as part of public transport.

This publication was prepared with the input of project partners and other participating parties from the Tallinn University of Technology (Estonia), the Vejle Municipality of Denmark, the City of Gdańsk (Poland), Applied Autonomy (Norway), Metropolia University of Applied Sciences (Finland).

Project Sohjoa Baltic (2017-2020) developed the knowledge and competences required to organise environmentally friendly and smart automated public transport. It also provided guidelines on the legal and organisational frameworks needed to operate a service efficiently.

About Sohjoa Baltic

The Sohjoa Baltic project developed the knowledge and competences required to organise environmentally friendly and smart automated public transport by researching, promoting and piloting automated driverless electric minibuses as part of the public transport chain, especially for the first/last mile connectivity. It also provides guidelines on the legal and organisational frameworks needed to operate a service of this kind in an efficient way. The Sohjoa Baltic consortium has partners from Finland, Estonia, Sweden, Latvia, Germany, Poland, Norway and Denmark with expertise in transportation planning as well as legal expertise combined with a strong technical understanding.

Sohjoa Baltic brought autonomous small buses to drive demo routes in five Baltic Sea Region cities. Demo routes were driven both in road traffic on open streets among other road users as well as on closed areas. The autonomous bus navigates independently on a predefined route, scans its surroundings and knows when to slow down or stop completely, if there are obstacles in the way. During the pilots there was always an operator on board.

With a run time from 10/2017 till 09/2020, the Sohjoa Baltic project was funded by the Interreg – Baltic Sea Region programme.

Info

What are automated vehicles?

Automated vehicles are vehicles that rely on an automated driving system rather than a manual system driven completely by a human. This means that they can operate without human intervention (SAE level 3 and higher) if specific conditions are met.

What is a vehicle operator?

The vehicle operator (also known as the 'steward' or 'safety driver') is a physical person who is present onboard the automated vehicle to guarantee safe operation, even in situations where the automated driving system fails to perform as intended. In such situations, the vehicle operator can override the automated driving functions and assume control of the vehicle.

I. Introduction to Procurement Challenges

"What are the three key domains of interest in public procurement?"

"What are the investment and risk-management challenges in public procurement decisions?"

Procurement is a key enabler for publicly funded innovations. In general, public bodies operate "within the box" setup with predefined rules of game how publicly gathered resources can be used and distributed. The private sector, on the other hand, can be more agile and flexible in how they invest into novel innovations and can apply "out of the box" rules and methods. Nevertheless, this does not mean that the life as a private entrepreneur is better, it just means it is different: companies are constantly facing the pressure where to get the funds whereas the public sector's pressing challenge is how to invest funds. The main question of interest of this chapter is whether cities or city enablers can also apply "out of the box" solutions to promote local innovations.

There is another pressure as well when initiating innovations within the public sector. In general, promoting innovations assumes taking risks which are sometimes managed and sometimes with a high degree of uncertainty. In highly innovation-concentrated fields, such as startup companies, taking risk is definitely a key enabler to test out ideas or concepts as soon as possible. For the most successful high-risk entrepreneurs, "fail fast" is a part of their bloodstream, which means that entrepreneurs are usually not successful in their first attempts. This is very different in the public sector which instructively uses, although not publicly stated, "almost never fail" principle. That is, public sector innovation promotion is based on the mitigated risk strategy, which promotes safe and planned outcomes instead of risky dynamic test and fail approach.

Table 1. Main challenges between cities and companies

	Cities	Companies
Investment challenge	How to invest?	Where to get funding?

Risk-management challenge	How to mitigate risks?	How to test and fail/succeed fast?

Our focus is on the automated mobility and the role of public bodies, mainly cities and city enablers in the procurement process. Automating the transport is already taking place in many cities, starting from driverless metros and trams to tens, if not hundreds, of driverless shuttle bus trials in the urban environment.

It is clear that automating urban transport cannot happen without the proactive role of the cities involved. This role can be twofold: 1. cities can invest themselves into new technologies or 2. cities can reduce barriers for companies to test out their solutions in the urban environment.

We are mainly focusing on the first part - how cities (or city enablers - partners working with cities, e.g. universities) can initiate automated mobility pilots. As cities themselves are not high-risk technology developers, this comes down to the question: "how cities procure automated mobility pilots?"

Empirically, we look into the procurement processes of six urban areas that jointly decided to run automated mobility trials with robot buses between 2017-2019 in the Baltic Sea Region, co-financed by the European Union's Interreg (BSR) programme, under the Sohjoa Baltic project.

According to the project plan, three European cities of Helsinki, Kongsberg and Tallinn were supposed to initiate large-scale open-street automated mobility pilots with a duration of at least 8 months and cities of Vejle, Gdansk and Zemgale small-scale pilots with a duration of 1 month.

As this project was funded by the European Union and the cities themselves, then the procurement process was at the central part of enabling successful outcomes. That is, cities faced a question how to instrumentally procure high-risk technologies like automated mobility electric shuttle buses.

1. Procurement of dynamic technologies (automated shuttle buses)

The public authorities have been designed to procure mature technologies driven by the mitigated risk strategy.

The first point of interest is that in general, "inside the box" driven public authorities have been designed to procure mature technologies driven by the mitigated risk strategy. That is, if a city is procuring new standardised urban buses, this process is well-developed with rather stable market supply (traditional companies as participants with rather stable market shares).

In addition, cities also introduce incremental changes to the procurement process ranging from adaption of IT technologies (e.g. procure buses that enable validation via smartcards) to procuring green technologies (e.g. buses with less emissions - gas or electric buses instead of diesel ones).

However, procurement of dynamic technologies is more difficult for cities mainly due to difficulties in specifying all requests beforehand in order to mitigate risks. This also applies to the automated shuttle buses market as this technology is under development with limited but dynamically changing market. During the procurement of the Sohjoa Baltic project, there were

only two companies (EasyMile and Navya) that were able to provide shuttle-buses for pilots use, although several companies were and are still in the development stage.

In the terms of the procurement, this stable-dynamic dimension translates to the option between price-dominated procurement (the one with best price-quality offer wins the bid) versus innovation- procurement (the bid with the most innovative solution is the most successful one). In reality, often evaluation with both elements are combined (e.g. price-dominated procurement with extra points for quality or then innovation procurement with weights for the best price/quality share).

2. Public sector innovation

How open are cities to make internal changes in order to advance the adoption of novel technologies?

The second point of interest is how open are cities to make internal changes in order to advance in the adoption of novel technologies. This usually also assumes increased collaboration between the stakeholders.

For example, the main requirements for the automated shuttle buses were developed jointly between all participating cities of the Sohjoa Baltic project, much based on previous procurement experiences of Metropolia University of Applied Sciences. On the other hand, it was also debated whether to conduct joint procurement or individual ones.

Initially, the City of Tallinn was interested in the joint procurement and indicated this during the large scale project meetings. On the other hand, Kongsberg wanted to move more rapidly and there was also uncertainty between the Norwegian (non-EU member) and Estonian and Finnish (EU member states) local legislations and regulations.

From the cross-border perspective, Helsinki-Kongsberg joint pilot (over 1000 km distance including Baltic Sea) is more difficult to organize, compared to Helsinki-Tallinn pilot (cities are 80 km apart over Baltic Sea with regular ferry connection). Therefore, in the mid and late 2017, the discussion remained whether and how Tallinn and Helsinki could do a joint procurement (similarly to the Finest Smart Mobility project that did several cross-border mobility pilots on behalf of two cities in 2017). Nevertheless, mainly due to legal and budgetary reasons, both sides reached an agreement to launch independent pilots.

Both options have clear advantages and disadvantages:

a) Joint procurement:

Main advantages:

- strong market power due to bigger market of three to six cities.
- provides very good potential for actual cross-border pilots (e.g. between Tallinn and Helsinki)
- same technical requirements for the procurement improving the scalability of the provided solution (working for instance in various countries with different climatological and infrastructural conditions
- procuring partners with less experience can have more support to the procuring process, especially regarding the technical part of the procurement.

Main disadvantage:

- very complex from a legal perspective
- have to adjust with specific local and EU laws and regulations at the same time

- relying only on one supplier with scarce resources could lead to delays and delivery problems
- timing wise the pilots could be difficult to arrange.

b) Single procurement:

Main advantages:

- More flexible in terms of when pilots run in each city, for how long and with which buses.
- Also provide more equal workflow within the project, otherwise the lead procurer takes bigger risk and more tasks.

Main disadvantage:

- single pilots are probably more expensive and less synchronised.
- procuring partners with less experience may have difficulties in launching the procurement and concluding it.

3. Impact on local economy

The public-sector initiated procurement can also be evaluated through economic spillovers to the local economy. That is, how does the procurement influence the local innovation ecosystem.

The third point of interest is the procurement decisions' impact on local economy. In the case of the Sohjoa Baltic project, several local innovation stakeholders participated the process either being project partners (e.g. TalTech) or via procurement process, e.g.

- Modern Mobility company in Estonia
- Holo company (previously Autonomous Mobility), which provided the pilots in Estonia, Norway.

It is also important to mention that Estonian TalTech-developed shuttle bus Iseauto (see iseauto.ttu.ee) did not qualify as it was not allowed to procure technologies from the consortium members.

II. Experiences from the Sohjoa Baltic pilots

After the successful national robot bus project SOHJOA in Finland, there was initiative to share the knowledge and experiences transnationally, and Metropolia University of Applied Sciences with Finnish partners searched for more partners interested in automated shuttle piloting in the Baltic Sea Region. The project consortia, supported by a positive funding result from Interreg (BSR) formed project Sohjoa Baltic successfully.

As the lead partner of the project and with previous experience of automated bus pilots, from route planning to procurements and deployment of pilot, Metropolia UAS has been advising, guiding and assisting other partners in planning and implementing their robot bus pilots.

In the previous pilots implemented by Metropolia UAS, the operation of the robot bus was arranged as an in-house labor. Thus, the procurement focused on buying or leasing the vehicle itself. However, in just a couple of years, the market had changed. The supply of the vehicles had become more service-oriented. Now the procurement had to incorporate also the operation of the vehicle, and this changed the nature of the call for tenders and the agreement processes.

In the beginning of 2018 it was first planned as a joint tendering in collaboration with the piloting cities. However, it started to seem as a too complex ensemble and was decided that all piloting cities should complete their own tender processes. However, all partners could use same kind of technical requirement sheets, which they could modify to correspond their preferences and duration of the pilot.

The difficulties in drawing up the invitation to tender was mainly due to the fact that there are no complete products on the market. The procurement can not be done based on clear needs of the procurer, but the limitations in the technology must be taken into account. This is why the pilot routes were not planned to run in the busiest intersections in the middle of large cities.

The Sohjoa Baltic pilots were divided into three large scale (numbers of months) and three small scale (number of weeks) pilots. Large scale pilots were coordinated by municipality of Kongsberg and small scale pilots by city of Gdansk in Poland.

1. Large scale pilots

There are many challenges related to the introduction of self-driving vehicles into regular traffic. In piloting wise with respect to legal adjustments, adjustments of infrastructure, operation and daily running, there were no special challenges in Norway, Estonia or Finland related to these conditions.

a) Norway: Kongsberg

Prior to the Sohjoa Baltic project, The Municipality of Kongsberg conducted a preliminary study in spring 2016, regarding the possibility of arranging a self-driving bus in Kongsberg. After Sohjoa Baltic received funds from Interreg in 2017, Kongsberg joined the project, coordinating the three large scale pilots.

First step – finding the local collaborators

Kongsberg received public funding to run a 9 month long pilot project and integrate the service into the public transport services.

In autumn 2017, a risk analysis of the proposed trajectory was conducted in collaboration with Statens Vegvesen (The Norwegian Public Roads Administration). The Municipality of Kongsberg signed a contract with Applied Autonomy to execute the project. The project was realised as part of a larger task in a collaborative project with Statens Vegvesen (The Norwegian Public Roads Administration), Applied Autonomy, public transport company Brakar and the operating company Vy. The entirety of the task was taken care of by Applied Autonomy. Knowledge was continuously shared between the partners locally and through the website www.cityandlab.no

Second step – limited technologies and vehicle options

Today's technology isn't ripe to be able to drive without safety operator on board. To bring down the costs, the vehicles must be certified without safety operator on board. While waiting for the safety functionality to become sufficiently good, frameworks and methods must be defined to certify the vehicles for specific use cases. However, the development of the vehicle software is making good progress, hence the vehicles are surprisingly inadequate in terms of mechanical properties and methods for troubleshooting to find faults.

The vehicle was acquired following a public tender:

1. The specification of requirements for the acquisition, based on common requirements established in collaboration between piloting cities.
2. The operating company Vy was the only provider who could offer lease of a vehicle.
3. The vehicle used in this pilot was an EasyMile EZ10 Generation 2, which was already approved for test purposes by the Norwegian legislation.
4. Leasing period was 9 months.
5. Applied Autonomy also leased safety operators for the vehicles.

The collaboration with the vehicle producer EasyMile worked well. Applied Autonomy has certified engineers to adjust the route and take care of the vehicles. Applied Autonomy has thus taken care of the daily operation of the vehicles. The vehicle safety operators were employees of Vy (the national Norwegian railway company). The operator must have a D1 driving license and be trained by the vehicle provider and on the pilot track. A total of 6 vehicle operators and employees of Vy were trained and certified by Applied Autonomy. The operators had extensive experience with public transport, which proved to be useful as it helped with the evaluation of traffic patterns, quick learning of the vehicle behaviours and good interaction with passengers. The operators also reported any anomalies of the vehicle and the route, and made proposals for improvements.

Third step – implementing to daily services

Norway was ranked 3rd among 25 countries on KPMG's Index with regards to being prepared for autonomous vehicles. The Sohjoa Baltic project and the work of Applied Autonomy have been a significant contributor to achieving this recognition. In the same analysis, Norway was ranked third in the world in terms of user acceptance and the use of autonomous vehicles.

After the Sohjoa Baltic pilot ended, it was decided to continue the implementation of automated buses as part of the city's public transit. Since 23/04/19, the self-driving buses have been part of the normal public transport network. They run Monday-Friday from 10:00 until 14:00, as there is no need for larger buses at these times. The buses run as route 450 and are monitored and integrated into route planning and ticketing tools like all other buses. In December 2019, Vy bought a newer generation (generation 3) of the EZ10 vehicle, which will be introduced into

service in early 2020. This bus will replace the existing buses in the longer term. Furthermore, replacement of other existing services is being investigated, in particular customised services such as the on-demand passenger pick up service (HentMeg) in Kongsberg.

In order to have a long-term effect on the project, we recommend contacting local partners who can build knowledge and contribute to business development.

Olav Madland, Project Manager, Sohjoa Baltic, Applied Autonomy

b) Finland: Helsinki

Even though Helsinki pilot's vehicle leasing and related services were going to be ordered as a turnkey solution, it was clear that Metropolia UAS should involve in the process of getting the vehicle running on the streets desirably. It was presumed that the service supplier could be from abroad as the number of national service providers was limited. Metropolia UAS prepared to act as a local contact point and assist in various matters..

First step – finding the supplier

The Sohjoa Baltic Helsinki large scale pilot procurement process involved the Metropolia UAS's project manager, project engineers, lawyer and chief of admissions. The process started by market dialogue where the goal was to find potentially interested and capable shuttle bus suppliers.

The discussion was opened with interested parties and the details were gone through more specifically. An important section of the procurement was the technical requirement sheet, where the relevant functions were listed out to make sure that a proper solution can be procured taken into account the current limitations of the technology.

The sheet was provided as an attachment among the other relevant tender documents.

The requirement sheet was divided into following 8 functions and further sub functions:

1. Vehicle requirements: Requirements for the vehicle such as the range of operation and amount of passenger seats.
2. Operational requirements: Such as ability to handle different intersections, e.g. T-junctions, roundabouts etc. autonomously.
3. Setup, deployment and operating: Indicating among other things the location of the pilot, duration of the service and operating schedule. It was important to distinguish the time needed to setup and program the route from the actual operation (passengers taken onboard). In case of this procurement, the setup stage was stated to be at max 1 month.
4. Site assessment: Requiring the supplier to depict the possible arrangements that have to be done on the route described in the call for tenders so that the vehicle can safely operate according to the rule of the road.
5. Delivery: Defining the preferred delivery time and location of the vehicle.
6. Regulations: Specifying briefly the regulation process for entering the roads with an automated vehicle in the said country and who will take care of the process (procurer or supplier).
7. Passenger information, branding: Specifying the requirements for instance for passenger info screens and taping of the vehicle.
8. CAN bus data availability: Defining the data that would be preferred to have through the bus's computer for the project's use.

The requirements were divided into must haves and optional functions indicated with X/O in case of each function in the provided requirements sheet as part of the procurement. The must

haves had to be of course fulfilled in able to consider the offer as eligible. When offering the optional requirements, the supplier could receive additional points. As part of the market dialogue, the technical requirement sheet was circulated between the potential suppliers to be sure that at least one of them can make an eligible offer.

The procurement procedure used was an open procedure below the EU threshold value and all willing suppliers could enter an offer. The call for tenders was opened on 25th of February 2019 and was open for 11 days closing up on 8th of March.

Despite of several visitors in the bid submission portal, it was received only one offer by the Danish company Holo (Autonomous Mobility A/S at the time). The offer was carefully reviewed and eventually seen as eligible. Decision to procure the service from Holo was easy as no other offers were received. Otherwise it would have been needed to wait for a two weeks appeal period after announcing the winner of the call for tenders. The decision (and instructions on how to appeal the decision) was sent by e-mail through the Hanki eTendering system to Holo on 20th of March 2019.

After the decision to procure the service from Holo was made, it was started to prepare the actual agreement to lease the vehicle and related services. The contract was mainly in line with the matters that was stated in the tender documents and general agreements between the companies. In addition it was given special attention on the issues below:

- Lease costs and fees: Stating the deductions that will take effect if the vehicle is not usable for the traffic due to remedies or other interruptions of use, referring to the operational time stated in the technical requirements sheet. It was also consulted by Helsinki Region Transport (HSL) in case of their compensation practices of bus traffic.
- Insurance: Depicting the compulsory insurances that the Lessor (Holo) should take.
- Leased vehicle description: Describing the vehicle identification information and who is going to apply for the mandatory permits (Traficom's test plate certificate) needed for the operation of the vehicle in road traffic.

The duration of the operation was agreed to be realized for 4 months, from 1st of June to 30th of September 2019. In addition, Holo had to reserve a period of circa 2 weeks in May for teaching and programming of the route for the vehicle. Vehicle had to be operated 6 hours per day and 7 days per week on a specified route.

The Second step – providing support for the supplier

It was agreed to have Finnish-speaking operators in the bus, so the first collaborative task was to help Holo in the recruiting process. The simplest way of proceeding seemed to be recruiting Metropolia's students. A recruitment announcement was published among other things on Metropolia's intranet. It was shown positive results and 3 metropolia's students were hired for the task. Assistance for the local salary and contract of employment issues was given as well.

Holo was using vehicle provider Navya's Autonom Shuttle robot bus for the procured service. For certain tasks Holo was dependent on the services provided by Navya, this applied for instance on the route programming. Start of the pilot was delayed by well over two weeks, as a commission specialist was not available to begin the programming of the route for the vehicle. More complicated maintenance services was also on the responsibility of Navya. Towards the end of the operation period a battery related issue came up which could not be fixed in time for continuing the operation. Due to lack of on site technological expertise, the bus was operated from 18th of June to 11th of September, over a month less (37 days) than initially planned. A spare vehicle was planned to bring to readiness to Metropolia's garage by Holo at the beginning of the operation, which could have been a solution for the issue but it did not realize.

As a flexible R&D partner Metropolia could provide help for various tasks and ease the implementation of the pilot such as:

- Offer a storage and maintenance place for the vehicle.
- Assist in acquiring the test plate certificate.
- Arrange a storage and charging place near the operated route.
- Plan and implement the temporary traffic arrangements.
- Arrange place for fixed GNSS RTK base (more accurate satellite connections for the robot bus used for localization).
- Help in operator recruiting process.
- Be the contact point to city and local public transport authority.

However, such collaborative work is not necessarily possible in every case. At this point the service subscriber of an automated bus pilot should at least prepare to act as a local contact point and guide the supplier to right direction (other relevant contacts) in implementing the pilot and consider these things when procuring the service.

Third step – listing the main learnings

All in all the collaboration went well especially when taking into account the difficulties in implementing such innovative solutions on public roads. Having international activities in a foreign country without officially established company, operations is definitely not an easy task.

Overall it was pleasant to see that businesses are born on the area of automated transport, not only new vehicle manufacturers, but also companies that take care of the operational service. At this point the general learnings from the procurement process of the Helsinki large scale pilot in Sohjoa Baltic project could be listed as follows:

- The technology of automated vehicles are constantly evolving, there are no complete products on the market that offers more sophisticated, flexible and cost effective solution for a public transport service than currently exists.
- The procurement can not be done based on clear needs and hopes of the procurer, it has to be taken into account the limitations in the technology.
- Just leasing of the vehicles might be a difficult task, procurer should prepare for leasing the full operational service.
- Procurer should be prepared to assist the supplier, especially if the company is foreign and has no established offices at the place where the activity is conducted, even though the service would be procured as a “turnkey” solution. However, this kind of collaborative work between the procurer of the service and the supplier is most likely the case to some extent with normal actors in public transport as well.
- Leasing a vehicle for a period of time instead of buying is a cheaper and more sensible option for the procurer/lessee as the technology is rapidly obsolete.

c) Estonia: Tallinn

The city of Tallinn procured the automated shuttle bus for the first time and this process took more energy and effort when it was planned. Ideally, Tallinn wanted to launch its pilot already late 2017 but this took more time due to weak supply of the products and services and also internal procurement capabilities of the city. In general, this process had three steps.

First step - pilot specifications framework for large scale pilots

The main framework for procuring the automated shuttle bus was initiated in a joint action with cities of Kongsberg, Helsinki and Tallinn jointly with connected partners of Holo (former Autonomous Mobility), Metropolia UAS and Tallinn University of Technology via joint drafting and bi-monthly meetings. This provided a synchronized understanding on the requirements for

the vehicles, although this was adapted and adjusted to each piloting site. This framework included:

- vehicle requirements (e.g needs to be electric)
- operational requirements (e.g. needs to operate both in automated and manual mode)
- setup and deployment (location and route)
- training plan (how operators will be trained)
- maintenance (all-inclusive)
- delivery (when can the shuttle be delivered and pilot started)
- regulations (local permissions).

Second step - designing the local procurement plan

Based on the general frame for specifications (step 1), the City of Tallinn jointly with Tallinn University of Technology drafted a formal procurement call in order to rent an automated bus. According to the call, the evaluation was a mixture of the monthly rental price (78% of final value) and specifications of the shuttle bus (22 % of total value). This call had a mandatory requirement to run the pilot for a minimum of 8 months to be started from 1.4.18 with a maximum budget of 112 500 euros.

Some of the specifics selected from the joint framework were mandatory and some optional and were categorised into five domains vehicle requirements, operational requirement, setup and deployment, training plan and maintenance and included altogether 59 points out which 37 were mandatory and 22 optional. In the evaluation, each optional point was calculated as one extra point.

This call also indicated a preferred location and schedule of the bus: the operation should take place in Kadriorg between the Weizenberg tram stop and National Art Museum of Estonia and the bus must be in open operation weekly from Wednesday to Sunday.

Third step - Tallinn procurement process

The Tallinn procurement was publicly opened 22.01.19 with a deadline of 18.02.19. This first call attracted no interest in suppliers (such as EasyMile and Navya). In brief, the city of Tallinn wanted more but the limited supply was interested in - the two shuttle bus manufacturers in Europe that were presumed to make an offer (EasyMile and Navya) did not follow this call.

In the second call, launched a day later (19.02.19) with a deadline of 04.04.19, the mandatory duration was cut to 5 months as minimum and more flexibility and budget was provided to the launch of the pilot. This attracted both EasyMile and Navya shuttle bus consortiums, although only one bid was submitted that included Navya shuttle bus operated by Danish company Holo in a local partnership with Modern Mobility. However, this call failed due to the consortium design.

The third call was opened 22.04.19 and ended with a successful bid for 5 months starting late August 2019. The agreement was signed with Modern Mobility and Holo 01.08.2019 and the Navya's shuttle bus started operations on 26.08.2019, although the initial launch was planned for 01.04.2019.

Starting late August, the pilot operated for approximately 2 months while having several technical problems due to limited distant maintenance. Late November (reaching first sub zero temperatures), it was decided to pause the pilot until Spring 20 for the last 3 months. Therefore, the pilot restarted during summer of 2020.

2. Small scale pilots

a) Poland: Gdansk

The city of Gdansk had the goal to join an innovative project and to be the first city in Poland to showcase an autonomous bus for the last mile public transport, before autonomous private vehicles become popular. From the consortium partners, we were mostly looking for advice on autonomous buses specifications and feedback on considered route choices. As a leader of the small scale pilots Work Package we initiated regular small scale pilot teleconferences, which we believe helped to organize a pilot in Gdansk.

We consulted the Public Procurement Bureau of the Municipal Office of Gdansk and it was decided that we would follow the mode of an unlimited tender. We had to provide a specification of the service we require and a specification of a vehicle that needs to be delivered. From the very beginning we were aware that it would be difficult to obtain an offer for a small scale pilot, running one month, and considering the fact that we wanted to outsource a wider range of bus presentation related service that it is usually expected by the companies providing services in the field of autonomous transport. For this reason we were networking extensively with potential bidders prior to tender announcement in order to make them aware that such an announcement is coming and what would be the expectations. Knowing that we were likely to mostly liaise with companies from abroad, we decided to both announce and run the procurement bilingually – in Polish and in English. These meant that not only the service specification and announcement had to be prepared in both languages, but also that we had to rely bilingually to any formal question we would receive in the course of the tender. We received as many as 100 formal questions, and proving replies involved much consultation between different departments and city units and much translation work as well.

If we could travel back in time we would have probably worried less about legal aspects and we would have consulted the local Police earlier. Since we hadn't liaised with the Police prior to the procurement process, the representative of the company outsourced to organize a showcase in Gdansk was summoned by the head of the traffic department within Police to dispel doubts about the use of the road in a special way less than a month before the planned presentation. In retrospect, we would have also used other procurement mode for the legal analysis in order to avoid not having this expense reimbursed, even though we are very satisfied with the result and doubtful whether other legal counsel would have suggested a way to organize a showcase in Gdansk considering many legal obstacles.

The final agreement was very similar to the template/ draft agreement that was published as an attachment to tender announcement. For logistic reasons such as e.g. lost courier service at the headquarters of the contractor or doubts of our Financial Department regarding VAT import, it took much longer to get the agreement signed than we had initially anticipated. Other than that, the cooperation with the service provider was fruitful and the contractor fulfilled all the obligations. For both parties to the agreement, the advantageous solution was that the foreign contractor entered into an agreement with a Polish technological partner.

b) Denmark: Vejle

Cumbersome permission policy

Denmark is represented by the Municipality of Vejle in the Sohjoa Baltic project. Vejle is among other things participating in the project with the investigation of possibilities for replicating a small scale pilot, and to develop and conduct the actual implementation of the small scale pilot. The main aim of the project was to demonstrate the first and last mile autonomous transportation, also to serve as pilot for transport operators and to have a marketing impact. Vejle Municipality has adopted Europe's first Resilience Strategy, in which the challenges of the

future are analyzed and described. Through a number of lighthouse initiatives, it is pointed out how the challenges can be used as drivers for future development, securing increased resilience. One of the described challenges is that the city is growing and this puts mobility under pressure. One of the solutions proposed to address this, is to look at new technologies including autonomous vehicles that can help solve the challenge.

In 2018, the Municipality of Vejle adopted a Mobility Plan that describes the future challenges. It also points to new technologies as possible solutions for the future, including autonomous technology. Vejle Municipality is a growing municipality that wants to take precedence over sustainable solutions, but at the same time wants to show common sense in actions and decisions (good administrative practice in accordance with the law). This, in conjunction with desires and trade-offs between effects on visibility, social resilience, uncertainty about the applicability of the new technology, testing of the new technology, attempts at implementation and the needs of different user groups, etc., have influenced the choice of a suitable route.

Vejle has conducted a market analysis based on intensive dialogue with the market, and has conducted a tender process to contract with an operator. Alongside, Vejle has been in dialogue with assessors and with the Danish Road Safety Agency. During this process it has been realized that the pilot scheme for approval of testing autonomous vehicles is cumbersome to a degree that the market finds impossible to build upon. The concluding remarks from the market was that the way the Danish application process is built, unfortunately, makes it extremely uncertain to bid for a project of short duration. The Danish legislative framework makes it extremely difficult and risky to take responsibility for this small scale pilot. For testing and demonstration of the introduction of autonomous buses the necessary permission must be obtained for the completion of the test, in accordance with the Danish Road Traffic Act. Another requirement is that the project must be assessed by an independent assessor in accordance with the Danish legislation.

Changes in desirable duration of showcases

A market analysis has been carried out by continuously investigating the developments in the market via news in the media and contacts at trade fairs, conferences and via partners' sharing knowledge and experience. In this way we have been in regular dialogue with other projects for the roll-out of autonomous vehicles, different operators and various technology providers. As a result of the market analysis, we have initiated dialogue with three selected operators, conducting a workshop with each and one of them. In connection with the further qualification of the route and the engagement of possible bidders, Vejle initiated dialogue with three selected operators in the market. The dialogue served the purpose of testing our route selection on the operators, acquiring knowledge of content in connection with the preparation of tender material, examining the operators' motivation and suitability for submitting tenders, etc.

In connection with our dialogue with the operators, it became clear that they see a challenge in that small-scale pilots are set for a limited time period of one month. (The Sohjoa Baltic project application states the small scale pilots to last for at least one month, but the budget limits the duration to no more than one month). They thus pointed out that they have now reached a stage within the area, where they have gone from "show testing" to long-term test periods of a minimum of six months and preferably longer. Several providers try to make projects of 1-2 years duration, in addition to testing the autonomous vehicles at the same time connecting other attempts to the project, including among other things, urban development.

The providers stated that the administrative work on applications, permits and setup of the route does not align with a short test of one month's duration in relation to their dividends by entering into such cooperation. This is because the application process has the same extension whether it is a one-month or 2-year trial. It will therefore be disproportionately expensive to carry out tests of short duration compared to the yield. The operators therefore requested that we contribute with knowledge about what relevance, visibility and motivation our test could

have for them. The Municipality reply to this was that there is an ongoing process of developing a new sustainable city district, Ny Rosborg, just next to the chosen route. In this new city district autonomous vehicles are considered a possible choice of future mobility, hence giving the possibility to enter a real market request.

In conjunction with local wishes and requirements for the route, political wishes and the purpose of the project to prepare a first draft of a requirement specification. This has subsequently been qualified by the dialogue with the market. Against this background, a final requirement specification has been prepared which is included in the final bid collection material, which the invited operators subsequently have the opportunity to ask questions upon before submitting the tender. The material has been sent out to the selected three operators (limited tendering process), all of whom had stated that they wish to receive the tender material. Based on the market analysis, it is assessed that there is no interest in making a genuine tender. Likewise, the expected budget for the task and the expected bids for the task are assessed to be below the thresholds for public procurement and EU tenders. It is therefore only a requirement to carry out a tender with three tenderers. A small amount is set aside from the material being sent to the operators until the deadline for tenders is to be received. This is considered to be reasonable time in relation to the scope of the task.

After the end of the deadline for bidding, we conclude that no operators were interested in placing an offer or bidding on the tender. We have received the following explanation and argument to this:

- The way the Danish application process is built, unfortunately, makes it extremely uncertain to bid for a project of this duration. E.g. the work with our first application (in another project) to the Road Directorate was started almost 1 1/2 years ago, and has not yet finished.
- The Danish legislative framework makes it extremely difficult and risky to take responsibility for this small scale pilot. There are no precedent examples of how it has been completed.

The Municipality of Vejle has since May 2019 again engaged with the stakeholders to investigate the possibilities for developing a test and demonstration of autonomous buses in the City of Vejle.

Proceeding was made with the most interested and comprehensive operator, a Danish company which operated the large scale Sohjoa Baltic project pilots in Helsinki and Tallinn, Autonomous Mobility, now Holo. The Road Authorities require an assessor consultancy. The learning from engaging with Holo, who to our experience showed a dialogue-based and solution oriented behavior.

Holo also had experience from the demonstration run at Bella Centre in 2018 in Denmark. The demonstration at the Bella Centre, was conducted with the police approval, as the route was fenced off, and hence no longer subject to the traffic law. It was considered no longer a possibility to conduct a similar demonstration in Vejle, due to the lack of interest for the market, and due to the lack of applicability with the EU grant in Sohjoa Baltic.

Holo repeated their answer of not finding the demonstration a short duration interesting due to lag of dividend compared to the cost of the process of setting up a demonstration. Directly asked what would be the best thing The Municipality of Vejle could do to enhance the roll out and application of autonomous vehicles in Denmark, it was replied that the best we could do was to, emphasize the above mentioned barriers to The Road Authorities, in time to influence the upcoming amendment of the law. We delivered the message to The Road Authorities, and was informed that we would be kept updated on the progress of the process on collecting experiences with the law and the upcoming amendment. At the time of writing (25th September 2019) we have still not been contacted. The contact at The Road Authorities also stated that if we wanted to influence the amendment of the law, it was a political matter.

The legislation is by all stakeholders described as comprehensive, complex and demanding. With this argument all potential bidders/operators have neglected to place an offer for a small scale pilot in Vejle, Denmark. As well the possibility to influence the upcoming Danish process with amending the legislation was discussed, to change the legislation and make the process for implementation and demonstration of autonomous vehicles more smooth and operational. From the dialogue with the third party assessor, it was concluded that the above information was sufficient to describe the Danish barriers and situation. Based on this ground, it must be concluded that a demonstration of a small scale pilot of one month duration was unfortunately not feasible to implement in The Municipality of Vejle.

c) Latvia: Zemgale

As a part of the project, we carried out an activity where experts examined the legislative situation in Latvia. That was a task where we developed good practice examples in legislation and proposals for the Latvian legislative base, taking into account European and global good practice examples. Latvia does not have a specific national legal framework in this area, so we have to follow the European Commission regulation. National legislation also states that cars may be driven only if they are accompanied by a guide or a person who can carry out manual operations when necessary. So there will be a trained person on the bus during our pilot demonstration.

Latvia, as an EU member state, has to follow this regulation, but we have developed and submitted legislative initiatives at national level. The Ministry of Transport is responsible for the further development of the legal base. So far, they have issued a document with “Guidelines for automated vehicles for technology testing” which outlines requirements for the operation of AVs on public roads.

We have learned that when starting out in a completely new and unknown field, you have to gather as much information as possible about the subject. We noticed that during the project nothing got better than planned, and it was not worse as well, but more limited. As a result we have shorter tracks, fewer opportunities and so on.

It should be noted that innovation and technological solutions also require a great deal of work from government bodies - our current impression is that technologies are developing faster than public administrations are able to keep up with them in terms of legislation. Officials have been unable to track technological developments because there is no legal basis for them to operate legally. They are not illegal, but they have no official legal basis.

If something innovative is being developed, cooperation with the ministry responsible for the particular field is very important. For example, if we had a pilot demonstration but had not communicated with the Ministry of Transport and the Road Traffic Safety Directorate, we would not have been able to realize the project’s intention. We have also gained a lot of practical information and knowledge about the topics in the field. After our showcase, we will be able to tell more information regarding this subject.

For purposes of procurement related to setting up the necessary infrastructure for the two pilots, it proved invaluable to have a local subcontractor in the transport industry. Organising a garage for the AV, its transport and even the stickers for it were all handled through a Latvian coach operator who already had a network of the required contacts on the ground. In addition, this partnership allowed easily finding the best suited candidates for becoming operators of the AV (as they already have experience with operating buses) and simultaneously ambassadors for the project.

III. Policy Recommendations

The procurement of new technology is somewhat a gambling game, where the motivation to shift towards new technology and the availability of desired technology do not always complement each other.

In Europe, the countries and regions that are at different positions. Some countries and regions are launching or already have launched their very first pilot to demonstrate the technology, there are countries, which have hosted multiple pilots enabling them to build local capacity in service delivery and technology development, and prepare or already implement changes in legislation. There are also countries that have not hosted any autonomous pilots yet. This creates a procurement barrier between the regions or cities, hence making the business feasible, it is very understandable that the operators are willing to offer their services for longer periods with multiple vehicles rather than serving to the cities just beginning the process of applying licenses for local demonstrations. Even if there were enough vehicles available to all potential customers, making them run takes time as each robot bus route still needs to be programmed individually by specialists. Each city being an unique environment there are no possibilities for (cheaper, quicker, easier) mass turnkey solutions.

It is near to impossible to foresee how the markets of autonomous vehicles develop and how the new tech solutions eventually change the transport sector. Generally, the supply/demand ratio is currently formed more locally, even seasonally. The local transport needs differ in urban and rural areas, and cities are unique in every way. The vehicle manufacturing and service operating companies are aiming to act globally. As there is not yet a one global standard for automated vehicles, competition between tech and business developing start-ups and companies is ongoing. Following years or decades will show, who won the race.

Top-7 tips for different decision-making levels:

1. National Public Road Authority: Focus holistically, not just on the vehicle. See risks aligned with the use case. Continue to prepare legal frameworks and learn from pilot projects.
2. Municipality: Wwork for having a strategy for sustainability and business development.
3. Public Transport Administration - work of having a strategy for sustainability and business development. Collaboration with Business and local municipalities. Facilitate innovation in tenders.
4. Public Transport Operators: Be ambitious, and think new.
5. Commercial actors: Think global while solving local and national projects.
6. County: Work for having a strategy for sustainability and business development.
7. Government: Work for having a strategy for sustainability and business development. Set aside budget for innovation in the transport sector.

Volumes of The Roadmap to Automated Electric Shuttles in Public Transport

1. The Legal Framework
    - What is the current legal status of automated driving in different European countries of the Baltic Sea Region? Sohjoa Baltic presents the relevant legal information for implementation and provides policy recommendations for the future.
2. Technology and Safety Requirements
    - What are the current relevant technological and safety challenges to be taken into consideration in the implementation of automated shuttle buses? Sohjoa Baltic provides information from Germany, Denmark, Poland, Finland, Sweden, Estonia, and Latvia.
3. Starting Your Own Pilot
    - How to deploy an automated vehicle pilot in a city? Sohjoa Baltic provides a practical toolkit with recommendations based on the practical experiences from automated shuttle bus pilots in Norway, Poland, Finland, Estonia, Latvia and Denmark.
4. Procurement Challenges
    - What are the barriers and enablers of autonomous vehicle procurement in public transportation? The experiences of Sohjoa Baltic's automated shuttle bus pilots in Estonia, Denmark, Finland, Latvia, Norway and Poland describe the complexity.
5. User Experience and Impact on Public Transport
    - How and why should cities prepare to implement automated public transport? What is the role of automated shuttle buses? Sohjoa Baltic provides views based on experiences from pilots in Norway, Poland, Finland and Estonia.