COMMERCIAL APPLICATIONS OF SPACE-ENABLED ROBOTICS – TRANSPORT AND LOGISTICS USE-CASES

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1. INTRODUCTION

This document lists the use cases to be used as part of the 'Transport and Logistics' thematic area within the umbrella of the "Commercial Applications of Space-Enabled Robotics" thematic call for proposals.

The use cases presented result from the cooperation between the European Space Agency (ESA) and various stakeholders with interests in the domain of Transport and Logistics. It aims at developing sustainable services leveraging space assets and robotics technology in consort to address key challenges and opportunities.

When writing the initial proposal (APQ/Outline proposal), the applicant will make clear which use case(s) their solution will address, if chosen from those listed here.

2. ANNEX A: TRANSPORT AND LOGISTICS USE CASES

2.1. City of Venice (VeniSIA Sustainability Innovation Accelerator)

Venice is facing vital sustainable development challenges, such as flooding, over-tourism, and depopulation. Other extraordinary cities share similar environmental and social problems. Sustainable Development Goals (SDGs) are an urgent call to action for people and countries but also for companies that must implement new production models. The latter require to develop and test new business ideas and technology solutions. VeniSIA is a corporate accelerator (Venice Sustainability Innovation Accelerator - VeniSIA) with the ambition to collect all global efforts to achieve the SDGs, mainly related to climate change and other environmental and social problems, with the aim to turn Venice into the oldest city of the future.

2.1.1. Autonomous Logistics of Medical Supplies

VeniSIA are interested in the deployment of smart mobility systems to support sustainable development in Venice. The use-case in question concerns the use of drones and/or autonomous surface vessels for the transportation of essential goods such as medicines and pharmaceuticals. Transporting medicines via autonomous systems may support increased care and life support to patients relying on long-term care in remote regions. Thus, novel mobility paradigms may help guarantee the delivery of recurring drugs in those regions where alternative transportation systems may struggle to do so. The solutions should consider the end-to-end delivery spanning the vehicle of choice, the docking station and means of final delivery to patients (which may require additional infrastructure). The target is a cost-effective, safe, and efficient means of regular delivery of the aforementioned goods.

2.2. City of Torino

Torino is one of the most advanced Italian cities, both in terms of research and testing in the field of innovative, cooperative, connected and autonomous mobility. This is a result of a policy process and of the subsequent application of the quadruple helix model[1] promoting the cooperation between the public administration, research, industry, and civil society. In this perspective, the City of Torino created three relevant operation tools:

Torino City Lab (TCL) - an initiative-platform born in 2018, aimed at creating simplified conditions for companies interested in conducting testing (in real conditions) of innovative solutions for urban living. It involves a vast local partnership of subjects from the public and private sectors interested in supporting and growing the local innovation ecosystem.

House of Emerging Technologies (CTE NEXT) - a project supported by the Italian Ministry of Economic Development aimed at transforming Torino into a technology transfer center for emerging technologies in sectors identified as strategic for the Torino area: intelligent mobility, industry 4.0 and innovative urban services, as well as the development of all 5G connectivity implementations such as IoT, Big Data, Artificial Intelligence and Blockchain.

[1] The quadruple and quintuple innovation helix framework describes university-industry-government-public-environment interactions within a knowledge economy

Living Lab ToMove (LL ToMove) a Living Lab spread over the territory of the City of Turin focused on the development of new smart and sustainable urban mobility scenarios by using innovative cooperative, connected and autonomous mobility solutions, integrating them into the "Mobility as a Service" paradigm. LLToMove is a project supported by the National Recovery and Resilience Plan (PNRR) in the framework of Maas4Italy project.

In terms of infrastructures, the city can count on the “Torino Smart Road” circuit, a 35 km technologically advanced public infrastructure in which the experimentation of innovative solutions of connected, sustainable and autonomous mobility is possible in real-life conditions.

Figure 1 - Torino Smart Road

The Torino Smart Road circuit technologies, to be implemented by 2024, includes:

- Intersections controlled by Urban Traffic Control (UTC) system;
- Bluetooth traffic sensors;
- Magnetic traffic sensors;
- Road-Side Units (RSU) for V2I short-range communication;

- LoRaWAN parking sensors;
- Underpass monitoring;
- Widespread 5G coverage (e.g. Innovation Mile).

Moreover, the local integrated Video Surveillance System and traffic monitoring, applying Machine Learning technologies, crosses the Smart Road circuit in some intersections.

Torino Smart Road will offer the opportunity to test innovations and technologies in real conditions and identify functional solutions to carry out pre-competitive testing of technologies, services and applications 'in-vivo', putting citizens at the centre of the innovation process, through a co-creation process with users, which is multidisciplinary and interdisciplinary and stimulates quadruple helix cooperation (government, industry, universities and citizens). This must be done in strict compliance with GDPR regulation.

The proposed challenges/use cases are intended not as a set of single unrelated activities, but as tangible implementations of the vision to drive Torino towards Smart Greener Sustainable Urban Mobility and Climate Neutrality putting at the centre the concepts of inclusiveness, accessibility, proximity and urban walkability, already at the cornerstones of urban regeneration policies in Torino.

2.2.1. Last-Mile Delivery in Urban Areas with Fleets of Autonomous Robots

E-commerce is continuously increasing and both customers and business delivery requests are becoming more demanding and hyper-personalised, asking for more flexibility (in terms of delivery locations, time-slots and even packaging), efficiency (same day or even more stringent timing) and sustainability (in terms of eco-friendly transport solutions).

Autonomous vehicles for goods deliveries can address all these requirements and provide a useful solution to improve last-mile logistics. In particular, autonomous robots, equipped with Global Navigation Satellite System (GNSS) positioning technology and appropriate sensors to safely navigate sidewalks, pedestrian zones or road infrastructures with the ability to interact with all road users including vulnerable road users, cars and motorised vehicles, represent a promising solution for the urban areas. These solutions (potentially integrated with traditional deliveries or with other green delivery options such as cargo-bikes) can increase the efficiency

and flexibility of couriers' operations in congested urban areas, enable or support the deliveries of local retailers and, at the same time, reduce the number of circulating vans and of driven kilometers, thus reducing externalities and environmental impacts.

The end-users of this case study include couriers and logistics operators that provide last mile logistics services but also local retailers and small commercial businesses that are enabled to provide efficient home-deliveries to their customers and can increase their competitiveness with respect to online stores.

2.2.2. Waste Collection and Street Upkeep/Cleaning

Keeping urban sidewalks and pedestrian areas clean is essential for ensuring a safe and pleasant environment for residents and visitors to traverse. By exploiting GNSS positioning technology, autonomous robots can navigate sidewalks and pedestrian zones precisely for cleaning designated areas under the supervision of human operators and/or collecting garbage bins. While working in fleets, large areas can be covered more efficiently, contributing to a cleaner and more visually appealing urban environment. In addition to cleaning tasks, autonomous robots may accomplish also other tasks like monitoring the pavements condition or identifying potential maintenance issues, in such a way to make a precise mapping of urban cleaning or maintenance needs, optimizing the planning of the resources needed to properly restore the relevant areas. Additionally, such autonomous operations limit wearisome activities to human operators by supporting them during their working tasks.

The end-users of this use case include municipal authorities, urban maintenance departments, and city cleaning services. By harnessing the capabilities of fleets of autonomous robots, these stakeholders can streamline cleaning operations, enhance maintenance efforts, and create cleaner, safer, and more livable urban environments for all residents and visitors.

2.3. City of Amsterdam

Amsterdam, capital of the Netherlands, is a few meters below sea-level and built on reclaimed land. The city is 'floated' on thousands of poles. The canal walls and bridges were never

designed to handle the loads they are being subjected to today by heavy vehicles and it is very difficult to assess the impact on the canal walls under water. Amsterdam has more than 100 kilometres of canals and would like to make further use of them by moving some of the land-traffic burden onto the canals. This use-case invites innovative robotics applications for the enhanced use of the canals across the following areas:

2.3.1. Garbage Collection and Delivery via Canals

The City of Amsterdam is not able to build underground garbage containers in the city centre. This means residents and businesses leave their garbage on the streets – the bags get opened and waste is dispersed by seagulls and rats. It would be of value to understand if the canals could be used for (autonomous) garbage collection and delivery of the garbage to waste sorting centres. Thus, offering an alternative to heavy vehicle transport in the city.

2.3.2. Goods Delivery via Canals

There are thousands of hotels, restaurants, cafes, etc. in the city centre, the City of Amsterdam would like to see transport over water for logistics distribution. It could be for food and perishable goods from the Food Distribution Centre, but also parcels/packages. The ability to efficiently transport items across the water would be positive but this would still require effective means of moving the goods from the water onto the land. which may require large-scale infrastructure changes such as use of cranes. Water transport can be very expensive and still requires large amounts of human intervention. Effective, affordable, autonomous solutions to goods delivery via the canals would be of interest, and this would also offer some alternative to heavy vehicle use on land.

2.3.3. Passenger Transportation via Canals

Autonomous solutions for passenger transportation via canals is of interest. This is in view of relieving the burden of land transport, but also to enhance the attractiveness of Amsterdam as a tourist destination with seamless and efficient canal-based transportation.