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The Urban Lab of Europe !

The TUPPAC-LINC project Journal N° 2

Project led by the City of Albertslund



**URBAN
MOBILITY**



The TUPPAC-LINC Project

The Transforming Urban Planning Providing Autonomous Collective mobility (TUPPAC) project will test electric autonomous shuttle busses as a solution for the first and last mile “mobility gap”. Four driverless vehicles will be tested, for the first time, to ensure the link to and from two pilot Light Rail Transport (LRT) stations built in the framework of the new LRT infrastructure of the Greater Copenhagen Region. During the controlled deployment of the vehicles, partners will be able to design the control systems, demonstrate the overall feasibility in two different urban environments while collecting and analyzing feedback from users on three key aspects such as scheduling, routes and communication. Special attention will be given to how pedestrians and cyclists experience interactions with the autonomous busses as well as to user experiences regarding in-buss safety, service inclusiveness and reliability. The knowledge generated during the testing phase will be used to integrate recommendations and guidelines for urban planning to incorporate autonomous busses as collective mobility services in a new Sustainable Urban Mobility Plan for the metropolitan area.

Partnership

- Albertslund Municipality
- Municipality of Gladsaxe
- Nobina Denmark - private company
- IBM Danmark ApS - private company
- Technical University of Denmark
- Roskilde University
- LOOP CITY - strategic collaboration on urban and business development
- Gate 21 - non-profit organisation

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1 Executive summary

This journal is authored by Dr. Anna Pernestål, UIA Expert for the TUPPAC project.

In this second UIA journal for the TUPPAC project the progress of the project during the last six months is described and a reflection about the service developed from a public transport operator's view is given. The main challenges and how the project is tackling them are presented, and finally major learnings are given.

During the last six months, the TUPPAC project has taken several major steps towards the operation of driverless busses in demand responsive services on public streets. Three self-driving shuttle buses are procured, delivered and prepared for operation, and type approval and operation permit applications will be finalized within the coming weeks. The test design for the first six months long test at DTU Campus is finalized. Finally, a monitoring and evaluation plan that connects the data collected in the tests with the project goals and overall vision is created.

Currently there are three main challenge areas: technical readiness, legislative readiness, and communication with target beneficiaries. The TUPPAC team is aware of the challenges and have clear strategies about how to meet tackle the challenges.

The process to get the approval to operate driverless buses in Denmark has shown to be very time consuming, as an external assessor is needed. This process has delayed the project, but the project has focused the necessary efforts into the task and will send in the final application in May. To smoothen the process, the TUPPAC team uses experiences from the other Nordic countries to support both themselves and the authorities.

Major learnings include the challenges within multi stakeholder collaboration, the handling of delays caused by external factors, and issues within communication.

2 What progress has been made since last time?

2.1 The vehicles are in place

Three vehicles of type Easymile EZ10 have arrived to Albertslund and are currently parked in the TUPPAC showroom. Minor adjustments are made to get them ready for type approval and to stripe them with the TUPPAC colors and logos. A lot of effort has been put into the work of getting type

approval and operation permits. The legal process in Denmark is long and requires thorough assessments performed by an external assessor. This work is now completed for the DTU Campus tests and the application will be sent to the approving authority in May.



2.2 The DTU Campus test design is ready

The project has completed the test design for the DTU Campus test. The process and the test design are described in detail in the TUPPAC Zoom-in no 1. The DTU test will be performed in three phases: fixed timetable & route, dynamic timetable & fixed route, and dynamic timetable & route. The dynamic routing will be based on data collected about flows

of users rather than individual data. At the DTU test the goal is to have many users, and preferably returning users. The service will be open to anyone to use, but there will also be a specific group of at least 500 test users that sign up to share data and take part in surveys. A communication plan is made to recruit users and in particular the 500 test users.

2.3 The monitoring plan is prepared

Tracking the progress of a large project as TUPPAC is challenging. It is important to monitor that the activities in the pilots actually contribute to the high-level vision. To track the progress of the project a monitoring plan is created. The monitoring plan is based on the TUPPAC vision subdivided into four research areas/focal points: operations, user experience, demand responsive

transport, and sustainable city development. For each of the areas, two main research questions are identified, as well as the data needed to respond to the research questions and the main responsible. For each research area there are also 1-2 KPI:s identified. The KPI:s will be used to monitor over time that the TUPPAC goals will be reached.

VISION GOALS		RESEARCH AREA	RESEARCH QUESTION	DATA/ OUTPUT	RESPONSIBLE	KPI
		OPERATION	ARE DRIVER-LESS VEH. SAFE & RELIABLE IN OPERATION?	OPERATIONAL DATA (SPEED, # OF STOPS, ENERGY USAGE)	NOBINA	UPTIME IN TESTS (NO DATA CAN BE COLLECTED IF VEH. NOT IN OPERATION)
	SUSTAINABLE BUSINESS MODELS?	USE CASE DESCRIPTIONS				

3 Reflections about driverless mobility – a public transport operator’s view

The TUPPAC project aims at exploring how innovative mobility services based on driverless technology and on-demand services can contribute to sustainable urban mobility. In particular, the project investigates how small, electric, and driverless shuttle buses can be used as a complement to high capacity public transport. The basic idea is simple – small busses that operate in a flexible and demand-responsive

way and solves the “first and last kilometer challenge” of public transport. However, there are still many open questions. At the site visit in Albertslund in April 2019 I got the chance to sit down and talk with Soren Jacobsen, project manager at Nobina, about the challenges and opportunities with the new mobility services based on driverless vehicles.



What is the role of the driverless busses in a future mobility service?

Soren describes the service tested in TUPPAC as a new type of mobility service that does not exist today. The aim is not to replace current public

transport, but to complement public transport. On the other hand, it should not be a taxi service that serves everyone separately. That is not sustainable.

Change-overs are pain points in public transport, Soren explains, and people are not willing to change more than one to two times every trip. He hopes that the driverless busses can make changes smoother. For example, the small electric buses can drive into residential areas where large

busses cannot drive. **One can see them as ‘rolling bus stops’** Soren says.

By improving public transport, he sees the possibility that people not feel the need for having a second car.

“On demand” mobility is a corner stone in the project, but what does that mean?

One important step is to go from using static timetables to predictive routing, says Soren. In predictive routing historic travel data from the past years, weeks, days or even hours are used together with for example weather data to predict the travel demand the coming day or coming hours. For example, transport demand often varies between different weekdays and if these variations can be predicted the routing of the buses can be adjusted accordingly. Questions that are still to solve are for example whether data collection and travel prediction should be on the level of individual users or rather on groups, and which time horizon that should be used.

In theory this type of predictive routing could be done with regular buses, but to Soren’s experience

this has been very complicated. **This type of dynamic routing is very difficult if there are drivers involved, as they need to know their working hours well in advance. If the busses are driverless it is much easier to add or remove busses as needs changes.** Soren looks forward to testing this type of predictive routing at the DTU test.

A fully demand responsive service is based on the individual travelers’ requests. This type is much more difficult, and the plan is to test this type of service at the Hersted testbed. However, as Soren points out, this type of service is close to be a taxi service, and it is not obvious that it should be included in the subsidized public transport offer.

The legal process to operated driverless technology in Denmark is quite extensive, what are your comments on that?

Soren explains that the process to get a permit has been very long, as there is a requirement from the authority that an external assessor should make an assessment. The project has put a lot of efforts into the process. When we talk, Soren is confident that the project will get permission to start operation during the fall. But

he sees a risk that the long, complex and costly process will become a barrier for future tests to continue to explore the opportunities of the driverless busses. With such long process it will be costly to perform shorter trials, and this is not good for the development of new services.

Why is the TUPPAC project important for you?

The most important task is to collect experience, Soren says. In that he includes experience about the users, the operation, and potential future

customers, and to learn about the opportunities and challenges with the technology.

4 Innovation, Challenges, Risks

4.1 Overview of challenges

An overview of the established UIA challenges as well as three project specific challenges is presented in Table 1. Besides the established UIA challenges, three more challenges are identified for the TUPPAC project: Financial sustainability, Technical readiness, and Legislative readiness. These three challenges are crucial for the success of the project to handle, and they all appear due to the high level of technology and service innovation in the project – the TUPPAC project is piloting a new technology in a new service with the aim to identify new business models.

In the table, the levels of the challenges are classified as follows: High level challenges are important issues that are necessary to focus on during the coming six to twelve months. If not resolved, they may impact the project result. Medium level challenges either have a plan or are potential showstoppers later in the project. Low level challenges have plan or platform in place to mitigate them. The main challenges (high level) are further discussed below the table.

Table 1: Mapping TUPPAC project against the established UIA Challenges and identified project specific challenges

UIA Challenges		
Challenge	Level	Observations
Leadership for innovation	Low	LOOP city, a collaboration between the 11 municipalities around the new light rail, had the role to anchor the developments and results in TUPPAC in various important networks. Now LOOP city is closed, and this role is taken over by Gate 21. Gate 21 is well equipped to take on this role, and the new light rail is a uniting factor. Therefore, the leadership for innovation is still considered strong.
Public Procurement	Low	The vehicles to be used in the project are procured and delivered. Only 2 out of 10 potential suppliers were willing to deliver. Easymile was chosen as supplier, and they have shown a great interest in being engaged in a partnership with the project which is beneficial for the future development. The aim of TUPPAC is to investigate how public organizations can procure the new service developed in TUPPAC, but this will be considered at a later stage in the project.
Integrated cross-departmental working	Low	Gate 21 has taken the role of uniting the municipalities around the new light rail when the formal collaboration ended with the closing of LOOP City. Today, the format of future collaboration is not defined, but the municipalities are still united by the vision of utilizing the Light Rail for development. At Albertslund municipality departments have different perspectives and roles in the project, but again they are united by their shared vision related to the new Light Rail.

Adopting participative approach	Low	<p>Until now, focus in the project has been on procurement of vehicles and design of the first pilot. From now on, focus will be on user engagement and plans for user engagement, recruitment of participants, and communication are developed. Users will also be engaged in the design of the service.</p> <p>It is important for the project to find the right balance between user involvement, technological innovation, and research results. All these questions are targeted in the test design.</p>
Monitoring & evaluation	Medium	<p>The project has developed a monitoring plan that targets the TUPPAC vision, the UIA targets and stakeholder expectations. Yet, there are lot of data that needs to be collected to ensure that the monitoring plan is feasible.</p>
Communication with target beneficiaries	High	<p>Communication in general is challenging in TUPPAC, as there is a gap between the visions about the benefits with automated vehicles and what can really be tested with the present technology and legislation. Politicians, municipalities, city developers – the project has planned to develop a communication plan, but the plan is not yet in place.</p> <p>There is a plan for communication with users, implementation of which is in high focus from May 2019.</p>
Upscaling	Medium	<p>The actual tests of the service and the automated vehicles are not started yet, so it is still unsure what the actual benefits will be for stakeholders and the municipalities. However, if the tests are positive, the contact network for upscaling is well in place.</p>

Project specific challenges

Financial sustainability	Medium	<p>The project has planned to identify the potential users and use cases, the operational costs, and how the service can be used for urban planning. This information will be collected during the tests, and then conclusions on financial sustainability can be drawn.</p>
Technical readiness	High	<p>The vehicles are delivered but not tested yet due to the delayed legislative approvals. The technology that will be used is in the frontline, both regarding vehicles, routing, and service. With Nobina, Sweden operating Easymile buses in Barkaby, Sweden, Nobina Denmark does not expect a lot of surprises in the operation. Yet, the surrounding traffic in DTU Campus is different from previous experiences, with many pedestrians and cyclists, and this might prove to be technically challenging. Also, implementing the route optimization is challenging. Therefore, technical readiness is still considered red.</p>
Legislative readiness	High	<p>The project is already delayed due to the unexpected long time to get legislative approvals and will be further delayed. The TUPPAC project team has made all measures they can to speed up the process, and this risk is to be considered as an external factor for the project.</p>

4.2 Challenge: Communication with target beneficiaries

There are two main target beneficiaries – users and urban planners/politicians. Currently, the main risks are primarily related to communication with (potential) users.

This challenge mainly arises due to the gap between the vision and expectations on automated vehicles and on-demand mobility services on the one hand and the level of the service that the vehicles and the app can deliver on the other hand.

In the test design for the DTU test, this has been taken into consideration and a plan about what to communicate to the users and when is created. There are three needs in the communication with the users. First, to attract people to use the service. Second, to keep users informed about what is happening during the test, so they understand what they can expect and continue to trust the service. Third, to give the public a positive view on automated buses as a complement to the new light rail, so that they want to use the service when (if) it is implemented in full scale.

There is a risk that the service level of the automated vehicles will not meet the expectations of the users. For example, due to technical and legislative limitations the buses will operate at a speed that is so low, it is almost faster to walk. Therefore, there is a risk that the users do not see

the point in using the service. If the users do not use the service, the data collected about user behavior and acceptance will make it more difficult for the project team to draw conclusions about the service.

During the tests there is a balance to keep users informed about the tests without informing them too much. For example, during the tests three operational schemes will be tested, but the difference for the users may be minor. Then the question arises – should users be informed about the differences or not?

The challenge within communication is to a high extent related to expectation management. Politicians, municipalities, city developers and users have very high expectations on what driverless shuttles and on on-demand services in general, and the TUPPAC project in particular, can deliver. Having a vision for how the shuttles can be used in sustainable urban design is important to push development and to realize the potential with the new technology. At the same time, the technology is under development and it is likely that the high expectations will not be met. Therefore communication must be made so that the vision is explained, while at the same time it is made clear what can be expected by the services at the test sites, and how the gap between the demonstrated services and the vision can be filled in the future.

4.3 Challenge: Technical readiness

The TUPPAC project aims at testing both new technology in terms of driverless vehicles and a new type of on-demand mobility service. Each of them has their challenges, and overcoming these challenges is crucial to reach the project's targets.

The vehicles. The vehicles are delivered, and currently final adjustments are made to prepare them for operation. A previous plan was to test the vehicles in closed off areas while waiting for the permit to operate on public streets. However, these tests are also delayed as the project is still

waiting for the type approval. The type approval is expected to come from the authorities in June. Before the vehicles are tested it is difficult to confirm that planned tests are possible to perform. However, Nobina has operated the same type of vehicles in other countries, so they already have operation experiences. The main challenge is rather on whether the tests planned by the project team will be able to perform as planned, or if the test at DTU campus needs to be redesigned.

The service. The service consists of a mobile application for the users to get access to the service and book trips and a dispatching, or routing, scheme that optimizes how the vehicles are used to fulfil the travelers' requests. Both

these components are in innovative and in the forefront of the development.

The mobile application is under development. Different project partners have different visions and expectations on the app, and the app needs to be a compromise between user needs, researchers' need for data collection, and the limited time to develop the app.

The project team is skilled and consists of all types of competences needed to develop the mobile application. TUPPAC has also planned for developing the application by using service design. However, as the app is central for the project's success, we track this challenge as a high risk challenge until we have seen how the plan unfold.

4.4 Challenge: Legislative readiness

Since the baseline journal written during the last fall, legislative readiness has changed from a medium risk to a high risk. The reason is that the process to get type approval and permit to operate the busses on public streets has been further delayed.

The type approval is expected in June according to the revised project plan, so that the buses can be tested during the fall. Though the Easymile EZ10 shuttles have approval to run in many other EU countries, these approvals do not live up to higher standards in the Danish legislation for vehicle approval. The vehicle approval must be ready before the permit for operation can be given.

The process to get permit for operation of driverless vehicles in Denmark is more complicated than in the other Nordic countries. In Denmark, an assessment made by an external assessor is needed. This slows down the process as the task is new also for the assessors. The

TUPPAC project is not the only team working on getting a permit to operate driverless busses in Denmark, and the other teams has had the same experience with getting the approval.

The project team is working hard to get both vehicle approval and test application ready before end of May 2010, in close collaboration with the assessor, the vehicle consultants and Easymile. The assessment made by the external assessor together with the complete application for operation permit at DTU campus is sent in during end of May, and the approval is expected to come from the authorities in September.

A new application for permit will be needed for the second test at Hersted Industry Park. To speed up the process for that application, and to support other future projects and initiatives with automated road vehicles, the TUPPAC team is also compiling and sharing their learnings during the application process.

The DTU test is delayed due to the legislative process. Consequently, the second test at Hersted will be somewhat delayed though not as much as the first test due to a time buffer in the initial planning. The project team has performed many measures to speed up the process, e.g. by using the experiences from other countries and working close with the vehicle manufacturer to solve vehicle-related challenges.

If the project gets the permit for testing in the fall, as the current plan is, there is still time to operate the tests as planned. However, there is

a risk that the permit will be further delayed. Therefore, the project should prepare for making a Plan B during the summer.



5 Take-aways from TUPPAC so far

Sustainable mobility in attractive cities is a top priority for many cities. The TUPPAC tests has not started yet, but there are some learnings that can be made from the project.

- Sustainable mobility innovation requires **many stakeholders**, including municipalities, mobility operators, vehicle suppliers, information and communication technology suppliers. The stakeholders share the vision of sustainable mobility, and the engagement to create a very good test. To cite one of the project members:

It is incredible with the excitement and the strong team!

Naturally, each of the partners have their own interest. This also leads to that there are several perspectives that need to meet in each decision in the project, e.g. the test design and the monitoring plan. One concrete example is that for some project partners it is important that the users like the service and become positive to new innovative mobility services, while for researchers it may be more important to find out *why* users like or not like the service than that the users actually like the service. This requires a **strong leadership** from the project leaders, and **clear vision and project goals**, something that the TUPPAC project is successful in.

- The project has been **delayed due to the extensive process** of preparing the legislative operation application. This creates more time before the start of the tests, and it is **critical for the project's success how such time is used**. This time has been effectively used by the project to create more thought-through plans and test designs. However, there is a risk that it is too much planning and discussion as new questions and thoughts are raised in the discussions, and that resources that are needed during the tests instead are used in the planning. An important task in projects like TUPPAC is to find the right time to end the planning and instead put the project in waiting mode until the test can start. Then, when the project starts again with tests, tests and analysis needs to be performed during a shorter period, and this needs to be prepared for.
- **Communication** in projects like TUPPAC – where innovative and new technology is tested as a first step to reach a long-term vision – is very important. For the project members it is easy to see the link between the tests and the vision. The users, on the other hand, will probably not experience the busses and the service as mobility from the future. Communication needs to consider this and tell what it is: **a project that tests new technology and services that may become a part of the future.**

6 Next steps

In this second journal the status of the project is presented, and the main challenges in the project are discussed. The driverless buses have arrived to Albertslund, and the project is waiting for the legislative permit to start operation at the DTU Campus test site that is expected after the summer. The next steps in the project is to recruit test persons for the DTU Campus test, so that the DTU campus test can start as soon as the permit

is given. Furthermore, the planning for the second test at Hersted business park has started. In the DTU test focus is on getting many users, while at Hersted the aim is rather to focus on a more technically challenging test exploring e.g. on-demand based on individual's requests. When we revisit the project in the next journal during the fall 2019, we hope that the operation of the driverless buses has started at DTU campus.

Urban Innovative Actions (UIA) is an Initiative of the European Union that provides urban areas throughout Europe with resources to test new and unproven solutions to address urban challenges. Based on article 8 of ERDF, the Initiative has a total ERDF budget of EUR 372 million for 2014-2020.

UIA projects will produce a wealth of knowledge stemming from the implementation of the innovative solutions for sustainable urban development that are of interest for city practitioners and stakeholders across the EU. This journal is a paper written by a UIA Expert that captures and disseminates the lessons learnt from the project implementation and the good practices identified. The journals will be structured around the main challenges of implementation identified and faced at local level by UIA projects. They will be published on a regular basis on the UIA website.



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