ULTIMO

Advancing Sustainable User-centric
Mobility with Automated Vehicles

DELIVERABLE

D1.4

Quality Assurance, Risk Assessment, Ethics & Regulatory issues - First version

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Table of Contents

List of Figures

List of Tables

Acronyms

ADS	Automated Driving Systems
AI	Artificial Intelligence
AM	Automated Mobility
API	Application Protocol Interface
AV	Automated Vehicle
BM	Bestmile
BMM	Business Modelling Manager
CAV	Connected and Automated Vehicles
CB	Consortium Body
CCAM	Cooperative, connected and automated mobility
CERN	European Organization for Nuclear Research
D7.1	Deliverable 7.1
DC	Demonstration Coordinator
DI	The department of infrastructure (Swiss Canton of Geneva)
DMP	Data Management Plan
DSES	Department of Security and Economy - Traffic Police (Swiss Canton of Geneva)
DTU test track	Technical University of Denmark test track
EAB	External Advisory Board
EC	European Commission
ECSEL	Electronic Components and Systems for European Leadership
EM	Exploitation Manager
EU	European Union
EUCAD	European Conference on Connected and Automated Driving
F2F	Face to face meeting
FEDRO	(Swiss) Federal Roads Office
FM	Fleet Management
FOT	(Swiss) Federal Office of Transport
GDPR	General Data Protection Regulation
GIMS	Geneva International Motor Show
GNSS	Global Navigation Satellite System
HARA	Hazard Analysis and Risk Assessment
IPR	Intellectual Property Rights
IT	Information Technology
ITU	International Telecommunications Union
LA	Leading Author
LaaS	Logistics as a Service
LIDAR	Light Detection And Ranging
MaaS	Mobility as a Service
MEM	Monitoring and Evaluation Manager
MT	MobileThinking
OCT	General Transport Directorate of the Canton of Geneva
ODD	Operational Domain Design
OEDR	Object And Event Detection And Response
OFCOM	(Swiss) Federal Office of Communications
PC	Project Coordinator
PEB	Project Executive Board
PGA	Project General Assembly
PRM	Persons with Reduced Mobility
PSA	Group PSA (PSA Peugeot Citroën)
PTO	Public Transportation Operator
PTS	Public Transportation Services
QRM	Quality and Risk Manager
QRMB	Quality and Risk Management Board
RN	Risk Number
SA	Scientific Advisor
SAE Level	Society of Automotive Engineers Level (Vehicle Autonomy Level)
SAN	(Swiss) Cantonal Vehicle Service
SDK	Software Development Kit
SLA	Sales Lentz Autocars
SMB	Site Management Board
SoA	State of the Art
SOTIF	Safety Of The Intended Functionality
SWOT	Strengths, Weaknesses, Opportunities, and Threats.
T7.1	Task 7.1
TM	Technical Manager
TPG	Transport Publics Genevois
UITP	Union Internationale des Transports Publics (International Transport Union)
V2I	Vehicle to Infrastructure communication
WP	Work Package
WPL	Work Package Leader

Executive Summary

The present document has been generated within the scope of task *T1.3 Quality and Risk Management*, which is part of Work Package *WP1 Project Management & Ethics*. The following deliverable – *D1.4 Quality Assurance, Risk Assessment, Ethics & Regulatory issues - First version* – contains quality and risk guidelines for the ULTIMO project.

The goal of task *T1.3 Quality and Risk Management* is to provide helpful quality and risk management guidelines for all members of the ULTIMO consortium. These guidelines provide the basis for producing high quality outcomes and for reducing the threat of risks throughout the project. Therefore, in *D1.4 Quality Assurance, Risk Assessment, Ethics & Regulatory issues - First version*, several procedures and measures are described for the assurance of quality and for the management of risks.

The document at hand, *D1.4 Quality Assurance, Risk Assessment, Ethics & Regulatory issues - First version*, presents the initial quality and risk assessment plan for the start of the project, on which the organisation of the project will be built and which will be further refined during the course of the project. The first part - *Quality Management* – contains all procedures for quality assurance that are in place for the ULTIMO project, such as for the preparation of documents or dissemination. Chapter 3, *Risk Management,* describes the implementation of a risk management process will be explained in detail based on its different steps. Finally chapter 4, describes the Ethics and Legal issues and how the project work will be conformant with ethical and legal requirements.

Throughout the ULTIMO project, all members of the ULTIMO consortium are encouraged to comply with the procedures and rules presented in this quality and risk assessment plan. The contents can also be found in a QRM manual, which is available to all members in the Share-Point.

1 Introduction

During the past few years many projects and initiatives were undertaken deploying and testing Automated Vehicles (AVs) for public transportation and logistics. However, despite their ambition, all these projects stayed on the level of elaborated experimentation and never reached the level of a large-scale commercial deployment of transport services. The reasons for this are many, the most important being the lack of economically viable and commercially realistic models, the lack of scalability of the business and operating models, and the lack of user-oriented services required for large end-user adoption of the solutions.

The ULTIMO project will create the very first economically feasible and sustainable integration of AVs for MaaS (Mobility as a Service) public transportation and LaaS (Logistics as a Service) urban goods transportation. ULTIMO aims to deploy in three sites in Europe 15 or more multi-vendor SAE L4 (see Table 1) AVs per site. A user-centric, holistic approach, applied throughout the project, will ensure that all elements in a cross-sector business environment are incorporated to deliver large-scale on-demand, door-to-door, well-accepted, shared, seamless-integrated and economically viable CCAM (Cooperative, connected and automated mobility) services. We target the operation without safety driver on-board, in a fully automated and mission management mode with the support of innovative user centric passenger services.

ULTIMO's innovative transportation models are designed for a long-term sustainable impact on automated transportation in Europe, around the globe and on society. The composition of the consortium ensures the interoperability between multiple stakeholders by making adoption of new technologies at minimum costs and maximum safety. The integration of the ongoing experiments of previous AV-demonstrator projects ensures highest possible technical and societal impacts from the very beginning of the project, as well as during the project lifetime and even long after its completion.

1.1 On-demand Mobility

Public transportation is a key element of a region's economic development and the quality of life of its citizens. Governments around the world are defining strategies for the development of efficient public transport based on different criteria of importance to their regions, such as topography, citizens' needs, social and economic barriers, environmental concerns, and historical development. However, new technologies, modes of transport and services are appearing, which seem very promising to the support of regional strategies for the development of public transport.

On-demand transport is a public transport service that only works when a reservation has been recorded and will be a relevant solution in places where the demand for transport is diffuse and regular transport is inefficient.

On-demand transport differs from other public transport services in that vehicles do not follow a fixed route and do not use a predefined timetable. Unlike taxis, on-demand public transport is usually not individual. An operator or an automated system takes care of the booking, planning and organization.

It is recognized that the use and integration of on-demand AVs has the potential to significantly improve services and provide solutions to many of the problems encountered today in the development of sustainable and efficient public transport.

1.1.1 Fully Automated Vehicles

A self-driving car, referred in the ULTIMO project as an AV, is a vehicle that can sense its environment and move safely with no human input.

The terms *automated vehicles* and *autonomous vehicles* are often used together. The Regulation 2019/2144 of the European Parliament and of the Council of 27 November 2019 on type-approval requirements for motor vehicles defines "automated vehicle" and "fully automated vehicle" based on their autonomous capacity:

An "automated vehicle" means a motor vehicle designed and constructed to move autonomously for certain periods of time without continuous driver supervision but in respect of which driver intervention is still expected or required

"Fully automated vehicle" means a motor vehicle that has been designed and constructed to move autonomously without any driver supervision

In ULTIMO we operate ***Fully Automated mini and micro shuttles for shared public transportation***. In relation to the SAE levels, the ULTIMO project will operate SAE Level 4 vehicles.

SAE INTERNATIONAL

SAE J3016™ LEVELS OF DRIVING AUTOMATION

	SAE LEVEL 0	SAE LEVEL 1	SAE LEVEL 2	SAE LEVEL 3	SAE LEVEL 4	SAE LEVEL 5
What does the human in the driver's seat have to do?	You are driving whenever these driver support features are engaged – even if your feet are off the pedals and you are not steering			You are not driving when these automated driving features are engaged – even if you are seated in "the driver's seat"		
	You must constantly supervise these support features; you must steer, brake or accelerate as needed to maintain safety			When the feature requests, you must drive	These automated driving features will not require you to take over driving	
	These are driver support features			These are automated driving features		
What do these features do?	These features are limited to providing warnings and momentary assistance	These features provide steering OR brake/ acceleration support to the driver	These features provide steering AND brake/ acceleration support to the driver	These features can drive the vehicle under limited conditions and will not operate unless all required conditions are met		This feature can drive the vehicle under all conditions
Example Features	• automatic emergency braking • blind spot warning • lane departure warning	• lane centering OR • adaptive cruise control	• lane centering AND • adaptive cruise control at the same time	• traffic jam chauffeur	• local driverless taxi • pedals/ steering wheel may or may not be installed	• same as level 4; but feature can drive everywhere in all conditions

Table 1: SAE Driving Automation levels (©2020 SAE International)

1.2 The ULTIMO dream for public transportation

Our city has a population of 700,000, and the local PTO (Public Transport Operator) deploys 3,000 km of public transportation services' routes, with 4 backbone tram lines, 8 backbone large bus/trolley lines, and 340 fully automated multi-manufacturer mini and micro-shuttles in an on-demand, door-to-door shared public transport service. The fleet of the 340 automated minibuses is composed of different vehicle generations and models from different manufacturers, as it was purchased in different batches during the last 12 years (it all started with the first 15 bought by a European project in 2023/24). Today, it is composed of the first 15 twelve-year-old vehicles from manufacturer A, 160 eight-year-old vehicles from manufacturer B and 160 two-year-old vehicles from manufacturer A, which are vehicles of the new generation of manufacturer A. These last 160 vehicles re-placed the last 70 old, driver based, thermic busses that reached the end of their life after 18 years in operation. The change from large busses with drivers to automated mini-buses and from fixed line service to on-demand, door-to-door, for the last area of the city, was decided 6 years ago, and was based on the great success of the already deployed AV-based services in the other parts of the city.

The integration of new vehicles in the PTO fleet was done within just a few days, thanks to the now standardised APIs (Application Protocol Interface) of the automate vehicles' connection with the AV fleet management and orchestration service, that allows a plug-and-operate functionality, but also enables the combination of AVs with all other means of transport, offering a seamless citizen centric journey to the users. Similarly, the now standardized HD (High Definition) maps between the vehicle manufacturers allowed us to reuse the maps created in the past for the 3,000 km of routes of the city, with small adaptations for the new vehicle capabilities. Together with the purchase of the last 160 AVs, we also switched to a new AV fleet management and orchestration service, from another provider, that offers more precise trip time estimations, also considering traffic jams in the city and weather conditions (that affect traffic in the city). The replacement was made within just two weeks, thanks to the new standardised interfaces between AV fleet management and PTO MaaS.

Passengers are now able to reserve on the fly or with pre-reservation trips from one side of the city to another via their mobile phone app, using the optimal transport mode available for them, with a combination of different transport modes, and having the AV arriving right (or almost) at their door entrance and bringing them to their final destination or to a backbone transport connection. All trips are offered with highly reliable and accurate transport and arrival times based on real time, dynamic route changes of the vehicles, responding to the passenger needs. Many passenger services are available in the AVs via a mobile phone app, adapted to all passengers' needs, from special needs passengers (visually impaired, wheel-chair users, pregnant women, elderly, children), to persons transporting suitcases or a baby-stroller, providing adapted information of their trip (where to get-off, PTO general information, and even infotainment, like city related information and historical facts and anecdotes, related to their current position).

With the full suppression of on-board operators, automated in-vehicle monitoring provides a multitude of passenger services, which were and are developed with a continuous collaboration and innovation between users and the PTO. An on-board unit identifies locally (that is, in the bus) incidents and events, like aggressions, vandalism, forgotten objects, littering, accidents, etc., and raises incident alarms to the PTO back-office. The PTO officer at

the back-office evaluates the incident and decides, based on the operator policies, what action to take: dismiss the incident or stop the vehicle and call one of the intervention teams to go to the vehicle and take the required action. The back-office operator, based on the number of incidents and intervention time legal obligations, can deploy any of the 15 intervention teams available in the city, ready to reach any AV within a few minutes. At the back-office, service operators can follow the vehicle status, trip reservations, routes chosen, open and closed road segments (due to works, accidents, etc. thus adapting dynamically the trip routings), with one set of screens linked to the fleet management, while following the passenger services' incidents and the status and location of the intervention teams in a second set of screens. The two systems, although independent, are linked so that the back-office operator can transfer incidents to intervention teams and turn-on video connection to inspect the incident when possible and under the local legal restrictions.

The public transport services are operating 24/7 with different active vehicles, depending on passenger transport demands. The PTO, being eco-sensible, has defined that the vehicle must have an average occupancy of at least 3 passengers. This of course has implications in the transport delays, especially in off-peak hours, but is fully justified for an optimal and eco-responsible operation. Exceptions are made for people with special needs or when the passenger is ready to pay an additional price.

While at peak-hours the full 340 strong fleet of AVs is in service for public transportation, in the off-peak and night hours part of the fleet is not serving passenger transportation due to the reduced transportation needs. However, because having a vehicle waiting idly is a waste of resources, the PTO has signed an agreement with LaaS providers. During the off-peak hours the unused vehicles are dynamically chartered by the different LaaS providers to be used for other types of incidental transport of goods or even non-public transportation of passengers. Local shops and enterprises use the service, on demand with dynamic reservation, to offer home delivery of online purchases or B2B delivery of goods from an urban consolidation centre to the distribution centre (hub, many to one or one to many) or even transport their VIP customers directly to their offices or exposition centres. This way they can deliver the goods to their customers in the city, with a delay of just 60 minutes with affordable prices, as the last mile is the most inefficient part of the goods delivery chain. The goods send can include books from local bookshops or libraries, supermarket bags, documents exchanged between companies or even waste. The local shops are using the service in the early hours (5am) for re-provisioning their shops for the day. The so chartered AVs are "returned" to the PTO for public transport at the peak-hours automatically, at the end of the chartered time period.

1.3 Preamble – Quality Assurance, Risk Assessment, Ethics & Regulatory issues

WP1 is dedicated in the activities related to the overall project management. ULTIMO maintains a set of management structures with clear responsibilities, while policies and procedures are defined assuring that the consortium members will act in a coordinated way and that the necessary quality levels will be met.

Deliverable D1.4, *Quality Assurance, Risk Assessment, Ethics & Regulatory issues - First version*, presents the initial quality and risk assessment plan for the start of the project, on which the organisation of the project will be built and which will be further refined during the course of the project. The first part - *Quality Management* – contains all procedures for quality assurance that are in place for the ULTIMO project, such as for the preparation of documents or dissemination. Chapter 3, *Risk Management,* describes the implementation of a risk management process will be explained in detail based on its different steps. Finally chapter 4, describes the Ethics and Legal issues and how the project work will be conformant with ethical and legal requirements.

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2 Quality Management

2.1 Purpose and Goal

Quality Management represents a vital activity in the management of projects. The introduction of suitable procedures ensures high quality project results and outcomes, which meet the expectations of the customer and all other stakeholders[1]. Therefore, it makes an important contribution to the overall success of the ULTIMO project. In the following, measures will be presented that ensure the quality of the project. This includes *guidelines for the preparation of documents, deliverables, and disseminations as well as guidelines for quality audits and corrective and preventive actions*.

2.2 Quality Management Roles

All members of the ULTIMO consortium have the responsibility to produce high quality outcomes. Therefore, the quality guidelines and procedures apply to all ULTIMO participants and hence must be followed by everyone.

For the purpose of effective management of quality and risk within ULTIMO, a quality and risk management (QRMB) board is set up. The QRMB board is managed by the Quality and Risk Manager (QRM), who distributes all necessary information and tasks to the board members. Furthermore, the QRM organises online meetings, when required, and face-to-face meetings in urgent situations.

The composition of the board is variable based on the tasks and problems to be solved (see **Error! Reference source not found.**). There are three possible constellations. The basis board always composes of the QRM and the Project Coordinator, who manage all matters around quality and risk. In the second composition there is one additional Work Package Leader (WPL) as part of the board, for example, when risks or deliverables in the respective Work Package need to be reviewed. The third constellation includes all WPLs, which is necessary for the discussion of quality and risk issues concerning the whole project.

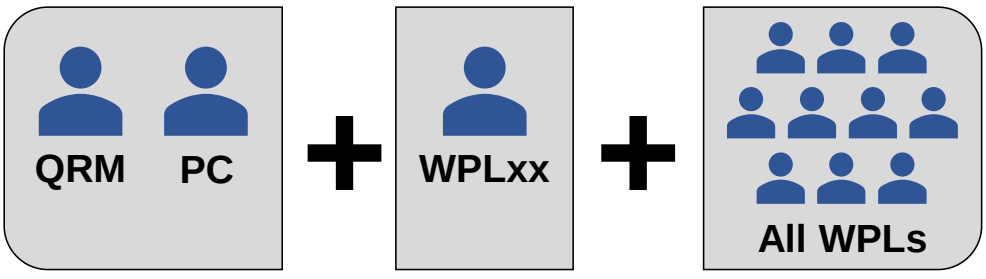

Figure 1 Constellation of the Quality and Risk Management Board

[1] Bea et al. 2008, p. 45.

The tasks of the QRMB include:

- the assurance of the correct implementation of the quality and risk guidelines in all WPs,
- the allocation of deliverable reviews and controls,
- the conduction of quality audits,
- the management of corrective and preventive actions,
- the monitoring of risks with their corresponding countermeasures and if necessary, the remedy of occurring risks,
- and finally, when necessary, the adjustment or introduction of quality and risk procedures.

The QRM together with the QRMB will ensure and check that the quality measures are performed correctly. Furthermore, the QRM is the central contact person for any questions or issues related to quality within the ULTIMO project.

2.3 Preparation of Documents

During the project duration several types of documents and files will be prepared. To make the preparation easier and to ensure a high quality of the documents, the following guidelines must be applied:

2.3.1 Templates

Several templates can be found in the Annex.

This includes: Deliverable Template, Deliverable Review Form, Internal Audit Report, Corrective/Preventive Action Request, Risk Record Template.

Members of the ULTIMO consortium are encouraged to check if suitable templates are available before starting the preparation of files. Additionally, the style sheets of the templates (e.g., heading level X, etc.) should be used.

2.3.2 Naming

To ensure easy and fast identification, documents and files will be labelled according to a consistent approach.

The following structure should be used for all types of documents that will be circulated internally:

YYYYMMDD_TYPE_TITLE_VERSION_WP_PARTNER_STATUS

- YYYYMMDD: Date of the last editing
- TITLE: Informative title
- WORKPACKAGE: Respective work package
- PARTNER: Acronym of the responsible partner
- STATUS: > Draft: work in progress

> Final: ready for submission, publication etc.

- VERSION: Vi.ii → i - for major changes; ii – for slight changes

E.g.: 20221128_D1.4 Quality Assurance, Risk Assessment, Ethics & Regulatory issues - First version_WP1_HSPF_Draft_V1.0

The following structure should be used for all documents that are finalized or/and will be made public: PROJECT_TITLE

E.g.: ULTIMO_D1.4 Quality Assurance, Risk Assessment, Ethics & Regulatory issues - First version

2.3.3 Software and File Formats

In general, the use of Microsoft Office Suite is recommended for the preparation of project files. Moreover, it is vital that the following file formats are used to ensure that everyone can open and edit the files.

- Documents: Microsoft Word – File format: .docx
- Presentations: Microsoft PowerPoint – File format: .pptx
- Spread sheets: Microsoft Excel – File format: .xlsx

All files for dissemination or publication must be saved as a PDF.

The use of another software is only allowed if all the following guidelines are fulfilled:

- Other file editors agree the use of the respective software.
- Other file editors have access to the respective software.
- The final version of the file must be made available as a PDF, so that everyone can open the file.

2.3.4 Email rules

All emails sent to project partners have to use a standardized topic: [ULTIMO]: [WP] …

2.3.5 Storage

The project repository in the share-point by Deutsche Bahn serves as central storage for all project related files. Therefore, a clear folder structure has been generated, which ensures the right allocation of all files. In case a suitable folder cannot be found, the setup of a new folder is possible, but should be done in consultation with the project repository manager (Mr. Andreas Fehr).

All members of the ULTIMO consortium are encouraged to store their files in the project repository to avoid loss of data and to make files available for other members (e.g., for reviews).

2.3.6 Language

All files and documents must be written in English. More specifically, they should be prepared in British English to avoid any confusion when checking the spelling. Therefore, the language in the Microsoft Office Suites should be set to English (UK).

Nevertheless, questionnaires, and documents serving to collect evaluations and information from passengers and users of the ULTIMO services, will be written or translated and adapted to the local language of the users, so that they can be clearly understood (this is very important especially for the consent forms). An English translation can be done when needed.

2.4 Production of Deliverables

All results and outcomes of ULTIMO will be presented in the form of deliverables. Therefore, the preparation and submission of deliverables is a key responsibility within the project. This task will be conducted according to clear rules and a structured process to ensure a high content-related and high formal quality of all deliverables:

2.4.1 General Information

- An overview of all deliverables is included in Annex I – Overview deliverables**Error! Reference source not found.**.
- A leading author (LA) must be determined by the WPL for each deliverable. The LA is responsible for the management of the entire production process.
- The LA prepares the first draft with contribution from several partners of the WP. Hence, the LA needs to identify the contents of the deliverable and allocate the responsibilities to the contributing partners.
- Please refer to 2.3 Preparation of Documents to produce the deliverable, as all guidelines (template, naming etc.) in this chapter must be applied.
- The project repository must be used for sharing deliverables to avoid sending them via email.

2.4.2 Production Process and Scheduling

The production of deliverables is composed of seven steps (see **Error! Reference source not found.**), which will be described in detail below:

1. The LA and the contributing partners prepare the first draft.

2. The LA provides the first draft in share-point in its respective folder (Path: *Deliverables* → *WPxx* → *Dx.x*) and informs the reviewers via email.

3. The assigned partners conduct the first review with use of the review template (see Annex III – Deliverable Review Form). The reviewers focus both on the content and formalities. The reviewers provide the review template and the reviewed draft in share-point.

4. Based on the comments and results of the review the LA prepares a second draft, places it in the project repository and again informs the reviewers.
5. The assigned partners conduct a second review to check whether their comments and corrections have been implemented with respect to content and formalities. The reviewers place the review template and the reviewed draft in the share-point.
6. Based on the results of the review the LA prepares the final version, places it in share-point and informs the PC.
7. The PC conducts a final review, informs the LA whether further improvements were necessary or not and finally submits the deliverable to the EC.

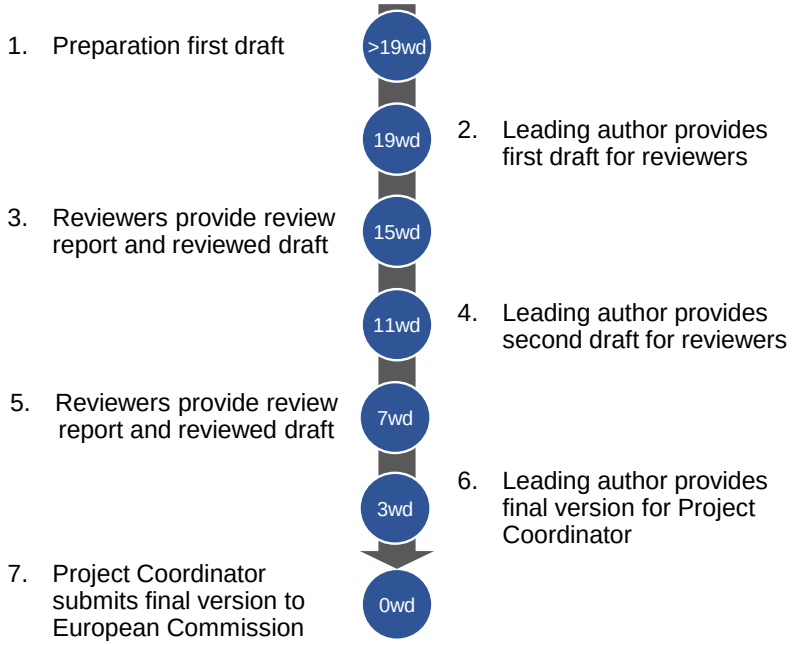

Figure 2 Deliverables Production Process

Numbers are included in the circles of **Error! Reference source not found.Error! Reference source not found.**, which display the day when a step must be taken. Those days only include working days (wd) from Monday to Friday. It is recommended to follow this scheduling, but it is not mandatory. In any case, the LA is responsible for the appropriate production of the deliverable with respect to quality and time.

The preparation of the first draft should be fulfilled four weeks before the submission to the EC. Hence, depending on the effort to produce a deliverable an early start is required (Step 1). Then Step 2 to Step 7 must be completed until the respective working day. **Error! Reference source not found. Error! Reference source not found.**represents a possible timetable according to the recommended scheduling.

October 2022						
Mo	Tu	We	Th	Fr	Sa	Su
31	1	2	3	4	5	6
Step 1			Step 2	Step 3		
			19wd	18wd		
7	8	9	10	11	12	13
Step 3			Step 4			
17wd	16wd	15wd	14wd	13wd		
14	15	16	17	18	19	20
Step 4		Step 5				
12wd	11wd	10wd	9wd	8wd		
21	22	23	24	25	26	27
Step 5	Step 6					
7wd	6wd	5wd	4wd	3wd		
28	29	30				
Step 7						
2wd	1wd	0wd				

Figure 3 Example Scheduling for Deliverables Production

2.5 Dissemination

Any type of dissemination like the external communication with third parties on project matters need to be approved when it contains internal and unpublished information (e.g., in the form of project results or work of a consortium member) about the ULTIMO project. This is necessary to make sure that internal, confidential information will not become public. In addition, it ensures that all disseminations and published information are of appropriate quality. Approval should be obtained from the PC, the QRM and all concerned parties of the ULTIMO consortium.

The dissemination of any project results or information needs to fulfil the regulations of the EC. For that reason, dissemination in any form (document, presentation, etc.) must contain an indication that the project is co-funded by the EU. For this reason, the following emblem must be included:

Co-funded by the European Union

Figure 4 European Union Funding acknowledgment

Furthermore, dissemination must contain a disclaimer excluding the EC. Consequently, the following sentence has to be included:[2]

> Co-funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them.

Furthermore, due to the fact that the project also receives funding from the Swiss Confederation, a statement acknowledging the co-funding will also be included.

Figure 5 Swiss Confederation Funding acknowledgment

2.6 Internal Quality Audits

In special circumstances, such as an occurring problem of major relevance, an internal quality audit can be performed at the respective partners' place. Its purpose is twofold: first, analyse the cause, for example by checking if all guidelines have been applied; second, identify measures for solving the issue and further potentials for improvement.

The audit object can be a process, an activity, a deliverable or something else depending on where the problem occurs.

The audit will be conducted by the PC and the QRM with support from the respective WPL. The QRM will organise and manage the execution of the complete audit. The PC and the QRM will note all findings, the potentials for improvement and the further procedure with the issue in an audit report, which will be distributed to all relevant partners. A template for the audit report is included in Annex IV – Internal Audit Report.

2.7 Corrective and Preventive Actions

In case of inappropriate performance of an ULTIMO partner, other participants can raise their concerns and propose corrective and/or (if required) preventive actions to solve the non-conformance. The goal of corrective actions is to rectify the problem; whereby preventive actions try to avoid problems before they occur.

The form in Annex V – Corrective/Preventive Action Request is provided for the notification of a recognised issue with a partner. The problem should be described in detail and corrective/preventive actions should be proposed. Then the form will be handed over to the QRM, who will notify the consortium member and the respective WPL. Thereupon, the

[2] European Climate, Infrastructure and Environment Executive Agency (CINEA) 2022, p. 37.

concerns and proposed actions will be discussed with all parties involved and concrete corrective and/or preventive actions for solving the issue will be agreed.

3 Risk Management

3.1 Purpose and Goal

Risk management is the act or practice of dealing with risks.[3] As risks affect every project including the ULTIMO project, it is vital to introduce and perform risk management activities. Through the performance of proper risk management, the probability of occurrence and/or the impact of an unfortunate event can be reduced.[4] Hence it is an important management activity to ensure successful project outcomes as well as overall successful project execution. The risk management within ULTIMO will be executed in a structured process composed of five phases, which will be presented in the following sections.

3.2 Necessity and Relevance for ULTIMO

Risk management within ULTIMO plays a major role as the project deals with a technology that entails high risks. Fully automated vehicles are still in development and therefore risks cannot be 100% excluded. The technology attracts a lot of attention world-wide and is often critically viewed. Especially in the case of accidents with automated vehicles, it is most likely that media around the world report about it and the technology could come in for criticism.[5]

Furthermore, occurring risks with respect to the technology (e.g., accidents with harm to passengers) can have a huge negative impact on the whole project and hence endanger the project's success.

3.3 Risk Management Roles

The QRMB is responsible for the overall risk management. Therefore, the QRM organise and structure the execution of the risk management process. The WPLs are responsible for the implementation and the correct conduct of the risk management in their respective WP. In any case, this task requires support of all members of the ULTIMO consortium. In particular, the identification, analysis and response planning of the risks will be conducted by all involved parties. The monitoring and control will be taken over by a responsible person, who will be identified for every risk. The communication of the risks will be carried out under the instructions of the QRM. The PC will also be involved for high risks to support the development of appropriate measures and actions.

[3] Kerzner 2013, p. 876.
[4] Project Management Institute 2013, p. 309.
[5] Vlasic and Boudette 2016.

3.4 Risk Management Process

The following Risk Management Process refers to the approach of the Project Management Institute[6]. It is an iterative process composed of four phases plus the phase of *Communication* (see **Error! Reference source not found.**). The process will be performed continually during the whole project duration and starts with phase 1 *Identification.*

For the execution of phase 1 to 3 an Excel-file (*Risk Submission* template) can be found in share-point. The completed Excel-Sheet must be handed over to the QRM, who will consolidate all the results in a central risk register.

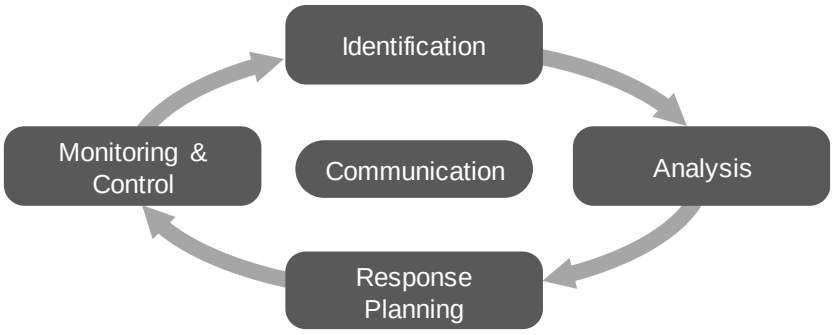

Figure 6 Risk Management Process

Below, a detailed list of all identified risks and countermeasures is presented, which is continuously updated throughout the project and regularly discussed with all partners.

3.4.1 Identification

The target of the first step is to identify and document all risks, which might harm the project. This step is crucial, as only identified risks can be treated. Therefore, it is the responsibility of all members of the ULTIMO consortium to identify risks. During this, task members not only should focus on risks within their WP, but also have a look at other WPs and areas.

Several methods can be applied for the identification of risks. The *Documentation Review* contains the idea to analyse project related documents, which might include indications for risks. For the *Checklist Analysis* lists with risks from past projects will be consulted and controlled whether they contain relevant risks for the current project. Finally, the creativity technique *Brainstorming* could be applied during project meetings for the identification of risks.[7]

[6] Project Management Institute 2013, pp. 309–353.
[7] Project Management Institute 2013, pp. 324–325.

3.4.2 Analysis

The second step is a qualitative analysis of the identified risks. The impact and the probability of occurrence must be determined for each risk.

The scale for the impact is from 1 (very low) to 5 (very high) and for the probability of occurrence from 1 (very unlikely) to 5 (very likely). Afterwards a risk number (RN) will be calculated of the impact multiplied by the probability of occurrence. According to the RN the risks should be ranked and classified as *low*, *medium,* or *high* risks. The following matrix had to be used for the categorisation of the risks.

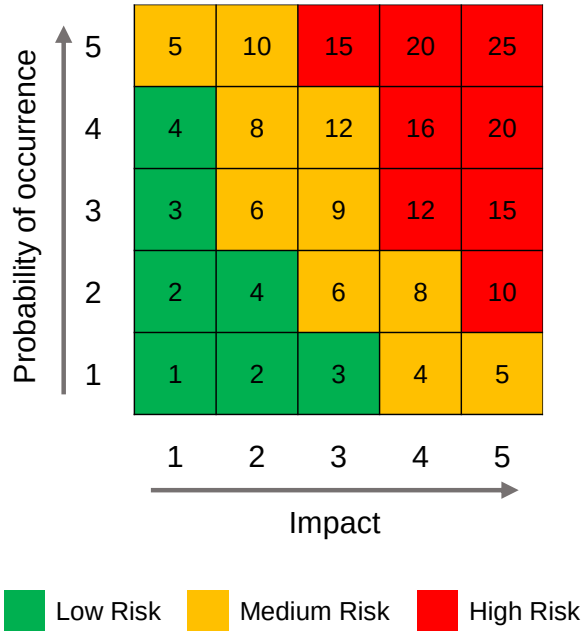

Figure 7 Risk Analysis Matrix

(Source: According to Project Management Institute 2013, p. 331)

3.4.3 Response Planning

Four different strategies to deal with risks can be applied. Those should be used in the following sequence:

- *Avoid* Put measures in place to eliminate the cause of a risk or reduce the probability of occurrence to zero.
- *Mitigate* Put measures in place to reduce the impact and the probability of occurrence of a risk.
- *Transfer* Externalise a risk to third parties (e.g., insurance).
- *Accept* Accept a risk and react when it occurs.

The treatment of the risks will be based on the classification of a risk as high, medium, or low (see **Error! Reference source not found.**). The respective procedures will be explained in the following:

- *High risk*

All risks which are classified as high risks must be described in detail and listed in the risk register. A person must be determined as responsible for the risk. This should be the respective WPL. Moreover, measures on how to deal with the risk must be described in detail including which strategy (*avoid*, *mitigate*, *transfer*, *accept*) will be applied. This should always be done in consultation with the QRM and PC. Also, actions must be described which will be carried out in case the risk occurs. An immediate meeting of the QRMB will be organised for an occurring high risk including the responsible person (WPL), the QRM and the PC.

- *Medium risk*

All risks which are classified as medium risks must be described in detail and listed in the risk register. A person must be determined as responsible for the risk. This should either be the respective WPL or a WP member. Moreover, measures on how to deal with the risk must be described in detail including which strategy (*avoid*, *mitigate, transfer*, *accept*) will be applied. Also, actions must be described which will be carried out in case the risk occurs. An immediate meeting of the QRMB will be organised for an occurring high risk including the responsible person (WPL), the QRM and the PC.

- *Low Risk*

All risks which are classified as low risks must be described in detail and listed in the risk register. A person must be determined as responsible for the risk. This should be the person who identified the risk. Measures need not but can be put in place. If the risk occurs the responsible person must take suitable actions.

3.4.4 Monitoring and Control

This phase includes the implementation of the defined measures for the risks and their continuous control by the respective responsible person. Furthermore, the probability of occurrence and the impact must be assessed again in defined periods, especially for the high and medium risks.

3.4.5 Communication

It is important to communicate the existing risks continuously during the whole project duration!

Communication raises awareness for the issue of risk management and leads as a result to the reduction of risks. Therefore, the risk topic must be discussed in a meeting, which will take place every 6 months and will be organised by the QRM. Moreover, the QRM will distribute a

risk report on a regular basis. In case of ambiguities or questions the QRM can be contacted and asked for advice.

3.5 List of Identified Risks[8]

ID	Description of risk	Category	Prob. of occur-rence	Impact	Priority	Countermeasures
1	Disputes over ownership of IPR amongst consortium partners.	Organisational	2	3	medium	**Avoid:** Standard IPR and access rights clauses will be included in the consortium agreement, which will be signed before work starts to avoid future disputes. Moreover, the consortium has already discussed internally these aspects during the proposal preparation phase to avoid problems.
2	A critical scenario (or several) is described by WP2 or WP3, and measures are not taken to mitigate the risks for users in the study.	Organisational	3	3	medium	**Mitigate:** Strong involvement of the coordination to apply the due measures.
3	A critical scenario is overlooked both by WP2 or WP3 or operators, which may result in severe incident / accident.	Organisational	2	3	medium	**Avoid:** Make available all critical scenario proposals to collaborators in case further input can be considered into the scenarios. Strong involvement of coordination to remind operators that WP6 can't be held responsible for the safety of their own site, and therefore, might not identify/model each threat.
4	Key staff illness/leave the team during the project duration.	Organisational	3	3	medium	**Mitigate:** All partners have experienced staff that may replace and take over the work assigned to the leaving member, either temporarily or permanently. We share all documents the same place, do accurate minutes after each meeting and mark all e-mails with ULTIMO making them easy to find and send to new project members.
5	Missing change management system or process.	Organisational	2	2	low	**Avoid:** Implement change management to respond to emerging problems or new insights. However, the change management should only be used when it is really needed. Subsequent changes are expensive and may involve new risks for other parts of

[8] The list represents the result of all consortium members involved in the risk management.

						the project that need to be re-clarified.
6	Open decisions can delay the course of the project unless clear deadlines and decision-making rules are defined.	Organisational	3	3	medium	**Avoid:** Define responsibilities and powers early and publicise them.
7	Key project technology partner ceases operations	Organisational	2	2	low	**Mitigate**: Any of the key partners can go out of business, and each holds know-how on central project technology. In this case, the project will be able to incorporate a new partner in the project that has developed a similar replacement of tools/product/services.
8	Unavailability of requested shuttle design safety analysis.	Organisational	4	4	high	**Avoid**:
9	Unavailability of standard shuttle behaviour models to evaluate risk coming from unpredicted situations or deviated human behaviours.	Organisational	4	4	high	**Avoid:** Implication of NAVYA simulation specialists in the project. Query intermediate milestones to determine a lack of time as quickly as possible. Currently, there are no standards to evaluate autonomous driving. It is a point to be integrated in recommendations: to develop a regulatory framework and standards to assess AD.
10	The results and/or methods of the scientific assessments within WP6 are challenged or impeached by stakeholders and/or academic peers which leads to reputation losses.	Organisational	3	4	high	**Avoid:** Document all research methods and results transparently; ensure that all research activities within WP6 follow the state of the art of the respective research methods and are executed neutral and unbiased; apply internal and external review of methods and results.
11	Insufficient feedback collected for evaluation studies during the demonstration phase.	Project Environment	3	3	medium	**Avoid:** Throughout the project a continuous evaluation process is established, which will iteratively refine itself to accommodate deficiencies detected during the demonstration phase.

12	Unable to create public awareness, user acceptance and external interest. Non-sufficient and/or immature development of business commercialisation strategies. Also, no interest among cities of becoming members of the ULTIMO.	Project Environment	3	3	medium	**Mitigate:** There are dedicated tasks concerning dissemination (e.g., publications, workshop, press releases and newsletters), exploitation and execution planning. Effort will be committed into defining the target domains and markets through cost benefits and effectiveness analysis. Involvement of stakeholders through broad project planning in several countries in business, science, and society. Before initiating activities to have city-members, a minimum of five "replication cities" will be consulted to identify, how to become attractive for network membership – and cooperation will be established with existing networks to obtain synergies effects. WP2 assessment and requirements analysis will greatly reduce the chance that uninteresting services for the wide public will be picked.
13	Different in-out of vehicle services are needed in the different sites due to different legislation, different users, and different strategies amongst the operators - making it difficult to build something that makes sense across the different sites.	Project Environment	3	3	medium	**Mitigate:** We agree on the evaluation criteria for the services - and perhaps even percent weight of each criterion - making sure that we end up selecting and developing the most relevant services.
14	Low social acceptance: uncertainty and fear of citizens against autonomous driving due to accident occurrences, endangers working places, etc.	Project Environment	2	4	medium	**Avoid:** Inform the users about the convenience of the transport system and the safety measures taken. Advertise with the (positive) tests in other cities. Transparency also helps to win the trust of the citizens.

15	Legal barriers: Not obtaining operating authorizations: A federal, district or municipal office refuses to authorize a specific route or to allow the vehicle. Consequently, the project will not be able to perform the planned demonstrations and evaluations at the selected site. Similar, changes in regulations, application of standardisation and maintenance of policies can delay or prevent the implementation into the demonstrators.	Project Environment	2	3	medium	**Avoid:** Clarify requirements of the authorisation process early and identify regional bodies to be involved. Decide very early on the urban deployment area and the corresponding infrastructure to be used. Identify other demonstrator regions where a continuous operation trial can be performed (fall-back scenario). In addition, the WP2 and WP3 and especially WP5 ensure the cooperation with relevant authorities from the start of the project and guarantee early adoption of legislations, regulations, standardisation, and policies. In collaboration with the public authorities adapt the operation of the services, according to their requirements, so that the required authorizations can be granted. Alternatively, "replication cities" that have expressed interest could replace the original intended location.
16	Complex road situation due to bad weather and snow, as consequence, potential risks related to safety components fail, e.g., sensors fail and risks of incident/accident and unforeseen situations.	Project Environment	3	5	high	**Mitigate:** Possibly introduction of a central system that notifies the vehicles of the weather conditions and adjusts the speed. And use multiple identical sensors to verify results and continue to ensure full functionality in the event of sensor failure.
17	It might be complicated to harmonize interests between all public transport providers.	Project Environment	2	2	low	**Mitigate:** WP2, WP3 and WP5 and coordinated meetings with public transport companies (TPG, Ruter, DB Regio Bus) will ensure picking the appropriate subset of all available services that are of interest for all the actors involved.
18	Site demonstrators' location areas change due to unexpected administrative, legal, resource reallocation or technical limitations issues.	Project Environment	2	4	medium	**Avoid:** Preparation and planning of site demonstrators' execution location areas is already defined before the start of the project. Also, several demonstrator regions will be identified and evaluated as fall-back scenarios.

19	Country-specific legislation might prevent some of the envisioned services (i.e., GDPR, special requirements/ rules for data collection, etc.).	Project Environment	2	3	medium	**Avoid:** Data should be treated according to legislation and properly anonymised so collecting and using it poses no problem from a legal point of view. A potential solution can be to process the information locally and not transmit it.
20	Country completely bans the operation of autonomous vehicles.	Project Environment	2	4	medium	**Avoid:** Dedicated tasks to cooperate with local authorities in each country. In the unlikely event of this particular situation materialising, "replication cities" that have expressed interest could replace the original non-viable pilot.
21	Cross-countries and cross development environments can result in hard integration and bad quality of achievements.	Project Environment	3	3	medium	**Mitigate:** Integration and deployment will require considerable efforts. The project has established a strong PGA to monitor in real time any potential deviation, and if necessary, all smart actions are perfectly scalable – allowing as last resource a downgrade on the expectations per task.
22	Resistance, protest or even obstruction of stakeholders like employees of the public transport system.	Project Environment	3	3	medium	**Mitigate:** Inform the employees that they will be integrated in the new system and get e.g., adapted training course. Constant dialogue, exchange, and feedback with employees to avoid/mitigate the negative impacts on job lost and to plan a job transition.
23	Unsatisfactory user requirements collection that can influence the system specification and appropriate development models.	Project Environment	2	3	medium	**Mitigate:** ULTIMO intends to use only approved user requirements collection and analysis techniques for efficient collection and documentation. In addition, an agile development methodology will be used during development and integration stages of the ULTIMO services to ensure the involvement of the end-users throughout full lifetime of the project.
24	End users (drivers, cities, fleet operators) find systems too time consuming.	Project Environment	3	2	medium	**Mitigate:** Where possible, totally automate functionality so that fleet operators' action is not needed.
25	The acceptance is too low due to low speed (like Bad Birnbach Project in Bad Birnbach, Germany).	Project Environment	4	4	high	**Mitigate:** Explain the necessity of safety and improve the technology to rise the speed and the acceptance.

26	Conflicts and misunderstandings in the project due to different professional backgrounds and countries.	Project Management	3	3	medium	**Mitigate:** Adaptation to the value systems and norms of each culture for the benefit of ALL. Respect and interest are key elements for a successful relationship: accept differences, be open minded, avoid harmful speech, be patient, aim at understanding, be patient, reliability.
27	Bad or missing communication; affected persons are not informed.	Project Management	2	2	low	**Avoid:** Every two weeks a standard meeting between the involved parties to clarify progress, emerging issues, and open questions. General Meeting are key moments to clarify open questions and conflict points.
28	If the delimination for the SoA work is not made very clear, we risk having a very broad analysis, making it difficult to agree on what our key focus area now and later on.	Project Management	2	3	medium	**Avoid:** WP2 and WP3 group will discuss a delimination and agree on this with the PM + potentially the rest of the consortium.
29	The quantity of potential safety threats is too important to be able to thoroughly model all critical scenarios and propose mitigation measures, given the resources available in WP2 and WP3.	Project Management	3	3	medium	**Mitigate:** Strong involvement of coordination to remind operators that WP6 can't be held responsible for the safety of their own site, and therefore, might not identify/model each threat.
30	Overestimation of the safety-related goals in the project. Potentially, contradiction between what is being advertised/promised and the feasible results.	Project Management	4	4	high	**Mitigate:** Caution in official statements/publications. To this end, strong implication of all partners and due consideration of all the contributions.
31	Failure to meet initial requirements. This could lead to the delays in the delivery and limited functionality on pilot sites installations.	Project Management	3	3	medium	**Avoid:** The consortium employs an iterative development and integration approach to ensure clear comprehensive and formal documentation of the user requirements. The use of modern tools for specification, design, development and integration specification and progress traceability will ensure the compliance with the initial requirements.
32	Poor confidence between partners, consortium has no harmony	Project Management	2	3	medium	**Mitigate:** The PC will continuously be in contact with all partners. This guarantees that any team problems are identified and solved before they escalate.

33	Poor quality of deliverables and delay in meeting the deadlines.	Project Management	2	3	medium	**Mitigate:** The TIM will provide templates and guidelines documented in a project management handbook for all significant items. Proper internal peer review procedures will be in place, to ensure quality of the deliverables and their preparation in a timely manner. Regular technical meetings will be held to ensure that activities are streamlined and that lessons learnt are shared.
34	Time and project management: potential risk concerning that the project has underestimated the effort and means required for its implementation (finding unforeseen problems during the project)	Project Management	3	3	medium	**Mitigate:** Time planning with milestones to compare the actual project progress with the planned one. In the event of a time difference, the project manager or WP supervisor should clarify the reasons and, if necessary, initiate countermeasures. Past experience should be included, and any risk times added.
35	Inaccurate selection of transport, in- and out-vehicle services due to prioritisation strategy, feasibility analysis and unforeseen dependencies.	Technical	2	4	medium	**Avoid:** A full work package is dedicated to the correct assessment and in-depth analysis of the automated transport ecosystem, ranging from end-user requirements analysis up to regulatory constraints. In addition, another work package is ensuring that the collected and evaluated feedback is soundly integrated into the refinements of the services deployed in the demonstrators.
36	In-vehicle / Out-of-vehicle data unavailable and therefore impediment to thoroughly model critical scenarios and propose mitigation measures.	Technical	3	3	medium	**Avoid:** Early interaction between NAVYA and SENSIBLE4 and operators for all four demonstrators.
37	Delayed or failed updates and integration into the running demonstrators due to last-minute equipment failures or lack of interest of end-users.	Technical	2	3	medium	**Mitigate:** The long-term demonstrator deployments foreseen in this project will provide us with a sufficient time frame to address the problematics. WP2 and WP3 in turn will provide additional evaluation on safety critical performance of the vehicles and integrated services. It is key to create awareness and stimulate involvement of as many external parties as possible.

38	Technological feasibility might prevent some of the envisioned services.	Technical	3	3	medium	**Avoid:** WP2, WP3, WP5 and coordinated meetings with public transport companies (TPG, Ruter, DB Regio Bus), Navya and SENSIBLE4 will ensure that services picked will be of interest and technically feasible.
39	Integration and interoperability problems with the APIs and existing platforms of the different transport providers.	Technical	3	3	medium	**Avoid:** A task of WP3 is fully dedicated to deal with integration of the different services with the APIs and existing platforms of public transport companies.
40	Vehicles used in the pilot breaks down for other reasons and cannot continue.	Technical	3	2	medium	**Mitigate:** Identify early during the project back-up vehicles or service alternatives in case no vehicles are available. The vehicles are insured and will be repaired, nonetheless, the service might be interrupted for a short time.
41	Technical problems create an interruption in the operational phase.	Technical	3	3	medium	**Avoid:** Find a solution during the implementation phase on how to handle this. Design for stability: put extra effort into the local adaptation phase and use extensive document and code reviews. Prepare a small-scale trial of the functionalities to verify functionalities prior to start of the operation.
42	Vehicles are not integrated properly to the ULTIMO platform and not behave accordingly.	Technical	3	3	medium	**Avoid:** Ensure that vehicles use the agreed protocol to communicate their telemetry data and receive missions from the ULTIMO platform.
43	Integration with third party systems becomes too complex and time consuming.	Technical	2	3	medium	**Mitigate:** Ensure that all integration efforts and specifications are clear and available from the beginning of the task. The ULTIMO platform should also try as it best to use standardised protocols for interfacing with 3rd party systems
44	Cyber attack	Technical	2	4	medium	**Mitigate:** Develop a technical strategy to prevent cyber-attacks.
45	The project is based on an innovative technology. However, this technology is still in the development phase. The risk of occurrence of technical problems during implementation is therefore higher than for daily projects.	Technical	3	2	medium	**Accept:** Progressive ramp-up: A certain scope of action should be considered in order that the performance of the vehicle is not optimally used from the beginning.

47	Accident which are occurring during the driving or testing of the autonomous vehicle.	Technical	2	3	medium	**Avoid:** Staff who accompany the vehicles should be properly trained. Disturbance factors along the travelled routes should be removed as far as possible.
49	Unavailability or lack of data to develop the required algorithms that set the base for the implementation of the vehicle as well as other ULTIMO services.	Technical	3	4	high	**Avoid:** The consortium employs an iterative development and integration approach to ensure clear comprehensive and formal documentation of the data to be utilised, exchanged, and stored. Early awareness of the data importance within the consortium will be employed to provide the required datasets.
50	Unavailability of additional PC into the vehicles may cause delays to the development of services, integration activities as well as the planned demonstrations and evaluations at the selected site.	Technical	2	4	medium	**Avoid:** The consortium employs an iterative development and integration approach to ensure on-time hardware and software implementation and delivery. Vehicle and system architectures are defined at the early stages of the project to allow enough time for implementation.
51	Unavailability of upgrading the operators' vehicles due to high cost.	Technical	3	4	high	**Avoid:** The early definition of vehicle and system architecture ensures the minimization of upgrade cost for the operators.
52	Cyber-security implementations can be depreciated fast due to the emerging evolution of this field.	Technical	3	3	medium	**Mitigate:** State-of-the-art cyber-security techniques and countermeasures will be employed to ensure sustainability of the approach for a long period.
53	GPS transmission fails. Normal safety procedure 1) radio transmission, 2) 3G/4G transmission, 3) Odometries + 3D mapping.	Technical	5	3	high	**Mitigate:** In case no radio transmission (should be default setting): reduce speed and continue with 3G/4G transmission. In case option 1 & 2 fail: reduce speed and return to depot.
54	Unclear responsibilities of risks - counter measures are not in place or only in paper	Project Management	3	3	medium	**Mitigate:** each person responsible for a particular risk should put countermeasures in place.
55	Safety of passengers in bus during an accident	Technical	2	3	medium	**Avoid:** safety and impact studies _ WP2 and WP3_ should focus on the persons inside the shuttle.
56	Data availability: context in which legal authorities request data which are not available. E.g., registering the video for a few days (as it is done today) to respond to	Technical	2	3	medium	**Avoid:** data registration and storage for few months.

	legal requests by the police.					
57	Current sample sizes for the zero measurement of social impact (changes in behaviour, acceptance etc.) are too small to achieve a high data quality in the sense of representative and reliable data. Requires additional finances to ensure representative samples.	Project management	3	4	low	**Avoid:** PTOs must ensure that the representative zero measurement is spread even further (e.g., Facebook campaign, websites, purchasing samples from online agencies) to significantly increase the current sample size. Hence, finances to ensure a representative sample are necessary.
58	Interruptions of general activities in the project and the pilot tests due to the Coronavirus pandemic (Covid-19). Delays in the project, the re-start of activities can take time, impacts on the results, potential impacts on the e-minibus usability/acceptance and so forth.	Project Environment	3	5	medium	**Mitigate:** The project activities that are not affected or less affected might keep running via home office/telework. WP's activities that are very affected are recommended to do a re-planning considering the interruption period and communicate changes through the WP's monthly meeting and during the General Meeting.
59	Consequences and Impacts Coronavirus: it can trigger behavioural change towards mobility preferences, people would prefer to use private cars to be more isolated and have less risk to be infected by coronavirus	Project Environment	1	5	medium	**Mitigate:** such changes could be reflected and analysed through the social surveys being implemented. Therefore, the idea is to monitor if the intentions to use and usability of the e-minibus will change before and after the Coronavirus. Additional questions have been added to the several surveys
60	Conducting social surveys (representative at city level, representative at local level & user survey) is delayed up to 3 months after resume of operational activities.	Project Environment	3	5	Medium	**Mitigate:** Start conducting social surveys as soon as operational activities are resumed. We shortened the waiting time between zero measurement and control measurement (from 1 year to 6 months). This will result in a delay of approximately 3 months.
61	COVID-19 crisis: all deployment sites are suspended for long periods due to health safety issues	Project Environment	3	5	high	**Mitigate:** For 3 to 4 months suspension, we will be able to catch up the demonstrators within the project duration. For the new routes we will start the operation of the vehicles with no passengers, creating fictitious reservations and validating the route. For longer periods

						we will need to have project extension for the collections of the required data.
62	COVID-19 travel restrictions: Travel is not possible for on-site project work and specifically road mapping for the new sites or changes at sites.	Project Environment	3	5	high	**Mitigate:** We will continue operating at the parts that have already mapped or test the related interfaces and software via the existing simulators.
63	COVID-19: travel restrictions do not allow for physical meetings to take place	Project Environment	3	5	high	**Mitigate:** We will be using video conference systems for meetings, adapting the meeting format as required.
64	Bankruptcy risk from ULTIMO partners, for instance tech companies and start-ups.	Project Environment	3	5	Medium	**Mitigate**: find a replacement for the bankrupt partner, exchange of know-how and project learnings
65	Not being able to completely remove safety drivers within 2 years	Project Environment	3	3	Medium	**Mitigate:** Start testing early, review governmental regulations, try "easy" routes first, have a bulletproof safety plan for when personal assistance is needed (e.g., someone must be in a 10min radius to reach the AV at any time)
66	Not knowing how to use what data so that is serves the public and general interest and confusing public and private data	Organisational	3	2	Medium	**Mitigate:** Define at an early stage what data will be public and what private, get permissions, review according to data security laws

Table 2: Identified Risks

Following to the list of identified risks, Figure 8 illustrates the risk distribution per risk priority and Figure 9 the risk distribution per probability of occurrence and impact.

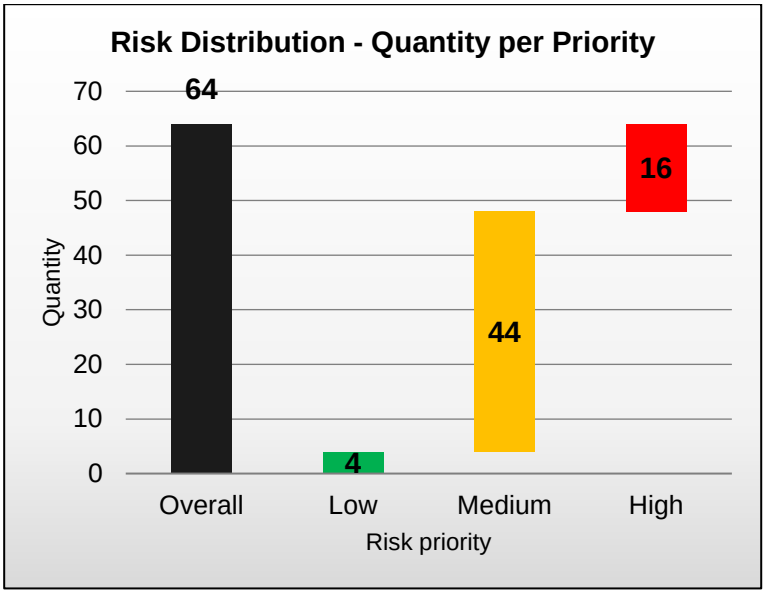

Figure 8: Risk distribution per risk priority: low, medium, and high

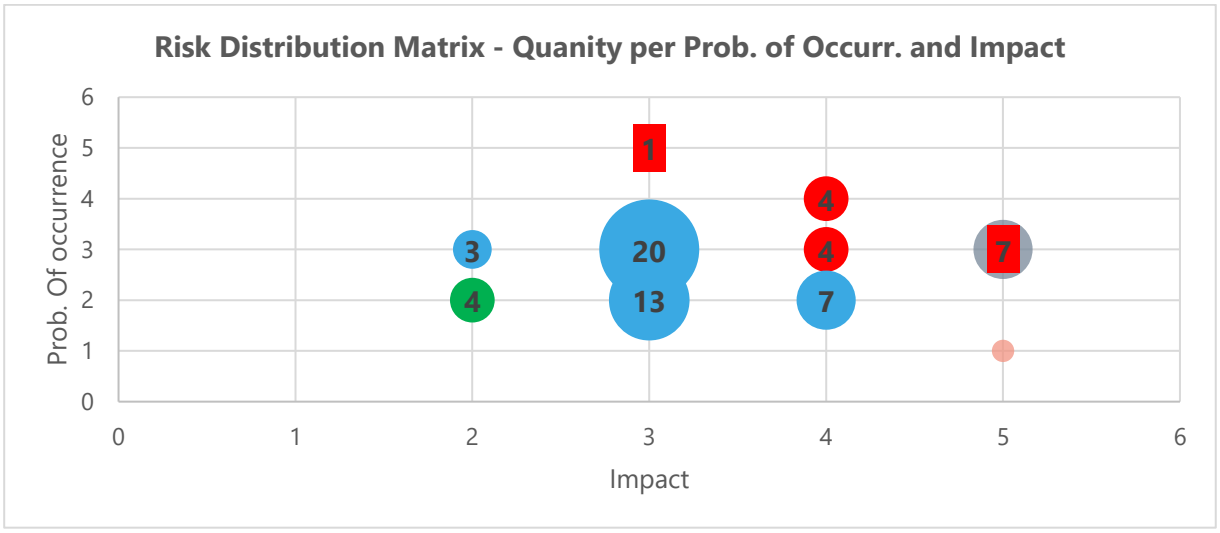

Figure 9: Risk distribution per probability of occurrence and impact

4 Ethics and Security

There is a long list of innovative digital solutions failing to be adopted by the intended users because they do not meet the appropriate ethical requirements that could support users' engagement and, ultimately, market uptake. ULTIMO, in line with the strategic plan defined by the EC for the safe, resilient transport and smart mobility cluster, has taken all necessary measures to ensure the secure and ethical development of the proposed platform, as well as of the respective integration of the existing policies and systems. The ULTIMO solutions place the end-users at the centre by considering all relevant ethical aspects related to safeguarding the rights of those potentially impacted, including data privacy, security, and autonomy. Understanding the responsibilities and risks that accompany the adoption of novel CCAM technologies in the automated driving domain, the inclusion of SSH expertise in the consortium was deemed necessary for reaching the objectives of the project, as well as for

increasing the impact and relevance of the project's results in the long run. To this end, since the early stages of the proposal preparation, STEM and SSH disciplines have been working together to make sure that the ULTIMO solution will be designed in a way that will reflect the actual needs and expectations of the end-users, and all issues of ethical, legal, and regulatory nature will be effectively addressed in a timely manner. In this context, the present document aims to identify legal and ethical issues that the proposed user-centric business models, namely MaaS for public transportation and LaaS for urban goods transportation, may pose. More specifically, the user-centric approach requires the consortium to focus on the potential adverse impact of the project on the interests of the key stakeholders namely, end-users, transport workers, public and private transport operators or even new mobility players (micromobility operators, technology provider, gatekeeper, etc.) . For the purpose of identifying effectively the applicable legal requirements and the relevant ethical considerations, it is of key significance to identify beforehand the interests of the key stakeholders, the respective interactions and the links between these stakeholders and the stakeholder qualifications. In that regard, this chapter identifies certain ethical and legal issues based on potential impact of the ULTIMO project on the key stakeholders. It is aimed that the identified ethical and legal issues will be taken into account by the consortium at an early project stage, therefore, allowing for the implementation of appropriate measure to mitigate for the occurrence of the related risks ahead of time.

4.1 Ethical and Legal Issues

Given that ULTIMO aims to introduce scalable business models based on user-centric CCAM and to complete the digital transformation of transportation in a way that is healthier, safer, more accessible, sustainable, cost-effective and demand-responsive, special attention needs to be given to both functionals and non-functional requirements that could affect people acting in different personas. Therefore, it is intended that ULTIMO ensures that key digital enablers such as electronic components for mobility, network infrastructure, cloud-to-edge resources, data technologies including mobility data space, will be adopted in the project in a legal, ethical, and trustworthy manner, hence, contributing to their sustainability. Taking into account, though, the intertwined nature of the intelligent urban mobility and logistic ecosystems offered by ULTIMO, it's hard to draw a strict line between the respective ethical and the legal implications. It is, thus, useful to adopt a holistic approach considering all elements that could have legal and ethical implication on the Citizen-Centric Connected, Cooperative, and Automated Mobility and Logistic Ecosystem envisioned by ULTIMO.

Figure 10 Ethical and Legal Elements in Citizen-Centric Connected, Cooperative, and Automated Mobility & Logistic Ecosystem

In light of these elements and of the varying interests and values of the key stakeholders, the most relevant ethical and legal issues are identified below . Note that by identifying the ethical and legal issues posed by the envisaged ULTIMO MaaS and LaaS, this deliverable also aims to pave the way for the development of the ethics manual and the risk assessment guidance to be provided under deliverables D1.5 - Quality Assurance, Risk Assessment, Ethics & Regulatory issues - Intermediate Version and D1.6 - Quality Assurance, Risk Assessment, Ethics & Regulatory issues – Final Version due at a later project stage.

4.1.1 Privacy and Protection of Personal Data

Given that the ULTIMO project uses autonomous driving technology in connected MaaS and LaaS ecosystem, a mass amount of personal data of individuals needs to be processed for the provision of the services. However, this may lead to a number of privacy and data protection concerns from two perspectives, passengers/users' and bystanders' perspectives.

4.1.1.1 Passenger Perspective

In public transportation domain, individuals usually have low expectations for privacy. For instance, once an individual gets on a public bus, a metro or a tram, they are mostly aware of the fact that they are under camera surveillance with the recording of sound by PTOs for security purposes. Moreover, as they are in public space, they know that their actions are likely to be watched by other passengers too. While the privacy expectations are rather low, it could be argued, though, that the passenger of the traditional public transportation may have ''more'' privacy compared to those using on-demand and door-to-door mobility services. For example, in traditional public transportation, the personal information disclosed to PTOs

or to public in general is limited such as the locations of the stops that the passengers get on/off the vehicle concerned. On the other hand, the ULTIMO on-demand door-to-door mobility service, by default, processes more data about a passenger which could disclose and give insight into the private life of that individual. This processing may provide information about a user of when, where, and how a user travels over a period of time and disclose the owner or passengers' information on where they live, work, frequent stores and healthcare professionals they visit, which religion temple they go to. This may eventually disclose sensitive information about those passengers, which would require a higher level of protection.

More importantly, the processing of such an amount of data for the provision of public transportation which is a basic need as well as right of the citizens could be also considered problematic from both ethical and data protection law perspectives. It is evident that there will be power imbalance between the passenger who needs to have budget friendly mobility service and the service providers. The passenger not having any mobility alternative apart from public transportation will be in significantly weaker position compared to the service provider, thus, possibly creating an impact for the protection of passenger's privacy.

The privacy related legal issues are likely to arise from the compliance with the EU General Data Protection Regulation (GDPR)[9]. Since CCAM technologies rely on processing of a large amount of raw data to measure and identify the needs of passengers or customers to provide integrated door-to-door mobility or logistic services, the PTOs as service providers will be required to ensure the compliance of all personal data processing operations with the GDPR. However, in such a complex ecosystem where a number of different actors plays significant role in the provision of the service, the compliance with certain GDPR requirements including the designation of data protection roles, the data minimisation and transparency requirements might be, in reality, quite challenging.

4.1.1.2 Bystander Perspective

In the connected and automated mobility domain, personal data of the non-passenger bystanders i.e., pedestrians walking outside the vehicle and other traffic participants are also processed with very limited possibilities to offer them meaningful notice and choice about data processing practices. This ubiquitous nature of capturing data in public further complicates the compliance with the GDPR, possibly, entailing ethical and legal implications. For instance, in such an ecosystem where a vast amount of data is being collected for the provision of mobility or logistic service through automated means, the principle of data minimization which requires only collection of personal data relevant, adequate, and not excessive with regard to the specific purposes of processing, constitutes a challenge.

[9] Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC(General Data Protection Regulation) OJ L 119, available at: https://eur-lex.europa.eu/eli/reg/2016/679/oj.

4.1.2 Safety Considerations

Safety is the main prerequisite for any transportation systems that operates in public roads. The safety of traditional transportation systems is generally assessed in accordance with the technical aspects of vehicles used in the system and the skills of the human operators. On the other hand, with respect to the safety of connected and automated transportation systems special emphasis should be placed not only on the technical specifications of hardware used in the systems, but also on cybersecurity. In other words, ensuring appropriate level of security in cyber space is crucial for providing overall safety of the system; the hyperconnected nature of the intelligent transportation systems and their dependencies on software and data for the execution of the vital operations may create several vulnerabilities to cyber incidents. For instance, malicious actors could disable networks, range sensors and cameras and cause multiple collisions or they could reroute hacked vehicles to an area where an organised crime is planned or occurs. In addition, an autonomous vehicle's operating system could be hacked, exposing personal information on other connected devices such as payment details of users stored on their mobile devices. Moreover, the lack of common cybersecurity standards and certification scheme for AI systems and Internet of Things (IoT) make very difficult for PTOs to vet the security of the systems. Particularly, within such an intertwined ecosystem, the reliance on third-party products and services challenges PTOs to ensure the overall safety of their MaaS and LaaS offerings.

4.1.3 Disruptive Impact on Transportation Sector

It is evident that the ULTIMO services will probably have disruptive impact on other commercial actors in transportation sector such as private transport operators, car rental agencies, leasing companies, taxi services etc.. For instance, offering on-demand door-to-door mobility as part of public transportation may impair the commercial activities of private transportation businesses. Moreover, offering intelligent mobility and/or logistics as a part of public transportation service is likely to strengthen the dominant position of PTOs in overall transportation sector. As the offered services are both more flexible, due to the smaller sizes of the vehicles and to its possibility to drive 'on demand', and in a more cost-effective manner with less personnel costs, it may consequently affect the competition in the private transportation and delivery sectors. Note that issues relating, also, to the evaluation of the economic implications of integrating AV in a transport system will be addressed extensively under WP6 – All impact evaluation and transformation towards an AV in ITS/ CCAM ecosystem.

4.1.4 Lack of Accountability as a Form of Responsibility

Accountability is one of the key legal and ethical duties. In moral interactions, it is essential that someone can be held responsible for their own actions. This means that a party should be in position to explain and give an account for its decisions and actions. Accountability in automated technologies requires explainability as to how and why decisions are taken, how algorithms and codes are programmed. However, the opacity of AI processes and the complex socio-technical nature of intelligent public mobility and logistics create legal and organizational black boxes, that is legal and organizational frameworks that do not sufficiently

allow for- or promote the exchange of meaningful explanations between relevant stakeholders.[10]

The European Commission's Expert Group on Connected and Automated Vehicles further note that even if the AI system used in vehicle is explainable, there is still a need to address the opacity, complexity and interactivity of whole ecosystem. Otherwise, it may lead to responsibility and culpability gaps. For example, in socio-technical systems involving AI, it becomes challenging to identify which one of the stakeholders, e.g., vehicle manufacturers, suppliers, software developers and mobility service providers, is responsible and how to enforce individual responsibilities when something is damaged, or someone is injured or killed in a crash due to an unjustifiable and inexcusable mistake of some human actor.[11] To be accountable for the actions, each of organisations, companies, networks and services involved in the system should have at least one person along the chain of design, development, control, regulation, and use who has sufficient power, knowledge, and expertise about the system and sufficient moral awareness of his role as a potential target of moral, social or legal requests of explanation in the case of misbehaviour of the systems.[12]

4.1.5 Social Exclusion of Certain Population Groups

Making mobility fair, just and inclusive for all has foremost importance in intelligent public transportation. In line with the European Commission Action Plan on Sustainable and Smart Mobility Strategy, this does not only requires making intelligent public transportation affordable for people with low disposable income but also sufficiently accessible for people with disabilities or reduced mobility, and for those with low IT-literacy. [13]

Furthermore, ULTIMO's impact on the transport workers who work for urban mobility and logistic services such as taxi, tram and bus drivers, gig workers such as delivery workers should also be taken into account in the assessment of ethical and legal issues. Their skills will be no longer needed and thus their jobs will be at risk. Moreover, other supplementary jobs in the transport sector, especially low- and medium-skilled jobs, may be at risk due to automation and moves towards greater sustainability.[14]

[10] Santoni de Sio, Filippo, the European Commission report on ethics of connected and automated vehicles and the future of ethics of transportation, Ethics and Information Technology 23, 713–726 (2021). https://doi.org/10.1007/s10676-021-09609-8

[11] Expert Group on Connected and Automated Vehicles, Ethics of connected and automated vehicles Recommendations on road safety, privacy, fairness, explainability and responsibility, 17 September 2020.

[12] Ibid.

[13] European Commission, Sustainable and Smart Mobility Strategy' together with an Action Plan, COM/2020/789, available at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020DC0789, European Commission, Study on the social dimension of the future EU transport system regarding users and passengers, August 2022.

[14] European Commission, A European strategy on Cooperative Intelligent Transport Systems, a milestone towards cooperative, connected and automated mobility, 2016.

4.1.6 Data Connectivity and Interoperability

On demand intelligent mobility and logistic services rely on a number of data sources; the vehicles' on-board sensors, mobile devices of the end-users where requests are made, information from other vehicles and the physical and digital infrastructure of the road. In this ecosystem, data connectivity and automation are not only complementary technologies but also, they reinforce each other. Data connectivity refers to data sharing amongst AVs and between AVs and infrastructure including digital service platforms, between the end-user's mobile device and the vehicle.[15] This connectivity is very crucial for the whole system operates as intended.

Data connectivity requires interoperable systems and business processes where digital systems and processes have the capacity to exchange real-time data and to share aggregated data and knowledge between each other. It is critical to have open, standard interfaces to ensure efficient data exchange, inter alia so that messages sent between vehicles and infrastructure can be transmitted independently from the underlying communications technology.[16] Ensuring the interoperability in transportation system would remove potential market entry barriers, ensure balanced win-win situations among all stakeholders and thus facilitate democratization of the intelligent MaaS and LaaS ecosystems.

However, the lack of a common European data space for data provision and exchange, the absence of a legal obligation to collect and share data, varying and incompatible standards, or data sovereignty concerns have been hampering data connectivity, access and exchange in the EU and thus obstructing the development of interoperable mobility systems.[17] Considering the value of the data to be generated by the intelligent mobility and logistic, it is very important to provide a level playing field for access to that so that innovation can thrive and new business models emerge. Otherwise, ultimate control over such data by a single entity or a group of entities may create significant power imbalances. Note that the latest EU policy and legal developments (e.g. European Strategy for Data, proposed Data Act) aim at catering for the abovementioned shortcomings.

4.2 Compliance with ethical principles and relevant legislations

To address the identified potential legal and ethical issues in an effective and timely manner and to ensure compliance of the project activities with the applicable ethical and legal

[15] European Commission, A European strategy on Cooperative Intelligent Transport Systems, a milestone towards cooperative, connected and automated mobility, 2016.

[16] Bulten, Marie Eline, Self-driving Cars and Data Connectivity: Striking a Balance Between Privacy Protection and the Need for Interoperability (October 20, 2017). Available at SSRN: https://ssrn.com/abstract=3407269 or http://dx.doi.org/10.2139/ssrn.3407269

[17] European Commission, A European strategy on Cooperative Intelligent Transport Systems, a milestone towards cooperative, connected and automated mobility, 2016.

requirements , the ULTIMO provides for the approach below allowing, also, for dedicated governance mechanisms within the consortium.

4.2.1 Ethics as an integral part of Project Management

The consortium will review ethics issues as a standing item in its Executive Board meetings. It will follow a structured approach to identifying, assessing, and disposing of ethical and legal issues throughout the project duration. All partners will have equal responsibility for meeting ethical and legal requirements in the context of the work they undertake in the project. Furthermore, the relevant ethical frameworks within the European values, democracy, transparency, accountability and the rule of law are and will be taken into consideration, both in the project at large as well as in each of the pilots and its various use cases.

4.2.2 Data management plan.

Data & Ethics Manager Arthur van der Wees (Arthur's Legal) will be the Data & Ethics Manager (EPM) who will provide support for ethics, privacy, legal and regulatory matters pertinent to the project's scope.

4.2.3 Research involving human participants

ULTIMO will involve individuals in project workshops addressed to partners and other stakeholders. Such an involvement entails, among other, the acquisition of a well-informed consent to participate in the project activities, as well as trust, dignity, fairness, also, wjth respect to how these workshops are conducted.. The consortium partners are familiar with the ethical challenges associated with research involving humans, given their training and previous experience with similar research methodology. They are familiar with the processes needed to meet and exceed these requirements when conducting workshops, meetings, and research tasks. Especially, the project partner with expertise in law and ethics, Arthur's Legal, is well experienced, also, with respect to end-users' engagement entailing personal data protection considerations. In this respect, Arthur's Legal will support the responsible partners with identifying any ethical and legal issues that might arise during the project as a part of the task T1.5- Ethical Issues Management.

4.2.4 Details on recruitment, inclusion, and exclusion criteria

The project will confirm its participant recruitment, inclusion, and exclusion criteria under the related WPs. In particular, ULTIMO will take all possible measures to ensure there is no discrimination or harm from the recruitment, exclusion, or inclusion process. Factors that may lead participants to coercion or undue influence, selection criteria, including gender balance and consent management are among the factors to be considered when engaging stakeholders in WP2 – Passenger use cases and vehicle ODDs for ITS/CCAM, WP5 – Deployment of a citizen centric AM in ITS/CCAM and WP6 – All impact evaluation and transformation towards an AV in ITS/CCAM ecosystem.

4.2.5 Provision of information to participants and informed consent process

The partners will advise interviewees and workshop participants that their participation is entirely voluntary. The consortium will obtain their informed consent in advance. Participants will be provided with Information sheets and consent forms in a language and terms fully understandable to them. These will describe the aims, methods, and implications of the interviews, workshops and online survey, the nature of their participation, and any benefits or risks (e.g., to privacy) that might be involved. The responsible partners will ensure that potential participants have fully understood the information and do not feel pressured or forced to give consent. All participants will be allowed to ask questions and receive understandable answers from the interviewers and test organizers about their participation. Consent will be obtained in a form suited to the different methods used in the project (e.g., by signing the consent form after the information process).

4.2.6 Adherence to High-Level Rules and Ethical Principles

ULTIMO is committed to adhering to the highest ethical and legal standards and it will ensure that all ethical, legal, privacy, social, ecological and safety issues related to the project activities are identified and taken into account, in compliance with applicable laws and regulations, both existing and foreseeable upcoming ones at EU level. These will be identified in WP1 and the applicable requirements will be further , assessed and addressed within the various pilots throughout the project duration. Moreover, the project will evaluate at regular intervals ethical issues such as those pertinent to human values, ecological values, data processing, data connectivity and data management and artificial intelligence, before, during and after the deployment of the services.

In that regard, it is aimed that ULTIMO takes into account the fundamental rights and freedoms set out in the Charter of Fundamental Rights of the European Union as well as the European Declaration on Digital Rights and Principles. Furthermore, ULTIMO will consider the legal requirements set out under the most relevant EU regulations and directives including but not limited to the EU General Data Protection Regulation, the Data Governance Act[18], the NIS 2 Directive[19], the Directive on the deployment of Intelligent Transport Systems[20], the Commission's Delegated Regulation on the deployment and operational use of cooperative intelligent transport systems will be analysed by the partners. The Commission's relevant policies and strategies such as the EU strategy for mobility of the future and the EU Sustainable and Smart Mobility Strategy will be closely followed during the deployment phase. Note that , to the extent necessary and relevant, the consortium will consider the guidelines and

[18] Regulation (EU) 2022/868 of the European Parliament and of the Council of 30 May 2022 on European data governance and amending Regulation (EU) 2018/1724 (Data Governance Act), OJ L 152/1.

[19] Directive (EU) 2022/2555 of the European Parliament and of the Council of 14 December 2022 on measures for a high common level of cybersecurity across the Union, amending Regulation (EU) No 910/2014 and Directive (EU) 2018/1972, and repealing Directive (EU) 2016/1148 (NIS 2 Directive), OJ L 333/80.

[20] Directive 2010/40/EU of the European Parliament and of the Council of 7 July 2010 on the framework for the deployment of Intelligent Transport Systems in the field of road transport and for interfaces with other modes of transport

opinions on data protection in the context of connected and automated mobility provided by the European regulatory authorities as, for example, the compliance package for a responsible use of data published by Commission Nationale de l'Informatique et des Libertés (CNIL) or the Guidelines 01/2020 on processing personal data in the context of connected vehicles and mobility related applications by European Data Protection Board (EDBP).

In the bigger scheme of things, , Ethics by Design is one of the main major success factors for the proposed AI driven services in ULTIMO. It is noted that if not taken in and demonstrated in an accountable way prior to any pilot deployment, during such pilot deployments as well as afterwards - also for double-looping, for continuous improvement purposes - ULTIMO is likely to fail to achieve its goal to build trustworthy AI driven services. Therefore, it is intended that the Commission's Guidelines on Ethics By Design and Ethics of Use Approaches for Artificial Intelligence highlighting the necessity for respect for human agency, privacy, personal data protection and data governance, fairness, individual, social, and environmental well-being, transparency and accountability and oversight will be taken into account for the deployment and implementation of AI driven automated vehicles in MaaS for public transportation and LaaS for urban goods transportation.

5 Conclusion

Summarised, two vital activities in the management of projects have been described, namely quality assurance and risk management. Therefore, procedures and respective tools for the execution of quality and risk management within ULTIMO have been explained. Moreover, the roles and responsibilities of the consortium members regarding those procedures have been defined. This guideline represents the initial version of the quality and risk management plan.

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Annex

Annex I – Overview deliverables

Deliverable No	Name	WP	Lead	Internal Reviewer	Deadline	Related tasks	Project month
Work Package (WP) 1							
D1.1	Project inception report & Data Management Plan - First version	WP1	DB Regio	CS	30.11.2022	T1.1,T1.3	2
D1.2	Project inception report & Data Management Plan - Intermediate version	WP1	DB Regio	OpenGeneva	31.03.2023	T1.4	6
D1.3	Project inception report & Data Management Plan - Final version	WP1	DB Regio	HSPF	31.05.2026	-	44
D1.4	Quality Assurance, Risk Assessment, Ethics & Regulatory issues - First version	WP1	HSPF	DB Regio	31.12.2022	T1.2,T1.3	3
D1.5	Quality Assurance, Risk Assessment, Ethics & Regulatory issues - Intermediate version	WP1	HSPF	Unige	31.03.2024	T1.2, T1.3	18
D1.6	Quality Assurance, Risk Assessment, Ethics & Regulatory issues - Final version	WP1	HSPF	MODAXO	31.01.2026	T1.2, T1.3	40
Work Package (WP) 2							
D2.1	Passenger and PTO requirements, needs, and use cases- First version	WP2	TPG	Ruter	30.09.2023	T2.1, T2.2, T2.3	12
D2.2	Passenger and PTO requirements, needs, and use cases - Final version	WP2	TPG	PADAM	31.03.2025	T2.1, T2.2, T2.3	30
D2.3	Inclusion, accessibility and co-creation framework - First version	WP2	SIEMENS	OpenGeneva	31.03.2024	T2.4, T2.5	18
D2.4	Inclusion, accessibility and co-creation	WP2	SIEMENS	CS	30.09.2025	T2.4, T2.5	36

	framework - Final version						
Work Package (WP) 3							
D3.1	Inclusion, accessibility and co-creation framework - Final version	WP2	NAVYA	SIEMENS	31.12.2023	T3.1, T3.2	15
D3.2	Vehicle adaptation and common vehicle API - Intermediate version	WP3	NAVYA	PADAM	31.03.2025	T3.1, T3.2	30
D3.3	Vehicle adaptation and common vehicle API - Final version	WP3	NAVYA	SIEMENS	31.01.2026	T3.1, T3.2	40
D3.4	Common platform and HD map - First version	WP3	SENSIBLE4	MODAXO	31.12.2023	T3.3, T3.4	15
D3.5	Common platform and HD map - Intermediate version	WP3	SENSIBLE4	MobileThinking	31.03.2025	T3.3, T3.4	30
D3.6	Common platform and HD map - Final version	WP3	SENSIBLE4	NAVYA	31.01.2026	T3.3, T3.4	40
D3.7	Open modular system requirements, architecture and tools- First version	WP3	TGE	YOGOKO	31.12.2023	T3.5, T3.6	15
D3.8	Open modular system requirements, architecture and tools - Intermediate version	WP3	TGE	Bax & Company	31.03.2025	T3.5, T3.6	30
D3.9	Open modular system requirements, architecture and tools - Final version	WP3	TGE	SENSIBLE4	31.01.2026	T3.5, T3.6	40
Work Package (WP) 4							
D4.1	MaaS passengers & LaaS Services - First version	WP4	Padam	ZF CV	30.11.2023	T4.1, T4.2	12
D4.2	MaaS passengers & LaaS Services - Intermediate version	WP4	Padam	Bax & Company	31.01.2025	T4.1, T4.2	28
D4.3	MaaS passengers & LaaS Services - Final version	WP4	Padam	SENSIBLE4	31.01.2026	T4.1, T4.2	40
D4.4	Vehicles and Infrastructure Services - First version	WP4	CERTH	NAVYA	30.11.2023	T4.3	12
D4.5	Vehicles and Infrastructure Services - Intermediate version	WP4	CERTH	SAAM	31.01.2025	T4.3	28

D4.6	Vehicles and Infrastructure Services - Final version	WP4	CERTH	TPG	31.01.2026	T4.3	40
D4.7	ITS Management Services - First version	WP4	YOGOKO	CAP	30.11.2023	T4.4	12
D4.8	ITS Management Services - Intermediate version	WP4	YOGOKO	UITP	31.01.2025	T4.4	28
D4.9	ITS Management Services - Final version	WP4	YOGOKO	UNIGE	31.01.2026	T4.4	40
Work Package (WP) 5							
D5.1	Large Scale Demonstration report - First version	WP5	RUTER	DB Regio	30.09.2023	T5.1, T5.2, T5.3	12
D5.2	Large Scale Demonstration report - Second version	WP5	DB Regio	TPG	30.09.2024	T5.1, T5.2, T5.3	24
D5.3	Large Scale Demonstration report - Third version	WP5	TPG	RUTER	30.09.2025	T5.1, T5.2, T5.3	36
D5.4	Large Scale Demonstration report - Final version	WP5	RUTER	CAP	30.09.2026	T5.1, T5.2, T5.3	48
D5.5	Big Data Collection Platform and Data Management Portal - First version	WP5	CERTH	ArgYou	30.09.2023	T5.4	12
D5.6	Big Data Collection Platform and Data Management Portal - Final version	WP5	CERTH	ZF CV	30.09.2026	T5.4	48
Work Package (WP) 6							
D6.1	Multivariate evaluation of ULTIMO CCAM ecosystem - First version	WP6	CS	DB Regio	31.03.2024	T6.1	18
D6.2	Multivariate evaluation of ULTIMO CCAM ecosystem - Final version	WP6	CS	Ruter	30.09.2026	T6.1	48
D6.3	Business plans, and partnerships for intelligent CCAM ecosystem - First version	WP6	HSPF	Unige	31.03.2024	T6.2, T6.1	18
D6.4	Business plans, and partnerships for intelligent CCAM ecosystem - Final version	WP6	HSPF	Ruter	30.09.2026	T6.2, T6.1	48

D6.5	Transformation guidelines towards future transport ITS/CCAM ecosystem - First version	WP6	DB Regio	Etat de Genève	31.03.2024	T6.2, T6.1, T6.3	18
D6.6	Transformation guidelines towards future transport ITS/CCAM ecosystem - Final version	WP6	DB Regio	CS	01.09.2026	T6.2, T6.2, T6.1	48
	Work Package (WP) 7						
D7.1	Communication and dissemination plan, reports and materials - First version	WP7	UITP	EatatGeneve	31.03.2023	T7.1, T7.2	6
D7.2	Communication and dissemination plan, reports and materials - Second version	WP7	UITP	OpenGeneva	31.03.2024	T7.1, T7.2	18
D7.3	Communication and dissemination plan, reports and materials - Third version	WP7	UITP	SAAM	30.09.2025	T7.1, T7.2	36
D7.4	Communication and dissemination plan, reports and materials - Final version	WP7	UITP	ArgYou	30.09.2026	T7.1, T7.2	48
D7.5	Stakeholders' engagement activities & Exploitation plans - First version	WP7	CAP	MobileThinking	31.03.2024	T7.2, T7.3	18
D7.6	Stakeholders' engagement activities & Exploitation plans - Final version	WP7	CAP	UITP	30.09.2026	T7.2, T7.3	48
D7.7	Impact and KPI assessment - First version	WP7	ArgYou	CERTH	31.03.2024	T7.3	18
D7.8	Impact and KPI assessment - Final version	WP7	ArgYou	HSPF	30.09.2026	T7.3	48

Annex II – Deliverable Template

The template added in this document, is V1 (December 2022).

Please check for new versions, the latest deliverable template can be found on share-point, in the folder of WP1

Annex III – Deliverable Review Form

Deliverable	
Review Date	
Reviewer	

General Impression

Suggestions for Improvement

Checklist				
Section	**Criteria**	**Yes**	**No**	**Comment**
Content	The content corresponds with description of the deliverable as stated in the Grant Agreement.	☐	☐	
	Great deviations from the description in the Grant Agreement are duly justified.	☐	☐	
	The deliverable is structured as specified in the provided template (Abstract, Introduction, Main Part, Conclusion).	☐	☐	
	The Abstract is short and precise.	☐	☐	
	The Introduction states goal and scope of the deliverable.	☐	☐	
	The Main Part is described in detail, for instance with help of figures, diagrams or tables.	☐	☐	
	The Conclusion shortly reviews the content and gives an outlook of the future procedure.	☐	☐	
Formalities	The provided template has been used.	☐	☐	
	Page number are correct, and table of contents, figures and lists are complete.	☐	☐	
	Concise and comprehensible formulation of the text	☐	☐	
	Appropriate spelling and grammar	☐	☐	
	All items in the deliverable are formatted consistently and with respect to the provided template.	☐	☐	

Annex IV – Internal Audit Report

Report No.		**Audited Partner**	
Audit Date			
Audit Team		**Audited Object**	

Problem/Issue

Cause

Corrective Measures

Further Procedure

Annex V – Corrective/Preventive Action Request

Request No.		**Concerned Work package**	
Request Date			
Requester		**Concerned Partner**	

No.	Problem	Proposed Corrective/Preventive Action