# AVENUE

**Autonomous Vehicles to Evolve to a New Urban Experience**

---

## D2.17 Second Trials use cases specification and evaluation plan

Authors: Lisa Labriga, Sylvie Mira Bonnardel

Lisa.labriga@bestmile.com, sylvie.mira-bonnardel@ec-lyon.fr

Bestmile, École Centrale Lyon

Deliverable Due Date: Month 18

Status: Accepted

Dissemination Level: Public

Co-funded by the Horizon 2020 programme of the European Union

**This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 769033**

# Revision & Contribution History

| Author | Entity | Date | Contribution | Comments |
|---|---|---|---|---|
| Lisa Labriga | Bestmile | 07.08.-29.08.2018 | Demonstrator roadmap template and draft versions of roadmaps for Copenhagen, Geneva, Lyon, and Luxembourg | Template and draft versions of roadmap |
| Stine Guldman | Autonomous Mobility | 27.08. - 09.10.2018 | Content demonstrator roadmap Copenhagen | Complete version of roadmap |
| Jeroen Beukers | TPG | 27.08. - 24.09.2018 | Content demonstrator roadmap Geneva | Complete version of roadmap |
| Clément Aubourg, Martin Graizon | Keolis, Kisio | 29.08. – 27.09.2018 | Content demonstrator roadmap Lyon | Complete version of roadmap |
| Georges Hilbert | Sales-Lentz Autocars | 27.08. – 04.10.2018 | Content demonstrator roadmap Luxembourg | Complete version of roadmap |
| Sylvie Mira Bonnardel | ECP | 29.08.-02.09.2018 | Drafting the evaluation plan | Draft version of the evaluation plan |
| Dimitri Konstantas | UNIGE | 14.09.2018 | Review of the evaluation plan | |
| Sylvie Mira Bonnardel | École Centrale Lyon | 14.09.-08.10.2018 | Inclusion of feedback received, draft of chapters 1, 3, 4.2 for D2.16 | Reviewed version of the evaluation plan; Draft version D2.16 |
| Karla Quintero | CEESAR | 25.09. – 10.10.2018 | Review of all four demonstrator roadmaps and input to SWOT analysis | |
| Dimitri Konstantas | UNIGE | 08.10.2018 | Review of all four demonstrator roadmaps | |
| Lisa Labriga | Bestmile | 09.10.-17.10.2018 | Drafting of action plans for each demonstration site (chapter 2) | Draft version D2.16 |
| Stine Guldmann, Pernille Lytzen | Autonomous Mobility | 12.10.-25.10.2018 | Review of chapter 2.1 | |
| Jeroen Beukers | TPG | 15.10.-24.10.2018 | Review of chapter 2.2 | |
| Michel Reisch, Georges Hilbert | Sales-Lentz Autocars | 17.10.-24.10.2018 | Review of chapter 2.3 | |
| Clément Aubourg, Quentin Zuttre | Keolis, Kisio | 17.10.-23.10.2018 | Review of chapter 2.4 | |
| Lisa Labriga | Bestmile | 09.10.-17.10.2018 | Drafting of chapters 1, 2, 4.1, 5 for D2.16 | Draft version D2.16 |

| | | | | |
|---|---|---|---|---|
| Dimitri Konstantas | UNIGE | 18.10.2018 – 25.10.2018 | Review of draft deliverable D2.16 | |
| Lisa Labriga | BM | 22.10.- 30.10.2018 | Inclusion of comments and feedback, preparation of final version of D 2.16 for submission | D 2.16 “A report on use case definition per Demonstrator city” |
| Stine Guldmann | Autonomous Mobility / Holo | 01.05.2019 – 15.10.2019 | Update of chapter 3.1 | Draft version D2.17 |
| Jeroen Beukers | TPG | 01.05.2019 – 15.10.2019 | Update of chapter 3.2 | |
| Michel Reisch | Sales-Lentz Autocars | 01.05.2019 – 15.10.2019 | Update of chapter 3.3 | |
| Quentin Zuttre | Keolis | 01.05.2019 – 15.10.2019 | Update of chapter 3.4 | |
| Stine Guldmann | Autonomous Mobility / Holo | 10.09.2019 – 26.09.2019 | User personas attribution | |
| Jeroen Beukers | TPG | 10.09.2019 – 11.10.2019 | User personas attribution | |
| Michel Reisch | Sales-Lentz Autocars | 10.09.2019 – 11.10.2019 | User personas attribution | |
| Quentin Zuttre | Keolis | 10.09.2019 – 14.10.2019 | User personas attribution | |
| Lisa Labriga | Bestmile | 14.10.2019 – 18.10.2019 | Integration of new contents and draft of deliverable | |
| Stine Guldmann, Jeroen Beukers, Michel Reisch, Quentin Zuttre | AM / Holo<br>TPG<br>SLA<br>Keolis | 18.10.2019 – 30.10.2019 | Review | |
| Dimitri Konstantas | UniGe | 28.- 29.10.2019 | Review | |
| Lisa Labriga | Bestmile | 22.10.- 31.10.2019 | Inclusion of comments and feedback, preparation of final version of D 2.17 for submission | D 2.17 “Second Trials use cases specification and evaluation plan” |

# Index

Revision & Contribution History ..... 2
Index ..... 4
1 Executive Summary ..... 7
2 Introduction ..... 8
3 Demonstrator roadmaps ..... 10
3.1 Copenhagen: Action plan and roadmap ..... 10
3.1.1 Baseline description ..... 10
3.1.2 Vision, needs, and goals ..... 12
3.1.3 The pilot site: Nordhavn (2019-2022) ..... 13
3.1.4 The pilot site: Ormøya, Norway (2019) ..... 14
3.1.5 User groups: Personas ..... 15
3.1.6 Use cases and roadmap ..... 17
3.1.7 Evaluation plans for the use cases ..... 20
3.1.8 Integrations and special needs ..... 21
3.2 Geneva: Action plan and roadmap ..... 23
3.2.1 Baseline description ..... 23
3.2.2 Vision, needs, and goals ..... 23
3.2.3 The pilot site: Meyrin ..... 24
3.2.4 The pilot site: Belle-Idée ..... 25
3.2.5 User groups: Personas ..... 26
3.2.6 Use cases and roadmap ..... 27
3.2.7 Evaluation plans for the use cases ..... 29
3.2.8 Integrations and special needs ..... 29
3.3 Luxembourg: Action plan and roadmap ..... 31
3.3.1 Baseline description ..... 31
3.3.2 Vision, needs, and goals ..... 31
3.3.3 The pilot sites ..... 32
3.3.1 User groups: Personas ..... 35
3.3.2 Use cases and roadmap ..... 37
3.3.3 Evaluation plans for the use cases ..... 37
3.3.4 Integrations and special needs ..... 38
3.4 Lyon: Action plan and roadmap ..... 39
3.4.1 Baseline description ..... 39
3.4.2 Vision, needs, and goals ..... 39
3.4.3 The pilot site ..... 40

3.4.4 User groups: Personas ..... 41
3.4.5 Use cases and roadmap ..... 42
3.4.6 Evaluation plans ..... 44
3.4.7 Integrations and special needs ..... 44
4 Evaluation plan ..... 45
4.1 Conceptual framework ..... 45
4.1.1 Understanding assessment ..... 46
4.1.2 Conformity assessment ..... 47
4.1.3 Satisfaction assessment ..... 47
4.1.4 Communication assessment ..... 48
4.2 Satisfaction KPIs ..... 49
4.2.1 User Satisfaction Score (USAT) ..... 49
4.2.2 Net Promoter Score (NPS) ..... 49
4.2.3 User Retention Rate (URR) ..... 49
4.2.4 SERVQUAL ..... 50
4.3 How to gather users' feedback ..... 50
4.3.1 Surveys ..... 51
4.3.2 Usability tests ..... 51
4.3.3 Monitoring of social media discussions ..... 51
4.3.4 Analytics data, online relations with users ..... 51
4.3.5 Service data ..... 51
4.3.6 Incentivize the feedback process. ..... 52
4.4 Economic evaluation ..... 52
4.4.1 The Total Cost of Ownership method ..... 52
4.4.2 The hidden costs ..... 53
4.4.3 Economic KPIs ..... 54
4.5 Conclusion of the evaluation plan ..... 55
4.6 Appendix to evaluation plan ..... 56
4.6.1 Examples of 3 personas ..... 56
5 Annexes (confidential) ..... 57
5.1 Annexes Autonomous Mobility ..... 57
5.1.1 Routing in the Nordhavn area for use case 1 ..... 57
5.1.2 SWOT analysis use case 1 ..... 57
5.1.3 Routing in the Nordhavn area for use case 2 ..... 58
5.1.4 SWOT analysis use case 2 ..... 58
5.1.5 Routing in the Nordhavn area for use case 3 ..... 59
5.1.1 Routing in the Nordhavn area for use case 4 ..... 60
5.1.1 Routing in the Nordhavn area for use case 5 ..... 60

5.2 Annexes Sales-Lentz Autocars ..... 60
5.2.1 Use cases and roadmap ..... 60
5.2.2 Evaluation plans for the use cases ..... 65

# 1 Executive Summary

Deliverable D2.17, A report on use case definition per Demonstrator city, consists of two main parts: the demonstrator roadmaps that details the action plan and roadmap for each of the four demonstration sites of the AVENUE project (Copenhagen, Geneva, Luxembourg, and Lyon) and the evaluation plan of the overall AVENUE services, technologies, and functionalities.

The **demonstrator roadmaps** contain a baseline description of autonomous shuttles running under the supervision of the transport operators and compares this to the vision outlined for the AVENUE project, and related needs. The vision is then broken down into concrete goals for the four-year project, which are outlined in detail in the action plan. The action plan describes the pilot site chosen, the use cases and the roadmap (including operation details, technical requirements, objectives and milestones and SWOT analysis per use case). It furthermore provides details on integrations planned and special needs to be addressed. Lastly, the demonstrator roadmaps contain some details on the evaluation plans for the use cases. While mainly referring to the comprehensive evaluation which forms the second part of this deliverable, each demonstrator details out the Key Performance Indicators to determine the success of the pilot as well as the data that they would like to collect in order to evaluate the demonstration of the different use cases.

The **evaluation plan** details the evaluation process to be established throughout the project and that will iteratively be refined. During the operation of the services, the needs of the different user groups, based on different classifications (age, activity, gender, special needs) and the barriers in the adoption and acceptance of autonomous vehicle transport services will be identified. A detailed evaluation of the service acceptance will be performed, measured both by subjective and objective KPIs: questionnaires for active and potential users, semi-structured interviews, number of new users in the service, number of users changing behavior etc. The evaluation of the costs and benefits will be done with the Total cost of ownership method, taking into account not only service operation costs, but also quantify the indirect societal and environmental benefits like parking cost savings, or efficient land development benefits, change of modal transfer, working hour gains and waiting time reductions, energy savings, carbon footprint and air pollution reduction and even changes in passenger habits resulting from the public service personalization.

Evaluation will take place during Phase four (M12-M48) and WP8. The economic analysis of the used autonomous electric vehicles will first focus on business viability and then on possible economic impacts for users and cities. The social impact analysis will study the user experience, the user acceptance and the potential changes in mobility behavior in the use of public transport systems.

# 2 Introduction

The target of the AVENUE project is to demonstrate and pilot the adaptability and efficiency of the deployment of small and medium autonomous vehicles (AV's) in Lyon, Luxembourg, Geneva, Copenhagen and 2-3 replicator cities as of the 3d year of the project. The AVENUE vision for future public transport in urban and suburban areas, is that autonomous vehicles will ensure safe, rapid, economic, sustainable[1] and personalized transport of passengers, while minimizing vehicle changes. The goal is to provide door to door autonomous transport allowing commuters to benefit from autonomous vehicles.

At the end of the AVENUE project - 4-year period - the mission is to have demonstrated that autonomous vehicles will become the future solution for public transport. The AVENUE project will demonstrate the economic, environmental and social potential of autonomous vehicles - for both companies and public commuters - while assessing the vehicle road behavior safety.

Work package 2 "Requirements and Use Cases" aims to define in detail the use cases of each demonstrator, the scenarios for each implementation phase, and the value-added services required for the success of the demonstrators. A human-centered design approach for the design of the use cases will be followed. The required data to be collected for the impact analysis will also be defined. Existing knowhow and best practices will be surveyed, assessed and analyzed. The work of tasks of WP2 is iterative, and as the provided demonstrators and services become more sophisticated, new iterations of the work of the different tasks will be contacted.

Task 2.5 "Demonstrator use case definition" target is to, on the one hand, develop the use case scenarios and, on the other hand, to enrich the provisional list of AVENUE services, selecting at least 10 services for demonstration. Part of the work in task feeds into deliverables 2.13-2.15, while the work of T2.5 that feeds into this deliverable focuses on the demonstrator roadmaps.

Task 2.5 targets the Use Case scenarios that will be developed and will reflect detailed realistic situations, behavior of the end-users in their regular autonomous vehicles' service requests. For all types of services and user groups, this task will develop and pre-study the user experiments per demonstrator city (initially) and (at a later stage) replicator city. The provisional list of AVENUE services will be further enriched, while at least 10 services will be selected for demonstration. Those services will be further detailed in line with the needs and feedback from the demonstrator and replicator cities. Each of those cities will define a baseline and an ambitious vision with corresponding goals for the realization of the respective AVENUE large-scale demonstrators. Different actions/ measures and services may be defined and selected. A SWOT analysis will be performed per city that could affect the implementation and success level of the respective action plan for large scale demonstration. This includes the type of experiment (focus group or user study), the number of expected participants, the study design, the data to be collected, as well as the evaluation method (an evaluation plan will be elaborated). The functional specifications will be defined for the usage scenarios, with focus on passenger and operation security, service quality and taking into account business development needs. All technical functionalities (hardware and software) will be identified

[1] Within urban transportation sustainable most often refers to electric vehicles.

in link with the defined user requirements. Specifications concerning end-user behavioral patterns and relevant triggers will also be integrated into the functional specifications. The use-case scenarios will be used for WP4, WP5 and WP6. This task contributes to deliverable of D2.5 and D2.6.

# 3 Demonstrator roadmaps

## 3.1 Copenhagen: Action plan and roadmap

### 3.1.1 Baseline description

Autonomous Mobility has currently three autonomous shuttle pilot projects running in Finland, Norway and Sweden and Estonia. Furthermore, we await approval of three pilot sites in Denmark.

Oslo (Norway) 2019-2021

The pilot project in Oslo runs for three years and is a collaboration between Oslo Municipality, the Norwegian Public Roads Administration, Ruter[2] and Autonomous Mobility. Oslo and Akershus wishes to have 0% emissions across their public transportation and this project will test if self-driving buses can support these ambitions for a sustainable public transport system

The first route was launched May 2019 in Akershusstranda. It runs on a route from Vippetangen, to the town hall city square and back again. This takes the shuttle service past the cruise-terminal and along the harbour front.

Details:

- Vehicle: 4 Navya Autonom Shuttle
- Route: Fixed route and fixed stops, 1.3 km one way
- Passengers: local commuters, tourists
- Operating hours: Monday-Sunday 8.20-21.15
- With an operator on board (required by Norwegian Road Authorities)
- Services: Fully integrated with the public transport in Oslo

Tallinn (Estonia) 2019

In a partnership with the City of Tallinn, we operate the route in the area of Kadriorg Park from August to December 2019. The pilot is part of the Sohjoa Baltic project that researches, promotes and pilots automated driverless electric minibuses as part of the public transport chain, especially for the first/last mile connectivity.

Details:

- Vehicle: 1 Navya Autonom Shuttle
- Route: Fixed route and fixed stops, 1.8 km
- Passengers: tourists, officials and local citizens
- Operating hours:
    - Tuesday, Wednesday, Friday: 10.00-16.00
    - Thursday, Saturday, Sunday: 10.00-18.00

[2] The public transport authority for Oslo and Akershus counties

- With an operator on board (required by Estonian Road Authorities)

Helsinki (Finland) 2019

The route that is operated in Helsinki is part of the Sohjoa Baltic project, that researches, promotes and pilots automated driverless electric minibuses as part of the public transport chain, especially for the first/last mile connectivity. It takes place from June to September 2019.

Details:

- Vehicle: 1 Navya Autonom Shuttle
- Route: Fixed route and fixed stops, 2.5 km one way
- Passengers: students, university employees and local commuters.
- Operating hours:
  - Monday-Friday: 09.00-15.00
  - Saturday-sunday: 12.00-18.00
- With an operator on board (required by Finnish Road Authorities)

Gothenburg (Sweden) 2018-2019

The pilot project in Gothenburg is divided into two phases. The first phase of the pilot project took place from May until September 2018 in the Chalmers university area for a duration of 6 weeks.

Details:

- Vehicle: 1 Navya Autonom Shuttle
- Route: Fixed route and fixed stops, 1.8 km one way
- Passengers: students, university employees and local commuters.
- Total passengers: app. 1500.
- Operating hours: Monday-Friday 07:00-18:00
- With an operator on board (required by Swedish Transport Agency)

The second phase takes place from April until October 2019 at Lindholmen Science Park for a duration of 6 months. Around 25.000 people travel through the area daily. At one end of the route is a parking area, where the monthly parking permit fee has been reduced, in order to encourage motorists to park there and take the shuttle for the last part of their journey.

Details:

- Vehicle: 2 Navya Autonom Shuttle
- Route: Fixed route and fixed stops, one roundabout, 1.8 km one way
- Passengers: employees at international companies and national authorities, students, scientists and residents.
- Operating hours: Monday-Friday 7-18
- With an operator on board (required by Swedish Transport Agency)

Learnings: Driving in mixed traffic provides many learnings regarding how the other road users act, and what obstacles and challenges that occur due to this. How much interference with the service arises when a cyclist or a car overtake the shuttle. Does the interest in this technology keep interests among citizens; how long does it take for the locals to accept the service as a natural integrated part

of the transport services, etc. Furthermore, many technical details regarding operation and the operator's functions are obtained.

Køge Hospital (Denmark) 2018-2020

The pilot project at Køge Hospital is divided in three phases. The first phase of the project took place from May until August 2018 in the Køge Hospital for a duration of three months.

Details:

- Vehicle: 1 Navya Autonom Shuttle
- Route: Fixed route and fixed stops
- Passengers: patients, relatives and hospital staff. Total passengers: > 6500.
- Operating hours: Monday-Friday 7:30-15:30
- With an operator on board
- Services: In the non-peak hours on-demand stops on the fixed route was tested, based on the fixed bus stops. The visitor could order the bus through the screen at the bus stop sign post, and then the bus would come to pick them up without stopping at the other stops unless others had made a demand.

Learnings: We gained important learnings about passengers with special needs, e.g. walking frames, wheelchairs, and elderly. The users expressed gratitude and relief due to the service provided, and the hospital experienced the impact of the service and the size of the need among their patients. The on-demand trials indicated the need to find the common denominator when communicating the how-to messages - so that all types of users can interact with the service. Furthermore, many technical details regarding operation and the operator's functions were obtained.

### 3.1.2 Vision, needs, and goals

Vision

The city of Copenhagen has an overall goal to become the World's first CO2-neural capital by 2025. Autonomous Mobility (AM) and the AVENUE project will support this goal by implementing and operating autonomous electric shuttles in Copenhagen as a green initiative to last mile public transport.

The overall goal for AM is to implement and test services under the Autonomous Mobility Cloud on the Copenhagen site. In order to do so, AM aims at deploying four vehicles during the project, while working towards expanding the route to multiple routes in the Nordhavn area. These routes will create a better connection between selected areas of Copenhagen and existing public transport solutions.

During the AVENUE project, AM wants to further expand the portfolio of vehicles and vessels to create more advanced features and integrations with the Mobility Cloud. The whole system is planned to integrate with existing PTO solutions in the Copenhagen area.

Our services should be experienced as “Helpful, Simple & Seamless”: When autonomous vehicles become an integrated part of the cityscape, the user will be able to define your transport needs -

and order your solution via AM's Autonomous Mobility Cloud. Shortly after the user will get picked up exactly at his/her location and will be transported to the end destination chosen. The cloud will also be shaped so that it can move goods, parcels, shops - all in various shapes and sizes - around when needed.

At the end of this project, AM aims to have:

- Developed and implemented autonomous mobility cloud in Nordhavn,
- In an on-demand (door2door) autonomous transport system without fixed routes, and
- With the whole zone mapped & geo-fenced.

Needs

By deploying autonomous shuttles in Nordhavn we address the following needs:

- Transport solution for the Nordhavn area: in the area and connecting to existing public transport hubs.
- Lowering the CO2 emissions for the Nordhavn area
- Lowering the number of vehicles used in the Nordhavn area

Corresponding goals

- Provide AV services that was actually needed.
- Demonstrate that AVs are safe, sustainable, economic and can provide personalized transport.
- Test a fleet operation with multiple AVs, on-demand in mapped area, off route, with a speed up to 50km/h, in mixed traffic, without safety drivers on board.
- Enhance the traveling experience in Nordhavn by connecting the area better, making sure that local residents and workers can move around easier and connect them to existing public transport stations.
- Take part in shaping a future neighborhood, by solving transport issues in smarter and more sustainable ways.
- Lower the CO2 emission in Nordhavn by deploying public transport shuttles, driven by 100 % electric engines.
- Demonstrate autonomous shared transport in Nordhavn and lower the number of vehicles.

### 3.1.3 The pilot site: Nordhavn (2019-2022)

The Copenhagen test site will be situated in an area of the city called Nordhavn. Nordhavn is an active industrial port that is undergoing a transformation – turning into Copenhagen's new international waterfront district offering residential and commercial buildings. When the development of Nordhavn is done, the area will house more than 40.000 residents and 40.000 employees.

Nordhavn aims at being an eco-friendly neighborhood and contributes to boosting Copenhagen's image as an environmental metropolis. Renewable energy and new types of energy, optimal use of resources, recycling of resources and sustainable transport will help make Nordhavn a model for sustainable development and sustainable design. A vibrant city: Nordhavn should vibrate with life as a versatile urban area with a multitude of activities and a wide range of shops, cultural facilities and

sports facilities. The area is becoming more and more populated, and the needs for local transportation is expected to keep growing.

Currently the Nordhavn area is serviced by a nearby S-train station and bus stops located near the station. There are however no buses or trains running directly in the area – creating a great opportunity for the autonomous vehicles to function as a new public transport solution, connecting the area much better than it is today. In 2020 two new metro stations will have been built – opening in the middle of the neighborhood close to the route.

The main expected users of the shuttle service will be the residents of Nordhavn (including families, children, and elderly), commuters working in Nordhavn, and visitors to the area. Several usage scenarios can thereby be anticipated:

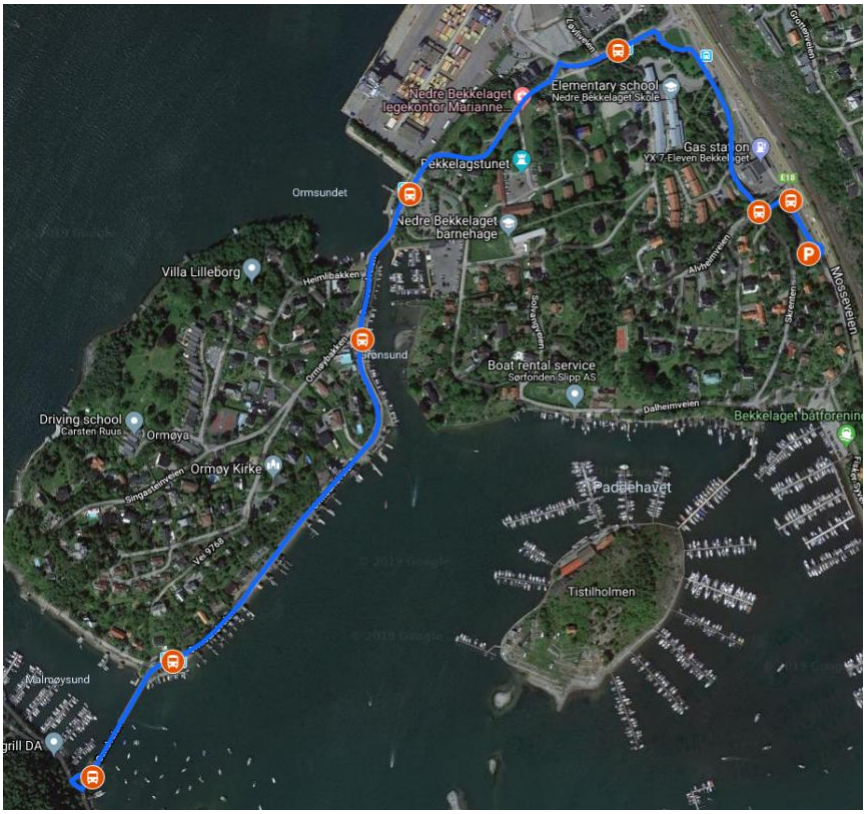
- Ease the mobility within the area for the residents and commuters working in the area.
- Used for the first/last mile from the main road/ entry point to the area to the different stops within the area for residents and commuters working there.
- Provide easier access from the main road to e.g. the harbor pool, restaurants, cultural facilities for visitors and families.

### 3.1.4 The pilot site: Ormøya, Norway (2019)

Amobility is collaborating with Oslo Municipality, the Norwegian Public Roads Administration and Ruter[3] about a three year self-driving trial project. The project is an important milestone in the process of getting self-driving buses to the Oslo area. Oslo and Akershus wishes to have 0% emissions across their public transportation and this project will test if self-driving buses can support these ambitions for a sustainable public transport system. The end goal is for autonomous buses to be part of Ruter's regular offer in a few years.

While waiting for the approvals in Denmark, two of AMs Avenue busses will be integrated to the second route 'Ormøya' in Oslo. The route is in the approval process and it is expected that operation can start winter 2019.

[3] The public transport authority for Oslo and Akershus counties




The aim of the Ormøya route is to provide a mobility service in an area of Oslo that is not covered that well today and connect the service to the existing public transport. Thereby test how suitable AVs are as a feeder service to the existing public transport and if it will reduce the usage of private cars.

Details:

- Vehicle: 3 Navya Autonom Shuttle max speed 18 km/h
- Route: Fixed route and fixed stops, 1.7 km one way
- Passengers: local citizens
- Operating hours: Monday-Sunday between 6:00-22:00 (final operation hours are not confirmed yet)
- With an operator on board (required by Norwegian Road Authorities)
- Services:
    - The bus requires tickets, like the rest of the public transport in Oslo.
    - The service is fully integrated into the travel plan 'RuterReise' showing the stops, time schedule and connections.
    - There are bus stop signs at the bus stops.

## 3.1.5 User groups: Personas

Task 2.2 in WP2 focuses on passenger needs and thus provides important content to the development of the action plans and roadmaps of the PTOs. Based on the analysis and specifications of passenger needs through surveys conducted in task 2.2, a series of personas have been developed,

as well as use cases based on these personas. For more details and the full background, see deliverable D2.5 “Second Passenger needs analysis and specifications”).

In this chapter, all user these personas have been evaluated by Holo / AM with respect to their relevance for each of the pilot sites. You can find the results here below:

**Passengers**

| | **Nordhavn (DK)** | | **Ormøya (NO)** | |
|---|---|---|---|---|
| | *Y/N* | *Comment* | *Y/N* | *Comment* |
| Alex | YES & NO | Possibly, but not under normal conditions | NO | The route is only for local people |
| Helena | YES | Common user | YES | Common user |
| Henry | YES | Common user | YES | Common user |
| Carolin & John | NO | Route in city center | YES | Local route in local area |
| Lilly & Lou | YES | Common users | YES | Common user |
| Fabio | NO | Not a night service | NO | Not a night service |
| Charlotte | NO | Not a night service | NO | Not a night service |
| Hanna | YES | Common user | YES | Common user |
| Bill & Clara | YES | Common users (local tourists) | YES | Common users (local tourists) |
| Erik | YES | Local user | YES | Local user |
| Philippe | YES & NO | Possibly, but not under normal conditions | YES & NO | Possibly, but not under normal conditions |

**Other roadusers**

| | **Nordhavn (DK)** | | **Ormøya (NO)** | |
|---|---|---|---|---|
| | *Y/N* | *Comment* | *Y/N* | *Comment* |
| Cristina | NO | Not a passenger but as an other road user in car | NO | Not a passenger but as an other road user in car |
| Richard | NO | Highly unlikely | YES | As a pedestrian |
| Manuel | NO | Not a passenger but as an other road user on bike | NO | Not a passenger but as an other road user on bike |
| Marcus | YES | As pedestrian or other road user in car | YES | As pedestrian or other road user in car |

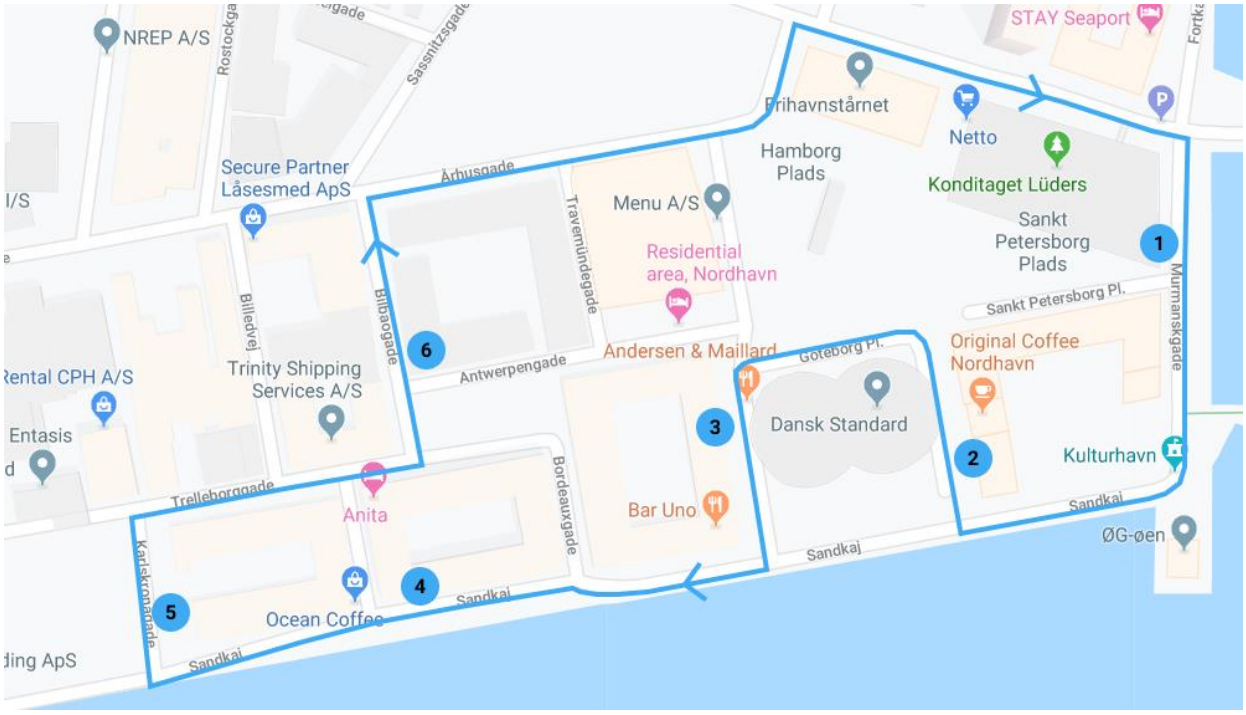
**Original personas**

| | **Nordhavn (DK)** | | **Ormøya (NO)** | |
|---|---|---|---|---|
| | *Y/N* | *Comment* | *Y/N* | *Comment* |
| Carlo | YES | Common user (local tourists) | YES | Common users (local tourists) |
| Mary | YES | Common user | YES | Common user |

| | | | | |
|---|---|---|---|---|
| Ned | NO | Route in city center | YES | Common local user |
| Katie | NO | As pedestrian | NO | Suburban route |

## 3.1.6 Use cases and roadmap

Autonomous Mobility will set up its AVENUE pilot project in the Nordhavn area of Copenhagen. Initially, the project will consist of one route, with other potential routes and route options being added throughout the project (if approved by the authorities). The operation of the first route (see map below) will start early 2020, once it has been approved by the authorities. The pilot route is going to be in mixed traffic with cars, pedestrians, bicycles etc. The area is in general a low speed area.




Planned services provided for the end users:

- The shuttles are free of charge during the pilot project in Denmark, so there is no ticketing yet.
- There are bus stops providing the position of the bus, relative to the given stop, but no real-time position in minutes available yet.
- Besides the bus stop sign, users can find information about the pilot project at AM website and Mobile App.
- It is the aim to test the services developed through the AVENUE project e.g. real-time position of the bus, on-demand booking, accessibility for disabled persons (at the moment it is unclear whether or not we will be allowed to accommodate wheelchairs).

| | Use case 1 | Use case 2 | Use case 3 | Use case 4 | Use case 5 |
|---|---|---|---|---|---|
| *Time* | Q1 2020 – Q2 2020 | Q3-Q4 2020 | Q1-Q2 2021 | Q3 2021[4] | As of Q3 2021 |
| *Approved?* | Ongoing | Not yet | Not yet | Not yet | Not yet |
| *Safety driver?* | Yes | Yes | Yes | No[5] | No |
| *Route* | Fixed-route, timetable or headway based, metro mode, loop line with multiple fixed stops, mixed traffic | Fixed route, on call stops, on-demand trials, loop with multiple fixed stops | Fixed route service, on-demand, introduction of new routes and dynamic routing on these routes, | Geo-fenced area with multiple mapped routes, dynamic routing, coordinate-based, testing of mobility cloud service D2D | Multiple types of shuttles, dynamic routing, coordinate-based, further testing of mobility cloud (D2D) service, live mapping process[6] |
| *Booking* | None | Instant booking | Instant booking and pre-booking | | |
| *Vehicles[7]* | 2-4 shuttles adjusting to demand | | | Introduction of new types of AVs[8] | |
| *Vehicle speed* | 20-30 km/h speed limit in the area. AV will drive at max. 23 km/h (expected 10-15 km/h) | | 20-50 km/h speed limit routes; AV at max. 23/30 km/h; expected 10-30 km/h | 20-50 km/h speed limit routes; AV at max. 50 km/h; expected 30-50 km/h) | 20-60 km/h speed limit routes; AV at max. 60 km/h; expected 30-60 km/h) |

[4] If technology and regulations allow for that.
[5] Safety drivers will be slowly removed from the shuttle. They will stay present on-site in an on-site office, always in max. 5 min reach from the shuttle.
[6] If technology and regulations allow for that.
[7] Until use case 4 (incl.) only Navya Autonom Shuttles
[8] Allowing the vehicle to drive into new streets. If technology and regulations allow for that.

| | |
|---|---|
| *Operation times* | The shuttles will run Mon-Fri. Exact timetable TBA. |

For all use cases:

The focus throughout the whole project lies for AM in passenger and operation security. Next comes the service quality provided, followed by business development needs.

In the annexes, you can find an illustration of the routing for the use cases 1-5 as well as the SWOT analysis for the first and second use case.[9] No SWOT analysis can be prepared yet for the use cases 3-5 since many things might change until those use cases are started.

### 3.1.6.1 Technical requirements

| Use case 1 | Use cases 1-5 | Use cases 2-5 | Use cases 4-5 | Use case 5 |
|---|---|---|---|---|
| Mobile app (optional) | • Bus stop signs<br>• AM webpage | An app or another solution to make the on-demand requests | Fleet management system | AM's Mobility Cloud |

### 3.1.6.2 Objectives and milestones per use case

*Table 1: Use cases and their specifications*

| | Objectives | Milestones |
|---|---|---|
| Use case 0 (05/18 - 02/20) | • Approvals from authorities.<br>• Ensuring stakeholder acceptance and support prior to operation. | • Baseline user surveys to be conducted and analyzed.<br>• Introducing stakeholders to the AV, the route and stops. |
| Use case 1 | Fixed route, loop line, fixed stops, in mixed traffic. | For use cases 1-5:<br>• Input from user surveys to be analyzed and implemented.<br>• Input from safety driver to be analyzed and implemented. |
| Use case 2 | The shuttles are expected to run on demand trials - on fixed route. | • On-demand on fixed route in non-peak hours. |
| Use case 3 | More AV's are introduced (up to 4 shuttles) will be operational on demand - off routes, with safety driver on | • More AVs are introduced.<br>• Increase in speed.<br>• Mapping of streets that shorten the route, to allow for shortcuts/ a network. |

[9] This information is confidential and can therefore be found in the annex only (annex is confidential).

| | | |
|---|---|---|
| | board, and increased speed.<br>The plan is to get approval to introduce new routes. | • Further expansion of on-demand on route.<br>• Possible extensions of route. |
| Use case 4 | Multiple AV's will be operational on demand - off routes, without safety drivers on board. Plan to have a geo-fenced area mapped - and have permission to drive here. | • On-demand on mapped routes will be tested.<br>• Slowly removing safety drivers on board towards safety drivers being present in an on-site office, 5 min from shuttle – if the technology and regulations allow it |
| Use case 5 | New types of Autonomous AV's will be introduced in Nordhavn, meeting more needs of the local travelers and commuters - if the technology and regulations allow it. The speed of the AV's is expected to rise, and the transport should become more efficient. The goal is to provide on demand services outside the route - meaning not dependent on a route - given that the technology and regulations allows it. The mobility cloud will be tested during the fourth year in combination with potential new services, meeting the needs of the users. | • Operation in geo-fenced area, on-demand within mapped area, increased speed.<br>• More types of AVs will be introduced if approvals and legislation allow to. |

### 3.1.7 Evaluation plans for the use cases

Autonomous Mobility does not yet work with a local company on evaluating the AV shuttles. For the AVENUE project, they will follow the evaluation plan proposed by ECL in this deliverable as well as the evaluation done by HSPF in the framework of WP8. According to these two frameworks, the study design will be decided, as well as the details of the evaluation (such as the number of expected participants to the evaluation).

**Key Performance Indicators** for AM to determine the success of the pilot are the following (non-exhaustive list):

- Passenger satisfaction (use cases 1-5)
- Number of passengers (use cases 1-5)

- Number of trips/km done by the shuttle (use cases 1-5)
- Punctuality of the shuttle (use cases 1-5)
- Uptime of the shuttle (use cases 2-5)
- App downloads/ on-demand system usage (use cases 2-3)
- Uptime of the fleet management system (use cases 4-5)
- Uptime mobility cloud (use case 5)

In order to evaluate the demonstration of the different use cases, AM would like to collect the following data (exhaustive list):

- Number of passengers (use cases 1-5)
- Types of passengers (use cases 1-5)
- Number of repeat passengers (use cases 1-5)
- Acceptance and support from passengers (use cases 1-5)
- User perception of the service (use cases 1-5)
- Customer satisfaction (use cases 1-5)
- Uptime / downtime of service - specified into sub categories e.g. hard resets, times manual overtake, time in autonomous mode, operational time (use cases 1-5)
- Impact from the weather conditions on the uptime / downtime (use cases 1-5)
- Quality of the information send to customers (e.g. waiting time, reloading time of the app) (use cases 1-5)
- Quality and usability of the safety driver app/webpage/system (use cases 1-3)
- User experience of the on-demand service and support system (e.g. app) (use cases 2-5)
- Quality and usability of the fleet management system (use case 4-5)
- User experience and acceptance of the Mobility Cloud (use case 5)

### 3.1.8 Integrations and special needs

Integrations needed

Autonomous Mobility is already evaluating an integration with existing PTOs in Denmark, particularly a traveler application called Rejseplanen that allows to look for connections throughout different PTOs. Additionally, a new metro station is currently being built in the area, which is connected with a pedestrian underground tunnel to the nearby train station, scheduled to open in spring 2020. This could be an interesting integration use case.

Special needs

Autonomous Mobility is interested to test all services that are being discussed in the framework of WP2 and developed in WP4. In particular, AM would like to ensure to provide a possibility to accommodate all types of passengers, including for example passengers with reduced mobility.

Furthermore, AM are interested to test on-demand if technically possible and approved by the authorities.

# 3.2 Geneva: Action plan and roadmap

## 3.2.1 Baseline description

TPG has currently already one autonomous project set up in the canton of Geneva. Since 02 July 2018, one Navya Autonom Shuttle is running on an urban route in the neighborhood of Meyrin. The "Line XA" connects Meyrin train station with Meyrin village, and provides a transport solution for residents in a zone that is not served today by standard bus lines. The shuttle runs on a 2.1 km long fixed route with 4 fixed stops. The roads are public and urban in a zone with a speed limit of 30 km/h. All traffic is possible in the area, since it combines a residential area with an industrial zone. No lanes have been predefined for the shuttle and many obstacles increase the complexity of the use case. The track is therefore very difficult and represents a real world urban driving test. The shuttle runs from Monday until Saturday during rush hour in the morning (06:15-08:30) and in the late afternoon (17:15-19:00), providing transport mainly to commuters going to and coming from work. Around 60 passengers are transported with the shuttle each day. A pool of 12 operators (safety drivers) takes turns in the shuttle, under supervision of two "super operators".

## 3.2.2 Vision, needs, and goals

Vision

TPG's primary objective is to be able to offer transport services for everyone, everywhere, on time and in an environmental way. With our current fleet of busses, it is too expensive and technically not possible to achieve such goals. A 12-meter bus is too large to enter a village road and smaller busses with a driver isn't cost effective.

In fact, it would be good to replace one large bus with four autonomous shuttles and to have the former bus driver oversee all four shuttles as an external operator. One example could be to offer internal transport in a smaller town. People who want to visit Geneva can take a regional bus or tram; people who want to visit the grocery store take the shuttle.

Another important argument to move towards autonomous, electric shuttles are the objectives of climate-neutral public transport. In future green villages, a vehicle with a combustion engine has no place. The pilot site in the AVENUE project is a real-world use case that can be used as a solution and add on to our existing bus and tram network.

Need

Able to offer transport services for everyone, everywhere, on time and in an environmental way.

Corresponding goals

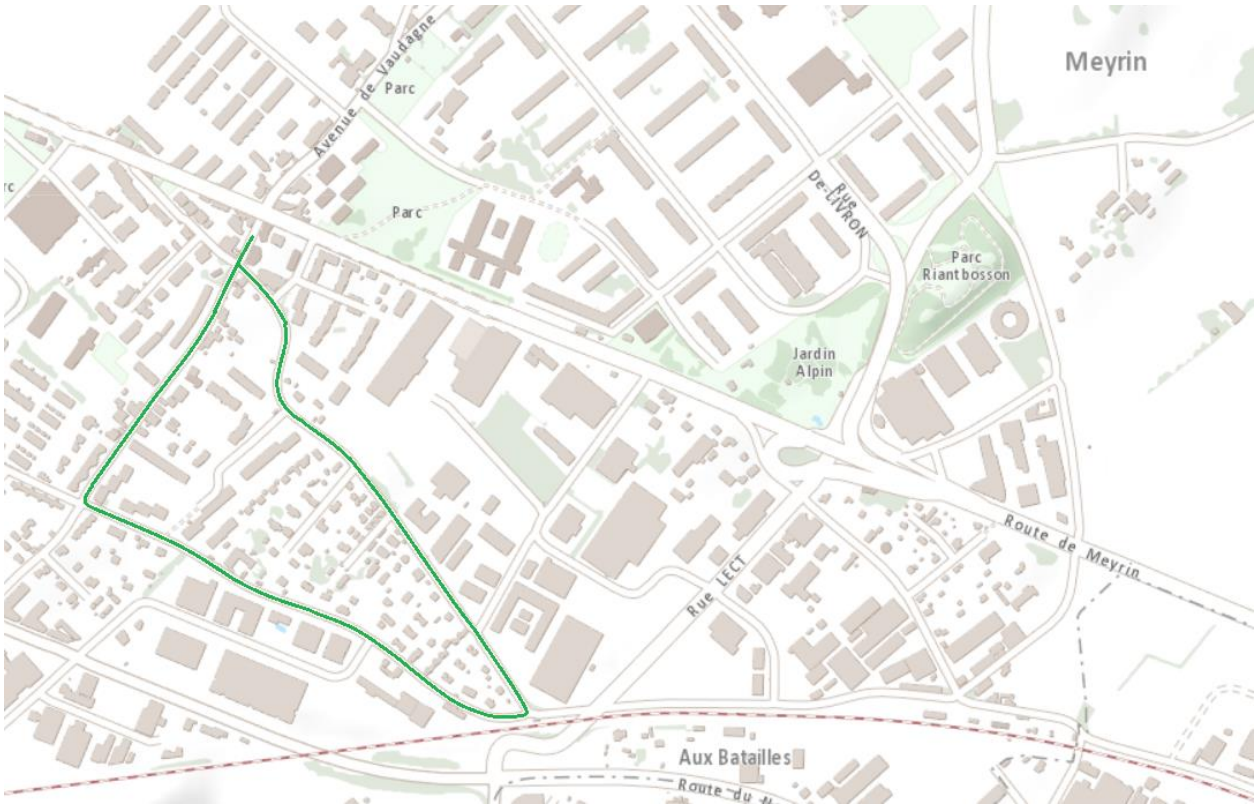
- On-demand
- On-time
- Personalized transport
- Full autonomous robotized small-scale transport network

## 3.2.3 The pilot site: Meyrin

The core objective is to be able to connect the Meyrin train station with the main TPG tram lines. Commuters, who live in suburban areas or in neighbouring France and who arrive by train, have to change their mode of transport in order to be dispatched around the centre of Geneva city. Up until the beginning of the project a public transport solution to connect both hubs did not exist. The distance between Meyrin train station and the tramlines at Meyrin Village is around one km, which is a 10-15 minutes' walk.

The TPG transport solution serves the sparsely populated area of Meyrin and connects both hubs during morning and evening rush hour while taking into account the connecting timetables related to in- and outgoing trains and trams. The vehicle circles around in the direction of the clock.

During the first operations of the Xa line, we rapidly noticed the importance of further developing the vehicle and fine-tuning its behaviour on the road.




| | |
|---|---|
| Driving direction | Clock-wise |
| Route length | 2.1 [km] |
| Speed limit all traffic | 30 [km/h] area |
| Road | Urban open road |
| Number of bus stops | 4 |
| Number of vehicles | 1 |
| Timetable | 07:00-09:00 and 16:00-18:00 |

### 3.2.4 The pilot site: Belle-Idée

In order to deploy a fleet of automated Shuttles as part of the Avenue project, an agreement has been reached with the Belle-Idée site in Thonex, in the Canton of Geneva. The Belle-Idée site is a Psychiatric as well as elderly Hospital and part of the University Hospital in Geneva (HUG). The HUG is committed in the development of green mobility initiatives. The Belle-Idée site offers:

- Private property
- Visitors do not need a badge to enter the site
- Main entrances closed by barriers
- Only accessible by motor vehicle after invitation
- Always accessible by foot or bicycle
- Bus line (1) and (31) through the main axe of the site
- Speed limit: 30 km/h in the whole zone

From the start of the project, between 2 and 4 vehicles will be running on the site, on a network of routes with around >45 stops. The picture below provides a first idea of possible routes.

*Figure 1: Network of possible routes at the Belle-Idée site in Geneva*

The expected main users of the services in the area will be the employees and visitors to the hospital, as well as passers-by. The following usage scenarios can be imagined[10]:

Hospital employees

[10] Lists inconclusive

- Regular bus stop to workplace
- Parking to workplace
- Workplace to restaurant
- On site transport to visit patients
- On site transport of patients
- On site transport maintenance workers

Hospital visitors

- Regular bus stop to patient
- Parking to patient
- Parking to restaurant
- Building to building

### 3.2.5 User groups: Personas

Task 2.2 in WP2 focuses on passenger needs and thus provides important content to the development of the action plans and roadmaps of the PTOs. Based on the analysis and specifications of passenger needs through surveys conducted in task 2.2, a series of personas have been developed, as well as use cases based on these personas. For more details and the full background, see deliverable D2.5 "Second Passenger needs analysis and specifications").

In this chapter, all user these personas have been evaluated by TPG with respect to their relevance for each of the pilot sites. You can find the results here below:

**Passengers**

| | **Meyrin** | | **Belle-Idée** | |
|---|---|---|---|---|
| | *Y/N* | *Comment* | *Y/N* | *Comment* |
| Alex | Y | Common user | Y | Common user |
| Helena | Y | Common user | Y | Common user |
| Henry | Y | Common user | Y | Common user |
| Carolin & John | Y | Village route | Y | Common User |
| Lilly & Lou | Y | Common user | Y | Common user |
| Fabio | N | Not a night service | N | Not a night service |
| Charlotte | N | Not a night service | N | Not a night service |
| Hanna | Y | Common user | Y | Common user |
| Bill & Clara | Y | Common user | Y | Common user |
| Erik | N | Unaccompanied children not allowed | N | Unaccompanied children not allowed |
| Philippe | Y/N | Maybe once | Y/N | Maybe once |

**Other roadusers**

| | Meyrin | | Belle-Idée | |
|---|---|---|---|---|
| | *Y/N* | *Comment* | *Y/N* | *Comment* |
| Cristina | N | Car user | Y | Car user |
| Richard | Y | Pedestrian | Y | Pedestrian |
| Manuel | N | Cyclist | N | Cyclist |
| Marcus | | | | |

**Original personas**

| | Meyrin | | Belle-Idée | |
|---|---|---|---|---|
| | *Y/N* | *Comment* | *Y/N* | *Comment* |
| Carlo | | | Y | Employee |
| Mary | | | Y | Employee |
| Ned | | | Y | Visitor |
| Katie | | | Y | Visitor |
| *Family* | | | Y | Visitor |
| *Pets / Animals* | Y | | Y | Accompanied only |

**Other non-identified persona profile?**

| | Meyrin | | Belle-Idée | |
|---|---|---|---|---|
| | *Y/N* | *Comment* | *Y/N* | *Comment* |
| Mister X | N | | Y | Mentally disabled people |

## 3.2.6 Use cases and roadmap

TPG will set up its AVENUE pilot project in the zone of the Belle-Idée hospital in Thonex. Currently, TPG is submitting the project with an ambitious use case foreseen for the end of the project for confirmation to the authorities with the intention, to already have the authorization for the most complicated use case from the start, allowing to move forward towards that use case as soon as feasible by the project partners.

Throughout 2018 and 2019, TPG is focusing its efforts on homologating the area of Belle-Idéé. Thereby the intention is to homologate a zone instead of a line, as well as three shuttles. The authorization process will take several months so that no service on the site will be possible before Q4 2019.

| | Use case 1 | Use case 2 | Use case 3 |
|---|---|---|---|
| *Time* | Q 4 2019-2021 | 2019-2022 | 2022 |

| | | | |
|---|---|---|---|
| *Objective* | Offer an “on demand” service with an operator inside every vehicle | Gradually introduce process automation to control, measure and manage | Deploy three/four fully autonomous driverless Shuttles, with an operator nearby |
| *Safety driver?* | Yes | Yes/No | No |
| *Route* | *Tbd: move as quickly as possible to full on-demand on the site.* | Dynamic route, predefined Shuttle stop based | |
| *Booking* | *Instant booking and pre-booking asap.* | Instant booking and pre-booking | |
| *Individual rides?* | For specific patients, a “VIP reservation” would be interesting to have. | | |
| *Operation times* | 07:00-19:00 on-demand with expected peak hours at 08:00, 12:00, 16:00, 18:00 | | |
| *Technical requirements* | - solutions for disabled people necessairy<br>- | | |

Increasing the speed of the AV is of less importance for TPG on this site. Safety is of utmost importance and development of object identification needs to be first priority.

The focus throughout the whole project lies for TPG in passenger and operation security as well as in the service quality, since the acceptance of autonomous vehicles completely depends on the user experience. Business development needs are of less importance than the former too.

### 3.2.6.1 SWOT analysis for this use case

| Strengths | Weaknesses |
|---|---|
| • Real life use case. When successful definitely to be copied. | • No choice of Shuttle manufacturer or comparison between several others.<br>• Potential lack of dynamic infrastructure information to avoid blockages in order to operate a flexible ‘On Demand’ service. |
| **Opportunities** | **Threats** |
| • Possibility to attain project goals with easy to understand technology. | • No agreement regarding project objectives by authorities (regarding the homologation route etc.), also because of a personnel change in December 2018<br>• Stagnation of hardware/software development<br>• Bankruptcy/ out of business hardware/software partner<br>• Safety-related: with an on-demand service with dynamic route many road users are not used to encountering the shuttle in specific areas.<br>• Safety-related: challenge for the shuttle provider to ensure |

| | |
|---|---|
| | safe behavior without predefined lanes.<br>• Safety related: development of road behavior Shuttle: positioning, braking, acceleration/deceleration etc.<br>• Safety related: stationary and moving object identification (not detection) |

## 3.2.7 Evaluation plans for the use cases

TPG does not yet work with a local company on evaluating the AV shuttles. For the AVENUE project, they will follow the evaluation plan proposed by ECL in this deliverable as well as the evaluation done by HSPF in the framework of WP8. According to these two frameworks, the study design will be decided, as well as the details of the evaluation (such as the number of expected participants to the evaluation).

**Key Performance Indicators** for TPG to determine the success of the pilot are the following (non-exhaustive list):

- Do the results match the objectives defined?
- Is TPG able to deliver the kind of services they had in mind?
- User experience

In order to evaluate the demonstration of the different use cases, TPG would like to collect the following data (exhaustive list):

- Number of instances where the driver must take manual control
- Number of emergency stops/decelerations per 1000 km
- Minimum accepted gap at intersections or in lane changes
- Average speed vs average speed of the rest of traffic flow
- Variance in journey time
- Driver frustration/aggressiveness in the presence of AVs
- Number of handovers from autonomous to manual driving at the vehicles' request per 1000km
- Down time frequency for mechanical servicing/cleaning
- Cost-per-vehicle-kilometer
- Operating efficiency
- Rider comfort
- Reliability
- Affordability
- Integration
- Satisfaction

## 3.2.8 Integrations and special needs

Integration

Integration with different operation systems for scheduling and traveler information. To be further defined in the project.

Special needs to be addressed?

TPG's primary objective is to be able to offer transport services for everyone. Therefore, and even more so because of the location of the pilot site at a hospital, passengers with special needs will certainly be included in the use case definitions, such as passengers with reduced mobility.

# 3.3 Luxembourg: Action plan and roadmap

## 3.3.1 Baseline description

Before the start of the AVENUE project, Sales-Lentz Autocars (SLA) did not have any autonomous shuttle projects running. In the framework of the project, pilot projects have started in September 2018 on two pilot sites, see chapter 3.3.3.

## 3.3.2 Vision, needs, and goals

Vision

By the end of the AVENUE project, Sales-Lentz Autocars vision is to set up an on-demand service with a fleet of autonomous vehicles running in level 4 (without an operator aboard) and with a speed of around 45 km/h which can be booked digitally.

SLA wants to deploy the autonomous shuttles for several tasks:

- First and last mile solutions to bring people from their location to a public transport stop, or from the public transport stop to a destination of their choice (e.g. their work place).
- Offer a mobility solution in city centers, urban areas, residential areas etc. where there is currently no mobility solution available due to several reasons (e.g. pedestrian zones, narrow streets, etc.).
- Connect different areas that are close to each other but where no mobility solution is available today.

Needs

- First & last mile transportation
- An environmentally friendly, on-demand mobility solution available and accessible for everyone
- Providing local mobility solutions for low passenger volumes
- Offering public transportation in areas where no public transport is available at the moment

Corresponding goals

- Operating the autonomous shuttle with a safety operator between two points on an open road without passengers on a trial basis
- Operating the autonomous shuttle with a safety operator between two points on an open road with passengers
- Gradually increasing the speed of the shuttles up to 50 km/h
- Operating the autonomous shuttles on-demand on different routes
- Operating autonomous shuttles without a safety operator
- Operating a fleet of autonomous shuttles on-demand on different routes
- Operating a fully autonomous on-demand mobility service

Step-by-step plan how to reach these goals

- First half of 2018: Getting the homologation for the autonomous shuttles in Luxembourg and for the different routes planned
- 2018-2019: Deploying different autonomous shuttle routes in Luxembourg on a fixed route with a fixed timetable and an operator on-board.
- 2019-2022: Extension of existing routes according to customers' needs. Beginning to deploy more shuttles in order to get an autonomous shuttle network, starting to switch to an on-demand service with no fixed timetable and no fixed stops
- 2022: Starting operations with no operator on board but the operator is supervising serval vehicles from the outside in a control center.

## 3.3.3 The pilot sites

Since September 2018, Sales-Lentz Autocars is running 3 autonomous shuttles on two sites:

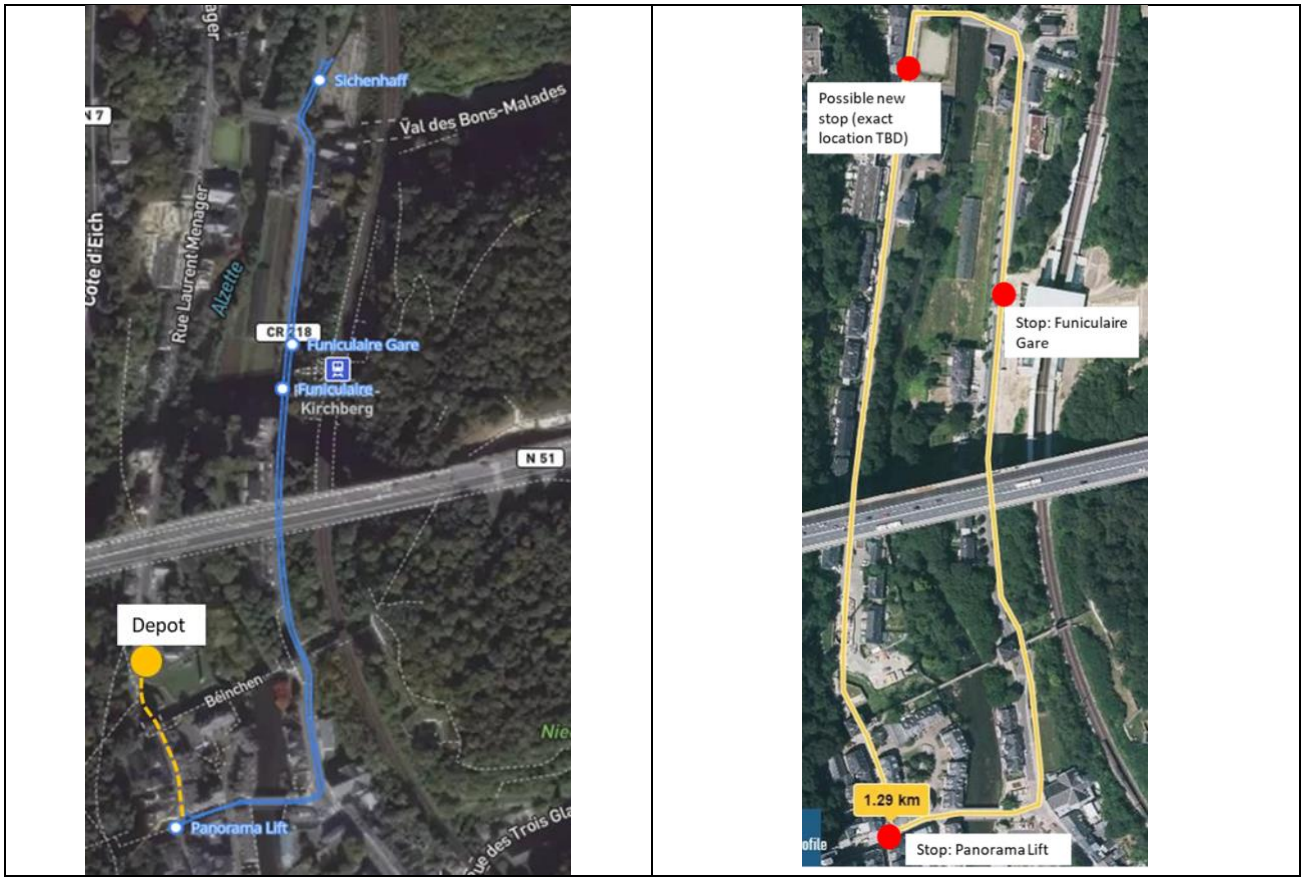
- Pfaffenthal, a valley in the city of Luxembourg, where two shuttles run on a short track connecting the residential area of Pfaffenthal to the panoramic lift in Pfaffenthal that goes up to the city of Luxembourg. Services on this line started on 24.09.2018.
- Contern, an industrial area located around 10km east of Luxembourg city, where one shuttle connects the train station of Contern-Sandweiler with "Campus Contern", a real estate development company. Services on this line started on 19.09.2018.

Both pilot sites will be described in more detail here below. Please note that the services as described apply to the beginning of the project, but can change throughout the project. It is also possible that the services will not be maintained on both sites throughout the whole project duration, and efforts might rather focus on one site.

### 3.3.3.1 Pfaffenthal

Two NAVYA Autonom Shuttles are running on the site of Pfaffenthal between two stations: the train and funicular station of Pfaffenthal, as well as the panoramic lift in Pfaffenthal that leads up to the city of Luxembourg. The track has four stops and the depot and charging station for the shuttles are close to the station at the Pfaffenthal lift, see map below.

| Current route: | Possible route extension: |
|---|---|




The speed limit on the whole route has been reduced to 30 km/h. In order to avoid massive overtaking by cars, SLA is challenging Navya as shuttle manufacturer to increase the maximum shuttle speed from the current 18 km/h to 25 km/h as soon as possible, with a mid-term objective of 30 km/h and a long-term objective to 45 km/h.

The main problem in Pfaffenthal was to find a mobile depot where they could park the shuttle during the night. The depot is especially important during winter and bad weather conditions.

Today the shuttles are driving a back and forth on the same streets. The goal of the route extension is to drive a closed loop as shown in the picture. This allows a smoother operation without the need of a complex turning maneuver at the end of the route as well as to implement another stop in the residential area of Pfaffenthal.

Many types of user groups have been identified in Pfaffenthal, from local residents, tourists, to work commuters, pupils and students – along all age and all socio-economic groups.

The main usage scenarios are:

- Tourists going from the old town to Kirchberg or other way round.
- People commuting to work by the different means of transportation that are arriving or departing in Pfaffenthal (trains, busses, individual cars, bicycles, scooters, etc). The shuttles are connecting different transportation hubs (bus stations, train station, funicular station, bicycle sharing station) so that the commuters can use the shuttles to get their next transport connection. Or to get to the different areas of Luxembourg city (e.g. the public elevator to

get to the upper city center, the funicular station to get to the business district Kirchberg or to the residential area of Pfaffenthal).

- Local residents taking the shuttle to get to the public elevator to reach the city center, reaching the funicular station to get to the shopping malls in Kirchberg or to the residential area of Pfaffenthal.
- Residents from a nearby retirement home located on the city centre site taking the elevator down to Paffenthal, then the shuttle to reach the funicular station to go either up to the Kirchberg area or taking a train to southern or northern Luxembourg.

### 3.3.3.2 Contern

One NAVYA Autonom Shuttle is running on the site of Contern between two stations: the new train station, and Campus Contern, a real estate development company.

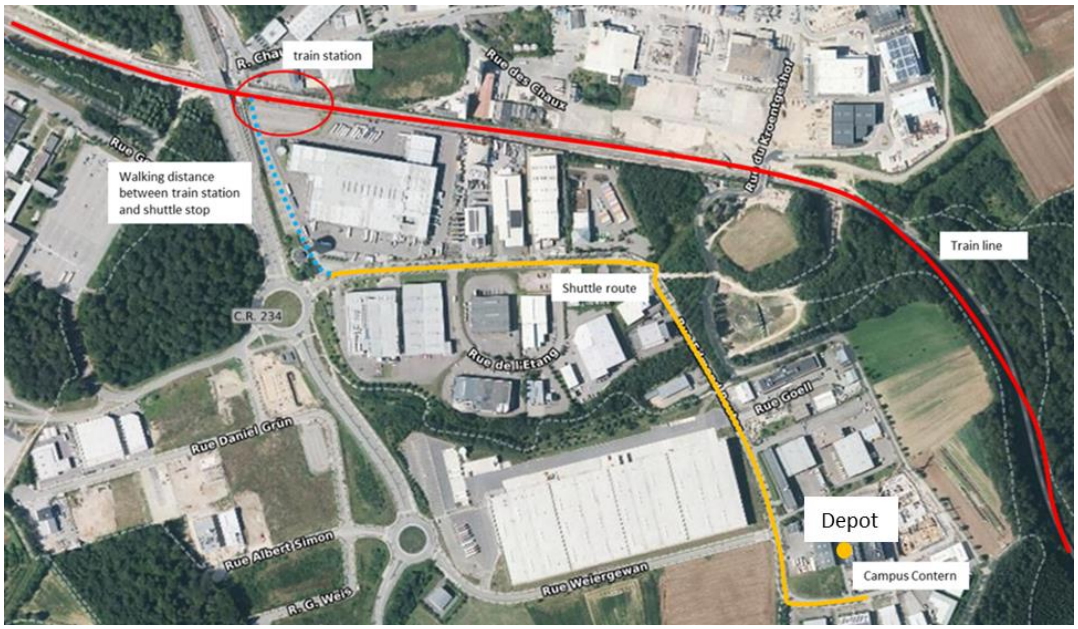



*Figure 2: Map of the pilot site in Contern: original route*

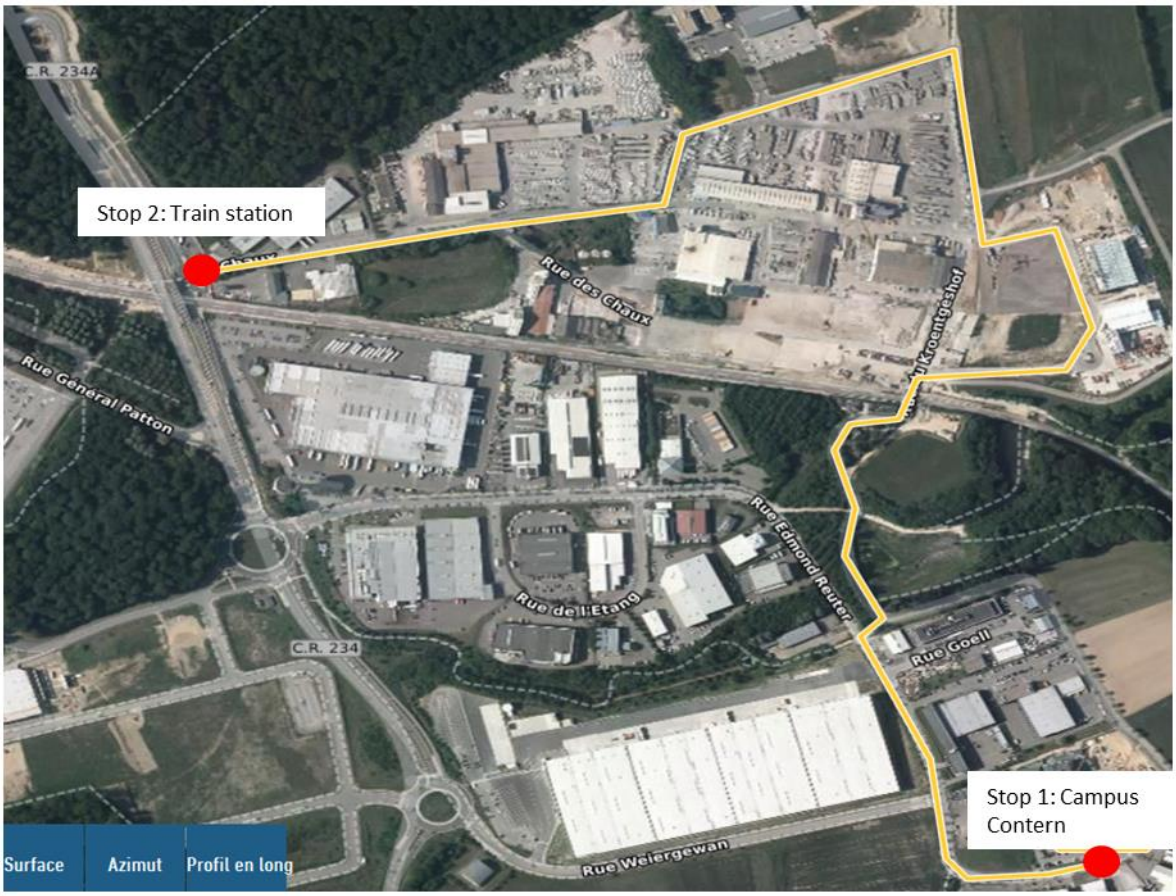



*Figure 4: Map of the pilot site in Contern: extended route*

Extension of current route in order to be closer to the train station and to connect more companies to the train station. In yellow the extended route, in red the shuttle stops. In a first phase only 2 stops are foreseen: one at Campus Contern and another one at the train station of Contern. During the trial of the extended route the addition of more stops is possible according to the passengers' needs. The depot stays in the same location.

The main users are mainly employees commuting by public transport that are working at Campus Contern and the companies nearby. Consequently, the main expected usage scenarios are commuters arriving in the morning by train or bus at the train station of Contern/Sandweiler and are taking the shuttle as a first and last mile solution to reach their working place (in the evening the other way round).

An extension to other parts of the industrial zone is currently being analyzed.

## 3.3.1 User groups: Personas

Task 2.2 in WP2 focuses on passenger needs and thus provides important content to the development of the action plans and roadmaps of the PTOs. Based on the analysis and specifications of passenger needs through surveys conducted in task 2.2, a series of personas have been developed, as well as use cases based on these personas. For more details and the full background, see deliverable D2.5 "Second Passenger needs analysis and specifications").

In this chapter, all user these personas have been evaluated by SLA with respect to their relevance for each of the pilot sites. You can find the results here below:

**Passengers**

| | **Pfaffenthal** | | **Contern** | |
|---|---|---|---|---|
| | Y/N | Comment | Y/N | Comment |
| Alex | yes | common user | yes | comment user |
| Helena | no | Shuttles makes the link between differents means of trnasport in Pfaffenthal, so you are forced to take several connections. This Person is no able to switch connections | no | route in industrial zone, mainly commuters to work who are taking the shuttle |
| Henry | yes | common user | no | route in industrial zone, mainly commuters to work who are taking the shuttle |
| Carolin & John | no | Inner city route | no | route in industrial zone, mainly commuters to work who are taking the shuttle |
| Lilly & Lou | yes | very common users but strollers not allowed inside the shuttle | no | route in industrial zone, mainly commuters to work who are taking the shuttle |
| Fabio | no | No operation during the night | no | no night service + route in industrial zone, mainly commuters to work who are taking the shuttle |
| Charlotte | no | No operation during the night | no | no night service + route in industrial zone, mainly commuters to work who are taking the shuttle |
| Hanna | yes | common user | no | route in industrial zone, mainly commuters to work who are taking the shuttle |
| Bill & Clara | yes | common users (a lot of tourists) | no | route in industrial zone, mainly commuters to work who are taking the shuttle |
| Erik | yes | common user | no | route in industrial zone, mainly commuters to work who are taking the shuttle |
| Philippe | yes and no | not for now but once the on-demand system is available, then it would be possible | yes and no | not for now but once the on-demand system is available, then it would be possible |

**Other roadusers**

| | Pfaffenthal | | Contern | |
|---|---|---|---|---|
| | Y/N | Comment | Y/N | Comment |
| Cristina | no | individual car user who gets annoyed by the presence of the shuttle because of its slow speed | no | |
| Richard | yes | as a passenger but also as an outside person (pedestrian) | no | yes and no not for now but once the on-demand system is available, then it would be possible |
| Manuel | no | not as a passenger but as an other road participant | yes | never happend up to now, but it could be that in future one of the companies in COntern is taking deliveries from a bike messeger, in this case yes, Manuel could be one of the other road participants |
| Marcus | yes | as another road participant, very common | yes | a another road paricipant. Sometimes it is a taxi driver that is illegally parked and blocking the shuttles, other times there are trucks,vans, etc blcking the road due to illegal parking |

**Original personas**

| | Pfaffenthal | | Contern | |
|---|---|---|---|---|
| | Y/N | Comment | Y/N | Comment |
| Carlo | yes | common user | yes | sometimes |
| Mary | yes | common user | yes | sometimes |
| Ned | no | route in city center | yes | sometimes |
| Katie | yes | as another road particpant | yes | as another road particpant |

## 3.3.2 Use cases and roadmap

The use cases and roadmap are confidential and can thus be found in the annex of this deliverable (chapter 5.2).

## 3.3.3 Evaluation plans for the use cases

The use cases and roadmap are confidential and can thus be found in the annex of this deliverable (chapter 5.2).

## 3.3.4 Integrations and special needs

### 3.3.4.1 Integration needs for both sites

- Integration to TRAPEZE and INIT systems.

### 3.3.4.2 Special needs

One of SLA's key objectives is to provide transport services for everyone, including passengers with reduced mobility.

Special needs for both Pfaffenthal and Contern

- Neither in Pfaffenthal nor in Contern we found an appropriate parking spot for the shuttles during the night. According to NAVYA it would be the best if the shuttles are parked inside a building during the night to protect the shuttles from humidity, coldness, corrosion and vandalism or theft. In Contern we built a temporary garage which is linked to very high costs and in Pfaffenthal the only solution was to build a fence around the parking spot and cover the shuttles during the night with a protective cover. This solution is working but is definitely not a long-term solution.
- Special services/equipment for passengers with special needs (e.g. visual or hearing-impaired people). This is especially important for the future when no operator is on board. For now, the operator can help the passengers.
- Increasing the operational speed of shuttles. With a current maximum of 18km/h, the shuttle is slowing down traffic.
- Safety operators are getting back and knee pains after operating the shuttles for several hours because the seats are too hard. A special seat for the safety operators is necessary.
- Safety operators are communicating with NAVYA technicians via Whatsapp. Sometimes a lot of communication between the two parties is necessary via the safety drivers' smartphone. A recharging possibility inside the shuttle is lacking. A solution could be the installation of a USB port in the shuttle (which is currently missing).

Special needs for Pfaffenthal:

Speed limit on the planned track varies between 30 km/h and 50 km/h. Currently the NAVYA Shuttle is operating at 18km/h. In order to avoid massive overtaking by cars, we would like a speed limitation of 30 km/h on the whole track (official request is submitted at the responsible institution (Ponts&Chaussées)). -> we have an official speed reduction to 30km/h on the route in Pfaffenthal since October 2018.

Special needs for Contern:

Stricter control on wrong/illegal parking in order to avoid that the shuttle is stopping due to the detection of obstacles (wrongly parked cars and trucks) on its path. In the industrial zone of Contern a lot of trucks and cars are parked on the side of the road and partly reaching into the street. The shuttle will detect these vehicles as an obstacle and will slow down or stop so that our safety operator is forced to take over the shuttle manually.

# 3.4 Lyon: Action plan and roadmap

## 3.4.1 Baseline description

The Keolis Group runs various autonomous shuttle projects worldwide. Keolis is currently running one autonomous shuttle project in Lyon, called “NAVLY”. Navly consists of two Navya Autonom Shuttles that run on a fixed-route with fixed stations in the area of Confluence in Lyon, an old harbor area that has been revitalized 15 years ago and nowadays combines businesses, services, restaurants, event venues with a residential neighborhood.

Since 1 December 2018, the AVs are running from Monday to Saturday, between 10’00 and 20’00. The service hours can be readapted during specific events.

The Confluence/Navly pilot project started in September 2016. Since then, the two AVs ran around 36.000 km and were used by more than 55 000 passengers.

For the Avenue project, Keolis Lyon a second itinerary on a new rapidly growing area around Groupama Stadium. This new itinerary will provide to test AV’s on 100% open road itinerary, with connected infrastructure that will help to go through very frequented crossroads and roundabout.

## 3.4.2 Vision, needs, and goals

Vision

Keolis Lyon vision for the AVENUE pilot project is to have several AVs running all around the area of the Groupama Stadium (see next chapter 2.4.3 for more information on the pilot site) to provide a service for the inhabitants and tourists.

The Stadium is the first step of the all area development. A medical center, hotel, office building, recreation center are getting build, and it will change attendance of the area. Public transportation is an important part of the transformation of an area, and AV’s will provide to accompanying changes and increase attractiveness of the area.

Needs

- Increase the mastery of AVs to offer regularity services. To be useful, AVs have to be at Décines Grand large station every 15 minutes during peak hours, and every 30 minutes during off-peak hours.
- Increase the technical level of Navya shuttle with V2X technology in order to be more efficient with traffic light crossroads and roundabouts.
- Shuttles as a complementary transportation mode to bus and tram.
- Integration of the shuttle into the passenger information tools used in Keolis Lyon.

Corresponding goals

- Offer a regular service

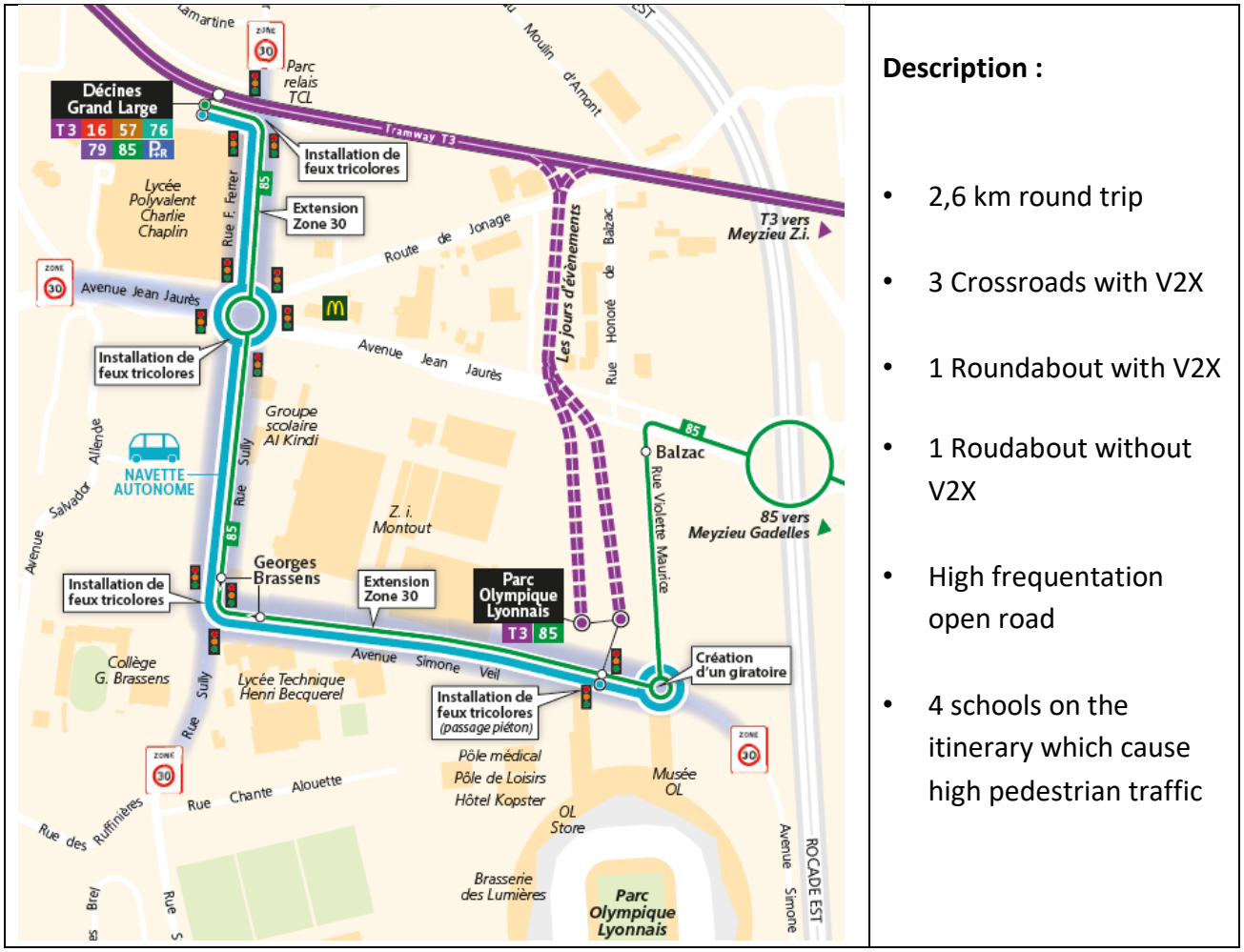
- Fluid interaction between AVs and urban traffic
- Social acceptance of AVs
- Improve passenger information

## 3.4.3 The pilot site

The area around the Groupama Stadium is currently being intensely developed. In the next months and years, several professional buildings, restaurants, a hotel, a recreation center, and a medical center will be built. These different kind of activities are expected to cause small flow passengers all along the day, and AVs would help speed up traveler flows and prevent congestion at the bus station Décines Grand Large.

The new AV service in the area would transport people between the tram station Décines Grand Large and the Groupama Stadium, being complimentary to another bus line. At the beginning of the pilot project, two shuttles will run between two stops, one at the tram station and one at the stadium. In a later use case, a third stop could be added.

The map below shows the route as foreseen for the first use case:




**Description :**

- 2,6 km round trip
- 3 Crossroads with V2X
- 1 Roundabout with V2X
- 1 Roudabout without V2X
- High frequentation open road
- 4 schools on the itinerary which cause high pedestrian traffic

*Figure 3: Route in Lyon, connecting the tram with the Groupama Stadium*

Envisaged route to include on demand stops in red area (later on):

**Addional site :**

- Area size = 16 000m² + 4 000m²
- 8 buildings coming soon
- Open hours from 07.00 am to 01.00 am

Usage of service

- Students, tourists, employees of the stadium and the area
- First and last mile solution between the mass transit system (T3 tram) and the stadium area

## 3.4.4 User groups: Personas

Task 2.2 in WP2 focuses on passenger needs and thus provides important content to the development of the action plans and roadmaps of the PTOs. Based on the analysis and specifications of passenger needs through surveys conducted in task 2.2, a series of personas have been developed, as well as use cases based on these personas. For more details and the full background, see deliverable D2.5 “Second Passenger needs analysis and specifications”).

In this chapter, all user these personas have been evaluated by Keolis with respect to their relevance for each of the pilot sites. You can find the results here below:

**Passengers**

| | **Groupama Stadium** | |
|---|---|---|
| | *Y/N* | *Comment* |
| Alex | Yes | Hotel customer |
| Helena | Yes | Common User |
| Henry | Yes | Common user |
| Carolin & John | Yes | Peri urban route |

| | | |
|---|---|---|
| Lilly & Lou | Yes | Common user |
| Fabio | NO | Not a night service |
| Charlotte | NO | Not a night service |
| Hanna | Yes | only rarely expected (museum visitor) |
| Bill & Clara | Yes | Common user |
| Erik | Yes | Professional seminary |
| Philippe | Yes | Wheel user passenger |

**Other roadusers**

| | **Groupama Stadium** | |
|---|---|---|
| | *Y/N* | *Comment* |
| Cristina | no | Pedestrian |
| Richard | no | Biker |
| Manuel | No | Cyclist |
| Marcus | Yes | Scooter |

**Original personas**

| | **Groupama Stadium** | |
|---|---|---|
| | *Y/N* | *Comment* |
| Carlo | No | |
| Mary | Yes | |
| Ned | No | |
| Katie | Yes | |

## 3.4.5 Use cases and roadmap

| | Use case 1 | Use case X |
|---|---|---|
| *Time* | Autumn 2019 – TBD | TBD |
| *Safety driver?* | Yes | Slowly removing the operator from the shuttle[11] |
| *Route* | Fixed route, 2 fixed stops, metro mode. First and last mile solution between the tram station Décines Grand Large (tram 3 & 5 buses) to the Olympique Lyonnais | • Extension of route to OL training center, OL museum, hotels<br>• Vehicles pass each other autonomously (without interference of the operator) |

[11] After several months of operation, Keolis expects to have gathered enough feedback to be able to start the service, according to the decree 2018-211, with an operator outside the vehicle.

| | | |
|---|---|---|
| | football stadium (Groupama Stadium); 2,5 km round trip, 100% open road | • On demand Transportation |
| *Objective* | • 100% autonomy driving<br>• 100 km/day<br>• Comfort of autonomy driving (without useless braking) | • Increase speed<br>• Increase potential of V2X system<br>• On deman service |
| *Stops* | 2 | 3 (additional on-demand stop) or more |
| *Booking* | None | Booking foreseen via mobile app, form tbd by PTA |
| *Vehicles* | 2 Navya Autonom Shuttles | 2 or more |
| *Vehicle speed* | 20 km/h | Increased AV speed |
| *Operation times* | • Monday to Saturday from 8:30 am to 8pm except during game day at the stadium. It might evolve regarding the evolutions of other modes of transport<br>• 15mn frequency on peak hours and 30mn frequency on off-peak hours | booking application<br>Synchronization of AV's with tramway<br>Integration of AV's in global fleet management system of Keolis Lyon |
| *VIP service?* | No | Yes |
| *Technical requirements* | • reliability of AV's<br>• Provide communication V2X | TBD |
| *Special services to passengers* | No | Provide a dynamic and real-time information on connections |

The focus throughout the whole project lies for SLA in passenger and operation security. Next comes the service quality provided, followed by business development needs.

### 3.4.5.1 SWOT analysis for use case 1

| Strengths | Weaknesses |
|---|---|
| • The itinerary choice is connected to tram station, so we can imagine offering an additional service to the standard service | • The itinerary pass through a disadvantaged district, and we're waiting for incivility. We are already thinking about the organization of awareness event |
| **Opportunities** | **Threats** |
| • The itinerary can level up in keeping with the new | • The different pole of attraction of the new area are |

| | |
|---|---|
| area development | really different, and it's going to be hard to define rush hours and off-peak |

## 3.4.6 Evaluation plans

Keolis does not yet work with a local company on evaluating the AV shuttles. For the AVENUE project, they will follow the evaluation plan proposed by ECL in this deliverable as well as the evaluation done by HSPF in the framework of WP8. According to these two frameworks, the study design will be decided, as well as the details of the evaluation (such as the number of expected participants.

**Key Performance Indicators** for Keolis to determine the success of the pilots are the following (non-exhaustive list):

- Be able to increase the part of itinerary run on open road
- Automatic run km/km total
- Km total/km expected
- Number of signal lost (with analysis of the reasons)
- Evaluate the efficiency of mobile app

In order to evaluate the demonstration of the different use cases, SLA would like to collect the following data (exhaustive list):

- Reliability indicator
- Users perception of AVs Service
- Reservation ratio, mobile app ratio, spontaneous use ratio, …
- Customer satisfaction measures
- Timekeeping
- Information treatment quality (specially to insure connection with tram)
- Quality of the information send to customer (ex: waiting time)

## 3.4.7 Integrations and special needs

Integrations

- 1st: Integrate with the tram schedule: One of the busses should be at the tram station when the tram arrives
- 2nd: Provide information on the app including the position of the shuttle, ETA and ETD

Special needs

No special needs to be considered for this site.

# 4 Evaluation plan

In order to perform the evaluation of the overall AVENUE services, technologies and functionalities at large scale demonstrations, the task 2.5 has to deliver an evaluation plan in D2.16. The evaluation should consider user experiences brought by AVENUE's fully automated urban transport systems and establish the framework for a detailed evaluation of the service acceptance, utilizing specific criteria and key performance indicators. Measuring both subjectively (questionnaires for active and potential users, semi-structured interviews) and objectively (number of new users in the service, number of users changing behavior, etc.)

This document presents the framework for an evaluation plan that will be conducted in the period from M25 to M48.

The evaluation plan is linked with the task T2.2 Passenger needs (including PRM) and requirements specification that will deliver the D2.5 Definition of AVENUE services (R, PU, M6, M18, M36) Enriching, updating and detailing the provisional list of services. The evaluation plan should be implemented consistent with D2.5, i.e. following the human centered design process for interactive systems (ISO 9241-210) and ensures that all relevant stakeholders (including younger and older persons, their family and healthcare professionals) play an important role in the requirement and the evaluation phases and throughout the project. Emphasis must also be put on the cultural and organizational differences within the user group, and member countries. This includes explorative, qualitative studies at the beginning of the project as well as the creation of personas to establish a common understanding among the project participants about the scope and basic ideas behind the user needs and expectations. To this end, user surveys will take place in all demonstrator cities and at least 10 additional ones among those expressing interest.

## 4.1 Conceptual framework

Rather than focusing on absolute terms, the evaluation framework is built on a systematic comparison between two dimensions of a service - the user side and the service provider side – and aims at assessing each service in relative terms.

On the user side, we must understand that the objective experiment assessed by the user at one place and one moment (hic et nunc) is widely determined by representations of the situation which are largely influenced by previous experiments, individual mind set and values. Therefore, the evaluation has to integrate the users' expectations and perceptions in the process in order to measure the gap between the user's cognitive reception and tangible data.

On the provider side, service specifications aim at building a specific added value for users that can be presented with objectives and quantitative KPIs. Nonetheless there may be significant differences between targeted specifications and the concrete realization of the service. Therefore, the evaluation has to compare initial objectives given to a specific service and the actual performance, the effective performance as well as the perceived performance.

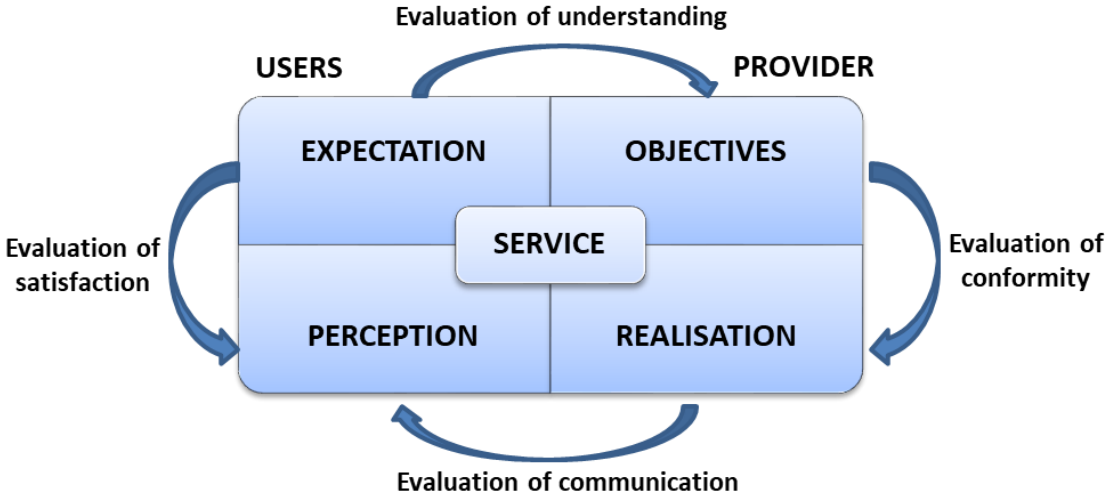



**Fig 1 – Evaluation process**

The evaluation process measures:

- Understanding (2.1): to what extent did the provider understand users' expectations and succeed in specifying an adapted service
- Conformity (2.2): the difference between the objectives identified by the provider by KPIs and the realization either measured by sensors or appreciated by the users
- Satisfaction (2.3): to what extent do users estimate that the service is answering to their expectations
- Communication (2.4): to what extent do users perceive and understand the range of proposed services.

## 4.1.1 Understanding assessment

The "users" is not just an abstract idea; they are living, breathing beings that move with all their "stuff". Understanding exactly who they are is imperative to propose relevant services.

To achieve this understanding, building detailed Personas and Journey Maps are the best way to identify exactly who the users are, what they need, and how they can engage with the autonomous shuttle.

Personas are fictionalized models the service provider create to represent users. They must be believable which means one must believe it, they must have names, personal backgrounds, and behavioural identifiers like motives, attitude, and negative trigger points (see 3 examples of personas in appendix 1).

Personas are made with detailed characteristics:

- Demographics: age, location, education, income, household or family size
- Personal Histories: goals, needs, and interests when they interact with your company

- Expectations: How their needs differ from various avenues and touch points, and how those needs change over time

The understanding assessment is concretely linked with the Task T2.2 Passenger needs (including PRM) and requirements specification. In this task "emphasis must also be put on the cultural and organisational differences within the user group, and member countries. This includes explorative, qualitative studies at the beginning of the project as well as the creation of personas to establish a common understanding among the project participants about the scope and basic ideas behind the user needs and expectations.

The service provider will create its own personas and compare its characters with the personas proposed by Task 2.2. The gap's evaluation measures the level of understanding. If needed, discussion with T2.2 team will help reduce the gap.

### 4.1.2 Conformity assessment

The conformity assessment procedures must demonstrate that a service is conforming to the essential requirements targeted by the specifications decided before the service is placed into the market.

Conformity assessment must not be confused with market surveillance, which consists of controls after the product has been placed into the market.

Conformity assessment should be performed by the service provider and registered for the whole duration of the AVENUE project.

The service provider should ensure the conformity of the service to the project requirements (T2.2, D2.2) implementing following tasks for each service:

- Identification of the applicable requirements
- Translation of the requirements into a set of KPIs adequate to the service
- Selection of all necessary measures so that the development process ensures compliance of the services with users' needs
- Implementation of detailed tests and controls consistent with the pre-identified KPIs
- Monitoring of the compliance of the service
- Reporting to the AVENUE WP2 team leader
- Decision on the go/no go to deliver the service to the users.

### 4.1.3 Satisfaction assessment

The satisfaction assessment process is embedded in T8.3 Social impact evaluation (M6-M48). The aim of this subtask is to study the user experience, the user acceptance and the potential changes in mobility behaviour in the use of public transport systems that has been induced by the use of an AV.

Benefices for all users will be examined within this task, mainly the quality of service assessed with the following matrix:

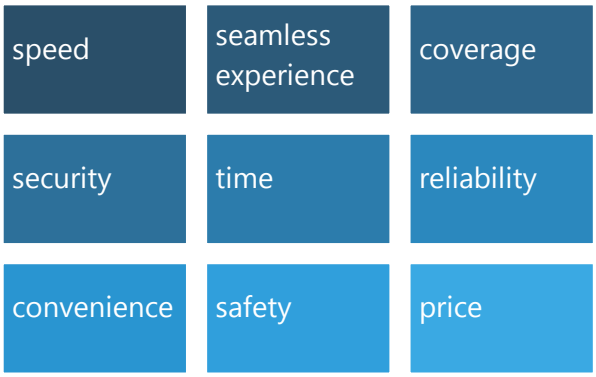



**Fig 2 – The satisfaction assessment matrix**

The social impact evaluation may help to estimates the potential shift from private cars or other means of transport to autonomous public transport or door-to-door service to quantify an urban impact (decongestion) and potential reduction of territorial and social inequalities.

Questions regarding the user experience connected to the overall autonomous public transport system will be answered via a combination of observation and interview techniques. These techniques will be adapted from classic methods used in user experience design and evaluation, such as usability testing or contextual enquiry.

To deduct the changes in mobility behaviour and the adoption of urban and suburban autonomous mobility concepts a user oriented survey (approximately 80 – 100 responses) among active and potential users per demonstrator will be conducted and flanked by follow-up semi-structured interviews with the stakeholders identified in task T2.3 “Stakeholders identification, expectations and barriers imposed”.

Questionnaires for users will be distributed in the autonomous project vehicles and published via official registers and websites of the participating cities. Other potential users like private car drivers will be integrated as well. Face to face interviews especially for PRM will be conducted for users with autonomous transport experience. The perception of the concept by potential users will be evaluated in larger numbers by using online panel interviewees.

### 4.1.4 Communication assessment

The goal of a communications assessment is to determine the level of effectiveness in the PTO’s communication on AVs communicating with the users.

The communications assessment should help answer the following questions -

- How do the POT’s customers know about the AV’s services?
- What do the PTO’s customers understand about the AV’s?
- Are the customers reached with the information they need, when they need it?
- Are the customers provided with feedback channels?
- Are all communication opportunities covered?

- How does communication plans support AV's deployment?

Communication will be assessed by the same questionnaires used for satisfaction assessment.

# 4.2 Satisfaction KPIs

The results of the surveys are due to present a relevant picture of social impact and customer satisfaction. The 4 following indicators will outcome the surveys as synthetic picture:

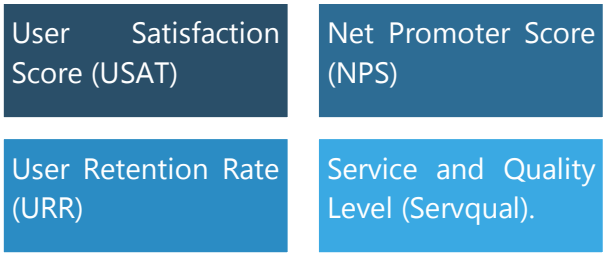



**Fig 3 – The satisfaction KPIs**

## 4.2.1 User Satisfaction Score (USAT)

Users are asked to rate their satisfaction with the service. The score is the average of all users' responses. The score has to be analysed per users' segment and at least twice during the key phases of service delivery. The USAT scale can consist of regular numbers, but it could also consist of stars, smiley faces, colours, etc.

## 4.2.2 Net Promoter Score (NPS)

The NPS measures how likely the users are to refer the service to someone else. Its advantage over the USAT is that it targets an intention and not an emotion. As a result, the reply is less influenced by the mood of the moment.

Users are asked how likely they are to recommend the service on a scale from 1 to 10. Their replies put them into one of three categories: promoters (9-10), passives (7-8), or detractors (0-6). Take the percentage of respondents who fall under the 'promoter' category (10 - 9) and subtract it from the 'detractors' (0 - 6), there's the NPS.

NPS measures may not be compared between the four operations sites of the AVENUE project because the four contexts are quite different. The important thing is to monitor each indicator over time in each site to appreciate its evolution.

## 4.2.3 User Retention Rate (URR)

User retention refers to the ability to keep the user over a set period of time. The AVENUE service might attract a lot of users, but to which extent do they become routine users? The users' retention

is an important indicator of the adequacy of the service to users' expectations and of the perceived quality of the service.

User Retention Rate = ((E – N) / S)) x 100

E = Number of users at end of period

N = Number of users acquired during period

S = Number of users at start of period

For now, a driver is needed in the autonomous shuttle. For the beginning of the experimentation, the driver, at least in Lyon, has been asking the name of all users. With this list we can have an evaluation of the URR.

When divers will not be necessary anymore, we will have recognition of the users within the service data. Thus it is possible can follow the users' reuse of the shuttle service in the demonstrators and extract statistics.

### 4.2.4 SERVQUAL

The multi-dimensional KPI measures "service + quality" are considered as the most common method for measuring the subjective elements of service quality. Users are asked to rate the service and this rate is compared to the expectations they previously expressed.

According to decision-making theory, it is easier to express judgements based on an anchor (the user's expectations). This allows the user to better understand and respond to abstract information (its satisfaction with a service).

The questions cover 5 elements of service quality: RATER.

- Reliability: the ability to deliver the promised service in a consistent and accurate manner.
- Assurance: the extent to which the service provider creates trust and confidence.
- Tangibles: the appearance of the service (e.g. the shuttle, website, equipment, ...)
- Empathy: the extent to which the service provider cares and gives individual attention.
- Responsiveness: the delay needed by the service provider is to offer rapidly an adapted service.

## 4.3 How to gather users' feedback

Users' feedbacks can be obtained either by specific inquiries by surveys or tests or by big data analysis.

### 4.3.1 Surveys

The most simple, direct, way to get feedback from the users is simply to ask for it with a survey — a list of questions about their experience. Surveys with multiple-choice questions can easily be quantified, which allows to draw conclusions from the data using graphs, scatter plots, etc.

Surveys are given at the end of the user's experience. For a specific service, the survey has to be conducted twice: at launching time to get spontaneous reaction and a few weeks later to see how the user get used to the service and appropriate it or rejected it. Surveys should be short and simple. The more simple and to-the-point the survey is, the more likely people are to fill it out.

Organizing a follow up survey is very important; it gives users some time to use the service before asking for their opinion. Feedback survey may be carried out by email, social media, or in-app and should be tailored to the users segmentation (demographic groups, uses groups, ….)

### 4.3.2 Usability tests

Usability tests offer the ability to obtain feedback from users during their use of the service, while observers watch and take notes. The participants may be asked to complete specific tasks with the service — if they can't complete them, this can be a sign that the service has design issues. Usability tests can give extremely valuable data about how to improve a service. The test will be organized by the operators in each city where the autonomous shuttle will be operated. An observation survey has to be planned during the AVENUE project coherently within the 4 operators in Geneva, Lyon, Luxembourg and Copenhagen.

### 4.3.3 Monitoring of social media discussions

Communication online about the AVENUE shuttles services is more likely to be honest, than it may be in person. Thus, evaluation will be supported by tools that should be implemented to analyse online conversations mentioning the shuttle and monitor social media "footprint".

### 4.3.4 Analytics data, online relations with users

Some users are probably going to visit the shuttle website; the provider may also encourage them to do so (with gaming for example). Evaluation process can use the power of web analytics to draw conclusions about the quality of service. By monitoring which pages users view, how long they stay on each page, and other browsing habits, it will be possible to get valuable overview of the quality of online service (popular web analytics tools include: Google Analytics (free), Open Web Analytics (free), Clicky (requires registration), Mint (paid), and Click Tale (paid)).

### 4.3.5 Service data

The AV's users will necessarily subscribe to the service provider to get the services portfolio. The service provider is about to get a large amount of data on users and on how and by whom the AV and its services are used. These data represent a huge amount of information that shall be used to evaluate the services and the AV's satisfaction level.

### 4.3.6 Incentivize the feedback process.

The evaluation process is more likely to get feedback from users if it makes it worth their while. It may be possible to incentivize users to give a good feedback by offering gift cards or store credit, free merchandise sponsored by surrounding businesses.

The evaluation team must also show users that their feedback matters. One easy way to do this is to respond to the users' comments and concerns on social media, where they will be most visible to all.

## 4.4 Economic evaluation

Economic evaluation is an output of the task T8.3 Economic impact evaluation. The economic analysis of the used autonomous electric vehicles will thus focus first on business viability. Therefore, a comparison of the demonstrators will be conducted via a Total-Cost-of-Ownership (TCO) calculation.

### 4.4.1 The Total Cost of Ownership method

The TCO takes a dynamic approach identifying savings and cost drivers, integrating investment costs as well as functional costs

- the development of electric energy costs,
- the energy costs due to shifts in battery
- the costs for the maintenance of charging station infrastructure for public transport
- hidden costs (e.g. cleaning costs or vandalism in vehicles without drivers)

The economic evaluation integrates savings through mobility on demand.

The task T8.3 will evaluate the economic viability of autonomous vehicles as a part of an integrated public transport system considering the global value chain.

Alternative business models will be analysed and the economic benefits of the urban automated vehicle fleets for the user and the potential users will be evaluated.

The economic effects on cities will be assessed and compared with other cities in Europe and the rest of the world (e.g. C40 cities): possible adaptation and investments in infrastructure like charging stations, software and other costs; free up of parking space through substitution of private cars; possible need of special lines; extension of transport services to narrow roads or urban areas with week infrastructure, possible growing attractiveness of suburban areas; possible job effects through evaluation of job cuts (e.g. drivers) and job creation (e.g. operator) etc.

With the use of this methodology, direct and indirect costs and savings as well as cost drivers and hidden costs (e.g. cleaning costs or vandalism in vehicles without drivers) will be clearly identified and evaluated as a basis for the development of a business plan to evaluate the economic viability of autonomous vehicles as a part of an integrated public transport system. The possible improvements of journey time and the possible substitution of traditional individual transport modes like cars will be analyzed.

Thus, business models and potentials will be evaluated regarding the balance between users demand and the economic benefits of the urban automated vehicle fleets for the city.

The economic effects on cities will be assessed and compared with other cities in Europe and the rest of the world, and the Task 8.3 will carry out a cost/benefit analysis regarding

- adaptation and investments in infrastructure like charging stations,
- software and platforms,
- free up of parking space through substitution of private cars,
- need of special lines,
- extension of transport services to narrow roads or urban areas with week infrastructure,
- growing attractiveness of suburban areas,
- job effects through evaluation of job cuts (e.g. drivers) and job creation (e.g. operator).

The TCO "Total cost of ownership" will be evaluated integrating different figures; the evaluation TCO takes into accounts the following concept that are to be estimated.

| Investment | Prospective | Operating costs | Business models |
|---|---|---|---|
| Asset | Ownership Life | Obvious Cost | Resource Base Model |
| Asset Lifecycle | Depreciable Life | Hidden Cost | Activity Base Model |
| | Economic Life | Cost Savings | Cash Flow Estimates |
| | Service Life | Opportunity Cost | Incremental Cash Flow |

The Task 8.2 will propose a TCO Calculator that will help to understand the total costs of the autonomous shuttle, over its whole life. The calculator will help to compare the TCO for several options and scenarios.

## 4.4.2 The hidden costs

The so-called "hidden" costs are the less apparent costs due to ownership that are easy to overlook or omit from acquisition decisions and planning. Hidden costs can be substantial and real. All hidden costs to consider in TCO analysis if both conditions apply:

1. the expenditures are indeed due to the decision to own the asset.
2. the costs are material i.e. large enough to matter.

Hidden Costs may include:

- Acquisition costs: These can include many kinds of spending due to identifying, selecting, ordering, receiving, inventorying, and purchasing. Any of these costs can signal the start of ownership life for the analysis.
- Upgrade, Enhancement, Refurbishing costs.
- Reconfiguration costs.
- Setup and Deployment costs: Costs due to configuring space, transporting, installing, setting up, integrating, and outside services.

- Operating costs: For example, expenses for human operator labor, or energy costs and fuel costs.
- Change management: costs: For example, expenses for user orientation, user training, and workflow or process change.
- Infrastructure support costs: For example, the costs of heating, lighting, cooling, or IT support costs due to asset acquisition.
- Environmental impact costs: For example, expenses for waste disposal, clean up, and pollution control. These may also include charges for "environmental compliance" reporting.
- Insurance costs.
- Security costs:
    - Physical security: For example, expenses for building locks, secure entry doors, closed-circuit television, and security services.
    - Electronic security: For example, the costs of security software, offsite data backup, and disaster recovery services.
- Financing costs: For example, fees for loan interest and loan origination.

The list of hidden cost categories above could, of course, extend further for the autonomous shuttle.

### 4.4.3 Economic KPIs

TCO analysis is relevant only if it includes cash flow statements. The task 8.2 will use several kinds of information to make these cash flow estimates mainly concerning revenue models, activity models and resource models that will allow the design of scenarios and cash flow statements for each scenario.

Finally, the TCO Analyst will use the "bottom lines" of the cash flow statements to compare scenarios using standard financial metrics. These metrics will be evaluated as economic KPIs.

These metrics are:

- 3-year net cash flow.
- Year by year cumulative cash flow.
- Net present value NPV.
- Total capital costs CAPEX.
- Total operating expenses OPEX.
- 3-year total cost of ownership TCO.
- Payback period.
- Return on investment ROI.
- Internal rate of return IRR.
- Break-even point.

## 4.5 Conclusion of the evaluation plan

Throughout the project a continuous evaluation process is established, which will iteratively be refined to accommodate deficiencies detected during the demonstration phase.

During the operation of the services, we will evaluate the needs of the different user groups, based on different classifications (age, activity, gender, special needs), identify the barriers in the adoption and acceptance of autonomous vehicle transport services. A detailed evaluation of the service acceptance will be performed, measured both by subjective and objective KPIs: questionnaires for active and potential users, semi-structured interviews, number of new users in the service, number of users changing behaviour etc

The evaluation of the costs and benefits will be done with the Total cost of ownership method, taking into account not only service operation costs, but also quantify the indirect societal and environmental benefits like parking cost savings, or efficient land development benefits, change of modal transfer, working hour gains and waiting time reductions, energy savings, carbon footprint and air pollution reduction and even changes in passenger habits resulting from the public service personalisation.

Evaluation will take place during Phase four (M12-M48) and WP8. The economic analysis of the used autonomous electric vehicles will first focus on business viability and then on possible economic impacts for users and cities. The social impact analysis will study the user experience, the user acceptance and the potential changes in mobility behaviour in the use of public transport systems.

The evaluation process will be implemented in 3 steps.

Step 1 – Plan and design the framework

- What is going to be evaluated
- Who are the specific users and the relevant number of inquiries
- Which are the relevant KPIs to be measured
- How data are going to be collected
- What is the schedule for data collection (starting and closing dates, replication frequency)

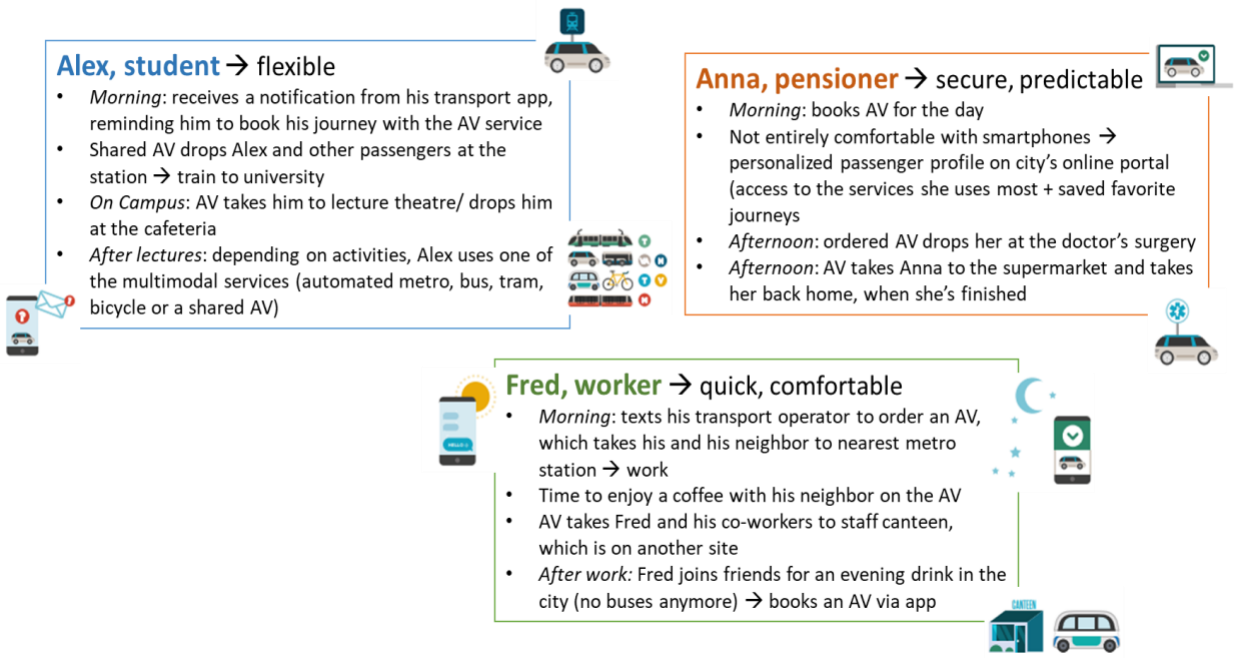
Step 2 – Implement the process accordingly with the framework

Step 3 – Data analysis

- Evaluation of the level of conformity
- Evaluation of social impact (satisfaction, communication, understanding)
- Evaluation of economic impact (TCO)

# 4.6 Appendix to evaluation plan

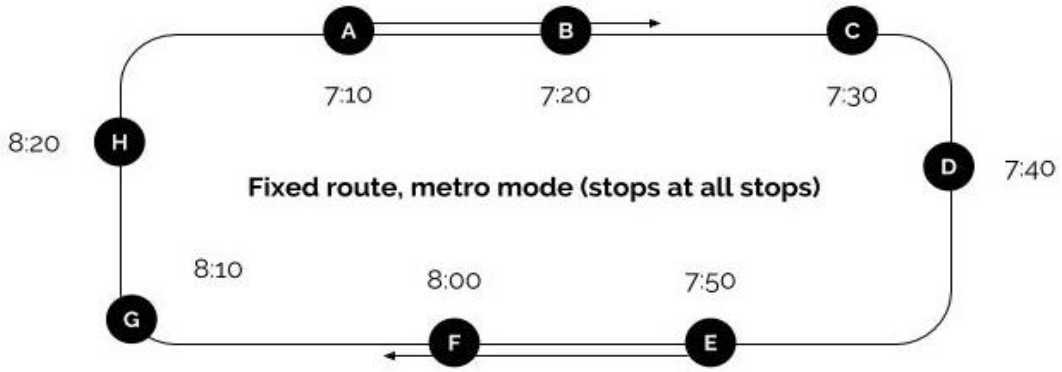
## 4.6.1 Examples of 3 personas



# 5 Annexes (confidential)[12]

## 5.1 Annexes Autonomous Mobility

### 5.1.1 Routing in the Nordhavn area for use case 1



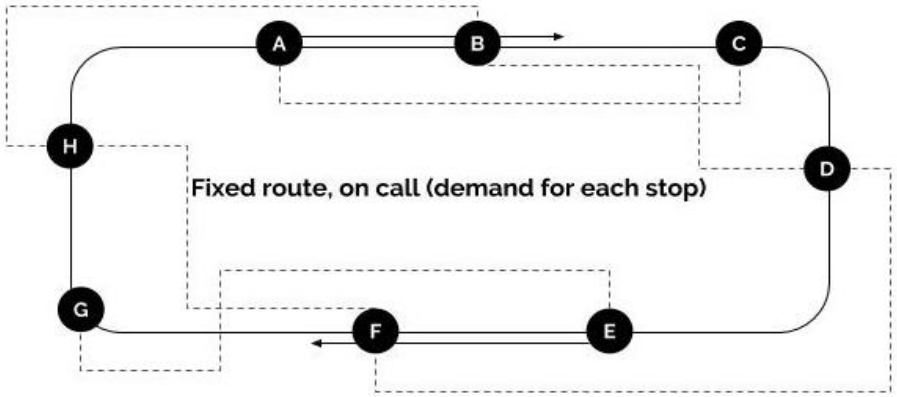

### 5.1.2 SWOT analysis use case 1

| Strengths | Weaknesses |
|---|---|
| • AM is currently the only company operating autonomous vehicle in Nordhavn.<br>• AM has tested autonomous vehicles in Denmark for almost 2 years.<br>• AM has established a technical team competent to monitor and operate vehicles on site.<br>• AM has prior experience from other pilot projects - hence experience in terms of registration and regulations of autonomous vehicles and approvals of AV's and specific routes in real traffic.<br>• AM is perceived as first movers in terms of operation of autonomous vehicles and has a strong political network.<br>• Proactive, nimble, change ready spirit<br>• Problem solving and focus on solutions<br>• Good relations to partners and stakeholders<br>• Due to proper organization, this first use case is the simplest possible scenario of operations and therefore a very good starting point to tune-in | • AM is the first to go through the legal framework in Denmark - requires time and resources.<br>• People are not necessarily aware of the service at the beginning.<br>• Travelling time is penalized since the shuttle will stop in every stop even if it's not required. |

[12] These annexes will be submitted to the European Commission but have to be removed from any public version of the deliverable.

| | |
|---|---|
| details for the following use cases.<br>• Fixed timetables can allow users to organize themselves in order to try the service in the first stage. | |
| **Opportunities** | **Threats** |
| • Unique position as operator of autonomous solutions in the Nordics and the Baltic countries<br>• In position to own agendas and frame the debate<br>• Authority from pilot experience in real traffic with real passengers<br>• The mobility cloud can change the perception of public transport, positively<br>• Deploy multiple types of vehicles to fit a broad range of customer needs | • Competitors winning end users' loyalty<br>• Critical incidents in pilots could damage trustworthiness of the brand AM<br>• Slowly developed laws and regulations could limit our operations, hence the development of AM<br>• The technology is not matured enough<br>• The technology is not robust enough<br>• The temporary AV legal framework is generated as a test framework - which will be revised in 5 years and shut down - this can potentially become a threat for the deployment of AV's in Denmark. |

## 5.1.3 Routing in the Nordhavn area for use case 2

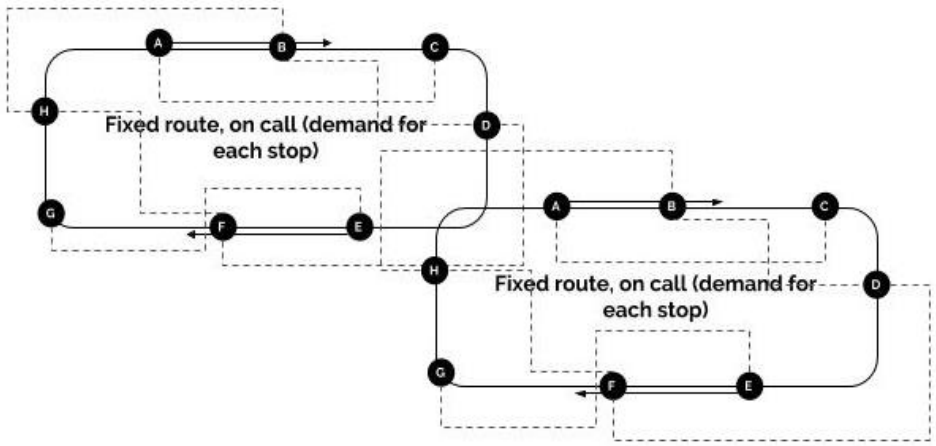



## 5.1.4 SWOT analysis use case 2

| Strengths | Weaknesses |
|---|---|
| • AM is the only Danish company operating autonomous vehicles at the moment.<br>• AM has tested autonomous vehicles in Denmark for almost 2 years.<br>• AM has established a technical team competent to monitor and operate vehicles on site.<br>• AM has the most experience in the Nordics in terms of registration and regulations of autonomous vehicles, as well as approval of vehicles and routes.<br>• AM is perceived as first movers in terms of | • Lack of focus and reflection in communications<br>• Target groups not considered sufficiently<br>• Messages too diverse<br>• Slow development pace, given regulations and laws |

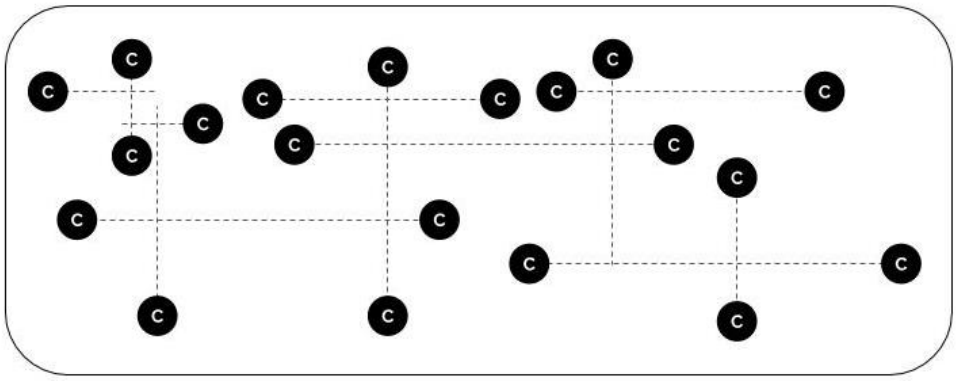
| | |
|---|---|
| operation of autonomous vehicles and has a strong political network.<br>• Proactive, nimble, change ready spirit<br>• Problem solving and focus on solutions<br>• Good relations to partners and stakeholders | |
| **Opportunities** | **Threats** |
| • Unique global position as operator of autonomous solutions in the Nordics and the Baltic countries<br>• In position to own agendas and frame the debate<br>• Authority from pilot experience in real traffic with real passengers<br>• The mobility cloud can change the perception of public transport, positively<br>• Deploy multiple types of vehicles to fit a broad range of customer needs<br>• An increase in number of users | • Competitors winning end users' loyalty<br>• Critical incidents in pilots could damage trustworthiness of the brand AM<br>• Slowly developed laws and regulations could limit our operations, hence the development of AM<br>• The technology is not matured enough<br>• The technology is not robust enough<br>• The temporary law is alternated in such a way that it obstructs the possibility to operate or it is drawn back. The law is being revised this year. |

## 5.1.5 Routing in the Nordhavn area for use case 3



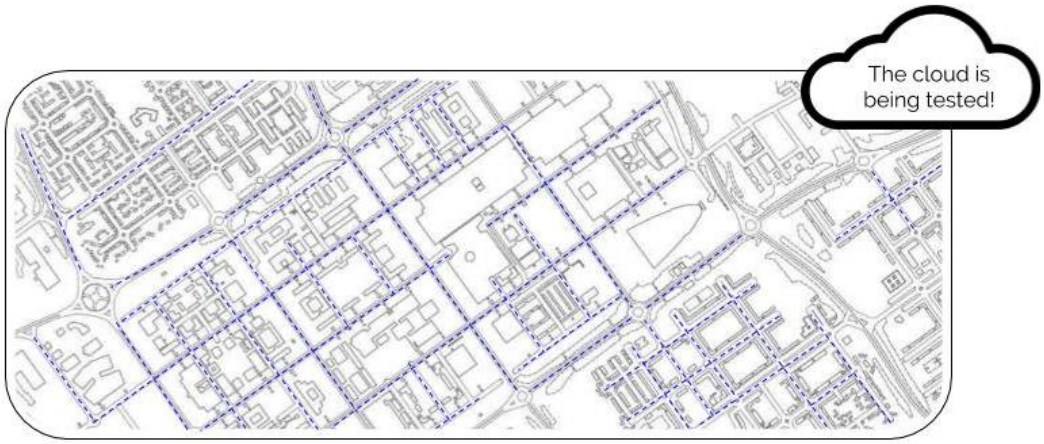

Fixed-route, on call (on demand coordinate based on two connected routes)

### 5.1.1 Routing in the Nordhavn area for use case 4



Dynamic routes, on call (on demand coordinate based)

### 5.1.1 Routing in the Nordhavn area for use case 5




Live mapping, dynamic routes, on call (on demand coordinate based - door to door transport everywhere)

## 5.2 Annexes Sales-Lentz Autocars

### 5.2.1 Use cases and roadmap

#### 5.2.1.1 Pfaffenthal

| | Use case 1 | Use case 2 | Use case 3 |
|---|---|---|---|
| *Time* | Q4 2018 – Q2 2019 | Q2 2019 – Q3 2019 | Q3 2019 - TBD |

| | | | |
|---|---|---|---|
| *Approved?* | Yes | Yes | Ongoing |
| *Safety driver?* | Yes | Yes | Yes |
| *Route* | Fixed route, station-based | Fixed route, station-based | Fixed route, station-based |
| *Vehicles* | 2 Navya Autonom Shuttle | 2 Navya Autonom Shuttle | 2 Navya Autonom Shuttle |
| *Booking* | None | None | None |
| *Vehicle speed* | 20 km/h | 20 km/h | 25 km/h |
| *Operation times* | Mo-Fr 07:00 - 21:00 | Tu,Th: 12h00-16h00 &16h45-20h00<br>Sa,Su, bank holidays: 10h00-21h00 | TBD |
| *Shared rides / Individual rides* | Shared | Shared | Shared |

#### 5.2.1.2 Contern

| | Use case 1 | Use case 2 | Use case 3 | Use case 4 |
|---|---|---|---|---|
| *Time* | Q4 2018 | Q4 2019 | Q1 2020 | Q3 2020 |
| *Safety driver?* | Yes | Yes | Yes | TBD |
| *Route* | Fixed route, station-based | Fixed route, station-based | Fixed route, on call | Dynamic or fixed route on call |
| *Vehicles* | 1 Navya Autonom Shuttle | 1 Navya Autonom Shuttle | 1 Navya Autonom Shuttle | TBD |
| *Booking* | None | None | TBD | TBD |
| *Vehicle speed* | 20 km/h | 20 km/h | 20 km/h | > 20 km/h |
| *Operation times* | Mo-Fr:<br>07:00 - 09:00,<br>16:00 - 19:00 | Mo-Fr:<br>07:00 - 09:00,<br>16:00 - 19:00 | TBD | TBD |

| | | | | |
|---|---|---|---|---|
| *Shared rides / Individual rides* | Shared | Shared | Shared | Shared |

As a public transport provider, Sales-Lentz Autocars does not want to offer the possibility of booking private rides on any of the sites, booking shall always be for pooled rides.

The focus throughout the whole project lies for SLA in passenger and operation safety. Next comes the service quality provided, followed by business development needs.

Technical requirements for both sites:

- Garage for parking the shuttles outside of the operational hours
- Mobile application for passenger information system
- Mobile application with the possibility to book the shuttle (use cases 3 & 4 Contern)
- TRAPEZE Connection (Pfaffenthal)
- INIT Connection (Contern)

### 5.2.1.3 SWOT analysis Pfaffenthal

#### 5.2.1.3.1 Use case 1 (Pfaffenthal)

| Strengths | Weaknesses |
|---|---|
| • A lot of pedestrian traffic between the planned stations, so there is a high chance that pedestrians will switch to the shuttle, especially during winter because of bad weather. | • Difficulties to find a garage to store and charge the shuttle during the night<br>• The great amount of pedestrian traffic could easily block operations of the shuttle if the infrastructure is not properly designed to control this flow.<br>• Shuttle speed is max. 15 km/h, speed limit on the road is 30 km/h, the shuttle could slow down the traffic which can lead to traffic jams and create frustration and anger amongst other car drivers. |
| **Opportunities** | **Threats** |
| • Collecting important data from implementing an AV into real traffic with very different other road users (cars, cyclists, pedestrians, trucks, busses, …)<br>• No other mobility solution available here<br>• Very dynamic environment for Pfaffental with very different and constantly changing user profiles. If the pilot is successful, it will give SLA an edge in the market and will also feed more simple contexts of operations for SLA and others. | • Construction works on the road, construction work traffic signs, construction vehicles parking on the shuttles' road etc. which will be seen as obstacles from the shuttles and will cause them to break or stop<br>• High traffic density in the morning and evening peak hours |

| | |
|---|---|
| • The presence of a retirement home near the shuttle route. The shuttle could be a mobility solution for its inhabitants. | |

#### 5.2.1.3.1 Use case 2 (Pfaffenthal)

| Strengths | Weaknesses |
|---|---|
| • The shuttle is not driving anymore in the morning peak hours when the traffic is very dense and hectic. This could lead to a smoother operation because the shuttles encounter less other vehicles on the road. Furthermore, the shuttle will not slow down the traffic during the morning peak hours. | • No mobility solution available in the busy morning peak hours for people that are commuting to work. |
| **Opportunities** | **Threats** |
| • The shuttle is now driving during the weekends and on all bank holidays when a lot of people are in Luxembourg City. Passenger volume will rise. | • Loss of passengers that used the shuttle in the morning peak hours to commute to work. |

#### 5.2.1.3.1 Use case 3 (Pfaffenthal)

| Strengths | Weaknesses |
|---|---|
| • Simplified route, no need of complex turning manoeuvres. | • Shuttle will have to cross a cycling path so it will encounter a lot of cyclists who will pass/overtake the shuttle. This could have a negative impact on the operation of the shuttles. |
| **Opportunities** | **Threats** |
| • Adding another stop in a residential area and thus offering a mobility solution to more people. | • Safety operator will get bored driving in a loop all day long. |

### 5.2.1.1 SWOT analysis Contern

#### 5.2.1.1.1 Use case 1 (Contern)

| Strengths | Weaknesses |
|---|---|
| • Little traffic | • Currently few potential clients: few people are currently using the train to get to Contern because there is no connection between the train station and the work place. A weakness could be that it |

| | |
|---|---|
| | needs a few weeks/months until people get aware that there is now a connection from the train station to their work place. A weakness could be that it needs a few weeks/months until people get aware that there is now a connection from the train station to their workplace. It could be that in the beginning of the shuttle service, the shuttle will not be much used. |
| **Opportunities** | **Threats** |
| • No public transport is available on the last mile to get from the train station to the working place, opportunity to fill this gap by the autonomous shuttle service. | • Speed limit on the shuttles route is 50km/h. The shuttles are driving max. 18km/h. The high difference of speed between the shuttle and the other traffic participants could be a safety issue and could lead to an aggressive behaviour from other users. |

#### 5.2.1.1.2 Use case 2 (Contern)

| **Strengths** | **Weaknesses** |
|---|---|
| • People know the shuttle already and acceptance is already there. | • The new route is far longer than in use case 1. Travel time will be much longer. |
| **Opportunities** | **Threats** |
| • Possibility to connect more companies to the train station because the new route is passing along more companies. | • If more stops are implemented the travel time will rise even more. User acceptance could drop because shuttle takes too long to go from A to B. |

#### 5.2.1.1.3 Use case 3 (Contern)

| **Strengths** | **Weaknesses** |
|---|---|
| • Shuttle will be used during the whole day and not only during the morning and afternoon peak hours. | • Maybe 1 shuttle is not sufficient to answer the demand. An estimation on the demand is difficult to make at this moment. |
| **Opportunities** | **Threats** |
| • Possibility to deploy more shuttles if the demand is there. | • User acceptance not there because of the shuttles low speed. |

#### 5.2.1.1.4 Use case 4 (Contern)

| Strengths | Weaknesses |
|---|---|
| • Shuttle is accepted by the users who know the shuttles from the previous use cases where the shuttle drove on a fixed schedule. Users are ready to test on-demand service without a fixed schedule. | • TBD |
| **Opportunities** | **Threats** |
| • The shuttles are only driving when there is a real demand. The shuttle is not driving empty. | • Technology not ready for on-demand trials. Users need a possibility to call the shuttle |

## 5.2.2 Evaluation plans for the use cases

For the evaluation method, SLA would like to focus on user studies (qualitative survey with in depth interviews). This is preferred over a focus group, because it is expected to be easier to execute and less time consuming than a focus group. In addition, more people can participate. Sales-Lentz Autocars expects around 500 participants in Pfaffenthal, and between 200 and 300 participants in Contern.

**Key Performance Indicators** for Sales-Lentz Autocars to determine the success of the pilots are the following (non-exhaustive list):

- Results of the user study
- Total number of passengers transported
- Feedback from safety drivers
- Feedback from other traffic participants

In order to evaluate the demonstration of the different use cases, SLA would like to collect the following data during use cases 1 in Pfaffenthal and Contern (exhaustive list):

- Acceptance and reactions from passengers, local residents and shuttle operator
- Integration of the autonomous shuttle into real traffic, reactions from other traffic
- Reliability of the autonomous software (% of time in autonomous / manual mode)
- Reliability of the NAVYA Shuttle (hardware)
- Uptime / downtime of service (if the vehicle is supposed to run 12 hours non-stop, how many minutes was the vehicle a) driving b) waiting c) stopped d) broke down, etc
- Impact of weather conditions on the autonomous shuttle software and hardware
- % of time in autonomous / manual mode
- Uptime/downtime of service (if the vehicle is supposed to run 12 hours non-stop, how many minutes was the vehicle a) driving b) waiting c) stopped d) broken down, etc.
- Shuttle punctuality
- % of manual mode per distance and not per time

- Total number of passengers
- Safety operators' feedback on operation of the shuttle

In addition to this, SLA would like to collect the following data for other use cases:

Pfaffenthal use case 2:

- Feedback from other road users due to the change of the operation hours (outside of morning peak hours and on weekends as well as on bank holidays)
- Difference in number of passengers due to the change of the operational hours

Pfaffenthal use case 3:

- Reactions from other road users on the fact that the shuttle is driving now in a closed loop and not on the same road forth and back as in use case 1.

Contern use case 2:

- Time the shuttles needs to drive from stop 1 to stop 2 and the reaction of the passengers in regard to the travel time. In use case 2 this distance is much bigger than in use case 1. We want to know if people think that the shuttle needs too much time to go from their starting point to their destination.

Contern use cases 3 and 4: TBD