



**5G LOGINNOV**

**D4.3**

**Achievements with new  
actors and opportunities**

[www.5g-loginnov.eu](http://www.5g-loginnov.eu)



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## List of abbreviations and acronyms

Abbreviation	Meaning
<b>5G</b>	5 <sup>th</sup> Generation (of broadband cellular networks)
<b>5G PPP</b>	5G Public-Private Partnership
<b>5GMF</b>	Fifth Generation Mobile Communication Promotion Forum
<b>AI</b>	Artificial Intelligence
<b>AR</b>	Augmented Reality
<b>ATP</b>	Automated Tuck Platooning
<b>CAD</b>	Connected Automated Driving
<b>CAM</b>	Connected Automated Mobility
<b>CAWI</b>	Computer Aided Web Interview
<b>CCTV</b>	Closed Circuit Television
<b>E2E</b>	End-to-End
<b>eMBB</b>	enhanced Mobile Broadband
<b>HPA</b>	Hamburg Port Authority
<b>IoT</b>	Internet of Things
<b>ITU-R</b>	International Telecommunication Union – Radio communication sector
<b>MEC</b>	Multi-access Edge Computing
<b>mMTC</b>	massive Machine Type Communication
<b>NB-IoT</b>	Narrow Band Internet of Things
<b>NZP</b>	China's Ningbo-Zhoushan port
<b>PG</b>	Promotion Group
<b>RRM</b>	Radio Resource Management
<b>RTPORT</b>	Real Time Port
<b>SME</b>	Small Medium Enterprise
<b>URLLC</b>	Ultra-Reliable Low Latency Communication
<b>VR</b>	Virtual Reality
<b>WP</b>	Work Package



## Document History

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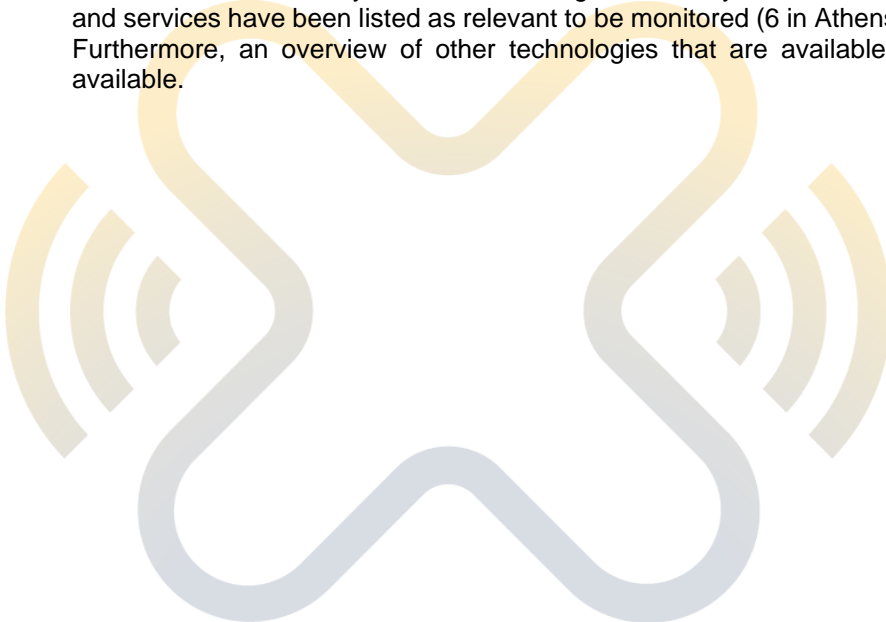
## EXECUTIVE SUMMARY

The 5G-LOGINNOV central innovation is to build a first-class European industrial supply side for 5G core technologies and to promote the emergence of new market players. The project has an impact on the logistics industry for which tests are developed and 5G-enabled services are evaluated. Furthermore, 5G-LOGINNOV contributes to the emergence of global standards and globally harmonised frequency bands for 5G. The project supports the generation of new 5G-enabled technologies for logistics operations in 3 real-life port-city areas that constitute the 5G-LOGINNOV Living Labs (LLs) in Athens, Hamburg, and Koper.

This deliverable starts outlining the 5G-LOGINNOV actions aimed at creating a favourable ecosystem for the development of 5G-and logistics-related applications by innovative SMEs or start-ups. For this scope, two distinct streams of activities have been implemented which, although running independently, have several points of intersection in disseminating the results achieved within the project as well as in bringing into the project experiences developed by external actors. The first set of activities was linked to the selection and integration of five SMEs/start-ups in the project. The 5G-LOGINNOV Open Call for Innovative Start-ups led to the selection of five innovative start-ups that have been integrated into the project to enrich the three Living Labs (Athens, Hamburg, and Koper) with additional use cases and solutions. The project accompanied the winners through a series of support events aiming to make them aware of 5G-LOGINNOV internal structure and procedures, to understand and possibly exploit the business development guidelines discussed during the project, and to help them finding new business opportunities through the dissemination of their activities to potential external stakeholders and through the networking with other similar realities. The second set of activities referred to the creation of a network of innovative, small-scale industrial actors, aimed at promoting the mutual exchange of information and experiences. This stream of activities contributed to identifying and establishing contacts with the existing ecosystems of SMEs and start-ups.

This deliverable also discusses stakeholders' expectations and needs in developing business models for the solutions implemented within 5G-LOGINNOV. Business opportunities were identified by involving both new entrants (winning start-ups) and initial project partners in the business modelling process. Athens focused on improving safety and optimizing port operations through 5G technology and AI systems. Initial funding supported development and testing, with future revenues expected from cost savings, usage fees, and licenses. Hamburg tested real-time monitoring of truck and emission data, communication systems, V2X communication, and green-light priority systems. Collaboration with external providers, compliance with standards, and sustainability alignment were recommended. Koper developed Virtual Network Functions (VNF) using 5G architecture, high-definition cameras, and real-time video surveillance. Costs were associated with 5G network development, HR, and scalability. Revenues were expected from licensing or usage fees. Additionally, this deliverable highlights the continuous interaction with the five winning start-ups to guide their business modelling within 5G-LOGINNOV and facilitate market integration.

A "Register of 5G-enabled products and services" was created, listing all products and services used in the Living Labs. Stakeholders' expectations were monitored, focusing on improving logistics efficiency, data collection and analysis, and enhancing connectivity within the logistics chain. In total, 31 products and services have been listed as relevant to be monitored (6 in Athens, 16 in Hamburg and 9 in Koper). Furthermore, an overview of other technologies that are available in the market, has been made available.





# 1 INTRODUCTION

## 1.1 Project intro

5G-LOGINNOV will focus on seven 5G-PPP Thematic and support to the emergence of a European offer for new 5G core technologies in 11 families of use cases. 5G-LOGINNOV main aim is to design an innovative framework addressing integration and validation of CAD/CAM technologies related to the Industry 4.0 and ports domains by creating new opportunities for LOGistics value chain INNOVation. 5G-LOGINNOV is supported by 5G technological blocks, including new generation of 5G terminals notably for future Connected and Automated Mobility, new types of Internet of Things 5G devices, data analytics, next generation traffic management and emerging 5G networks, for city ports to handle upcoming and future capacity, traffic, efficiency and environmental challenges. 5G-LOGINNOV will deploy and trail 11 families of use cases beyond TRL7 including a GREEN TRUCK INITIATIVE using CAD/CAM & automatic trucks platooning based on 5G technological blocks. Thanks to the new advanced capabilities of 5G relating to wireless connectivity and Core Network agility, 5G-LOGINNOV ports will not only significantly optimise their operations but also minimise their environmental footprint to the city and the disturbance to the local population. 5G-LOGINNOV will be a catalyst for market opportunities build on 5G Core Technologies in the Logistics domains, thus being a pillar of economic development and business innovation and promoting local innovative high-tech SMEs and Start-Ups. 5G-LOGINNOV will foster the integration of SMEs and Start-Ups in new markets using its three Living Labs as facilitators and ambassadors for innovation on ports. 5G-LOGINNOV promising innovations are key for the major deep-sea European ports in view of the mega-vessel era (Hamburg, Athens), and are also relevant for medium sized ports with limited investment funds (Koper) for 5G.

## 1.2 Purpose of the deliverable

The overall objective of this deliverable is to show the achievements of the Task 4.1 “Strategy supporting next generation logistics operations”, Task 4.2 “Emergence of new actors”, Task 4.3 “Boosting economic opportunities”. All these project activities aimed at creating opportunities for the existing and new actors, and at establishing a common vision for the take up of 5G enabled and innovative Next Generation Logistics’ Operation. The work presented in this report has the following objectives:

1. To promote opportunities for new actors in the logistics ecosystem, allowing them to be part of a real network.
2. To define 5G-enabled business opportunities to current and new actors, by engaging them in the business modelling process.
3. To assess the products and services currently used in Living Labs to define the potential benefits from their usage on business models and operations.

Achieving the above-mentioned objectives has been the main scope of Work Package 4 (“Marketplace and new actors”) during the whole project duration, in line with the technical implementations in the three Living Labs, and with a continuous interaction with all involved actors. At the same time, eyes were open towards the life beyond the project, and external stakeholders have been contacted, while other initiatives have been monitored.

The objectives related to this deliverable have been achieved in full and as scheduled.

## 1.3 Intended audience

This deliverable is the primary source of information on opportunities provided to new actors and established actors of the project to create new businesses and emerge in the market. It provides a detailed report of the activities performed with the five winners of the 5G-LOGINNOV Open Call for Innovative Start-ups, aiming to provide them with a wide range of opportunities for networking and for showcasing their products and services. Furthermore, the document allows to get in touch with the project experience in getting linked to similar current initiatives, at the local and EU level, paving the way to a long-lasting network of start-ups. Therefore, this type of content could be useful to anyone that are

willing to get inspired by 5G-LOGINNOV in further activities with and for new actors (e.g., Business Incubators, Big Corporations, Independent Consultants).

This document also provides the Living Labs' stakeholders with business models and strategies allowing 5G core technologies for logistics to enter in the market in the short and medium term. It follows that industrial and public stakeholders of the 5G-LOGINNOV Living Labs may find it useful to get in touch with this deliverable for setting up new relevant projects.

Furthermore, the deliverable provides an interesting overview of the current products and services enabling 5G related innovations to work in real-life, including an assessment of competition. This allows any public or private actors dealing with market research on 5G in logistics to get relevant baseline knowledge.

## 1.4 Structure of the deliverable and its relationship with other work packages/deliverables

The present deliverable is the output of the second phase of Task 4.1 "Strategy supporting next generation logistics operations" and of Task 4.2 "Emergence of new actors" and provides the outcomes of Task 4.3 "Boosting economic opportunities".

The document has the following structure:

- Chapter 2 reports the activities aimed at creating a favourable ecosystem for the development of 5G- and logistics-related applications by innovative SMEs or start-ups.
- Chapter 3 describes the main outcomes in relation to business opportunities for Living labs and for new entrants (winning start-ups).
- Chapter 4 provides the main findings on the stakeholders' expectations from 5G-enabled products and services and the market overview of available technologies.
- Chapter 5 illustrates the main conclusions and the final remarks.

Finally, Annex 1 allows finding the detailed list of products and services monitored in each LL.

The activities reported in this deliverable have been developed in parallel with other project actions, specifically:

- WP2 "Living Labs development and deployment" and WP3 "Living Labs trials and evaluation" provided the baseline information on the technical implementations performed in the three Living Labs.
- Task 4.4 "Lessons learned and recommendation for stakeholders" took as an input the main findings linked to business requirements and strategies reported in this deliverable.
- A strong collaboration occurred between WP4 "Marketplace and new actors" and WP5 "Dissemination and exploitation". This was more evident in consideration to the strategic joint efforts for promoting the new entrants (synergy between Task 4.2 "Emergence of new actors", Task 5.1 "Communication channels and plan", Task 5.3 "Dissemination events and plan" and Task 5.5 "Clustering and networking"). In addition, the findings of Task 4.1 "Strategy supporting next generation logistics operations" and Task 4.3 "Boosting economic opportunities" have been the starting point to define the Living Labs and new entrants' exploitation plans in Task 5.3 "Exploitation"

## 2 ENHANCING NEW ACTORS' EMERGENCE

The creation of a favourable ecosystem for the development of 5G-and logistics-related applications by innovative SMEs or start-ups is one of the main ambitions of the 5G-LOGINNOV Project. This goal was pursued through two streams of activities:

1. The selection (through the 5G-LOGINNOV [Open Call for Innovative Start-ups](#)) of five SMEs/start-ups to be directly on-boarded in the project.
2. The creation of a network of innovative, small-scale industrial actors for the mutual exchange of information and experiences related to the development of applications related to transport and logistics through the exploitation of novel wireless communication platforms such as 5G (and in perspective targeting also 6G candidate technologies).

The two streams of activities, although running independently one from the other, had several points of intersection in disseminating towards the outside world the results achieved within the project (**by** selected SMEs), as well as in bringing into the project (**to** selected SMEs) experiences developed by external actors already connected through other existing networks, eventually creating a productive bidirectional flow of information.

This section provides an overview of the above-mentioned activities. Specifically, section 2.1 describes the work performed with the five winners of the 5G-LOGINNOV [Open Call for Innovative Start-ups](#), section 2.2 defines the achievements in order to establish the so-called 5G-LOGINNOV Network of Start-ups.

### 2.1 Selection, integration, and continuous support to 5G-LOGINNOV start-ups

This stream of activities mainly consisted in the organization and conduction of the 5G-LOGINNOV [Open Call for Innovative Start-ups](#), that led to the selection of five innovative SMEs/start-ups to be integrated into the project to enrich the three Living Labs (Athens, Hamburg and Koper) with additional use cases and solutions. Furthermore, before and after the Open Call, more support activities have been carried out.

The management of the Open Call (preparation phase, conduction, evaluation, etc.) has been thoroughly described in project [Deliverable 4.2 "Start-ups integration report"](#), to which the reader can make reference to get detailed information.

#### 2.1.1 Implementation of the 5G-LOGINNOV Open Call for Innovative Start-ups

The preparation and implementation of the 5G-LOGINNOV Open Call for Innovative Start-ups led to the following outcomes:

- Development of the Open Call Tender Conditions. The detailed tender conditions have been prepared to inform potential applicants about the project concept and structure, the general objective of the call and the eligibility criteria, the legal information, and documents to be included in their application form. Tender conditions were published on the project website at the Open Call launch date.
- Development of the Open Call application form. The Application Form consisted of the following sections: General information about the applicant; Identification of target Living Lab(s), Ambition and development plans, technical description of the ICT solution; Operating descriptions of the ICT solutions, Project structure, Resource/budget allocation.
- Planning and implementation of the dissemination strategy of the Open Call, in collaboration with WP5. The event was advertised on the project website, on the ERTICO official site and through various communication channels (e.g., LinkedIn), as well as promoted by Living Lab leaders at local level.
- Planning and implementation of the evaluation process of the received applications. The evaluation team was composed by representatives of the 5G-LOGINNOV Project Management Team. The

evaluation process has been carried out in respect of the principles of fairness and transparency, according to the assessment criteria established by the Tender Conditions.

- Selection of the 5 winners of the Open Call and their engagement in the project Living labs:

Acronym	Full Title	Applicant	Athens LL	Hamburg LL	Koper LL
<b>TRITON</b>	auTonomous dRones for marITime OperatioNs	Hellenic Drones			X
<b>RESONATE</b>	Real timE drowSiness detectiON, AlerTing and rEporting	Libra AI	X		
<b>5G4A</b>	5G-Loginnov-4-Amazon	eShuttle (now Uze Mobility)		X	
<b>TAADD</b>	TAXi-AD Data	Uze! Mobility GmbH		X	
<b>ITGS</b>	Intelligent Traffic Guidance System	Roads.AI		X	

Table 1: Winners of the 5G-LOGINNOV Open Call for Innovative Start-ups

### The 5G-LOGINNOV Open Call Tender Conditions are now available!

Apr 23, 2021 | News



As of April 26th, 2021, interested start-ups in the form of SMEs will be able to submit their applications to the 5G-LOGINNOV Open Call for innovative start-ups. The detailed tender conditions are now available to be downloaded!

The 5G-LOGINNOV project is organizing an Open Call for the selection of five innovative start-ups and SMEs aiming to develop 5G-based solutions in the framework of activities carried out at the three Living Labs of the project Athens (Greece), Hamburg (Germany) and Luka Koper (Slovenia).

As of April 26th, 2021, interested start-ups in the form of SMEs legally established in an eligible country will be able to submit their applications to:

[OpenCall\\_applications@outlook.com](mailto:OpenCall_applications@outlook.com)

The full 5G-LOGINNOV Open Call Tender Conditions can be found on this [link](#).

The 5G-LOGINNOV Open Call Application Form can be downloaded [here](#).

Prior to applying interested start-ups should read the Open Call conditions thoroughly and make sure that, they are eligible to participate in the Open Call!

The selected applicants will be incorporated in 5G-LOGINNOV consortium through a **service contract providing a global price of max. € 50.000 (VAT included) each**. Important dates of the Open Call can be found below:

**Call Opening Date:** 26/04/2021 | **Call Closing Date:** 30/06/2021 | **Notification Email sent to Applicants:** 17/09/2021 (planned date)

For further information on the 5G-LOGINNOV project, the Open Call and the conditions of participation, please have a look at the dedicated website/ the Open Call Tender Conditions or send an email to:

[OpenCall\\_helpdesk@outlook.com](mailto:OpenCall_helpdesk@outlook.com)

Figure 1: Launch of the 5G-LOGINNOV Open Call for Innovative Start-ups on the project website



## 5G-LOGINNOV Open Call Winners

Oct 12, 2021 | Events, News



Figure 2: Announcement of the 5 winners of the 5G-LOGINNOV Open Call for Innovative Start-ups on the project website

### 2.1.2 Continuous engagement in the project of the 5G-LOGINNOV Open Call for Innovative Start-ups winners

Following the preparation and execution of the 5G-LOGINNOV Open Call for Innovative Start-ups, the project accompanied the winners through a series of support activities aiming to make them aware of 5G-LOGINNOV internal structure and procedures, to understand and possibly exploit the business development guidelines developed within WP4, and to help them finding new business opportunities through the dissemination of their activities to potential external stakeholders and through the networking with other similar realities. The main achievements of the start-up support activities are listed below:

- **Planning of the strategy for the integration of new actors in 5G-LOGINNOV.** The strategy consisted of the creation of a dynamic ecosystem supporting the Living Labs through multiple targeted actions (in close cooperation with task 5.5 “Clustering and Networking”), including continuous support to the Open Call winners and dissemination towards academia and industry. A network of start-ups paving the way to a new generation of 5G-enabled logistics applications has been defined and managed.
- **Implementation of the strategy for the integration of new actors in 5G-LOGINNOV.** The strategy defined at previous point has been put in place, and the 5 winners of the Open Call got fully integrated within the project, both at technical side (under the supervision and guidance of the LL Leaders) and at the business side. Five seminars addressed to the 5 winning start-ups have been organised in the context of 5G-LOGINNOV:
  - 15/03/2022 – Welcome aboard: a roadmap to the full integration of SMEs within 5G-LOGINNOV.
  - 07/06/2022 – Business Modelling and Communication: WP4 and WP5 tools for SME support.
  - 13/12/2022 – 5G-enabled solutions for logistics and ports (dedicated session within the monthly meeting of Docks the Future Network of Excellence).
  - 23/02/2023 – 5G goes 6G: new opportunities of mobile communication for better city & better life (physical workshop in Hamburg).
  - 16/10/2023 - EU funding opportunities for SMEs in relation to 5G/logistics.

- **Communication initiatives specifically tailored to give visibility to selected SMEs;** such initiatives included:
  - Presentation of selected SMEs on the project official LinkedIn profile.
  - Invitation of selected SMEs to a series of valuable events (ITS European Congress in Hamburg, ALICE Collaborative Innovation Days in Athens, Transport Research Arena in Lisbon, workshop “5G goes 6G” in Hamburg).
  - Engagement of selected SMEs in project networking activities (Docks the Future Network of Excellence, NetworkEurope SME WG, other 5G sister projects).

The following images contain a series of screenshots and pictures related to the activities described above.

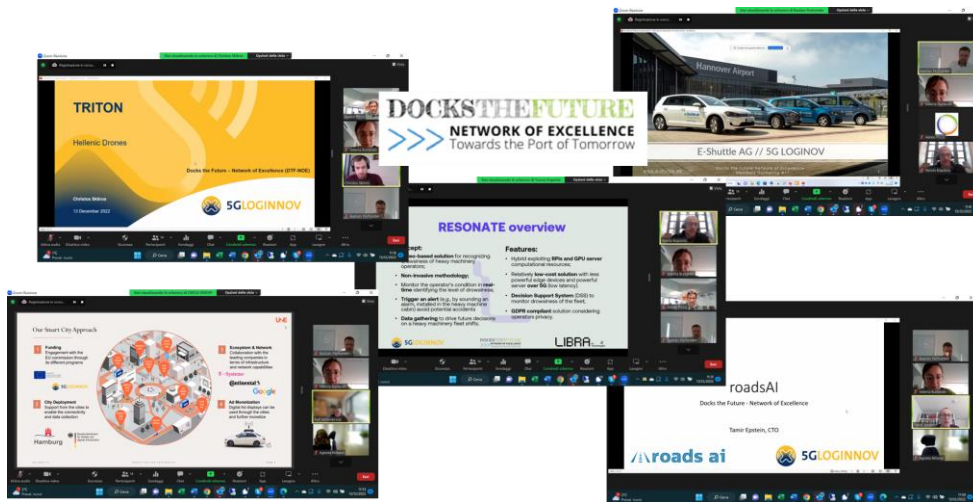


Figure 3: Presentation of selected SMEs at the Docks the Future NoE (Network of Excellence) meeting, December 2022

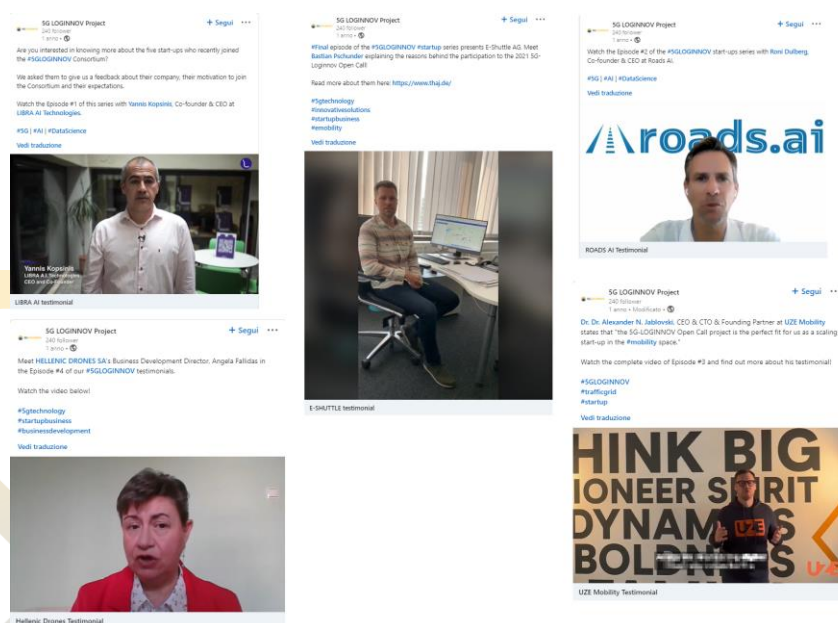


Figure 4: Video presentation of selected SMEs on the project official LinkedIn profile

## 2.2 Establishment of the 5G-LOGINNOV Network of Start-ups

This stream of activities aimed at identifying and contacting the existing ecosystems of SMEs and start-ups that could be relevant for a mutual exchange of information and experiences related to transport and logistics; being a particular kind of communication and dissemination, these activities have been carried out in close cooperation with WP5 “Dissemination and Communication”.

### 2.2.1 Collaborative Innovation Day (CID) with ALICE

The first key action was the organization of a Collaborative Innovation Day (CID)<sup>1</sup> under the umbrella of ALICE European Technology Platform<sup>2</sup>. Collaborative Innovation Days are periodic events organized by ALICE members to focus on specific themes that are particularly relevant for the logistics community; although non-specifically dedicated to start-ups, the event has been an excellent opportunity for showcasing the results of the project, with special attention to business modelling and opportunities for small to medium size organizations. The event took place in virtual form on October 4<sup>th</sup>, 2022, and saw the participation of 75+ attendees; within the event, the 5 winners of the Open Call had the opportunity to present themselves and their applications to such a broad audience, thus having a great business opportunity to liaise with primary players in the 5G/6G arena; in the afternoon, a dedicated workshop was specifically dedicated to Emerging 5G business models, which took again the focus on opportunities for SMEs and start-ups.



Figure 5: Announcement of the 5G-LOGINNOV Collaborative Innovation Day

<sup>1</sup> 5G-LOGINNOV-ALICE | Collaborative Innovation Day, <https://www.etp-logistics.eu/5g-loginnov-alice-collaborative-innovation-day/>

<sup>2</sup> ALICE - Alliance for Logistics Innovation through Collaboration in Europe), <https://www.etp-logistics.eu/>

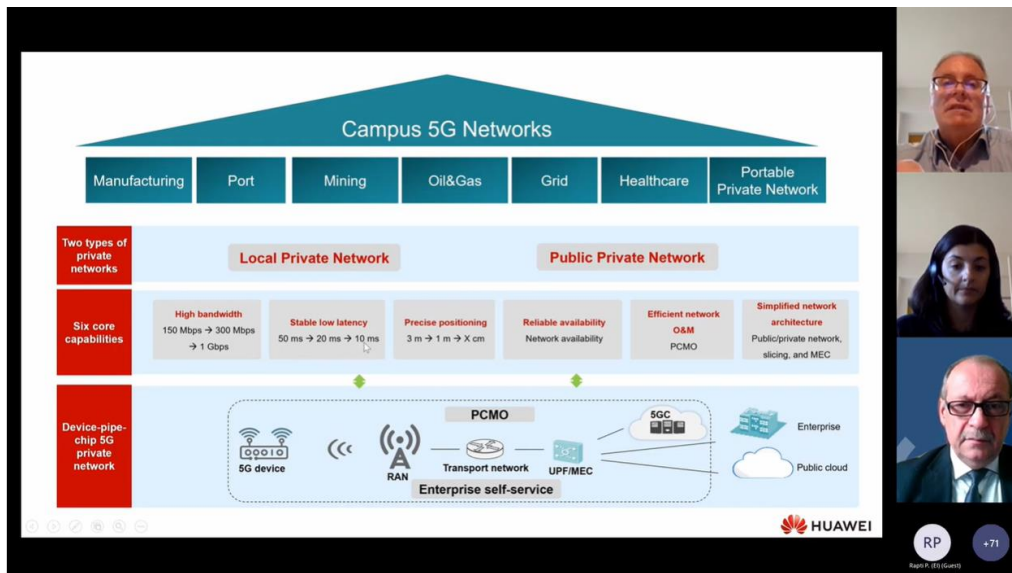


Figure 6: One moment of the 5G-LOGINNOV ALICE Collaborative Innovation Day on 04/10/2022

## 2.2.2 Collaboration with other relevant networks

The second key action consisted in identifying potential networks of SMEs active in the 5G/6G area; in this perspective, the presence in the consortium of T-Systems was an optimal channel to reach the Hamburg local ecosystem of innovative start-ups through the **Logistics Initiative Hamburg**<sup>3</sup>. In addition to being a prolific ground for innovation in logistics, this liaison also resulted in the organization of the Hamburg event (see in the following) and the liaised through the Collaborative Innovation Day.

The search for networking opportunities scaled up at a global European level, starting from **6G-IA**<sup>4</sup>, the European industry association representing the private side in both the 5G Public Private Partnership (**5G-PPP**) and the Smart Networks and Services Joint Undertaking (**SNS JU**). In this global search, an excellent result has been achieved with **NetworldEurope**<sup>5</sup>, the incorporation of the European Technology Platform (ETP) for communications networks and services, which has a Working Group specifically dedicated to SMEs<sup>6</sup>. Following the liaison with NetworldEurope, it was agreed to present 5G-LOGINNOV and the 5 winners of the Open Call to the SME Working Group, through a dedicated session within one of their periodic meetings. The presentation has been carried out on January 16<sup>th</sup>, 2023, and saw the participation of 45+ attendees in virtual mode. After a general overview of the project, the session presented a special focus on opportunities for new actors (start-ups) and established actors (SMEs) to create new business opportunities and emerge in the market of 5G-related solutions in the port and logistics domains.

<sup>3</sup> Logistics Initiative Hamburg, <https://www.hamburg-logistik.net/en/>

<sup>4</sup> 6G Smart Networks and Services Industry Association (6G-IA), <https://6g-ia.eu/>

<sup>5</sup> NetworldEurope, <https://www.networlddeurope.eu/>

<sup>6</sup> NetworldEurope SME Working Group, <https://www.networlddeurope.eu/sme-wg/>



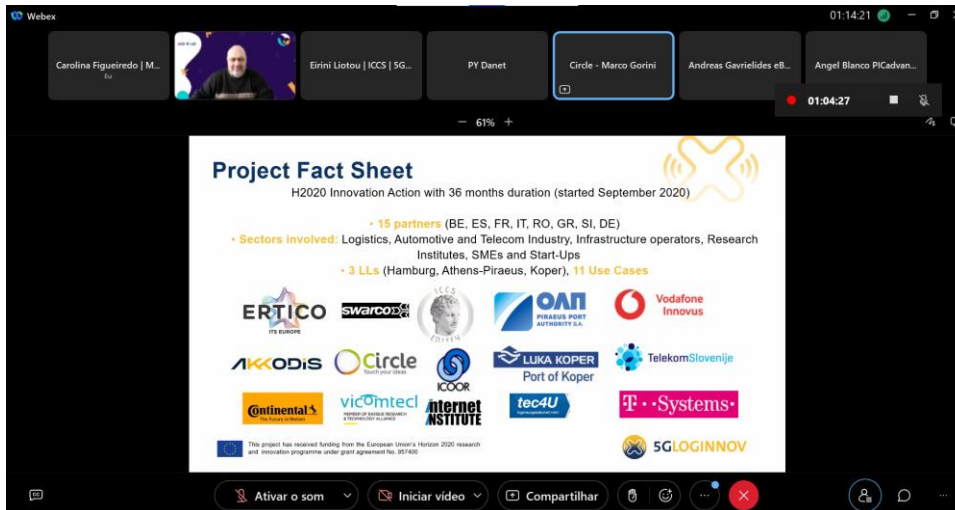


Figure 7: One moment of the 5G-LOGINNOV session at the NetworkEurope SME WG meeting on 16/01/2023

### 2.2.3 The event in Hamburg: “5G goes 6G: New Opportunities of Mobile Communication for Better City and Better Life”

As mentioned above, a milestone in this stream of activities has been a large hybrid event in Hamburg on February 23<sup>rd</sup>, 2023. The event was titled “5G goes 6G: New Opportunities of Mobile Communication for Better City and Better Life”. It was organized in cooperation with the Logistics Initiative Hamburg. The first part of the event (morning) presented major challenges and opportunities of next generation networks, basing on real use cases currently under development. In this context, the session “5G-LOGINNOV Use Cases - Lessons Learned” illustrated the role and the achievements of the 5 start-ups within the project. In the afternoon, the workshop “New opportunities for 5G-enabled next generation: plans towards 6G” put under the spotlight the roadmap for evolving current applications towards the new technology, providing highly valuable inputs (both technical, operational, and business-oriented) to the audience of candidate developers.



Figure 8: Pictures from Hamburg event, 23/02/2023

## 3 CO-CREATED BUSINESS MODELS

In line with the need to satisfy the increasing global request for freight transportation, one of the most promising technologies is represented by the 5G communication network that, together with other companion technologies, facilitates the collection, integration, and sharing of large amount of data from different sources. However, to ensure the market adoption of 5G-enabled innovative products and services, different actors of the logistics value-chain must be involved.

This section analyses the approach to assess stakeholders' expectations and their actual needs in the development process of the business models of the solutions implemented in the context of the 5G-LOGINNOV project. Specifically, it aims to define the main business opportunities by engaging in the business modelling process both the new entrants (the 5 start-ups that won the 5G-LOGINNOV Open Call for Innovative Start-Ups) and the established actors (the initial partners of the project, including SMEs).

### 3.1 Business Models in 5G-LOGINNOV Living Labs

#### 3.1.1 Athens

In the Athens Living Lab five different use cases have been developed and tested during the 5G-LOGINNOV Project:

- **UC2: Device Management Platform Ecosystem**, aimed to implement a data hub to offer a real-time data exchange between vehicles and fleet managers, thus providing truck drivers with alternative routes or alternative schedules, and reducing traffic and waiting times.
- **UC3: 5G&AI-enabled collision warning system between trucks and personnel**, focused on providing a 5G&AI enabled collision warning service between trucks and people in proximity, using data collected through high resolution cameras installed on the yard vehicles.
- **UC4: 5G&AI enabled human presence detection**, aimed to develop and implement a 5G&AI-enabled human presence detection service, using data collected through surveillance cameras installed on port's infrastructures, such as building and pillars.
- **UC5: 5G&AI enabled container seal detection for supporting the logistics supply chain**, aimed to use the NSA network of the port and advanced computer vision techniques (AI-enabled video analytics) to automatically detect the presence (or absence) of container seals during the loading (and unloading) process of vessels.
- **UC7: the 5G-LOGINNOV Predictive Maintenance**, focused on real-time collection and exchange of telemetry data of the yard vehicles to feed a predictive maintenance algorithm, with the objective to reduce maintenance costs and breakdown events of the vehicles, and increase their service lifetime.

#### Business Model adopted by the Athens Living Lab

Analysing the business models adopted by the Athens Living Labs with reference to the implementation of each UC, it is possible to highlight the **common value proposition of providing data exchange platforms between vehicles, infrastructures, and yard operators with the aim to improve the safety conditions of port's personnel (thus improving the working conditions), and to optimize ports' operations and resource planning**. All the data are collected through IoT sensors and high-definition cameras on vehicles and infrastructures and exchanged using a 5G platform to ensure a real-time and low latency collection and exchange of information.

The use cases implemented in Athens share a common focus on safety, technology integration, optimization, and user impact within a port environment, while also recognizing the broader benefits they can provide to various stakeholders in the logistics and transportation industry. It is possible to highlight **specific business objectives** for each of the use cases developed in Athens Living Lab.

- In **UC2**, the objective is to develop and test an easy to use and install product to provide the truck drivers with a "bird eye view" of the truck while manoeuvring, to increase the safety of the port personnel and to monitor the traffic inside the port. The main end-users impacted by this innovative solution are:

- **truck drivers**, with direct benefits in terms of improved information and reduction of working stress;
  - **port personnel**, directly impacted in terms of increase of safety within the port area;
  - **Port Authorities and Operations Managers**, impacted in terms of improvement of the safety and of the working conditions inside the port, thus reducing the costs for potential incidents (social cost).
- The objective of **UC3** is to develop and test a collision warning system based on 5G communication networks and AI algorithms, to prevent potential collisions between trucks manoeuvring in port areas and port personnel, with the aim to automatically detect the presence of humans and to send an alarm to truck drivers. The main benefits of this innovative solution are the increased safety for yard personnel (with reduction of potential injuries and reduction of working stress, even for truck drivers), and the optimization of operations and risk management. The main final users involved in UC3 are:
    - **Port Authority and Operations and HR management**, responsible for the safety of the human resources working in the port area, and for the working conditions of the port's personnel;
    - **security management**, directly impacted since it will be able to manage the security in the port's area with more detailed information, directly gathered in real time from the yard vehicles;
    - **yard personnel**, impacted by the increase of working conditions, and early detection of potential sources of risk events.
  - Concerning **UC4**, the objective is to develop a detection system for human presence in high-risk areas of the port, adopting a 5G and AI enabled video analytic service, to increase the safety for yard personnel, to allow a more effective detection of not allowed personnel in critical areas, to reduce potential injuries, and to optimize operations and risk management. The main final users involved are:
    - **Port Authority and Operations Management and HR management**, responsible for the safety of the human resources working in the port area and for the working conditions of the port's personnel.
    - **security management** will rely on more detailed and real-time information to manage the security in the port's area.
    - **yard personnel**, positively impacted by the improvement of working conditions and real-time detection of potential sources of risk events.
  - The value proposition of **UC5** is to develop an automated system to monitor and detect the presence or absence of container seals using an AI-enabled video analytics system. The main objectives are to optimize port operations (through automation of the seal monitoring), to improve the effectiveness in monitoring the correctness of the shipment, and to increase the safety for the goods handled in the port area (detecting potential compromised containers). The main final users involved in UC5 are:
    - **Port Authority and Operations Management**, in terms of optimization of the control procedures for the containers handled in the port area.
    - **legal department**, impacted by the improved capability of detection of potential compromised or missing cargoes, and the identification of the responsibility in case of non-compliant events.
  - Concerning **UC7**, the objective is to develop a 5G and AI enabled analytics service for the monitoring of the status of yard trucks, to increase their effectiveness through predictive maintenance actions, thus increasing their service life, and to reduce the breakdown events and downtimes for repairs. Furthermore, the development of an effective predictive maintenance programme leads to the reduction of maintenance costs, and to the reduction of stocks for spare parts. The main final users impacted by this solution are the ones mostly involved with the operations with yard trucks, and specifically:
    - at the planning level, **fleet management** is positively impacted by the increase of efficiency of the fleet of machineries, since the reduction of negative externalities (breakdowns and downtimes) will allow a better and easier planning of the yard activities.

- the increased monitoring of the status of the yard fleet will potentially increase the effectiveness of the maintenance actions (cost reduction for maintenance operations and reduction of safety stocks for spare components), and the increase of the service life of yard machineries will reduce the cost for their substitution.
- the increased service level of the yard machineries also has positive impacts on the **external transport and logistics companies** since they can rely on a more effective handling service (with reduced downtimes and breakdowns), allowing them to better plan their operations.
- from the **yard vehicle operators'** point of view, the increased monitoring of the status of the vehicles means better working and safety conditions, reducing the effects of stressful working conditions.

For all the use cases, the main channels through which the innovative solutions will be delivered are the live demonstrations, tests, and trials during the project, to spread the potential benefits and reach potentially interested stakeholders.

The main activities and required resources to develop the innovative services of the Athens Living Lab use cases rely with the deployment of the 5G network to ensure the real time data exchange, as well as the development, training and testing of the AI enabled systems to analyse the collected information and extract valuable outcomes from them. Moreover, high-definition cameras must be installed on vehicles and port infrastructures and integrated with existing systems.

To ensure the correctness and effectiveness of the development phase, the main key partners considered are network and telecom operators, IT providers and research institutes to develop the AI algorithms, HW providers (for the video surveillance devices) and vehicle providers.

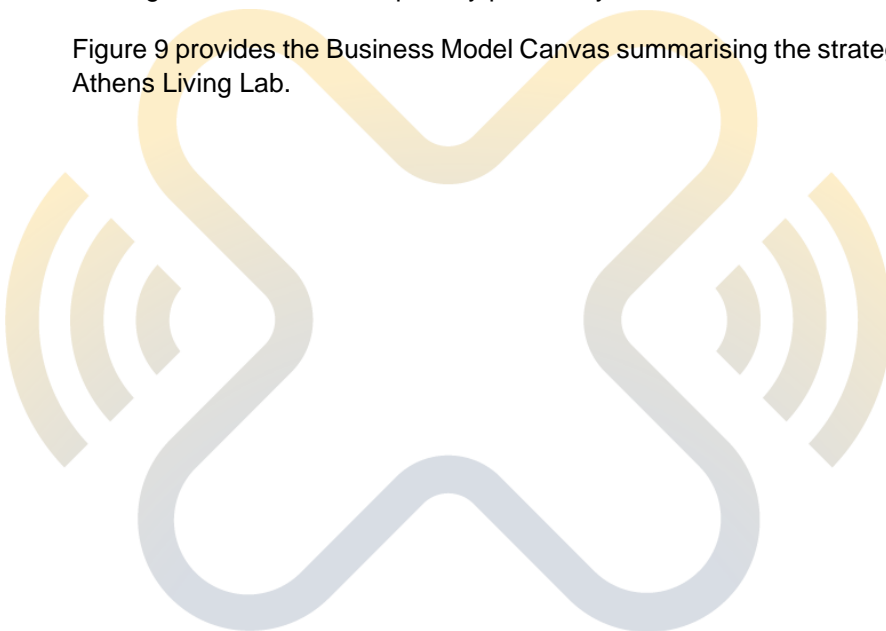
Concerning the economic perspective, the main sources of costs for the Athens use cases rely with

- the development costs of the communication network and AI enabled systems.
- the purchase, installation, and integration of the video surveillance devices on port's vehicles and infrastructures.
- operation and maintenance and administrative costs.
- scale up costs to foster the market adoption of the innovative services beyond the end of the project.

Considering the revenues, European funding will cover the initial development and test in the context of the Living Lab, while after the end of the project, the main sources of revenues are:

- cost savings coming from the optimization of the processes and of the infrastructure usage (increase of the service life for yard vehicles, reduction of failures and of downtimes for maintenance) will have positive impacts on maintenance costs, and indirect benefits on the effectiveness of the operation planning (relying on more efficient vehicles and infrastructures).
- increase of the quality of work for the yard personnel (reduction of working stress and improvement of safety are seen as social benefits).
- usage fees and licenses paid by potentially interested actors and stakeholders.

Figure 9 provides the Business Model Canvas summarising the strategy adopted by stakeholders of the Athens Living Lab.



<p><b>Key Partners</b></p> <ul style="list-style-type: none"> <li>- Network and telecom operators (analysis of the requirements and development of the network)</li> <li>- IT providers</li> <li>- Research Institutes (development of the AI algorithms)</li> <li>- HW providers (video surveillance devices)</li> <li>- Vehicle providers (integration of video devices and yard machineries)</li> </ul>	<p><b>Key Activities</b></p> <ul style="list-style-type: none"> <li>- Development of 5G networks for data exchange</li> <li>- Development, training and testing of the AI enabled systems to extract value from data</li> <li>- Installation of high definition cameras and integration with existing systems</li> </ul>	<p><b>Value Proposition</b></p> <ul style="list-style-type: none"> <li>- Provide data exchange platforms between vehicles, infrastructures, and yard operators to             <ul style="list-style-type: none"> <li>- improve the safety conditions of port's personnel</li> <li>- optimise ports' operations and resource planning</li> </ul> </li> <li>- Specific objectives             <ul style="list-style-type: none"> <li>- provide the truck drivers with a manoeuvring assistance tool (UC2)</li> <li>- develop and test a collision warning system to prevent potential collisions between trucks and port personnel (UC3)</li> <li>- develop a detection system for human presence in high-risk areas of the port (UC4)</li> <li>- develop an automated system to monitor and detect the presence or absence of container seals (UC5)</li> <li>- develop a 5G and AI enabled analytics service for the monitoring of the status of the yard trucks (UC7)</li> </ul> </li> </ul>	<p><b>Customer Relationships</b></p> <ul style="list-style-type: none"> <li>- Collaboration in the development and test phase of the Living Lab activities)</li> <li>- Customer-provider relationships for the exploitation phase of the solutions (after the end of the project)</li> </ul>	<p><b>Customer Segments</b></p> <ul style="list-style-type: none"> <li>- Vehicles' operators (improved information and reduction of working stress)</li> <li>- Port personnel (increase of safety conditions)</li> <li>- Port authority and operations             <ul style="list-style-type: none"> <li>- improvement of safety conditions</li> <li>- reduction of impacts of potential incidents</li> <li>- optimisation of operations and risk management</li> <li>- optimisation of the control procedures in container handling and identification of sources of non-compliance (UC5)</li> <li>- reduction of maintenance costs and spare parts stocks (UC7)</li> </ul> </li> <li>- Fleet managers             <ul style="list-style-type: none"> <li>- increase of efficiency of the fleet of machineries</li> <li>- increase of the service life of yard machineries</li> </ul> </li> <li>- Transport and Logistics operators (optimisation of operation planning)</li> </ul>
	<p><b>Key Resources</b></p> <ul style="list-style-type: none"> <li>- 5G networks</li> <li>- Video surveillance devices</li> <li>- IT skills to develop data exchange platforms</li> <li>- AI/ML developers to implement algorithms</li> <li>- Legal expertise to address data exchange policies at national and European level (e.g., GDPR)</li> </ul>		<p><b>Channels</b></p> <ul style="list-style-type: none"> <li>- Live demonstrations, tests, and trials to spread the potential benefits and reach potentially interested stakeholders</li> </ul>	
<p><b>Cost Structure</b></p> <ul style="list-style-type: none"> <li>- Development costs of the communication network and AI enabled systems</li> <li>- Purchase, installation and integration of the video surveillance devices on port's vehicles and infrastructures</li> <li>- Operation and maintenance costs</li> <li>- Administrative costs</li> <li>- Scale up costs to increase the potentials of market adoption of the solutions beyond the end of the project</li> </ul>		<p><b>Revenue Streams</b></p> <ul style="list-style-type: none"> <li>- European funding to support the initial development and test in the context of the Living Lab</li> <li>- Usage fees and licenses paid by potentially interested actors and stakeholders</li> <li>- Revenues coming from the adoption of the innovative tools</li> <li>- Cost savings coming from the optimization of the processes and of the infrastructures usage             <ul style="list-style-type: none"> <li>- increase of the service life for yard vehicles</li> <li>- reduction of failures and of downtimes for maintenance</li> <li>- increase of the effectiveness of the operation planning</li> <li>- increase of the quality of work for the yard personnel (reduction of working stress and improvement of safety conditions)</li> </ul> </li> </ul>		

Figure 9: Business Model Canvas (Athens Living Lab)

## Recommendations for the business success of the Athens Living Lab

Given the objectives of the use cases developed and tested in the Athens Living Lab, it is possible to define recommendations for deploying the innovative solutions.

For all the use cases, the Decision Makers are the **Port Authorities** and **Port Operations Managers**, since they are the main responsible of the operations in the port area, and they oversee the decisions related to infrastructure usage and operation planning. Moreover, they are the main entities involved in decisions related to process monitoring. It is important to ensure the **collaboration with external providers (mainly Network and Telecom Operators and IT Providers)**, in terms of analysis of the requirements of the tools and devices for the development of the innovative solutions, and the integration with existing systems in the port.

Port Authorities and Port Operations Managers are also the main users of the solution since the outcomes of the implementation of the innovative services are valuable for the optimization of the port's processes. Moreover, vehicle operators and yard personnel are also considered final users since their daily work will be impacted by the adoption of the solutions. Concerning UC5, the legal department of the port is considered a final user in terms of optimization of the monitoring of the shipments.

To ensure the success, the most important activities are the **configuration and customization of the IoT sensors and video surveillance devices to meet the specific requirements**. Secondly, **video capabilities will be incorporated into the platforms** to collect data and information about the port environment. The **development and deployment** of the monitoring platforms, service control platforms, and AI-enabled applications are also key decisions to consider. Lastly, **demonstrations, presentations, and awareness-raising activities** are planned during the Living Lab phase to showcase the use cases' potential and to engage stakeholders. Moreover, the innovative services tested in the Living Lab must be integrated with **existing policies and processes of the Port**.

The main information required to deploy the solutions are specifications related to 5G networks, information about monitoring devices and high-definition cameras, and knowledge and expertise in AI-enabled video analytics and information processing. Moreover, information about port operations, including traffic patterns, common scenarios for operations, policies and requirements are important to ensure the compliance of the innovative solutions.

Beside the technical constraints directly related to the technical development of the solutions, it is important to consider also national and European policies (such as GDPR) related to data confidentiality, since the use cases rely on video acquisition and sharing between different entities.

### 3.1.2 Hamburg

In the Hamburg Living Lab three different use cases are tested in 5G-LOGINNOV:

- **UC8/9: 5G-LOGINNOV Floating Truck & Emission Data (FTED)**, with the aim to implement a real-time monitoring of truck and emission data.
- **UC10: 5G-LOGINNOV 5G GLOSA & Automated Truck Platooning (GTP)-under 5G-LOGINNOV green initiative**, to develop and test the Green Light Optimized Speed Advisory (GLOSA), a platform to optimize vehicle usage and to reduce emissions and consumption.
- **UC11: 5G-LOGINNOV dynamic control loop for environment sensitive traffic management actions (DCET)**, aimed at implementing a V2X communication system to optimize operations and to reduce negative externalities in ports and surrounding areas.

### Business Model adopted by the Hamburg Living Lab

The main peculiarities of each use case tested in Hamburg are related to their value proposition and to the targeted **customers**.

For **UC8/9**, the value proposition is the provision of a framework to analyse the energy and fuel consumption per trip, as well as an analysis of the impacts of traffic management actions to reduce consumption and emissions, at the same time increasing service lifetime of vehicles and optimizing the scheduling of the operational workforce. The most impacted customers are expected to be:

- The **Port Authority**, in terms of increased users' satisfaction, optimization of the infrastructure planning, increased capacity management, and improvement of international cooperation.
- The **Terminal and ramp Operations Manager**, in terms of increased operational efficiency and optimization of cost and time management.
- The **Yard personnel**, impacted by the optimization of workflow, better alignment with internal and external operators and shippers, improved working conditions and reduction of work stress and potential injuries.
- The **Public Authority**, in terms of improved quality of life and work in the urban area, and compliance with sustainability goals.

For **UC10**, the value proposition is represented by the availability of a communication system between vehicles and infrastructures to optimize the usage of road networks and monitor vehicle positions to better synchronize operations, also implementing an automatic truck platooning system to optimize speed profiles. The main expected benefits are related to the reduction of emissions and consumption of vehicles, the improvement of the synchronization of port operations through real-time data collection from vehicles, with direct positive impacts on working conditions for personnel. The customer segments targeted for UC10 are represented by:

- The **Port Authority**, due to the increased users' satisfaction and optimization of the infrastructure planning and compliance with net-zero carbon policies.
- The **Port operations Manager**, in terms of optimization of the management process of daily peaks and deployment of truck platooning.
- **Port personnel**, impacted by the optimization of workflow, with improvement of the working conditions and reduction of work stress and potential injuries.
- The **Municipality**, in terms of sustainable traffic management, compliance with sustainable policies and requirements, and improvement of the safety in the road network.

Concerning **UC11**, the value proposition lies in the provision of a V2X information exchange system to reduce pollution in ports and retro-ports through the development of green-light priority, speed advisory systems, and the reduction of stop-and-go traffic conditions. For this use case, the main customer segments are:

- **Port Authority and Operations Managers**, due to the optimization of the activities and processes in the port area, cost reduction for vehicles' usage, reduction of incidents, and improved working conditions for personnel.
- **Terminal and Logistics Operators**, for the improved planning of the activities, in terms of synchronization of the terminal operations.
- **Public Authority**, in terms of optimization of the traffic flows within the urban area, increased quality of life for citizens and workers (reduction of congestion and pollution), compliance with sustainability policies and requirements.

The business models linked to the implementation of the three UCs in the Hamburg Living Lab have many common points. Specifically, the most relevant activities for all the UCs are:

- the development of 5G network and applications.
- the development of the platforms to collect and analyse data.
- the creation of the communication system to deliver the information to the final users.

In the Hamburg context, new monitoring systems on vehicles must be installed, and it is important to ensure the integration of these innovative systems with existing port's processes.

The 5G network and the linked connectivity infrastructure are the main resources required for implementing each use case developed in Hamburg, as well as the platforms for data collection, analysis, and communication. Concerning the administrative and legal management related to data collection and exchange, legal competences are needed to ensure the compliance of the innovative solutions with GDPR and other national policies.

The key partners involved in the development of the innovative products and services are:

- **network operators and IT service providers**, to ensure the feasibility of the solutions and the integration of the innovative systems with existing port processes.
- **research institutes** to support the development of the data collection and analysis platforms.
- **vehicles' suppliers** to ensure the data exchange between vehicles and infrastructures.

Concerning the customer relationships during the implementation and testing of the innovative services in the context of the Living Labs, co-creation and collaboration relationships are foreseen, while other kind of relationships (mainly customer-provider) will be applied to maintain and adopt the innovative solutions after the end of the project. For instance, the innovative service can be managed by a single entity and provided to other interested stakeholders or final users through subscriptions and usage fees.

The main channels through which to communicate the solution to the customers and to improve the customer base are part of the testing processes and procedures performed during the 5G-LOGINNOV duration. To deliver the outcomes of the data analysis to the targeted customers, applications for mobile devices and wearables will be adopted (e.g., direct messages to smartphones and tablets, alerts sent to smartwatches, etc.).

The main costs for implementing the UCs are related to:

- the development costs and the purchase and integration costs of the monitoring systems on vehicles and infrastructures.
- HR costs devoted to administrative and legal issues (compliance with GDPR and national policies on data collection and management).

Looking beyond the end of the project, scale up costs are foreseen to foster the actual market adoption of the innovative services and solutions in the market.

Considering the revenue streams, the initial development and test phase (in the Living Labs) is covered by European funding, while other sources of revenues, such as usage and licensing fees, must be foreseen to ensure the economic sustainability of the innovative solutions beyond the end of the project. Moreover, the main source of revenues to consider is the optimization of the port's operations and management, with direct impacts on the reduction of fuel consumption and emissions, time reduction for the port processes, and increase of the vehicles' efficiency (and of their lifetime).

Figure 10 provides the summary of the Business Model Canvas adopted in the Hamburg Living Lab.





<p><b>Key Partners</b></p> <ul style="list-style-type: none"> <li>- Network operators for the analysis of the requirements and implementation of the 5G network</li> <li>- IT service providers to ensure the feasibility of the solutions and the integration with existing port processes</li> <li>- Research institutes to support the development of data collection and analysis platforms</li> <li>- Vehicles' Suppliers and Infrastructure Managers to ensure V2X communication</li> </ul>	<p><b>Key Activities</b></p> <ul style="list-style-type: none"> <li>- Development of 5G network and application</li> <li>- Development of the platforms to collect and analyse data</li> <li>- Creation of the communication system to deliver the information to the final users</li> <li>- Installation of new monitoring systems on vehicles and integration with existing systems and processes</li> </ul>	<p><b>Value Proposition</b></p> <ul style="list-style-type: none"> <li>- Provide a framework to analyse the energy and fuel consumption per trip and analyse the impacts of traffic management actions to reduce consumption and emissions (UC8/9)</li> <li>- Provide a communication system between vehicles and infrastructures to optimise the usage of road networks and monitor vehicles' position (UC10)</li> <li>- Provide a V2X information exchange system to reduce pollution in ports and retro-ports, through the development of green-light priority, speed advisory systems, and reduction of stop-and-go (UC11)</li> </ul>	<p><b>Customer Relationships</b></p> <ul style="list-style-type: none"> <li>- Co-creation and collaboration relationships during the test phase in the context of the Living Lab</li> <li>- Customer-provider relationships to foster the adoption of the innovative solutions after the end of the project</li> </ul>	<p><b>Customer Segments</b></p> <ul style="list-style-type: none"> <li>- Port Authority <ul style="list-style-type: none"> <li>- increased users' satisfaction</li> <li>- optimisation of the infrastructure planning</li> <li>- increased capacity management</li> <li>- improved international cooperation</li> <li>- compliance with net-zero carbon policies</li> </ul> </li> <li>- Port Operations <ul style="list-style-type: none"> <li>- increased operational efficiency (management of daily peaks)</li> <li>- optimisation of vehicles' usage</li> <li>- implementation of truck platooning</li> <li>- cost and time optimisation</li> </ul> </li> <li>- Public Authority and Municipality <ul style="list-style-type: none"> <li>- improved safety and quality of life and work in urban area</li> <li>- optimisation of traffic flows</li> <li>- compliance with sustainability goals</li> </ul> </li> <li>- Port/Yard Personnel <ul style="list-style-type: none"> <li>- workflow optimisation</li> <li>- alignment between internal and external operators</li> <li>- improved working conditions (reduction of injuries)</li> </ul> </li> </ul>
	<p><b>Key Resources</b></p> <ul style="list-style-type: none"> <li>- 5G network and connectivity infrastructure</li> <li>- Platforms for data collection, analysis, and communication</li> <li>- Legal experts to ensure the compliance with GDPR and local policies</li> </ul>		<p><b>Channels</b></p> <ul style="list-style-type: none"> <li>- Tests and trials in the context of the Living Lab activities to spread the potential benefits and increase the awareness</li> <li>- Applications for mobile devices and wearables to deliver the outcomes of the data analysis to the targeted customers</li> </ul>	
<p><b>Cost Structure</b></p> <ul style="list-style-type: none"> <li>- Development costs for communication networks and data collection and analysis platforms</li> <li>- Purchase costs for monitoring systems and integration with vehicles and infrastructures</li> <li>- HR costs <ul style="list-style-type: none"> <li>- administrative and legal resources</li> <li>- scale-up (commercial and marketing resources) to foster the actual market adoption of the innovative services and solutions in the market beyond the end of the project</li> </ul> </li> </ul>		<p><b>Revenue Streams</b></p> <ul style="list-style-type: none"> <li>- European funding to support the initial development and test in the context of the Living Lab</li> <li>- Usage and licensing fees to ensure the economic sustainability of the innovative solutions beyond the end of the project</li> <li>- Cost savings coming from the optimization of the processes and of the infrastructures usage <ul style="list-style-type: none"> <li>- optimisation of the port's operations and management</li> <li>- reduction of fuel consumption and emissions</li> <li>- time reduction for the port processes</li> <li>- increase of the vehicles' efficiency and lifetime</li> </ul> </li> </ul>		

Figure 10: Business Model Canvas (Hamburg Living Lab)

## Recommendations for the business success of the Hamburg Living Lab

The main decision makers are the Port Authority and Port Operations' Managers, in collaboration with external providers (mainly Network and Telecom Operators and IT providers), because these entities are the ones in charge of the management of the port processes, and therefore of the choice of the implementation of innovative solutions.

The **Port Authority** and **Port Operations' Managers** are also the main users of the deployed solutions, since the outcomes of the implementation of the innovative services are valuable for the optimization of the management processes of the port, and for the reduction of consumption and emissions. Moreover, **Port Personnel** are also considered final users since they will be directly impacted by the adoption of the solutions. Concerning the environmental objective to monitor and reduce negative externalities in the port and surrounding areas, also **Public Authorities** and **Municipalities** are final users of the solution, since the proper application of the innovative services will improve their monitoring capabilities and provide them with more effective decision-making tools.

Concerning the decisions to be taken:

- For UC8/9 the main one is to **adopt the [ISO-23795-1](#) standard** as the foundation for analysing energy and fuel consumption per trip. This standard will provide a consistent framework for measuring and evaluating the environmental impact of transportation activities. Second, a **comprehensive solution must be developed and tested** to effectively analyse energy and fuel consumption per trip, aligning with the same standard. This solution will enable accurate monitoring and assessment of consumption patterns, facilitating targeted improvements. Additionally, continuously optimizing traffic management in the port and surrounding areas is essential. This involves implementing measures to reduce consumption and emissions to enhance environmental sustainability. Furthermore, taking **actions to fostering alignment and collaboration with internal and external operators and shippers in yard operations** will contribute to more efficient resource utilization and improved traffic flows. By making these informed decisions, the solution can effectively address the challenges associated with energy and fuel consumption, optimize traffic management, and deliver valuable benefits for actors and stakeholders in the port and its surrounding areas.
- For UC10, the **possibility to implement a Communication System and Automatic Truck Platooning is a crucial decision**. This involves establishing a reliable and efficient communication network that enables vehicles to interact with infrastructures and to optimize their speed profiles through truck platooning. Secondly, it is essential to **ensure the feasibility and seamless integration of the solution with existing systems**. Additionally, the decision to adopt the 5G-GLOSA (Green Light Optimal Speed Advisory) platform and monitoring systems is necessary to collect real-time data from vehicles and to enable synchronization of port activities. Furthermore, the solution should align with sustainable policies and requirements, ensuring **compliance with environmental regulations at national and European level**.
- Concerning UC11, at decisional level it is **important to increase the collaboration of actors and stakeholders** acting along the logistics corridors, **implementing** measures to foster cooperation. Secondly, the exchange of complex V2X information requires the development and utilization of a robust 5G network infrastructure, to enable the seamless and efficient communication between vehicles and infrastructures for data exchange and coordination. Therefore, the decisions to be addressed rely with the **analysis and definition of the network requirements, to comply with the integration with already existing systems and processes**. For the same reason, the development and implementation of a dedicated platform for data collection plays a crucial role, and at decisional level is important to **define the most suitable architecture to ensure the correct deployment** of the use case.

All the above-mentioned decisions imply the knowledge and collection of valuable and reliable information.

- In the **UC9** context, information regarding the logistic industry plays a crucial role to provide insights about factors such as energy and fuel consumption, emissions, and traffic control. These data help in identifying opportunities for optimization and efficiency improvements. Moreover, the adoption of 5G networks and companion technologies needs a significant source of information: for instance, research institutes may provide valuable insights into industry trends and best practices, while technology providers could offer state-of-the-art solutions and knowledge in implementing and leveraging emerging technologies.
- For **UC10** and **UC11**, it is very important to rely on information regarding the logistics industry, to provide insights concerning factors such as fuel consumption, emissions, truck platooning and traffic control. This data helps in identifying opportunities for optimization and efficiency improvements. Secondly, the adoption of 5G networks and the integration with 5G-GLOSA (UC10) is a significant key enabling factor to provide a high-speed and high-volume data exchange infrastructure, as well as the adoption of V2X communication protocols (UC11). Also in this case, Research Institutes provide valuable insights into industry trends and best practices, while technology providers offer state-of-the-art solutions and knowledge in implementing and leveraging emerging technologies.

Beside the technical constraints directly related with the technical development and implementation of the 5G network and with the setup and integration of the sensors and devices with existing port processes and systems, it is important to consider as a potential constraint the requirements for the adoption of the ISO-23795-1 standard. Moreover, since the solutions developed in Hamburg deal with data acquisition and management, it is important to consider also national and European policies (such as GDPR) related with data confidentiality.

### 3.1.3 Koper

In 5G-LOGINNOV, the Koper Living Lab is committed to testing and developing three use cases:

- **UC1: 5G-LOGINNOV Management and Network Orchestration platform (MANO)** has the aim to use the 5G-LOGINNOV architecture to deploy VNF (Virtual Network Functions) components.
- **UC5: The 5G-LOGINNOV automation for ports: port control, logistics and remote automation**, in which port machineries are equipped with high-definition cameras to capture images and to identify container markers and to detect damages, as well as vehicles operating in the port area are equipped with IoT devices for real-time data collection.
- **UC6: The 5G-LOGINNOV 5G mission critical communications in ports**, concerning the implementation of a real-time video surveillance to monitor specific port areas.

### Business Model adopted by the Koper Living Lab

The three use cases tested in the Koper Living Lab led to the identification of three linked business models, each having a specific value proposition.

Concerning **UC1**, the value proposition consists in the provision of a 5G-based architecture for the deployment of Virtual Network Functions (**VNF to enable automatic and on demand components**), with the aim to improve the communication in the port environment, optimising operations, and processes. The reliable, resilient, and low latency data acquisition enabled by the 5G network will have a positive impact on port operations, such as the **reduction of downtimes and optimization of resource usage**. Moreover, data collection and sharing with other port systems can bring positive effects in the entire value chain.

For **UC5**, the value proposition is represented by the availability of **high-definition cameras installed on port machineries**, to collect and share data with other port management systems. Images collected by the cameras will be processed to identify container markers and to detect damages on the containers, with direct benefits on operational optimisation (**reduction of downtimes and optimization in container handling**) and higher security (**improved detection system for damages**). At the same time, the use of IoT devices for real-time data collection and transmission from vehicles operating in the port area gives the port operator more information that can be used in further optimizing fuel consumption, as well as potentially enabling predictive maintenance.

Considering **UC6**, the value proposition is represented by the provision of **5G-based video surveillance systems** to optimize port operations and to improve safety and security in the port area, with main benefits related with the optimization and automation of security operations and procedures, through the implementation of a reliable, resilient, and low latency infrastructure for data acquisition, with increased **personnel safety and security** in specific areas of the port, and support for the operations of security management. The implementation of the proposed solution will directly affect the communication in the port area, with added value in terms of reduction of downtimes and improved working conditions for personnel.

The key partners necessary for the development and test of the innovative services related to all the UCs deployed in Koper are mainly Network and Telecom Operators and IT Service Providers to develop the VNF components, in collaboration with Software Developers and Research Institutes.

The three business models are addressed to similar customer segments:

- **Port Authority, Port Operations Managers, and Security Management Coordinators** of the port, with expected benefits related to improved effectiveness of operation planning and reduction of downtimes, and increased efficiency of the monitoring of specific port area.
- **personnel** of the port area will be impacted by enhanced security and therefore by better working conditions.
- **ICT and IT Managers** will also have a direct impact thanks to the increased quality of collected data.
- in UC5, the **Fleet Managers** operating in the port area can benefit by increasing the effectiveness of the usage of port machineries, thus increasing their lifetime, and reducing damages.

To reach the customer groups, the communication channels are the demonstrations and testing processes and procedures during the Living Lab activities. In addition, training activities may be foreseen together with the usage of applications for mobile devices and wearables.

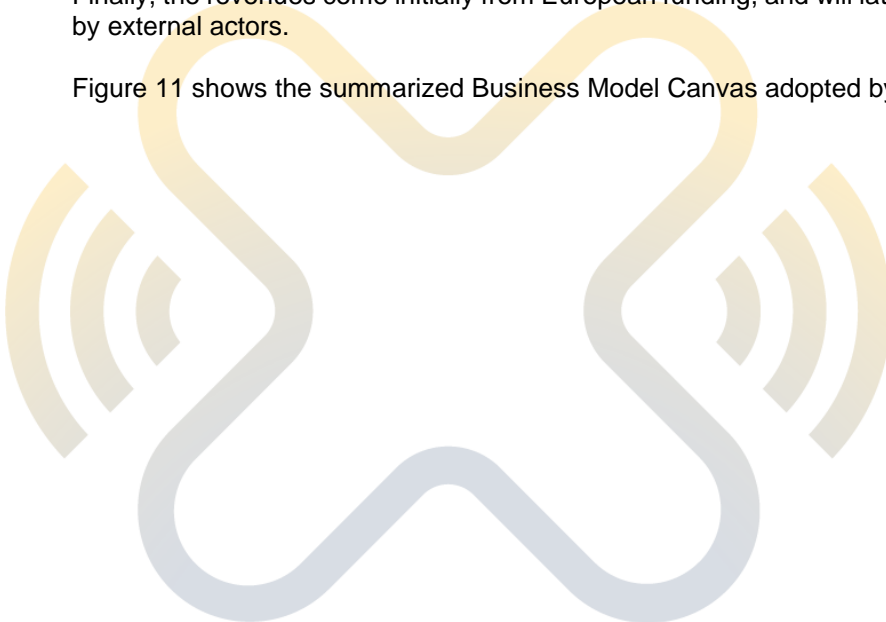
In terms of activities envisaged in the three cases, it appears predominant the **development of the 5G network, and system integration with existing platforms in the port operations**, such as the Terminal Operation System (TOS), and communication processes. In this context, training sessions for the end users are necessary to ensure the correct application of the innovative services. Consequently, the main key resources are those needed to deploy these activities, such as the **expertise of IT and TELCO operators to develop communication networks and protocols**, at the same time ensuring the integration with existing systems. For this purpose, ICT competences and access to intellectual property are necessary.

Other common points of the business models of the Koper Living Lab are the costs and revenues related to the development and deployment of the innovative services. The costs are mainly related to:

- the development of 5G networks and VNF.
- the integration of the innovative services and components with existing port processes and platforms.
- HR costs for specific personnel involved in the R&D phase, and administrative and legal personnel.

Finally, the revenues come initially from European funding, and will later be licensing or usage fees paid by external actors.

Figure 11 shows the summarized Business Model Canvas adopted by the Koper Living Lab.



<p><b>Key Partners</b></p> <ul style="list-style-type: none"> <li>- Network and Telecom operators for the analysis of the requirements and implementation of the 5G network</li> <li>- IT service providers and SW developers to develop the VNF components</li> <li>- Research Institutes to support the development of data collection and analysis platforms</li> </ul>	<p><b>Key Activities</b></p> <ul style="list-style-type: none"> <li>- Development of 5G networks</li> <li>- Integration with existing platforms (e.g., Terminal Operating System)</li> <li>- Training sessions to ensure the correct application of innovative tools</li> </ul> <p><b>Key Resources</b></p> <ul style="list-style-type: none"> <li>- Expertise in IT and TELCO context to develop communication networks and protocols and integrate them with existing systems</li> <li>- ICT competences</li> </ul>	<p><b>Value Proposition</b></p> <ul style="list-style-type: none"> <li>- Provide a 5G-based architecture for the deployment of Virtual Network Functions (VNF) (UC1) <ul style="list-style-type: none"> <li>o enable automatic and on demand components</li> <li>o improve the communication in the port environment</li> <li>o optimise operations, and processes</li> </ul> </li> <li>- Install high-definition cameras and real-time data collection IoT devices on port machinery and vehicles (UC5) <ul style="list-style-type: none"> <li>o data collection and sharing with other port management systems</li> <li>o identification of container markers and container damages</li> <li>o optimisation of container handling</li> </ul> </li> <li>- Provide 5G-based video surveillance system (UC6) <ul style="list-style-type: none"> <li>o optimise port operations</li> <li>o Improve safety and security in the port area</li> <li>o Reduce downtimes</li> <li>o Increase working conditions for personnel</li> </ul> </li> </ul>	<p><b>Customer Relationships</b></p> <ul style="list-style-type: none"> <li>- Co-creation and collaboration relationships during the test phase in the context of the Living Lab</li> <li>- Customer-provided relationships to foster the adoption of the innovative tools and services beyond the end of the project</li> </ul> <p><b>Channels</b></p> <ul style="list-style-type: none"> <li>- Demonstration and testing of the innovative solutions during the Living Lab activities</li> <li>- Applications for mobile devices and wearables to communicate the outcomes to the end users</li> <li>- Personnel trainings</li> </ul>	<p><b>Customer Segment</b></p> <ul style="list-style-type: none"> <li>- Port authority and operations <ul style="list-style-type: none"> <li>o increase the effectiveness of operation planning</li> <li>o reduce downtimes</li> </ul> </li> <li>- Port Security Management <ul style="list-style-type: none"> <li>o increase the monitoring capabilities in specific port areas</li> </ul> </li> <li>- Port Personnel <ul style="list-style-type: none"> <li>o improve safety and security in the port area</li> <li>o improve working conditions</li> </ul> </li> <li>- Port ICT and IT Management <ul style="list-style-type: none"> <li>o increase the quality of collected data</li> </ul> </li> <li>- Fleet Management (UC5) <ul style="list-style-type: none"> <li>o optimise the usage of port machineries (reduce damages and increase of service lifetime)</li> </ul> </li> </ul>
<p><b>Cost Structure</b></p> <ul style="list-style-type: none"> <li>- Development of 5G networks</li> <li>- Development of VNF functions</li> <li>- Integration of the innovative services and components with existing processes and platforms</li> <li>- HR costs <ul style="list-style-type: none"> <li>o resources with specific skills involved in the R&amp;D phase</li> <li>o administrative and legal costs (to address potential issues concerning GDPR and data confidentiality)</li> <li>o scale-up (commercial and marketing resources) to foster the actual market adoption of the innovative services and solutions in the market beyond the end of the project</li> </ul> </li> </ul>		<p><b>Revenue Streams</b></p> <ul style="list-style-type: none"> <li>- European fundings to support the initial development and test in the context of the Living Lab</li> <li>- Usage and licensing fees from external actors and stakeholders to ensure the economic sustainability of the innovative solutions beyond the end of the project</li> <li>- Cost savings coming from the optimization of the processes and of the infrastructure usage <ul style="list-style-type: none"> <li>o increase of the effectiveness of port operations</li> <li>o increase of the safety and security in the port area</li> <li>o increase of vehicles efficiency (reduction of failures and downtimes)</li> </ul> </li> </ul>		

Figure 11: Business Model Canvas (Koper Living Lab)

## Recommendations for the business success of the Koper Living Lab

The identified main decision makers of the Koper Living Lab case are the Port Authority and Port Operations Managers, in collaboration with external providers such as Network and Telecom operators and IT providers. Port Authority and Port Operations Managers are also final users of the solution since the outcomes of the implementation of the innovative services are valuable for the optimization of the management and of the safety of the port processes. Moreover, port personnel are directly impacted by the adoption of the solutions in terms of increased safety and working conditions.

The main decisions to be taken include, in general, the **selection of the appropriate 5G network components and architectures**, considering factors such as scalability, performance, and compatibility with the specific requirements of port operations.

- For UC1, **determining the integration approach for connecting the 5G network and VNF components with existing platforms** in the port operations is crucial to establish seamless communication and data flow between systems, optimizing the performance and effectiveness of the use case.
- Concerning UC5, the main decisions are the **right selection of which type of high-definition cameras to adopt** considering factors such as image quality, resolution, durability. Moreover, the **definition of the integration approach** for connecting the high-definition cameras, video-analytics software, and other port support systems, such as the Terminal Operating System (TOS), is a key decision. In regard to IoT devices deployed in the port vehicles, the main decision is related to the data collected, as well as its frequency; while the deployed IoT devices allow collecting a large amount of data, careful consideration must be taken in whether this data can lead to decisions that improve fuel efficiency, as well as enable predictive maintenance.
- For UC6, the **identification of requirements** for the development of a reliable and resilient 5G network is a milestone. Moreover, suitable video surveillance devices, including body-worn cameras, portable surveillance cameras, and drones, need to be selected and integrated with existing platforms. The development and testing of analytics software are necessary for real-time monitoring and data acquisition, as well as personnel/team status monitoring. Training sessions should be conducted to ensure proper utilization of the video surveillance systems. Communication and coordination mechanisms should be established to support security management and operational efficiency. **Continuous assessment** and improvement of the solution based on feedback and evolving security needs are also crucial.

To ensure the correctness and effectiveness of the decision processes, a set of Information and resources is needed.

- For UC1, **detailed information about the 5G-LOGINNOV architecture and its extensions** is required to help the design and development process and to ensure compatibility with port operations. **Knowledge and experience** in 5G network technologies, virtualization, and network function virtualization (NFV) is essential. **Access to intellectual property** related to 5G networks, VNF components, and network management is crucial for building upon existing knowledge and for avoiding potential legal issues. Research institutes may provide valuable **insights into industry trends and best practices**, while technology providers offer **state-of-the-art solutions and knowledge** in implementing and leveraging emerging technologies.
- Concerning UC5 and UC6, **specifications related to 5G networks**, information about monitoring devices and high-definition cameras, and **knowledge and expertise in AI-enabled video analytics** is essential for the correct implementation of the decision process. Moreover, for UC5, information about the different types of containers used and their characteristics is crucial, while for UC6 it is important to have a detailed knowledge of the potential risk factors, as well as the policies and national/European laws in terms of work safety. Information related to data present in the vehicle internal communications bus is important, to enable proper data collection through the use of IoT devices.

The technical constraints are directly related with the technical development and implementation of the 5G network and with the setup and integration of the sensors and devices with existing port processes and systems. Moreover, since the solutions developed in Koper rely with acquisition and management of data coming from video surveillance systems, it is important to consider also national and European policies (such as GDPR) related to data confidentiality.

## 3.2 Business opportunities for new actors

A relevant ambition in 5G-LOGINNOV is to support new actors in their emergence in the logistics industry by exploiting the opportunities raised by the introduction of 5G and soon, by 6G. To deal with this ambitious scope, 5G-LOGINNOV has promoted the 5G-LOGINNOV Open Call for Innovative Start-ups, described in detail in [Deliverable 4.2 “Start-ups integration report”](#) and whose follow up activities are reported in Section 2.1 of this document. As a result, five innovative solutions have been introduced in the 5G-LOGINNOV Living Lab:

- **Hellenic Drones<sup>7</sup> introduced the TRITON solution**, which aims to develop a system that will enable autonomous drone flights specifically designed for port environments, within the Koper Living Lab.
- **Libra AI<sup>8</sup> proposed the RESONATE solution**, to be developed and tested in the Athens Living Lab, with the aim to develop an effective and low-cost driver drowsiness detection system targeting professional drivers and fleets.
- **eShuttle<sup>9</sup> presented the 5G4A (5G-Loginnov-4-Amazon) idea** for the Hamburg Living Lab, which has the objective to share anonymized data of telematics devices as well as road characteristics.
- **Uze! Mobility GmbH<sup>10</sup> launched the TAXi-AD Data (TAADD) solution** for the Hamburg Living Lab, to collect directly from vehicles data related to energy behaviour and provide a detailed manoeuvre analysis in specific time-windows.
- **Roads.AI<sup>11</sup> brought “Intelligent Traffic Guidance System” (ITGS) solution** for the Hamburg Living Lab with the aim to improve traffic flows by transmitting optimal driving advisory to selected vehicles on the network.

To increase the impact of the project on the five companies, a continuous interaction with each of them was established to guide the modelling of their business within the context of 5G-LOGINNOV and facilitate their business integration in the market. In addition, a plan for their future business model has been identified (and reported in Deliverable 5.5 “Exploitation Report”, that will be published on the [5G-LOGINNOV project website](#) when the project is formally ended).

This section refers to the business modelling analysis done with the start-ups winning the 5G-LOGINNOV Open Call for Innovative Start-ups. Specifically, we present the business strategies and solutions discussed and designed with each of them).

### 3.2.1 Hellenic Drones business strategies for TRITON

The initial objective of the TRITON solution is to **develop a system for autonomous drone flights in port environments**. This involves defining aerial paths for drones to conduct various port operations, with the aim of reducing CO<sub>2</sub> emissions and improving the port's environmental impact. Additionally, TRITON seeks to enhance health and safety standards by introducing autonomous drone operations and reduce costs associated with port activities through the utilization of advanced drone technology. Outside the Living Lab, when TRITON enters the market, the objectives will expand: the focus will be to **enable fully autonomous drone operations**, allowing drones to navigate and operate without human intervention. This autonomy contributes to cost efficiency as it minimizes the need for extensive human resources. Furthermore, TRITON aims to develop a vehicle-agnostic system, ensuring compatibility with different types of drones to accommodate diverse industry needs and preferences. Lastly, TRITON seeks to provide an expendable and upgradable solution.

The TRITON project managers play a crucial role in guiding the development and implementation of the autonomous drone solution in port environments, together with the 5G-LOGINNOV partners in Koper, who contribute with their expertise and provide insights to shape the direction of the partnership and ensure the successful integration of 5G technology. Additionally, the Luka Koper Port Authority plays a pivotal role in making decisions related to the implementation and operation of the TRITON system within the port environment.

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<sup>7</sup> <https://hellenicdrones.gr/>

<sup>8</sup> <https://www.libramli.ai/>

<sup>9</sup> <https://www.e-shuttle.de/>

<sup>10</sup> <https://www.taxi-ad.de/>

<sup>11</sup> <https://www.roadsai.co/>

Luka Koper Port Authority is the critical end-user during the project. In general, beyond the 5G-LOGINNOV domain, port authorities and agencies, along with service providers for port operations, could become key users of the TRITON system. Maritime companies also may emerge as final users. Initially targeting the European market, TRITON aims to expand its system offerings globally. This means that final users across different regions and markets can benefit from the TRITON solution, providing autonomous drone operations for a wide range of applications and industries.

In the initial phase, the solution relies on strong partnerships with 5G-LOGINNOV Consortium Partners and other participants in the Koper Living Lab. These partners bring their expertise, resources, and domain knowledge to drive the development and deployment of the autonomous drone system in port environments. As the solution progresses beyond the end of 5G-LOGINNOV, drone service providers join the partnership network, further enriching the ecosystem.

During the experience in the Koper Living Lab with 5G-LOGINNOV, several decisions are implemented to drive the TRITON project forward. In particular, the main decisions are:

- The implementation of the autonomous drone flights in port area implies that the infrastructures and devices have to **comply with national and European policies and requirements** (with the engagement of the Civil Aviation Agency of the Republic of Slovenia). Moreover, the compliance with existing policies and requirements is important to foster the market penetration of the innovative services in other contexts, external to the port environment.
- Outside the Living Lab, in the market penetration phase of the TRITON solution, the focus remains on technology development and dissemination, ensuring that the system evolves to **meet the changing demands of future Urban Air Mobility (UAM) technologies**. Upscaling the TRITON system becomes a priority, expanding its scope and applicability to broader UAM applications beyond port environments.
- Concurrently, activities are implemented to **foster public acceptance of UAM applications** in urban environments.

Thanks to 5G-LOGINNOV, TRITON has access to valuable information and resources. This includes **specifications related to 5G networks and algorithms**, essential for developing and optimizing the autonomous drone system. The project also provides access to a cloud server and telecommunication infrastructure provided by the Koper Living Lab. Outside the Living Lab, the availability of information and resources remains crucial: in this phase TRITON benefits from its own dedicated and experienced staff, who bring expertise in developing and maintaining the system. The cloud server and telecommunication infrastructure provided by the Koper Living Lab may continue to be valuable assets.

The robustness and reliability of the 5G network infrastructure is crucial for the successful implementation of the autonomous drone system. Additionally, building strong relationships with stakeholders such as port authorities, technology providers, and potential customers is also essential but can be challenging due to varying interests and priorities. Lastly, gaining public acceptance of UAM applications in urban environments may pose a constraint. Outside the Living Lab, there are further potential constraints to consider. Activities aimed at public acceptance, such as educating the public and addressing concerns, continue to be important to overcome barriers and foster acceptance of UAM applications. Upscaling the TRITON system to be compatible with various future UAM technologies poses a **challenge**, requiring further development and adaptation. Managing sales, maintenance, replacement, and repair processes also becomes crucial as the customer base expands, necessitating efficient customer support and service.

During the experience in the Koper Living Lab, the costs of the TRITON solution include various components:

- equipment costs (procurement of drones, sensors, cameras, and computers).
- personnel costs for skilled professionals.
- marketing expenses to promote the solution and create awareness among potential stakeholders.



Outside the Living Lab, the costs expand to support ongoing operations and growth. In particular, the main cost sources to consider are:

- sales costs (technical architecture, equipment and supplies, and expendables/consumables) required for deploying and maintaining the TRITON system.
- R&D costs for continuous product updates and innovations to ensure competitiveness and meet evolving market demands.
- marketing expenses for product promotion.
- administrative expenses (staff costs and payroll, facilities renting, stationery, travelling, repair and maintenance, as well as subscriptions) to support the day-to-day operations and management of the TRITON solution.

### 3.2.2 Libra AI business strategies for RESONATE

The primary objective of the RESONATE driver drowsiness detection solution is to **support drivers and prevent accidents in the workplace**. By continuously monitoring the driver's condition and alerting them when signs of drowsiness are detected, the system aims to

- **ensure the safety** and well-being of **drivers** while on the road.
- **optimize the efficiency and safety of the workforce** by reducing the risks associated with driver fatigue and drowsiness, increasing productivity, and reducing downtimes.
- assist to be **compliant with policies and regulations** related to driver safety.
- improve road and traffic conditions by **mitigating the risks** posed by drowsy drivers.
- **prevent accidents** and potential traffic disruptions.

Once tested in the Athens Living Lab, the solution can be widely adopted in the market, also fostering the results of a real use case to communicate its effectiveness and low impact (at driver level). The partners of the 5G-LOGINNOV consortium can increase the impact of the development and test phase of the solution, providing valuable insights on the port environment, as well as on policies and requirements regulating the logistics activities. Beyond the end of the project, the Consortium can act as an exploitation channel to foster the market adoption of the RESONATE tool.

During the experience in the Athens Living Lab of 5G-LOGINNOV, the **decision makers** include:

- project managers from Libra AI, responsible for overseeing the development and implementation of the driver drowsiness detection system;
- Port Authority to provide valuable insights and guidance on the specific requirements and regulations within the transport industry.

Outside the Living Lab, the decision-making landscape expands to include different stakeholders. In particular:

- local Public Authorities are responsible for enforcing regulations and ensuring road safety;
- transport companies as potential customers and end users of the driver drowsiness detection system.

In 5G-LOGINNOV, the RESONATE driver drowsiness detection system targets multiple **final users** within the port environment.

- **Fleet Operators** and **Fleet Managers** in the port are key users, responsible for the management and operation of the vehicle fleets. They can use the system to enhance fleet safety and mitigate the risks associated with driver drowsiness.
- **Drivers**, with direct benefit from the system's real-time monitoring and alerting capabilities, helping them maintain their alertness and prevent incidents.
- **Port Authorities**, interested in promoting safety and efficiency within the port environment.

Beyond the Living Lab, the range of final users expands.

- **Fleet operators** and **fleet managers** across various industries and transportation sectors become decision makers in adopting the technology.
- **Drivers** continue to be important users who rely on the system to maintain their alertness and well-being.
- **Local Public Authorities**, including government and regional bodies, take on decision-making roles to ensure regulatory compliance and promote road safety.
- **Unions** continue to advocate for the rights and well-being of drivers, considering the impact of the system on their working conditions.

The **channels** for promoting the RESONATE driver drowsiness detection system include networking events and social media platforms for showcasing the technology, Living Lab tests for validation and improvement, mobile apps and wearables for convenient implementation and communication with final users. To ensure effective fleet management and monitoring, a dashboard is provided as a channel for fleet operators and managers. Beyond the project it will be possible to maintain and improve the same communication channels.

To implement the RESONATE driver drowsiness detection solution effectively, important **decisions** need to be made. These decisions imply the specifications of the high-speed communication platforms and of the Decision Support Systems to be adopted, as well as how to integrate them with the existing systems and procedures to ensure real-time monitoring, accurate drowsiness analysis, and efficient data exchange. The same decisions shall be considered also after the end of the project and in other contexts.

The successful implementation of the RESONATE solution requires **specific information and resources** to support its development and operation.

- Detailed specifications related to 5G networks, including their capabilities, coverage, and reliability, are necessary to ensure the compatibility and optimal utilization of AI and ML algorithms.
- Understanding the specific requirements and technical aspects of the 5G network will enable the design and implementation of an efficient and robust communication infrastructure for the solution.
- Access to a reliable cloud server and telecommunication infrastructure is crucial.

The same resources are needed for the application of the tool in different contexts outside the project; in these terms, the experience gathered in the development of the 5G-LOGINNOV project acts as an important asset for the future market penetration of the RESONATE solution.

The implementation of the driver drowsiness detection solution is subject to several potential **constraints**:

- the robustness and reliability of the 5G network are crucial to ensure uninterrupted communication and data transfer between the on-board system and the cloud-based ML-API service;
- the availability of skilled professionals with coding and programming expertise is essential for successfully developing and implementing the solution (development of the image-based detection system, design the Decision Support System, and perform APIs and web development for seamless integration with other support systems).

To address these challenges, the activities and tests performed in the context of the Living Lab are important to create a scalable and repeatable process, and to identify the potential risks and barriers, as well as the strategies to overcome them. To ensure an effective and wide adoption of the solutions beyond the end of the project, it is important to foster the integration of the solution with other systems through APIs and web development, with the aim to make it flexible and easily adaptable to different contexts. Lastly, while the availability of relevant data is important in the Living Lab context to train the ML and AI models, the **policies for data collection and exchange** must be addressed in the commercialisation phase of the solution (beyond the end of the project) to ensure data privacy and compliance with GDPR and other national and European regulations.

The costs associated with implementing the driver drowsiness detection solution can be categorized into fixed costs (which include employee salaries) and variable costs. Variable costs include.

- maintenance costs for the tool itself.
- hardware costs (including its installation in vehicles).
- on-site support (essential to provide technical assistance).
- development and implementation costs.

These cost categories are relevant both for the development and test of the solution within the Living Lab and for its future commercialisation outside the 5G-LOGINNOV project. Moreover, to foster the wide adoption of this system beyond the end of the project, it is important to consider also scale up and marketing costs, as well as administrative costs to manage the relationships with the customers.

### 3.2.3 eShuttle business strategies for 5G4A

The objectives of 5G4A are multifaceted and aim to address various aspects of dispatching, order management, sustainability, and collaboration within the logistics industry. In the project's scope, the objectives include:

- improving dispatching and order management processes for Amazon fleets.
- optimizing route and tour planning to enhance efficiency and reduce delays.
- achieving savings in fuel consumption and emissions through data-driven optimizations.
- aligning with sustainability goals to contribute to carbon reduction.

These objectives not only focus on immediate project goals but also extend beyond its end. After the project concludes, the general objectives include further carbon reduction efforts, continued fuel savings based on fleet data from suppliers, fostering enhanced collaboration with logistics partners such as Amazon suppliers and eShuttle customers, and sustained optimization of route and tour planning.

During the experience in the Hamburg Living Lab with 5G-LOGINNOV, the decision-making process involved several key stakeholders.

- The **project managers from e-Shuttle** play a crucial role in overseeing and coordinating the various activities, ensuring the smooth execution of the project.
- Among the 5G-LOGINNOV partners, the **Port Authority**, being responsible for the infrastructure and operations, holds decision-making power to facilitate the implementation of the project within the premises.

Outside the Living Lab, the Port Authority maintains its decision-making role. Additionally, an **IT Developer**, possibly engaged during the project, may continue to play a decision-making role, providing ongoing technical support, maintenance, and further development of the implemented solution. Together, these decision makers ensure the sustainability, optimization, and continuous improvement of the project's outcomes.

While **Port Authority** and **Logistics Service Operators** are the most impacted stakeholders and final users of this solution within the Living Lab, looking beyond the end of the project the potentially interested users of the 5G4A solution encompass various stakeholders within the logistics and business landscape. In particular:

- **Logistics Service Operators**, facing pressure to reduce fuel costs, can benefit from the optimized route planning and order management capabilities.
- **Large-scale and local enterprises** (e.g., private transport operators, fleet management companies, etc.), particularly under pressure to save carbon emissions, can leverage the project's insights and tools to meet their sustainability targets.
- additionally, the solution positions itself as a reference for LCMM and potential CO<sub>2</sub> certificates through the electrification of the logistics process.

The promotion channels involve conducting meetings with relevant management levels. These meetings serve as a platform to present the potential savings in fuel and costs that can be achieved through the proposed solution. Additionally, follow-up activities are undertaken to ensure the integration of fuel-saving practices into the organization's commercial activities. Beyond the project, the same communication and promotion channels can be improved to foster the market penetration of the solution.

During the experience in the Hamburg Living Lab with 5G-LOGINNOV, several decisions had to be made.

- Firstly, it was crucial to define the **data anonymization and privacy policies** to ensure the secure sharing of telematics data with Amazon logistics services. This step was vital to protect sensitive information while enabling the exchange of valuable insights.
- Another important decision relied with the **design and specifications of the infrastructure and software** for data collection, storage, and analysis to ensure the effectiveness of the innovative service. In this context, the tests performed in the Living Lab are mostly important to provide insights about the performances needed by the infrastructure, and to provide a benchmark for future applications.

Outside the Living Lab, important evaluations need to be made. The first is to assess the **potential carbon reduction** achieved through the optimized route and tour planning facilitated by the shared data. Furthermore, it is essential to analyse the collected data comprehensively. By delving deeper into the dataset, additional opportunities for efficiency improvements and emissions reduction can be identified.

With 5G-LOGINNOV, several information resources are required to ensure the success of the project. These include specifications related to 5G networks to facilitate seamless connectivity and data transfer. Integration with the Amazon platform and APP is crucial for effective order management and communication with certified Amazon logistics suppliers. Additionally, the availability of telematics data and devices is essential to gather real-time information on vehicle and driving behaviour, as well as negative road characteristics. Outside the Living Lab, the focus shifts to additional information resources, such as an e-Shuttle team of experienced personnel and reliable suppliers that will continue the implementation of the solution.

During the experience in the Hamburg Living Lab, there are several potential constraints to consider.

- First, the **availability and reliability of the 5G network connectivity** must be ensured to support the data transmission and communication requirements of the solution.
- Effective **coordination and collaboration** among the various stakeholders involved, including eShuttle, Amazon logistics, and 5G-LOGINNOV partners, are vital to ensure smooth implementation and operation of the solution.
- Privacy constraints to **safeguard the exchange of the anonymized telematics data**.

Outside the Living Lab, new constraints may arise; the most impacting ones deal with:

- the **acceptance and adoption** of the solution by logistics service operators and other stakeholders in the market.
- the **scalability and flexibility of the solution** to accommodate larger fleets as it expands beyond the initial pilot phase (in this context, adapting the solution to different operational contexts and requirements will be necessary).
- the **integration potentials** of the solution with existing processes and systems of logistics service operators.
- the **compliance with regulatory and policy landscape** related to data privacy and transportation, essential for successful implementation and long-term viability.

The costs associated with the implementation of the solution encompass various aspects. Firstly, there are **data costs** related to the collection, analysis, and modification of data, ensuring its accuracy and usefulness. **Hardware costs** include the acquisition and integration of devices necessary for data collection and transmission. Software costs involve the development and maintenance of a common interface that enables efficient data management. Additionally, there are **maintenance and administrative costs**. To foster the market adoption of the 5G4A solution beyond the end of the project, other costs must be considered. These costs are mainly linked to the **setup of a proper organization** in charge of business development, marketing activities, and administrative functions. Moreover, it is mostly important to **comply with policies and regulations referred to data collection and exchange**, and this implies the engagement of human resources with legal expertise.

### 3.2.4 Uze! Mobility GmbH business strategy for TAADD

TAADD aims to improve data collection by addressing the need of comprehensive traffic data. By utilizing taxi fleets equipped with sensors, the solution enables the collection of valuable information on various mobility factors, allowing for a more accurate understanding of traffic patterns and conditions. TAADD seeks to **optimize inner city traffic** by proactively managing and improving traffic flow. Another objective is to **monitor fuel costs and carbon footprint**. By gathering data on energy behaviour and analysing fuel consumption, the solution contributes to the monitoring and reduction of fuel costs and carbon emissions. Furthermore, the solution aims to support testing scenarios and traffic management.

During the experience in the Hamburg Living Lab, Uze! Mobility GmbH project managers, the 5G-LOGINNOV consortium members, and the Network Provider collaborate for the development and implementation of the TAADD solution, leveraging the capabilities of 5G technology and ensuring seamless integration with the existing network infrastructure. Outside the Living Lab scopes, the solution implementation may involve also other IT partners, and local public authorities.

In the Hamburg Living Lab, the final users are **network providers, fleet operators, Public Authorities**, owners of the traffic infrastructure, and **start-ups specializing in big data**. These users play crucial roles in using and testing the solution within the lab environment. Their expertise and involvement are essential for evaluating the effectiveness and feasibility of the proposed system. Outside the Living Lab, the final users expand to a broader range of stakeholders:

- **public sector entities** such as ports and airports can benefit from the solution's data collection and optimization capabilities to enhance their operational efficiency.
- **transport operators** such as taxi companies and taxi drivers can leverage the solution to optimize their operations, thus providing a more effective and reliable service through a real-time monitoring of the traffic conditions.

Within the context of the Living Lab, various tools to facilitate the usage of TAADD are foreseen: the main one is the individual interface that enables seamless data exchange with the 5G and 6G providers. Additionally, regular meetings are held to evaluate and optimize the strategy for implementing the solution. Furthermore, group meetings involving all key partners and customers play a crucial role in fostering collaboration and coordination among stakeholders. These meetings facilitate knowledge sharing, alignment of objectives, and collective decision-making, ensuring a cohesive and unified approach to implementing the solution. Beyond the end of the project, it is possible to maintain and improve the same approach.

Several decisions need to be made:

- firstly, there is the decision to prioritize the equipment of taxi fleets with sensors.
- secondly, the design and analysis of the needed specifications of software solutions, crucial to ensure the reliable and effective collection, management, and analysis of the mobility data collected.
- increasing the number of sensors is another key decision to ensure a more comprehensive and accurate understanding of road conditions, traffic flow, and other relevant factors.

To implement the solution, both in the context of the Hamburg Living Lab and, in the future, various sources of information are required. Firstly, patents or information related to the technology and processes involved in the solution are crucial. Additionally, establishing contacts in the taxi business is important to understand market dynamics, operator needs, and potential collaborations.

The complexity of data collection and processing may be a challenge. Additionally, significant investments are needed to advance the hardware, develop the necessary software, and deploy sensors on taxis. Furthermore, ensuring the proper calibration, durability, and maintenance of the sensors is crucial to guarantee reliable data collection. This requires ongoing monitoring and upkeep to maintain accurate and consistent results.

Various costs categories need to be considered.

- **costs associated with data collection** (data acquisition, processing, and storage).
- **hardware costs** covering the acquisition of devices and their installation in taxis.
- **software costs** associated with developing and maintaining a common interface.
- **maintenance costs** for regular hardware check-ups, support for taxi entrepreneurs using the solution, and IT support for system maintenance and updates.
- **administrative costs** for personnel and communication expenses, planning and coordination efforts, as well as accounting and financial management related to the implementation and operation of the solution.

Beyond the end of the project, other costs are to be considered. These costs are mainly linked to the **setup of a proper organization** in charge of business development, marketing activities, and administrative functions.

### 3.2.5 Road.AI business strategy for Intelligent Traffic Guidance System (ITGS)

During the experience in the Living Lab, the main objectives of the Intelligent Traffic Guidance System (ITGS) is to **improve traffic flows and generate optimal driving decisions** that contribute to reducing CO<sub>2</sub> emissions and environmental impact. The focus is on developing and implementing strategies that enhance traffic management and optimize driving behaviour. These efforts aim to increase road capacity, to reduce emissions, and to promote sustainable transportation practices. Additionally, the solution aims to explore ways to enhance road safety and to ensure the efficient and safe introduction of Automated Driving Systems (ADS). Outside the Hamburg Living Lab domain, the objectives remain consistent, with a continuous emphasis on improving traffic flows, reducing emissions, saving fuel, enhancing road safety, and ultimately providing a better driving experience by minimizing travel times and creating a more efficient transportation system.

In the Hamburg Living Lab, the key actors for implementing the ITGS solution are the Roads AI project managers and the 5G-LOGINNOV consortium members. Moreover, **Network, IT, and Telecom Operators** are responsible for ensuring the robustness and reliability of the 5G network infrastructure that supports the ITGS system. **Port Authorities**, as stakeholders in the project, are involved in making decisions related to traffic management and optimizing port operations. Outside the Living Lab scopes, the typology of actors would remain similar; in addition, **local public authorities**, such as roads and transportation departments, may have decision-making authority in implementing and integrating the ITGS platform into the existing road infrastructure.

During the 5G-LOGINNOV experience in the Hamburg Living Lab, the final users of the ITGS platform encompass a diversified range of stakeholders. This includes:

- **local public authorities** responsible for managing road infrastructures and traffic flows.
- **truck fleet operators** who rely on efficient logistics operations.
- **port Authorities** and logistics hubs involved in the movement of goods.
- **professional and non-professional drivers** benefit from the improved driving advisory and traffic information provided by the solution.

In general, beyond the project scopes, the user base may encompass a wider audience including drivers, fleet managers and operators of ADS fleets.

Within 5G-LOGINNOV, the ITGS solution utilizes various **channels to maximize its impact**. Within the lab, these channels include the integration of the ITGS system with existing Intelligent Transportation Systems (ITS). Additionally, the solution seeks to integrate with ADS and Advanced Driver Assistance Systems (ADAS) developers, and navigation applications. Outside the Living Lab, the solution can be integrated into existing navigation applications, providing a convenient way for users to access and benefit from the ITGS system. Integration with tolling platforms also presents an opportunity to incentivize drivers and promote compliance with flow optimization messages.

The development of the ITGS platform itself requires **taking decisions on the technology stack, architecture, and traffic data management infrastructure**. Other important decisions are related to the **marketing and promotion strategy** for the ITGS platform to maximize its adoption and utilization. These decisions are the same to be addressed beyond the project scopes.

Both considering the development of the solution within and beyond the project context, the successful implementation of the solution requires **specific information and resources** to support its development and operation. Firstly, detailed information related to 5G networks, including their capabilities, coverage, and reliability, are necessary to ensure the compatibility and optimal utilization of AI algorithms. Understanding the specific requirements and technical aspects of the 5G network will enable the design and implementation of an efficient and robust communication infrastructure for the solution. Additionally, access to a reliable cloud server and telecommunication infrastructure is crucial.

It must be considered that the uptake of the ITGS solution may deal with three main constraints:

- the robustness and reliability of the 5G network.
- the reliability and scalability of the ITGS platform.
- the availability of relevant data while considering data privacy.

These constraints must be addressed to ensure seamless communication, efficient processing of traffic data, and the secure handling of personal information. In these terms, the expertise gathered during the development of the use case in the Living Lab is important to address and overcome these constraints beyond the end of the project, thus increasing the opportunities for the adoption of the solution in different contexts.

During the experience in the 5G-LOGINNOV project, the costs involved were those related to the administrative costs for managing the project, the cost of on-board units (OBU), the costs for the deployment of cloud-based platforms, perception systems, and sensors. Additionally, there were costs associated with building the communication (5G) network and incentivizing users to participate in the system. Outside the Living Lab, the costs mainly revolve around operational expenses and the cost of maintaining and scaling the cloud-based computational infrastructure.



## 4 MARKET MONITORING

The 5G-LOGINNOV project aims to support and facilitate the introduction of 5G-enabled technology innovation in the logistics sector. To address this goal, in parallel with the development, testing and validation of technical solutions exploiting the 5G network capabilities of the three Living Labs areas, an analysis of the market has been performed, in the context of Task 4.1 “Strategy supporting next generation Logistics operations”.

In this framework, an initial phase was meant to define the potential market opportunities through a qualitative analysis, defining future perspectives for potential applications of 5G technologies, while analysing the state-of-the-art. This assessment has been performed during the first part of the 5G-LOGINNOV project when, on one side, the current market scenario has been studied based on desk research on past and current projects; on the other side, a LLs’ stakeholders survey captured stakeholders’ needs, gains and pains, and interactions linked to the uptake of recent innovations. The findings of these initial activities are available in [D4.1 “Plan for boosting marketplace and emergence of new actors”](#). The market analysis continued with a second phase, aiming to identify products and services enabling 5G related innovations to work in real-life, specifically in the 5G-LOGINNOV contexts. In particular, the products and services currently used in Living Labs have been assessed, in order to define the potential benefits from their usage on business models and operations. Furthermore, products and services developed outside 5G-LOGINNOV that could be relevant as potential competitors have been analysed.

This section provides the findings related to the second phase. In Section 4.1 the approach to create and populate the “Register of 5G-enabled products and services” is explained together with the assessment of expectations linked to the usage of these products and services. Section 4.2 allows to have an overview of other technologies that are available in the market.

### 4.1 5G-LOGINNOV Register of 5G-enabled products and services and Stakeholders’ expectations

The main activity in the context of the market analysis was the development of a Register to monitor the products and services that exploited the capabilities of 5G in the project domain.

Through the Register, for each listed product and service, it was possible to establish their application area (i.e.: Network Slicing; MEC; NFV-MANO; Precise Positioning; Traffic Management; High-performance CCTV Surveillance; Real-Time Tracking & Enhanced Visibility; Maintenance Support) and their usage in the LL context (before, during and after 5G-LOGINNOV). Furthermore, the Register monitored the expectations of LLs’ stakeholders regarding the ability of each product and service to improve the efficiency of the LLs’ logistics chains and to create an impact on the local business models. Finally, the assessment of the relevance of the 5G network in the implementation of these products and services took place.

#### 4.1.1 Athens Living Lab

In the Athens Living Lab, 6 products and services have been listed as relevant to be monitored:

- Surveillance and Video Analytics (service offered by ICCS)
- Container Seal Detection in 5G Crane Operations (service offered by ICCS)
- Rapid Alert System in Yard Truck Operations for Collision Avoidance (service offered by ICCS)
- Predictive Maintenance system (service offered by PCT)
- Fleet Management Platform (product offered by Vodafone Innovus)
- 5G Enabled Video Analytics for Drowsiness/Tiredness Detection of Truck Drivers (service offered by LIBRA AI -Open call winner)



All of them have as main application area the “Real-Time Tracking & Enhanced Visibility”. The services offered by ICCS deal also with “MEC”; “NFV-MANO” and “High-performance CCTV Surveillance” applications; the latter application area is also covered by the LIBRA AI service. The product by Vodafone relates to the “Traffic Management” application area.

The stakeholders’ expectations from these products and services related primarily to improving human safety in the workplace and to optimizing the port logistics operations.

- **Improving human safety in the workplace.** The expected benefits for logistics operations were associated with the ability to provide alert systems to detect human presence in high-risk areas, minimize the risk of vehicle collisions, and provide services to detect elements of drivers’ health status, such as fatigue and other symptoms, and elements such as container seals in vessel loading/unloading processes.
- **Optimising the logistics processes through better forecast and data collection capacity.** The main expected benefits were related to the improvement of maintenance capacity through the possibility of predicting possible breakdowns of transport vehicles (trucks), and to the more accurate data collection to provide real-time information, such as exact positioning, optimal speed, arrival and departure times and waiting times.

The expected impact on the business models of products and services used in the Athens LL are mainly related to the expected reduction of operational and maintenance costs and to the streamlining of management practices, specifically:

- The optimization of loading and unloading processes will be leading to **minimized costs**.
- 5G-enabled services will enable a **better use of resources**.
- An improved ability to operate on risks of accidents will improve the efficiency of the supply chain, **eliminating many tasks that would otherwise be performed by people**.

The products and services implemented in the LL of Athens have found a large use during the project period and, according to the expectations of the stakeholders, their use will be implemented even after the end of the project.

Finally, it is possible to denote that 5G technologies have had a relevant impact in improving the effectiveness of all products and services in the Athens Living Lab, in accordance with the expectations of the stakeholders.

## Products and Services introduced by new actors

The solution provided by Libra AI in the Living Lab of Athens is expected to improve the capability of detecting health parameters of truck drivers, such as drowsiness and tiredness, thanks to video analytics applications installed on vehicles. This system is expected to provide a more efficient traffic flow by means of the improvement in the amount, quality and speed of data exchanged between the different parts of the logistics chain. This will allow to make the traffic flow more efficient, on one hand, and reduce the risks of collisions, on the other. 5G technologies have improved “5G Enabled Video Analytics for Drowsiness/Tiredness Detection of Truck Drivers” solution developed by Libra AI in Athens LL, thanks to 5G IoT systems installed on yard trucks. The Libra AI service is expected to be used after the end of the project in the Athens Living Lab area.

### 4.1.2 Hamburg Living Lab

In the Hamburg Living Lab, 16 products and services have been listed as relevant to be monitored:

- Virtual Traffic Management Centre (service offered by SWARCO)
- V2X technology (service offered by SWARCO)
- Automated Truck Platooning (ATP) (service offered by T-Systems)
- Green Light Optimal Speed Advisory (GLOSA) app (product offered by T-Systems)
- LCMM (Low Carbon Mobility Management) (service offered by T-Systems)
- “cellular” V2X technology (service offered by T-Systems)
- 5G-Mobile Edge Server (service offered by T-Systems)
- Entruck (product offered by tec4u)

- IoT devices (service offered by Continental)
- 4K Video broadband communication (eMBB) (service offered by Deutsche Telekom AG)
- Precise positioning service (service offered by Deutsche Telekom AG)
- Collision warning alert message service (service offered by Skylark)
- Local intelligent Traffic orchestrator (LiTO) (product offered by RoadsAI - Open call winner)
- Location based services (service offered by Uze! Mobility GmbH- Open call winner)
- Rooftop Digital advertisement (service offered by –Uze! Mobility GmbH-Open call winner)
- Supporting sustainable shuttle and urban logistic service provision (service offered by E-Shuttle - Open call winner)

All the products and services implemented in Hamburg Living Lab are associated with “Precise Positioning” and “Traffic Management” application areas. The other main application areas covered by the products and services of the Hamburg Living Lab are “Real-Time Tracking & Enhanced Visibility”, “MEC” and “Network Slicing”.

Concerning stakeholders’ expectations for logistics operations in Hamburg Living Lab, they relate mainly to the expected increase of the ability to collect, analyse, and predict information and the higher capability to exchange data and transfer the information among the different components of the logistics chain.

- **Improved ability to collect, analyse and predict information.** The technologies used in Hamburg are expected to improve information on air quality, fuel consumption and traffic flows inside and outside of the port’s area. The increased amount in the data collected and the better capacity of analysing information on traffic flows will have a positive impact on the accuracy of data regarding precise positioning, vehicle, and flow mapping, as well as parameters regarding road characteristics.
- **Higher capability to exchange data and transfer data.** The products and services implemented in Hamburg LL will make it possible to integrate the greater amount of information produced on the consumption of resources and the quality of the environment, on the characteristics of the infrastructure’s road traffic and information from vehicles. In terms of logistics operations, the information produced will provide new elements of support as regards decision-making processes on the entire logistics chain, but also on individual behaviour through the provision of information in real-time and the greater micro-dynamics connections between individual vehicles and port infrastructures.

Regarding the benefits for the Business Models, the products and services implemented within Hamburg LL will:

- Improve the management of the traffic flows of trucks, increasing the ability to make the **production chain more interconnected and less costly in terms of resources.**
- Allow truck platooning and contribute to the **cost minimization related to waiting times and congestion.**
- **Reduce workplace accidents** such as collisions and **health risks** related to the quality of the work environment.

According to stakeholders’ expectations, all the products and services will be implemented after the deployment of 5G-LOGINNOV, except for “4K Video broadband communication (eMBB)”.

In accordance with the information provided by the stakeholders, 5G technologies’ role in the implementation of the products and services introduced in Hamburg LL can be resumed as follows:

- 5G was not required for the implementation of “V2X technology” and “Rooftop Digital advertisement”.
- The introduction of 5G technologies has made it possible to increase the efficiency and effectiveness of “Virtual Traffic Management Centre” and “Entruck”.
- The products or services could not have been used without 5G in the case of: “Automated Truck Platooning (ATP)”, “Green Light Optimal Speed Advisory (GLOSA) app”, “IoT devices”, “LCMM (Low Carbon Mobility Management)”, “cellular V2X technology”, “4K Video broadband communication (eMBB)”, “5G-Mobile Edge Server”, “Collision warning alert message service”, “Precise positioning service”, “Local intelligent Traffic orchestrator (LiTO)”, “Location based services”, “Supporting sustainable shuttle and urban logistic service provision”.

## Products and Services introduced by new actors

The products and services introduced by the start-ups joining the Hamburg LL are focused primarily on “Precise Positioning” and “Traffic Management” application areas. The expectations around their products and services are mainly related to the introduction of systems capable of providing a huge amount of more accurate data related to fuel consumption and CO2 emissions, allowing better traffic management. The solutions are constituted by 5G&AI enabled tactical driving guidance systems and cloud interfaces able to enhance real-time exchange of data and provide traffic management solutions among the different parts of the logistics chain.

The products and services developed by Uze! Mobility GmbH, e-Shuttle and Roads AI are expected to improve the management capabilities to make the traffic flows more efficient, thanks to the improved capacity of collecting, analysing, and communicating information within the different parts of the logistics chain. Moreover, the solutions developed by the start-ups in Hamburg Living Lab are expected to reduce costs, providing more accurate data on fuel consumption and CO2 emissions.

5G technologies have been a determinant factor in the implementation of all the products and services introduced by the start-ups in the LL of Hamburg, allowing to implement the communication capabilities, the amount and the accuracy of the data collected regarding obstacles’ detection, fuel consumption and CO2 emissions.

All the products and services introduced by the start-ups are expected to be used after the end of the project.

### 4.1.3 Koper Living Lab

In the Koper LL, 9 products and services have been listed as relevant to be monitored:

- Private 5G mobile systems (service offered by ININ)
- Industrial grade 5G IoT System (service offered by ININ)
- Quality assurance services for 5G networks and cloud-infrastructures designed for ports and industry 4.0 environment (service offered by ININ)
- Commercial 5G mobile system (service offered by T-SLO)
- System for gathering port machinery telemetry (service offered by CONTI)
- 5G IoT devices (products offered by CONTI)
- System for container markers detection on port crane (service offered by VICOM)
- AI/ML-based Video Analytics platform (product offered by VICOM)
- Vision-based aerial obstacle detection and avoidance (TRITON) (service offered by Hellenic Drones)

The main application areas for the products and services implemented within the Koper Living Lab can be identified in “MEC”, “NFV-MANO”, “Real-Time Tracking & Enhanced Visibility”, followed by “High-performance CCTV Surveillance Applications”.

The expectations of stakeholders for what regards the impact of the products and services on logistics operations are mainly that they are expected to enable the improvement of the data collection and analysis systems in industry 4.0 environments and to improve the connectivity of the communication networks among the various sectors of the logistics chain.

- **Improved data collection and analysis systems.** The benefits regard the provision of high-resolution graphic data, such as images and videos, capable of providing more information on the progress of the ports’ activities and thus allowing their more efficient monitoring.
- **Higher connectivity of the communication networks** among the various sectors of the logistics chain. The mobile networks introduced in Koper Living Lab will contribute to the improvement of the connection system, supporting a greater automation and digitalization, helping to increase the resilience and adaptability of the port infrastructure and the optimization of resources spent in the logistics chain.

The above-mentioned expectations linked to the Koper LL operations are reflected into the expected impact on business models, as local stakeholders perceive the adopted products and services as

enablers for **improved value proposition of the Port's areas**, that can welcome new innovative experiments and partnerships soon.

All the products and services are expected to remain be implemented after the end of 5G-LOGINNOV project and it is observed that 5G technologies played a key role in the implementation of the products and services within Koper LL.

## Products and Services introduced by new actors

In the Koper Living Lab, the TRITON system provided by Hellenic Drones is expected to improve the efficiency of port operations thanks to its capabilities of detection of possible obstacles on the route. More specifically, Hellenic Drones' solution is expected to provide more accurate data and support decision making processes thanks to the provision of more accurate aerial images of traffic flows by means of aerial vision models and path planning algorithms.

This solution is expected to be used after the end of the project in the Living Lab area and 5G technologies have been a determinant factor in the implementation these products in the Living Labs of Koper, allowing to increase communication capabilities, the amount and the accuracy of the data collected regarding obstacles' detection, fuel consumption and CO2 emissions.

## 4.2 Analysis of products and services available on the market

The assessment of the products and services used in the 5G-LOGINNOV LLs was useful to have a clear understanding on the scopes and expectations related to the project's implementations. However, to have a more holistic and comprehensive picture on the current industry supply side, an analysis of other products and services available in the market have been performed.

The analysis was conducted through a series of consultations with stakeholders within the three LLs and through desk research. The analysis was aimed at identifying the main market areas and the related providers. Four market areas could be identified:

- Video analytics market area, which includes all the suppliers of video surveillance systems, AI applied to the analysis of images and videos, sensors, and detection systems.
- IT market area, which includes all the providers of IoT and AI systems aimed at performing the activities of data collection, data storage and data analysis.
- Automotive market area, which includes all products and services provided by vehicle manufacturers.
- Telecommunications market area, which includes all the providers of mobile phone products and services and 5G network infrastructure.

The identification of market areas made it possible to pick out the solutions available on the market and the related providers. Therefore, it was possible to classify the products and services available on the market into four groups:

- Products and Services exploiting machine learning techniques.
- Products and Services using IoT/AI technologies.
- Products and Services supporting (automated) driving.
- Products and Services exploiting the Mobile network infrastructure.

The ambition is hence to provide alternative solutions that may be considered in future activities aimed at innovating logistics hubs, exploiting the potentialities of most recent technologies.

### 4.2.1 Products and Services exploiting machine learning techniques

The first category (Products and Services exploiting machine learning techniques) includes mainly solutions **offered by video analytics service providers, 5G&AI monitoring systems providers, and alert 5G&AI alert systems providers**. The products and services include video analytics devices such as smart cameras and AI analytics systems mainly used to assist the operators and the drivers during vehicle usage. These systems are designed to **increase human safety, providing analytics solutions**

**based on cameras, 5G networks and AI applications.** These solutions are used to detect, analyse, and provide alerts on potential risks, such as obstacles and driver's fatigue symptoms. Moreover, the products and services included within this group enable users to predict machinery failures, supporting maintenance activities.

Table 2: describes the products and services assessed within this category.

Provider	Products /Service	Short description
Teledyne DALSA	Imaging components & systems	Teledyne video analytics services include 5G-enabled & AI smart cameras (Boa and Boa2), video sensors (Boa Spot) and Vision systems (GEVA), supporting Gen6 Core i7 processors and compatible with a wide variety of visual applications.
Lattice Semiconductors	Lattice mVision Solution Stack	Lattice mVision solutions stack uses modular hardware platforms, IP building blocks, FPGA design tools, and a network of custom design services and solves design challenges as sensor connectivity, bridging, aggregation, and image signal processing. These solutions include also customizable performance and flexible interface connectivity (MIPI CSI-2, LVDS, PCIe, GigE, etc.).
AllReadAI	Agile Recognition Software (ARS) Crane	ARS Crane solution include IP cameras; digitalized codes' detection (BIC – ISO 6346, License Plates of tractors and trailers, modules such as Dangerous goods, type of vehicle and presence of security seals).
Mobileye	Mobileye SuperVision	Mobileye Supervision system includes traffic management systems (REM), high-definition cameras and video analytics solutions (Radar & Lidar system) applied to Autonomous Vehicles.
Siemens	Senseye Predictive Maintenance	Senseye Predictive Maintenance platform automatically generates AI machine and maintainer behaviour models to support maintenance activities within the industrial plant. It also integrated with any asset, using data already collected or with sensors as part of a complete package. It constitutes a highly scalable cloud-based solution, Senseye Predictive Maintenance can operate in more than one plant.
Volvo; Nvidia	Nvidia Drive Orin Architecture	Nvidia systems installed on Volvo's electric cars recognises and distinguishes tiredness symptoms on drivers. The system is equipped with a sensor on the dashboard to monitor driver's eyes and to develop precise safety systems that detect the driver's health status. Driver State Estimation system enables the car to determine for itself whether the driver can take control when the conditions for driving autonomously are no longer present.
AVIN	AVIN ADAS Driver Fatigue Detection System	Driver Fatigue Detection System is an application aimed at detecting driver's fatigue and alerts the driver based on concept of Deep Learning and AI. It uses camera sensors that can detect drowsiness and fatigue symptoms by continuously monitoring driver's face, with a processor aimed at analysing video images to take the decision to provide the alert.
	AVIN ADAS Sound Signal Analysis (SS-ADAS)	AVIN ADAS Sound Signal Analysis (SS-ADAS) is based on AI and Deep Learning concepts and is aimed at detecting siren sounds and to identify specific zones, such as

	congested areas, associated with characteristics sound signals. The technology provides driver alert by acquiring sound signals data, providing localization and analysis of the data collected through Time Difference of Arrival (TDoA) algorithms.
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Table 2: Products and Services exploiting machine learning techniques

#### 4.2.2 Products and Services using IoT/AI technologies

The second category (Products and Services using IoT/AI technologies) includes a wide range of solutions enabling to **collect, analyse, and communicate data to traffic management centres and among vehicles**. The systems are interconnected through 5G enabled IoT and V2X devices installed on vehicles, using standardized communication interfaces. Enabled 5G V2X and IoT applications allow to collect a huge amount of data, including position, speed direction and information on the environment, that are analysed through AI systems in support of decision-making processes.

Table 3 provides an overview of the industrial offering for these types of products and services.

Provider	Products /Service	Short description
Yunex	Traffic Management Centre platform	Traffic Management Centre platform includes traffic management, traffic control and parking guidance. Yunex Traffic Management Centre is based on modular concept which allows the modules of the system to be expanded and combined. It uses a standardised communication interface and can be easily connected to existing applications and devices. The availability, reliability and security of the traffic centre platform is certified to the <a href="#">ISO/IEC 27001</a> standard.
	Cooperative Management System (CMS)	The Cooperative Management System (CMS) uses V2X technology, including Roadside Units (RSU) and 5G enabled technologies to link the vehicles and the traffic management centres. RSU communicates both with vehicles and traffic management centres, sending both time-critical information and time-noncritical information to the vehicle. It provides position, speed, and direction of travel via Vehicle2X Onboard Units. The information collected by RSU system are then analysed via the CSM system, supporting a more efficient traffic management.
Prisma	PRISMA TRAFF-X solutions	TRAFF-X is a modular solution platform for cooperative traffic management and administration. The system collects and analyses information supporting the areas of eGovernment and traffic, TRAFF-X, forming the link between administration, traffic guidance and commercial navigation systems.
GEVAS SOFTWARE	Vtmanager	VTmanager system enables automated reactions and strategies to define traffic scenarios. The system can switch traffic lights and boards and pass on traffic information to mobility service providers. Through the VTmanager event system, it can record traffic obstructions and danger spots due to accidents. VTmanager controls the traffic signals based on models with the aim of achieving an optimal traffic flow for the entire network. VTmanager provides a wide range of functionalities within the framework of cooperative traffic management and V2I services, such as

AI-based switching time forecast for traffic lights and the green wave assistant traffic pilot.

Table 3: Products and Services using IoT/AI technologies

### 4.2.3 Products and Services supporting (automated) driving

The third group (Products and Services supporting (automated) driving) includes **solutions offered by OEMs and automotive suppliers**. The systems developed by the OEMs and by the automotive suppliers are aimed to provide a huge amount of **data related to vehicle and traffic environment**. They are mainly equipped with **driving assistance technologies**, such as V2X, redundant systems and 5G enabled technologies aimed at collecting, analysing, and communicating data regarding position, direction, and vehicle status, providing different tools in support to automate driving.

These systems are mainly applied to vehicles and are used to assist the driver during the vehicle usage, such as for detecting possible obstacles on the routes and provide information on traffic using camera, radar and lidar systems. Moreover, the systems are applied to collect and analyse information on journey planning, such as time of arrival and route planning, by providing data on precise position and driving direction. Another application of these technologies regards vehicle's monitoring; the 5G enabled system applied on vehicles can collect information on vehicles' status and predict maintenance necessities.

Table 4 provides an overview of the assessed products and services supporting (automated) driving:

Provider	Products /Service	Short description
Daimler AG	Daimler assisted and automated driving solution	Daimler assisted and automated driving solution is aimed at scanning traffic and vehicle situations through different sensor technologies, including camera, radar and lidar. Safety-related functions are equipped with redundant systems to operate even in case of system's failure. Steering and braking systems are continuously monitored by the vehicle to ensure maximum safety. In case of malfunctions, the redundant systems can safely control the truck. Daimler system can be integrated with already installed hardware and software.
MAN	MAN TeleMatics app	MAN TeleMatics app can access all relevant data for the vehicles in real-time. The app can contact the driver and shows real-time data such as precise positioning and driving direction, enabling the driver to correct possible deviations.
Denso	ETC (Electronic Toll Collection System) and ETC2.0 On-Board Equipment	ETC (Electronic Toll Collection System) and ETC2.0 On-Board Equipment calculate tolls based on vehicle data registered in on-board devices and data in inserted ETC card, to automatically pay on toll roads. The systems are 5G enabled to detect and communicate vehicle data such as precise positioning and vehicle's status. The systems operate to perform safe-driving assistance, realizing efficient traffic flow via wireless vehicle-to-vehicle and road-to-vehicle communication.
Hyundai	SmartSense	SmartSense is a driver assistance system, aimed at increasing driver's safety and provide relevant data on potential risks. The system monitors the environment to prevent possible collisions during driving. It includes Smart Cruise control, Downhill Brake Control, Lane Keeping Assis, Blind-spot Collision Warning system. All these solutions allow to

automatically adjusts the vehicle's speed to maintain a safe distance from other vehicles by controlling braking or acceleration. By providing information on road slope, it assists the driver on different types of terrain, providing information to depress the brake pedal, and detecting if your vehicle is starting to depart the lane.

Table 4: Products and Services supporting (automated) driving

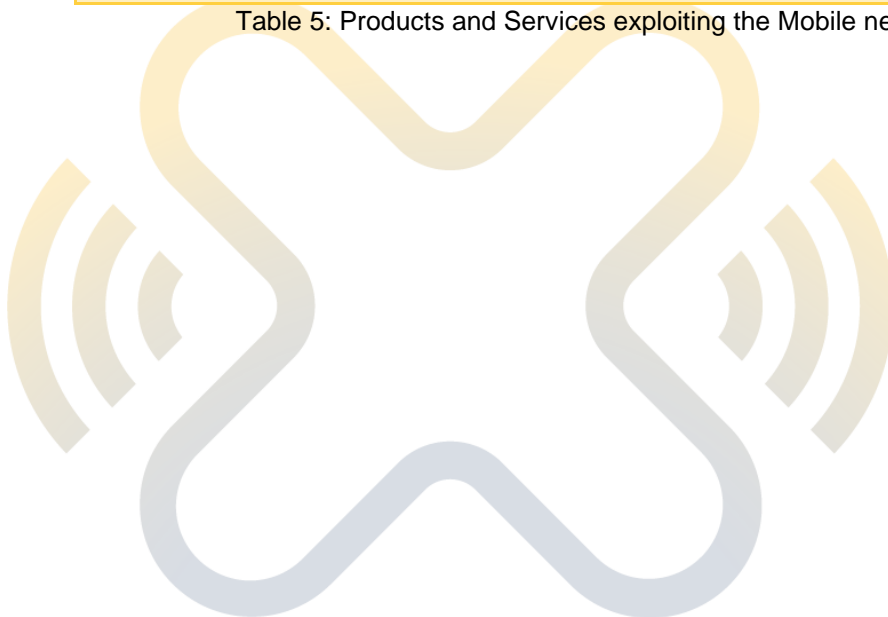
#### 4.2.4 Products and Services exploiting the Mobile network infrastructure

The last group (Products and Services exploiting the Mobile network infrastructure) includes solutions offered by **5G technology vendors, providers of services, service integrators, consulting service providers**. These companies provide a wide range of **5G/loT solutions with cloud-native principles**, which are usually applied to improve communication networks and data exchange among the logistics chains and industrial environments.

Table 5 provides an overview of such solutions.

Provider	Products /Service	Short description
Vodafone	Vodafone Automotive 5G-enabled solutions	Vodafone provides a wide range of 5G-enabled solutions for vehicles, which include V2X, cellular V2X, V2I, V2P, and V2N technologies. Vodafone 5G solutions applied to vehicles allow the latter to adjust their speed or plan an alternative route. VODAFONE's 5G-enabled communication system use the Vodafone network, providing automated alarm and video surveillance systems, localization systems for precise positioning and real-time tracking.
Google	Google Distributed Cloud	Google Distributed Cloud Edge uses Google Cloud's infrastructure and services. Google Distributed Cloud Edge allows to run 5G Core and radio access network (RAN) and other applications to support tasks including computer vision and AI edge inferencing. Google Distributed Cloud Edge allows also to run local data processing, low-latency edge compute workloads, and deploying private 5G/LTE solutions across a wide range of industries.
Telemach	5G enabled solutions for business	Telemach provides a wide range of business solutions, which include EON smart boxes, cloud storage services, 5G network access for communications. Telemach mobile services can be applied to all the parts of the logistics chain, applying 5G technologies and providing IoT devices aimed at improving business activities.

Table 5: Products and Services exploiting the Mobile network infrastructure





## 5 CONCLUSION

This deliverable is the final report on the activities performed within the Task 4.1 “Strategy supporting next generation logistics operations”, Task 4.2 “Emergence of new actors”, and Task 4.3 “Boosting economic opportunities” of the 5G-LOGINNOV project. It allows to get acquainted with the efforts done during the project to make the five winners of the 5G-LOGINNOV Open Call for Innovative Start-up emerge in the new market (Section 2). Furthermore, the document allows to understand the main details of the 5G-LOGINNOV Living Labs from the business modelling perspective and to discover the main business trends defined by the new start-ups that joined the Living Labs, after the Open Call (Section 3). The document finally provides a detailed market analysis allowing to uncover the main products and services utilized in the LLs, including their impact on stakeholders, and completed with an assessment of similar products available on the market (Section 4).

The integration of the five winners of the 5G-LOGINNOV Open Call for Innovative Start-ups is a success story **demonstrating the mutual benefits** of matching innovative ideas (brought by small and dynamic realities) with complex industrial environments and real use cases. 5G-LOGINNOV aimed at replicating this approach at a larger scale and across the boundaries of the project. In fact, through the creation of a network of liaisons for matching the needs of the industry and transport operators, the innovative solutions offered by these new actors could get integrated with the technical and commercial framework operated by large industry players and experienced logistics actors, paving the way to next generation of 5G/6G-enabled applications for ports and logistics.

To stimulate the emergence of new actors in the Living Labs scenarios and beyond, 5G-LOGINNOV has focused on the **promotion** of such companies in the wide logistics environment, making them closer to existing networks of SMEs and start-ups to exchange information and experiences related to 5G/6G-enabled applications for transport and logistics. In addition, the roles, applications, and outcomes of the five SMEs within 5G-LOGINNOV have been presented in major events, such as the Collaborative Innovation Day and the Hamburg event. The seamless integration of innovative small-scale organization within a complex project with major players represents a success story and an inspiring example for other similar realities (for instance, those belonging to NetworldEurope), as well as a good self-promotion opportunity towards the industry. Furthermore, the bidirectional exchange of information (from the project to external network and vice versa) represented a useful exercise to keep start-ups and SMEs aligned with concrete needs and opportunities offered by logistics operators and MNOs. This allowed matching the ideas proposed by innovative SMEs and start-ups with the concrete needs of the industry and the infrastructure offered by telecommunication players.

By assessing the business models adopted by each project Living Labs, it is possible to conclude that the **adoption of 5G technology in port logistics can bring several advantages**, as it offers significant improvements in connectivity, data transmission, and automation capabilities. However, the three Living Labs have specific peculiarities:

- The Athens Living Lab mainly deals with technologies for real-time tracking and enhanced visibility of 5G yard-trucks for service optimization, job allocation and predictive maintenance. Concerning the potential benefits of the innovative solutions, the expectations of the stakeholders relate mainly to the **optimization of loading and unloading processes** with the aim of minimizing costs associated with these processes and risks to human health. Moreover, **automated services will lead to a strong efficiency in the utilization of resources** and a **better ability to operate on risks** related to accidents that may compromise the efficiency of the supply chain. Supply chain efficiency will be positively impacted by the introduction of information gathering, analysis and forecasting systems, capable of providing information on the maintenance status of vehicles and relevant supply chain data such as location, travel time, fuel consumption, etc., thus reducing operating costs and increasing the lifetime.
- The Hamburg Living Lab addresses the usage of 5G to improve port operations, specifically for connecting the Hinterland to the port’s facilities. The products and services introduced in Hamburg will have a positive impact on the ability to manage the flow of trucks, thus making the **logistics chain more interconnected and less costly in terms of resources**. Moreover, innovative solutions play a key role in **allowing truck platooning** and, thanks to the data collection and analysis systems and to the improved communication networks, will contribute to the **cost minimization related to waiting**

**times and congestion while reducing workplace accidents** such as collisions and health risks related to the quality of the environment.

- The Koper Living Lab focuses on 5G-enabled technologies to improve the automation of logistics processes in ports and to support mission critical services in the port area. The products and services introduced in Koper aim to create a more **flexible and interconnected infrastructure**, through the application of new or improved systems with 5G technologies that can be used to implement different solutions. Moreover, products and services developed in Koper will foster a greater automation and digitalization, helping to **increase the resilience and adaptability** of the port infrastructure and the optimization of resources spent in the logistics chain.

In all cases, the main users are mostly **port authorities, who receive the highest impact**, with benefits related to optimization of operations and processes, as well as the improvement of the safety and security conditions inside the port areas; in addition, **yard personnel and yard truck operators**, are impacted by the improvements of their working conditions.

In parallel, **5G-LOGINNOV has guided the five start-ups that joined the LLs in their business models definition**. Some common trends have been observed in the business models of these innovative solutions. All five solutions target specific industries or sectors, such as port operations, transportation, logistics, and traffic management, demonstrating a **niche-focused approach**. **Collaboration** with partners, mainly 5G-LOGINNOV consortium members and relevant authorities, is a common trend to leverage resources and expertise. All solutions emphasize **sustainability** by aiming to reduce CO<sub>2</sub> emissions, improve fuel efficiency, or enhance safety, aligning with environmental and regulatory trends. The five companies have **ambitions for regional or global expansion** beyond their initial Living Lab settings, indicating scalability and growth-oriented strategies. **Data collection, analysis, and exchange are central** to the proposed solutions, highlighting the importance of data-driven decision-making and advanced technologies like 5G and cloud resources. This is an important aspect, aligned with the requirements of all Living Labs. In this context, integration with existing systems and collaboration with relevant stakeholders will play key roles in the success of these solutions. The cost structures vary, with expenses covering equipment, personnel, R&D, marketing, and administrative aspects, emphasizing the importance of financial planning and sustainability.

Referring to the **analysis of products and services** utilized in the Living Labs, it must be concluded that most of the products and services have their effective scope in **improving practices regarding the analysis of data** regarding tracking in time reality and safety in carrying out logistic operations. The second scope of application is **improving traffic management**. Regarding the usage of these products and services, only half of them had been previously used in the port hubs covered by the Living Labs, but all of them are expected to be used after the end of the project. Observing the overall trend in the three Living Labs, it is possible to state that the stakeholders' expectations regarding the current use of the products and services have been met. In accordance with the expectations expressed by the stakeholders, the improvement of logistics operations regards three aspects. The first one concerns the **implementation of safety systems**, including those products and services aimed at reducing work accidents in risk areas during loading and unloading processes, and minimizing the risks of collisions due to drowsiness and tiredness of yard truck drivers and to the presence of obstacles on the logistics corridors. The second aspect relates to the **improvement of the systems aimed at collecting and analysing data** with respect to fuel expenditure, polluting agents, optimal speed, traffic flows, precise positioning, waiting times, journey planning and real-time tracking of vehicles. This aspect primarily relates to the introduction of tools capable of supporting the communication networks and make the port infrastructures more interconnected both internally and with the external environment. The third aspect relates to the possibility to introduce systems aimed at **improving decision-making processes**. In particular, the products and services introduced in the Living Labs are expected to provide innovative solutions for collecting, analysing, and forecasting information, playing a key role in supporting decision-making processes regarding the minimization of the resources spent in the logistics chain, ensuring a greater interconnection between the different sectors of the logistics activities.

## 6 REFERENCES

1. ALL ReadAI. Agile Recognition Software (ARS) Crane. Link available at: <https://www.allread.ai/en/ars-crane-2/>. Retrieved on 22/09/2023.
2. AVIN. AVIN ADAS Driver Fatigue Detection System; AVIN ADAS Sound Signal Analysis (SS-ADAS). Link available at: <https://www.avinsystems.com/services/ai-assisted-adas/>. Retrieved on 22/09/2023.
3. Daimler AG. Daimler assisted and automated driving solution. Link available at: <https://www.daimlertruck.com/en/innovation/autonomous-driving/our-path-for-autonomous-trucks>. Retrieved on 22/09/2023.
4. Denso. ETC (Electronic Toll Collection System) and ETC2.0 On-Board Equipment. Link available at: <https://www.denso.com/global/en/business/products-and-services/mobility/safety-cockpit/>. Retrieved on 22/09/2023.
5. GEVAS Softwares. VTmanager. Link available at: <https://www.gevas.eu/losungen/vtmanager>. Retrieved on 22/09/2023.
6. Google. Google Distributed Cloud. <https://cloud.google.com/blog/topics/hybrid-cloud/announcing-google-distributed-cloud-edge-and-hosted>. Retrieved on 22/09/2023.
7. Hyundai. SmartSense. Link available at: <https://www.hyundai.news/eu/articles/stories/how-to-use-hyundais-smartsense-safety-tech.html>. Retrieved on 22/09/2023.
8. Lattice Semiconductors. Lattice mVision Solution Stack. Link available at: <https://www.latticesemi.com/en/Solutions/Solutions/SolutionsDetails02/mVision>. Retrieved on 22/09/2023.
9. MAN. MAN TeleMatics app. Link available at: <https://www.man.eu/de/en/service/man-telematics-37198.html>. Retrieved on 22/09/2023.
10. Mobileye. Mobileye SuperVision. Link available at: <https://www.mobileye.com/solutions/super-vision/>. Retrieved on 22/09/2023.
11. Prisma. PRISMA TRAFF-X solutions. Link available at: <https://prisma-solutions.com/en/>. Retrieved on 22/09/2023.
12. Siemens. Senseye Predictive Maintenance. Link available at: <https://www.siemens.com/global/en/products/services/digital-enterprise-services/analytics-artificial-intelligence-services/predictive-services/senseye-predictive-maintenance.html>. Retrieved on 22/09/2023.
13. Teledyne DALSA. Imaging components & systems. Link available at: <https://www.teledynedalsa.com/en/products/imaging/>. Retrieved on 22/09/2023.
14. Vodafone. Vodafone Automotive 5G-enabled solutions. Link available at: <https://www.vodafone.com/business/iot/automotive/manuals>. Retrieved on 22/09/2023.
15. Telemach. 5G enabled solutions for business. Link available at: <https://poslovni.telemach.ba/paketi/biznis-paketi/>. Retrieved on 22/09/2023.

16. Volvo; Nvidia. Nvidia Drive Orin Architecture. Link available at: <https://blogs.nvidia.com/blog/2021/06/30/nvidia-volvo-cars-software-defined-future/>. Retrieved on 22/09/2023.
17. Yunex. Traffic Management Centre platform; Cooperative Management System (CMS). Link available at: <https://www.yunextraffic.com/company/>. Retrieved on 22/09/2023.



## ANNEX 1: PRODUCTS AND SERVICES USED IN 5G-LOGINNOV LIVING LABS

### Products and services used the Athens Living Lab

Products / Service	Provider	Application Area
<b>5G&amp;AI Enabled Surveillance and Video Analytics</b>	ICCS	<ul style="list-style-type: none"> <li>• MEC;</li> <li>• NFV-MANO;</li> <li>• High-performance CCTV Surveillance Applications;</li> <li>• Real-Time Tracking &amp; Enhanced Visibility.</li> </ul>
<b>5G&amp;AI Enabled Container Seal Detection in 5G Crane Operations</b>	ICCS	<ul style="list-style-type: none"> <li>• MEC;</li> <li>• NFV-MANO;</li> <li>• High-performance CCTV Surveillance Applications;</li> <li>• Real-Time Tracking &amp; Enhanced Visibility.</li> </ul>
<b>5G&amp;AI Enabled Rapid Alert System in Yard Truck Operations for Collision Avoidance</b>	ICCS	<ul style="list-style-type: none"> <li>• MEC;</li> <li>• NFV-MANO;</li> <li>• High-performance CCTV Surveillance Applications;</li> <li>• Real-Time Tracking &amp; Enhanced Visibility.</li> </ul>
<b>Predictive Maintenance</b>	PCT	<ul style="list-style-type: none"> <li>• Real-Time Tracking &amp; Enhanced Visibility.</li> </ul>
<b>Fleet Management Platform</b>	Vodafone Innovus	<ul style="list-style-type: none"> <li>• Traffic Management Applications;</li> <li>• Real-Time Tracking &amp; Enhanced Visibility.</li> </ul>
<b>5G Enabled Video Analytics for Drowsiness/Tiredness Detection of Truck Drivers</b>	LIBRA AI	<ul style="list-style-type: none"> <li>• High-performance CCTV Surveillance Applications;</li> <li>• Real-Time Tracking &amp; Enhanced Visibility.</li> </ul>

### Products and services used the Hamburg Living Lab

Products / Service	Provider	Application Area
<b>Virtual Traffic Management Centre</b>	SWARCO	<ul style="list-style-type: none"> <li>• MEC;</li> <li>• Precise Positioning;</li> <li>• Traffic Management Applications;</li> <li>• Real-Time Tracking &amp; Enhanced Visibility.</li> </ul>
<b>Automated Truck Platooning (ATP)</b>	T-Systems	<ul style="list-style-type: none"> <li>• MEC;</li> <li>• Precise Positioning;</li> <li>• Traffic Management Applications;</li> <li>• Real-Time Tracking &amp; Enhanced Visibility.</li> </ul>
<b>Green Light Optimal Speed Advisory (GLOSA) app</b>	T-Systems	<ul style="list-style-type: none"> <li>• MEC;</li> <li>• Precise Positioning;</li> <li>• Traffic Management Applications;</li> <li>• Real-Time Tracking &amp; Enhanced Visibility.</li> </ul>

<b>Entruck</b>	tec4u	<ul style="list-style-type: none"> <li>• Precise Positioning;</li> <li>• Traffic Management Applications;</li> <li>• Real-Time Tracking &amp; Enhanced Visibility.</li> </ul>
<b>IoT devices</b>	Continenta I	<ul style="list-style-type: none"> <li>• Precise Positioning;</li> <li>• Traffic Management Applications;</li> <li>• Real-Time Tracking &amp; Enhanced Visibility.</li> </ul>
<b>LCMM (Low Carbon Mobility Management)</b>	T-Systems	<ul style="list-style-type: none"> <li>• Precise Positioning;</li> <li>• Traffic Management Applications;</li> <li>• Real-Time Tracking &amp; Enhanced Visibility.</li> </ul>
<b>V2X technology</b>	SWARCO	<ul style="list-style-type: none"> <li>• Traffic Management Applications;</li> <li>• Real-Time Tracking &amp; Enhanced Visibility.</li> </ul>
<b>“cellular” V2X technology</b>	T-Systems	<ul style="list-style-type: none"> <li>• MEC;</li> <li>• Precise Positioning;</li> <li>• Traffic Management Applications;</li> <li>• Real-Time Tracking &amp; Enhanced Visibility.</li> </ul>
<b>4K Video broadband communication (eMBB)</b>	Deutsche Telekom AG	<ul style="list-style-type: none"> <li>• Precise Positioning;</li> <li>• Traffic Management Applications;</li> <li>• Real-Time Tracking &amp; Enhanced Visibility.</li> </ul>
<b>5G-Mobile Edge Server</b>	T-Systems	<ul style="list-style-type: none"> <li>• MEC;</li> <li>• Traffic Management Applications.</li> </ul>
<b>Collision warning alert message service</b>	Skylark	<ul style="list-style-type: none"> <li>• Network Slicing;</li> <li>• MEC;</li> <li>• Precise Positioning;</li> <li>• Traffic Management Applications;</li> <li>• Real-Time Tracking &amp; Enhanced Visibility.</li> </ul>
<b>Precise positioning service</b>	Deutsche Telekom AG	<ul style="list-style-type: none"> <li>• Precise Positioning;</li> <li>• Traffic Management Applications;</li> <li>• Real-Time Tracking &amp; Enhanced Visibility.</li> </ul>
<b>Local intelligent Traffic orchestrator (LiTO)</b>	roadsAI-Open call winner	<ul style="list-style-type: none"> <li>• Precise Positioning;</li> <li>• Traffic Management Applications.</li> </ul>
<b>Location based services</b>	Uze! Mobility GmbH-Open call winner	<ul style="list-style-type: none"> <li>• Precise Positioning;</li> <li>• Traffic Management Applications;</li> <li>• Real-Time Tracking &amp; Enhanced Visibility.</li> </ul>
<b>Rooftop Digital advertisement</b>	Uze! Mobility GmbH-Open call winner	<ul style="list-style-type: none"> <li>• Precise Positioning;</li> <li>• Traffic Management Applications;</li> <li>• Real-Time Tracking &amp; Enhanced Visibility.</li> </ul>
<b>Supporting sustainable shuttle</b>	E-Shuttle-Open call winner	<ul style="list-style-type: none"> <li>• Precise Positioning;</li> <li>• Traffic Management Applications;</li> </ul>

and urban logistic service provision

- Real-Time Tracking & Enhanced Visibility.

## Products and services used the Koper Living Lab

Products / Service	Provider	Application Area
<b>Private 5G mobile systems</b>	Internet Institute	<ul style="list-style-type: none"> <li>• Network Slicing;</li> <li>• MEC;</li> <li>• NFV-MANO.</li> </ul>
<b>Industrial grade 5G IoT System</b>	Internet Institute	<ul style="list-style-type: none"> <li>• MEC;</li> <li>• NFV-MANO.</li> </ul>
<b>Quality assurance services for 5G networks and cloud-infrastructures designed for ports and industry 4.0 environment</b>	Internet Institute	<ul style="list-style-type: none"> <li>• NFV-MANO.</li> </ul>
<b>Commercial 5G mobile system</b>	Telekom Slovenije	<ul style="list-style-type: none"> <li>• MEC.</li> </ul>
<b>System for gathering port machinery telemetry</b>	Continental	<ul style="list-style-type: none"> <li>• Real-Time Tracking &amp; Enhanced Visibility;</li> <li>• Maintenance Support.</li> </ul>
<b>System for container markers detection on port crane</b>	Vicomtech	<ul style="list-style-type: none"> <li>• Real-Time Tracking &amp; Enhanced Visibility.</li> </ul>
<b>AI/ML-based Video Analytics platform</b>	Vicomtech	<ul style="list-style-type: none"> <li>• High-performance CCTV Surveillance Applications;</li> <li>• Real-Time Tracking &amp; Enhanced Visibility.</li> </ul>
<b>5G IoT devices</b>	Continental	<ul style="list-style-type: none"> <li>• Real-Time Tracking &amp; Enhanced Visibility;</li> <li>• Maintenance Support.</li> </ul>
<b>Vision-based aerial obstacle detection and avoidance (TRITON)</b>	Hellenic Drones	<ul style="list-style-type: none"> <li>• High-performance CCTV Surveillance Applications;</li> <li>• Real-Time Tracking &amp; Enhanced Visibility.</li> </ul>

