



ROBOTICS FOR INSPECTION  
AND MAINTENANCE

# Robotics for Inspection & Maintenance

## *Status and Progress*

Peter Trampus

# What is RIMA

## EU-funded project, 2019-2022

- Total budget 16M Euros
- 8M Euros distributed to SMEs via 2 Open Calls

## Network of Digital Innovation Hubs and Industrial Organizations

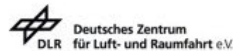
- Supporting and facilitating **the uptake of robotics by industry**
- Gathering information into one knowledge base
- Sharing practices

## Offer of services by DIHs

- Tech transfer, proof of concept, access to testing facilities
- Advising, coaching, training, matchmaking,
- Path to market, market deployment
- Communication, dissemination
- Links with stakeholders, actors of value chain: asset owners or operators, techno and service providers, investor, certification bodies

# Who We Are

- Digital Innovation Hubs and Industry Organizations from across Europe



# Industry Sectors Covered by RIMA



ENERGY

## Energy generation and distribution

Includes wind, solar, hydro, coal, and power distribution, covering both off-shore and on-shore infrastructure



OIL & GAS

## Oil & gas and chemical

Refining and distribution infrastructure, including off-shore infrastructure and decommissioning.



NUCLEAR

## Nuclear

Including decommissioning, waste disposal, maintenance and life extension



HUBS

## Transport, cargo and mobility

Includes large transport hubs like ports, airports and interchanges.



WATER

## Water supply and sanitation

Sustainable, safe water infrastructures include clean water, wastewater and storm water infrastructures



TRANSPORT

## Urban and suburban transport routes connected with cities

Local transport systems such as trams, track and trackside equipment, bridges, tunnels and roads rolling stock and geo-physical maintenance

## Our Vision

**Actor of reinforcement of European leadership in I&M robotics by connecting technology to industrial/sectorial needs and fostering cross border co-operation through the **RIMA Network****

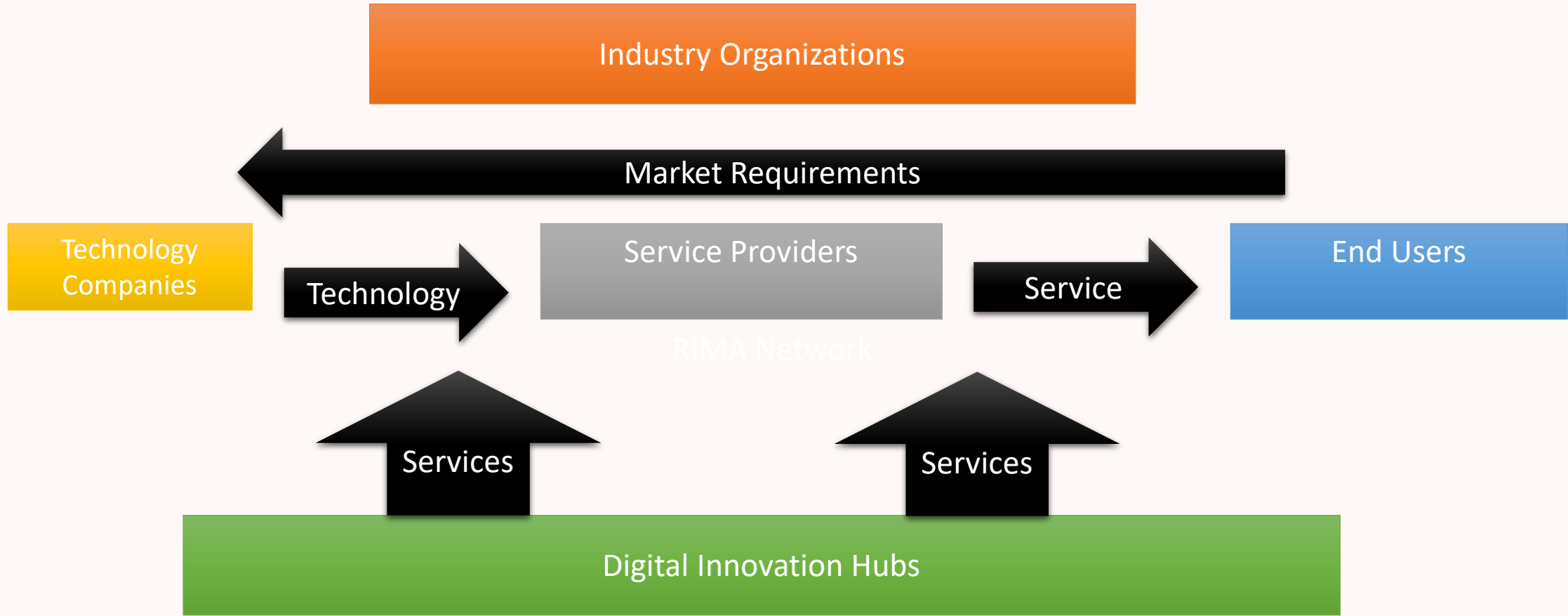
## Our Goal

- **Connect** research, technology & service providers, end users, investors and certification bodies **under one roof**
- Support end user to **share** their challenges
- Support SMEs to **commercialize** their solutions
- Provide **education and training** on robotics

# RIMA Network

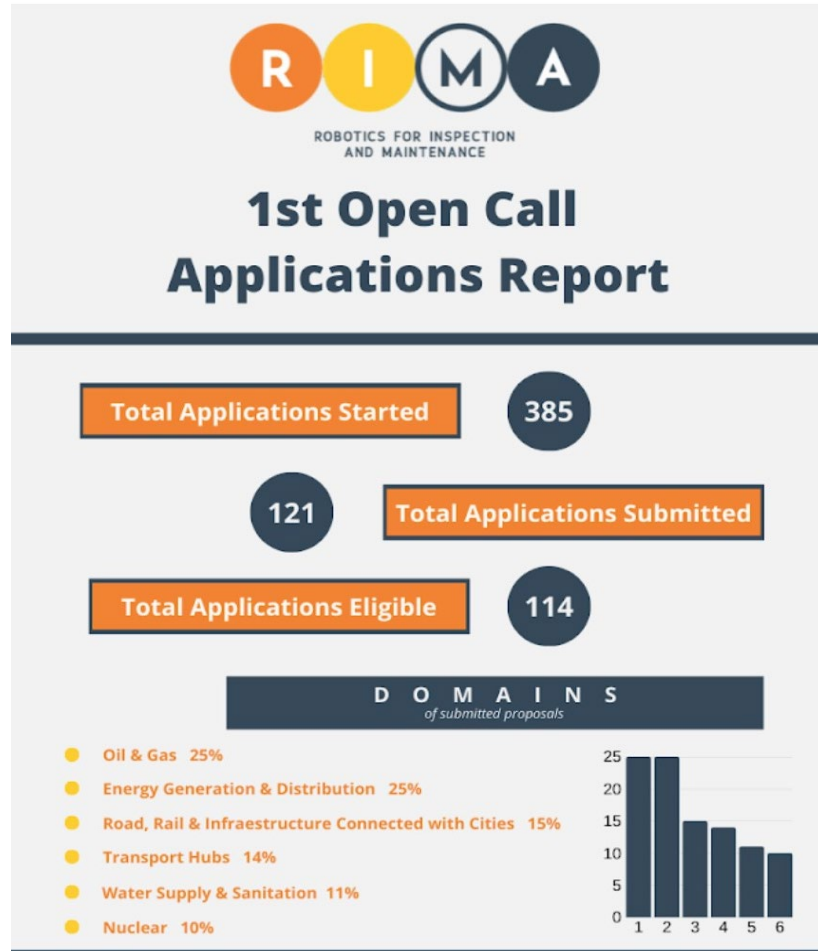


# RIMA Network





# 1st Open Call



- 19 funded projects within the 6 industries
- **Technology Transfer Experiments (TTE)**
  - Developing, testing and validating the technical and economic viability of a robotic-based representative model or prototype system to be applied in 'Target Use Domain' operational environment.
  - Max 300k Euros per TTE and project timescale max 14 months
- **Technology Demonstrators (TD)**
  - Validating the technical and economic viability of a new or improved Robotic-based technology, product, process, service or solution in a 'Target Use Domain' operational environment, whether industrial or other, involving where appropriate a larger scale prototype or demonstrator.
  - Max 100k Euros per TD and project timescale max 6 months

# Energy – Funded Projects

**Tango:** First beyond radio line of sight drone flights in power line inspections in Europe



SISTEMAS  
NAVARRA

**AeroDefectScan:** Automatic defect detection system in solar panel inspection



**DRONE4PV:** Product for optimiing O&M activities at utility-scale PV plants



**Leaks Buster:** The first ROV-based solution for acoustic leaks detection



# Nuclear – Funded Projects

**MiROS:** Sensor-robot solution for nuclear facility inspection

**INNOWTECH**

elements

**UCODE:** Cobot for underwater nuclear decommissioning

**FORTIS**  
REMOTE TECHNOLOGY

createc

**PRIMUS:** Platform for NDT in complex and hazardous industrial environments

Fuzzy Logic  
ROBOTICS

Visionic

# Oil & Gas – Funded Projects

**RCU:** Robotic manipulator  
for complex weld  
geometries inspection  
using Ultrasonics Phased  
Array



**ATEXDRONE:** Pneumatic  
ATEX-compatible drone for  
inspection of hazardous  
facilities



**APRORAP:** Platform for  
NDT in complex and  
hazardous industrial  
environments



# Water – Funded Projects

## **WISE-INSPECT:**

Autonomous flying robot  
for inspection of  
underground water supply  
and storage systems



**INOWATT:** Drone with 3D  
localization/mapping  
properties for indoor  
inspection of water  
treatment plants



**Pondsurvey:** Autonomous  
industrial pool monitoring  
and inspection



# Road and Rail Infrastructure – Funded Projects

**3Rc:** Robot cell to repair cracks on the roads



**MAP4CAT:** Tandem car/drone for delivering simultaneous 3D mapping of corridors

geonumerics



**PreventaBot:** Automated system for preventative tunnel drainage maintenance



# Transport Hubs – Funded Projects

**APIBOT:** Aerial robotic system for airport pavement inspection



**RAHIP:** Autonomous robot for algae harvesting



**FIDR:** Ground robot for perimeter fence inspection and automatic breach detection



# 1st Open Call

- Take a look at the funded proposals in more detail on the RIMA website

<https://rimanetwork.eu/rima-knowledge-base?kbcats=open-call-dissemination>



## PROJECT: AERODEFECTSCAN

Automatic defect detection system in solar panel by aerial robot

The solution is based on an unmanned aerial vehicle and AI-based image processing for the automated detection in solar panels in a solar plant. Image datasets from a thermal camera onboard of the UAV will be processed by a ground station throughout deep learning for a diagnosis report.

By Elimco Aerospace and Rovimatica S.L.



## PROJECT: INOWATT

Indoor inspection of water treatment plant by use of drone with 3D localization/mapping capabilities

Water treatment plants are found all over the world. Most plants comprise large indoor facilities and require regular inspections to check structures for corrosion and cracks. Tall structures typically require the use of scaffolding or a team of climbers. ScoutDI is developing a complete drone inspection system that enables safe and easy inspection of such environments. ScoutDI drones can navigate safely in GPS-denied environments due to a 3D LIDAR as well as state-of-the-art localization and mapping algorithms. Since the drone can accurately estimate its location at all times, inspection data can be "location-tagged" and processing of data can be related both to time and location to develop trends.

By Aisens AS and Scout Drone Inspection AS



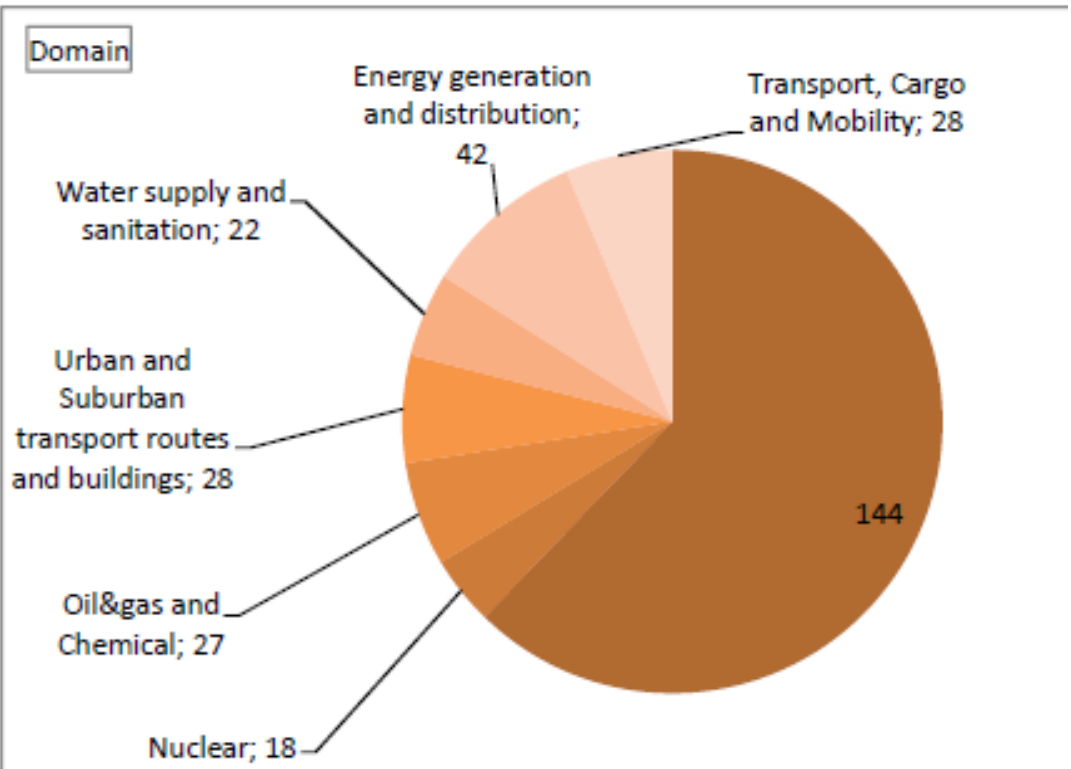
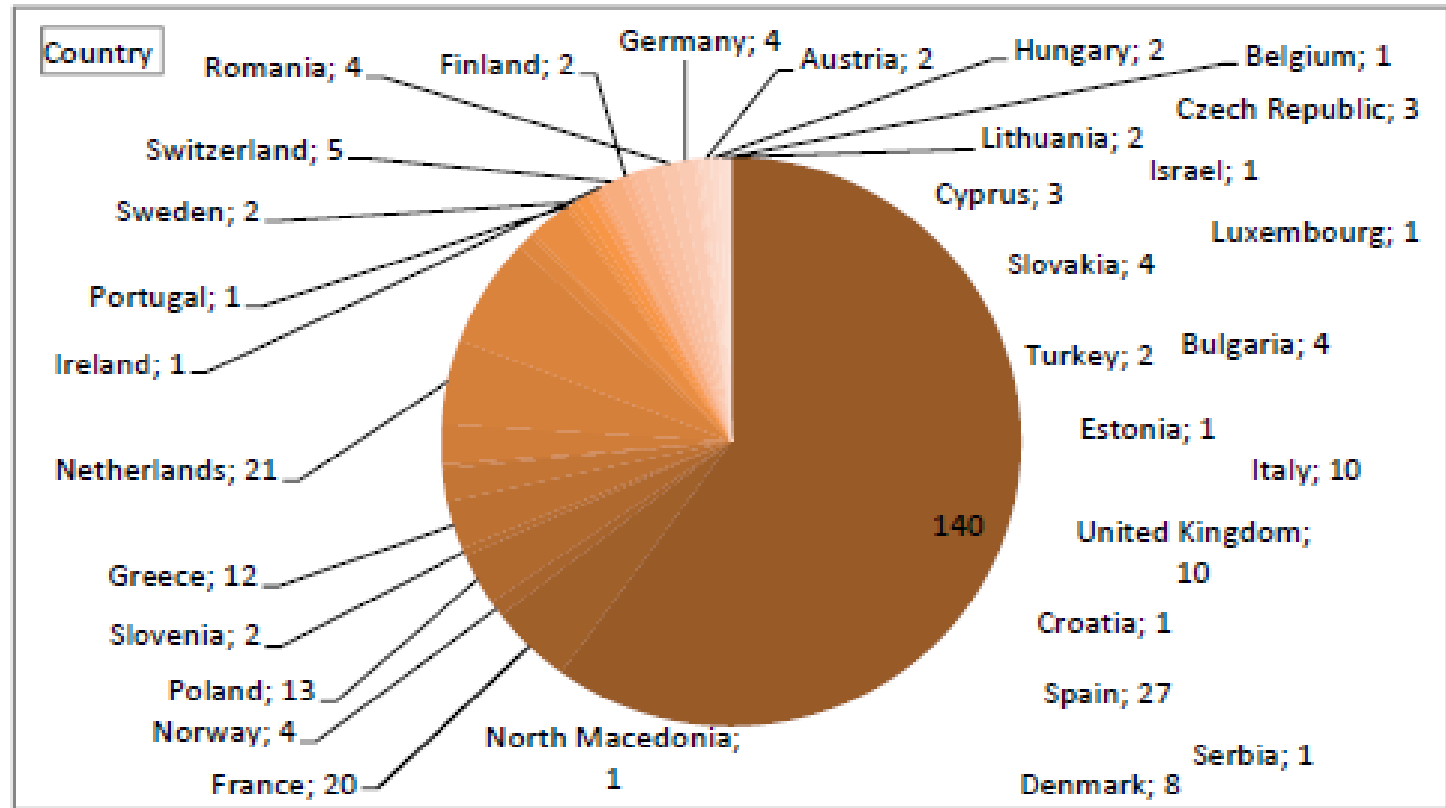


# 2nd Open Call

## Submission of applications

- The open call started on **15th of December 2020**
- Deadline was: **17th of March 2021**
- **Result: application started – 437  
submitted - 154**

# 2nd Open Call



# 2nd Open Call

## RIE (Robotics Innovation Experiment)

- **Duration:** RIE (up to 14 months)
- **Funding:** up to €150 k

## Beneficiaries

- SMEs or slightly bigger companies from EU member states or associated countries
- Minimum of 2 independent entities

## TRL

- Min TRL 5

# ENERGY GENERATION AND DISTRIBUTION

**Energy generation and distribution includes wind, solar, hydro, marine power, power lines and substations**

## Challenges

- Large and remote areas, long endurance missions
- Harsh environments, underwater
- Complex environment



# ENERGY GENERATION AND DISTRIBUTION

## New solutions from robotics?

- Resident robots, permanently stationed in e.g. an offshore wind park
- Highly mobile and agile robots
- Robust autonomous navigation
- Robots capable of limited maintenance/intervention



# OIL & GAS AND CHEMICAL

## Challenges

- Data harvesting and data analysis
- Above ground storage tank inspection, cleaning and maintenance
- Pressure vessel inspection and damage classification
- Process piping inspection and maintenance in challenging environments
- Remote operators
- Offshore installation inspection, maintenance and repair



# OIL AND GAS

## What could robotics solve?

- Resident robot performing regular in-service inspections
- Inspection of space between vessel wall and insulation (possibly using nanobots)
- Development of NDE methods to enable high-coverage wall thickness measurements using robotics
- In service (i.e. partially full tank) robotic cleaning
- Automated data analysis techniques
- Robots with the ability to climb over obstacles
- Robotic removal and re-mounting of insulation
- Autonomous surveillance, anomaly detection and facility mapping
- On-site robotic operator, teleoperated with autonomous capabilities
- Resident Unmanned Aerial Vehicle (UAV) to provide autonomous monitoring of the state of the installation



# NUCLEAR

**Nuclear Power Plants, reprocessing facilities, facilities for mining & processing**

## Challenges

- Mapping of site infrastructure
- Health monitoring of components during lifetime
- Inspect / support repair of equipment
- Clean robustly (parts of) nuclear infrastructure
- Waste disposal / decommissioning
  - Clean / reduce sizes of (irradiated) waste
  - Dismantle components
  - (Re)move waste items within working areas





# NUCLEAR

## New solutions from robotics?

- Mapping complex structures, HVAC, stacks etc.
- Autonomous health monitoring resulting in maintenance recommendations, warnings etc. in hazardous or confined areas
- Unmanned or remote-controlled sample takings, inspections or repairs
- Cleaning of surfaces; long-term storage pools, access restricted area's
- Decontamination of irradiated items
- Automated waste size reduction in accordance with safety requirements of site



# TRANSPORT, CARGO AND MOBILITY

## Challenges

- Inspection and Maintenance activities in the following:
  - Perimeter infrastructure
  - Waterways, quay walls and locks
  - Runways
  - Vegetation around the hubs
  - Rails
  - Maritime: ships & ports



# TRANSPORT, CARGO AND MOBILITY

## What could robotics solve?

- Robotized inspection, repair and maintenance of the perimeter infrastructure
- Increasing safety for the proper operation of transport hubs
- Underwater robotic solution for I&M activities below water level
- Visible and under surface condition, debris, ice and snow removal technologies
- Detecting, monitoring and removing vegetation by robotized systems
- Enhanced performance of cargo or repairing activities.
- Vessel and ship inspection for structural and/or machinery condition monitoring.



# WATER SUPPLY AND SANITATION

## Challenges

- Confined spaces with GPS-denied environments
- Presence of debris
- Risks of highly hazardous and corrosive chemicals
- Presence of pressurized water

The accessibility to these underground areas for I&M operations is important considering the impact it has on surrounding environment (traffic disruption, noise)



# WATER SUPPLY AND SANITATION

## New solutions from robotics?

Technologies need to be safe, efficient, robust, easy to use and low cost to operate difficult environments – also aerial robots can be considered. Solutions that can produce

- CCTV, 3D reconstructions or defect profiling with ground penetrating radars
- Laser sensors or sonars potentially adapted to pipes with different sizes, shapes and materials enabling accuracy for end-of-life estimations
- Multi-sensing and autonomous robots to navigate in GPS-denied environment and adapt to various shapes and sizes of infrastructures,
- Robotic devices that are able to operate in partially / fully water submerged pipes and canals, and able to cover larger distances
- Robotics devices for lifting heavy manhole covers to reduce occupational hazards





# URBAN AND SUBURBAN TRANSPORT ROUTES CONNECTED WITH CITIES

## Challenges

- Increase efficiency in the I&M activities of civil infrastructure
- Reduce risk for workers during I&M activities on civil infrastructures
- Ensure that civil infrastructure is operational and safe
- Worker – machine on jobsite cooperation
- Open (facilitating technologies development)





# URBAN AND SUBURBAN TRANSPORT ROUTES CONNECTED WITH CITIES

## What could robotics solve?

- Minimize the time that facilities are not available due to I&M activities
- Increase cost-efficiency in the accomplishment of I&M activities
- Use multi-sensing inspection robots in order to detect defects in different infrastructures
- Robotic solutions for approaching unreachable places and performing I&M operations
- A combination of methods and tools that can support the aforementioned resources to resist to difficult environmental conditions (night conditions, windy areas, etc.)
- Increase supporting tools for the operators during the execution of I&M activities.
- Introduce safety resources that will supervise operators' activity.
- Provide robotic solution that improve safety conditions for operators when performing I&M activities.
- Safety approved devices and methods that will increase the operators' safety during the execution of I&M activities.



LinkedIn #RimaNetwork  
Twitter @NetworkRima  
Web <https://rimanetwork.eu>  
Email [info@rimanetwork.eu](mailto:info@rimanetwork.eu)

Peter Trampus, RIMA contact, EFNDT  
[peter.trampus@ttsa.hu](mailto:peter.trampus@ttsa.hu)