ERF 2022 Workshop

Application of Robotics in Sustainability and Environmental aspects

28th June, 2022

EUROPEAN ROBOTICS FORUM

ERF2022 ROTTERDAM 28-30 JUNE

eu ROBOTICS

FELICE COLLABORATE TU WIEN PROFACTOR

ober österreich EFRE

Organizers

Sharath Chandra Akkaladevi,
Profactor GmbH, Austria

Franziska Kirstein,
Blue Ocean Robotics,
Denmark

Maria Pateraki,
National Technical
University of Athens,
Greece

Markus Vincze,
TU Vienna, Austria

This workshop is conducted within the EU Robotics topic groups

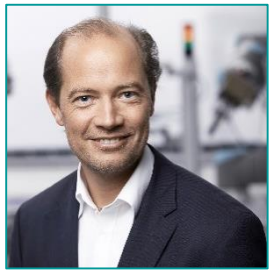
- Sustainability and Environmental aspects
- AI and Cognition in Robotics

Application of Robotics in Sustainability and Environmental aspects

The focus of the workshop is

- on the application of robotics to sustainability,
- as first steps **discover/**define sustainable and environmental aspects in different sectors (manufacturing, agriculture, marine, energy, …) and
- clarify the (**current**) role of robotic applications in manufacturing, recycling and agriculture with sustainability perspective

Agenda



14:25 Introduction to Robotic Applications for Sustainability

Dr. Christian Eitzinger, Head of Machine Vision Department, Profactor GmbH, Austria

14:35 Robotic applications for Sustainability – Manufacturing

Dr. George Michalos, Senior Project Manager, Laboratory for Manufacturing Systems and Automation (LMS) - University of Patras, Greece
https://www.linkedin.com/in/george-michalos-13497713

14:45 Robotic applications for Sustainability – Marine

Dr. Damien Salle, Coordinator of Robotics & Automation, TECNALIA, Spain
https://www.linkedin.com/in/damiensalle/

Agenda

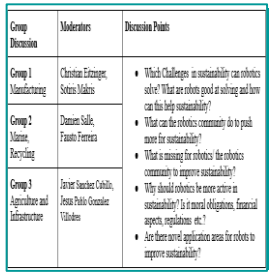
14:55 Robotic applications for Sustainability – Infrastructure

Javier Sánchez-Cubillo Robotics and Automation Manager at ZeniaLabs Automation Intelligence

https://www.linkedin.com/in/JavierSCubillo/

15:05 Robotic applications for Sustainability – Green Energy

Prof. Stjepan Bogdan, Laboratory for Robotics and Intelligent Control Systems, Faculty of EE&C, University of Zagrebence



Group Discussion	Moderators	Discussion Points
Group 1 Manufacturing	Christian Eitzinger, Sotiris Makris	• Which Challenges in sustainability can robotics solve? What are robots good at solving and how can this help sustainability? • What can the robotics community do to push more for sustainability? • What is missing for robotics' the robotics community to improve sustainability? • Why should robotics be more active in sustainability? Is it moral obligations, financial aspects, regulations etc.? • Are there novel application areas for robots to improve sustainability?
Group 2 Marine, Recycling	Damien Salle, Fausto Ferreira	
Group 3 Agriculture and Infrastructure	Javier Sanchez Cubillo, Jesus Pablo Gonzalez Villodres	

15:15 Interactive Session

Group Discussions

15:35 Conclusion and Wrap-up

ERF2022
ROTTERDAM
28-30 JUNE

ERF 2022 Workshop

Industrial Robots and Sustainability

28th June, 2022

@ DOCK10, 28th June 16:10

how can companies work in a more sustainable way with the help of industrial and collaborative robots

SOCIAL ROBOTS:

THE DUALITY OF SUSTAINABILITY AND SOCIETAL APPLICATIONS

EUROPEAN ROBOTICS FORUM

ERF2022 ROTTERDAM 28-30 JUNE

eu ROBOTICS

@ DOCK10, 29th June 09:50

The beauty lies in the objective to investigate the two sides of the coin and their interdependency: Sustainable Societal Applications and Societal Applications for Sustainability.

29th June, 2022 @ ERF 2022, Rotterdam, The Netherlands

ROBOTICS FOR SUSTAINABILITY

EUROPEAN ROBOTICS FORUM

ERF2022 ROTTERDAM 28-30 JUNE

eu ROBOTICS

MANUFACTURING OF SUSTAINABLE ROBOTS

@ DOCK15, 30th June 08:30

How can robots be designed, developed and manufacture in a more sustainable way around the aspects of energy, materials, lab and recycling / circular product design?

30th June, 2022 @ ERF 2022, Rotterdam, The Netherlands

Quick Poll


Go to www.menti.com and use the code 2260 5488
Mentimeter
Instructions
Go to
www.menti.com
Enter the code
2260 5488
Or use QR code

Group Discussion

Group	Moderators	Discussion Points
Group 1 **Manufacturing**	Christian Eitzinger, George Michalos	▪ Which Challenges in sustainability can robotics solve? What are robots good at solving and how can this help sustainability? ▪ What can the robotics community do to push more for sustainability? ▪ What is missing for robotics/ the robotics community to improve sustainability? ▪ Why should robotics be more active in sustainability? Is it moral obligations, financial aspects, regulations etc.? ▪ Are there novel application areas for robots to improve sustainability?
Group 2 **Marine, Recycling**	Damien Salle, Franziska Kirstein	
Group 3 **Infrastructure and Energy**	Javier Sanchez Cubillo, Stjepan Bogdan	

Thank You

Get the Slides →

https://www.profactor.at/events/erf-2022-applications-sustainable-robots/

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Robotic Applications for Sustainability
An Introduction

Christian Eitzinger, Profactor GmbH

EUROPEAN ROBOTICS FORUM

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Sustainability

- Possible applications of robots in “Sustainability”
- How to characterize sustainable robotics ?

Sustainability =

environmental ← **This workshop**
economic
social

Sustainability

Robots for cleaning the environment

Sustainability

Cleaning robots

- Cleaning of waste along roads
- Collection of plastics from the oceans
- Beach cleaning robots

Sustainability

Robots for Disassembly and Dismantling

Sustainability

Disassembly robots

- Disassembly of electronic devices
- Dismantling of cars, planes, …
- Demolition robots

Sustainability

Long-term Future: Robots fighting climate change

Sustainability

Addressing climate change

- Cloud seeding robots
- Tree planting robots
- Waste-to-energy conversion

Sustainability

- How to characterize “sustainable” robots?

Are robots sustainable that

- … assemble electrical vehicles
- … manufacture light-weight parts for energy efficient transport
- … clean and inspect solar power plants
- … automate disassembly processes to enable remanufacturing
- … collect waste
- … collect waste and convert it into energy
- … plant trees

?

Sustainability

First attempt for discussion

(Environmentally) sustainable robots realize processes, that

have direct and positive impact on the environment.

Laboratory for Manufacturing Systems and Automation
Department of Mechanical Engineering and Aeronautics
University of Patras, Greece

Dr. George MICHALOS (michalos@lms.mech.upatras.gr)

Product, Process, System Sustainability – Robotics Perspective

Product sustainability

Robots as a product

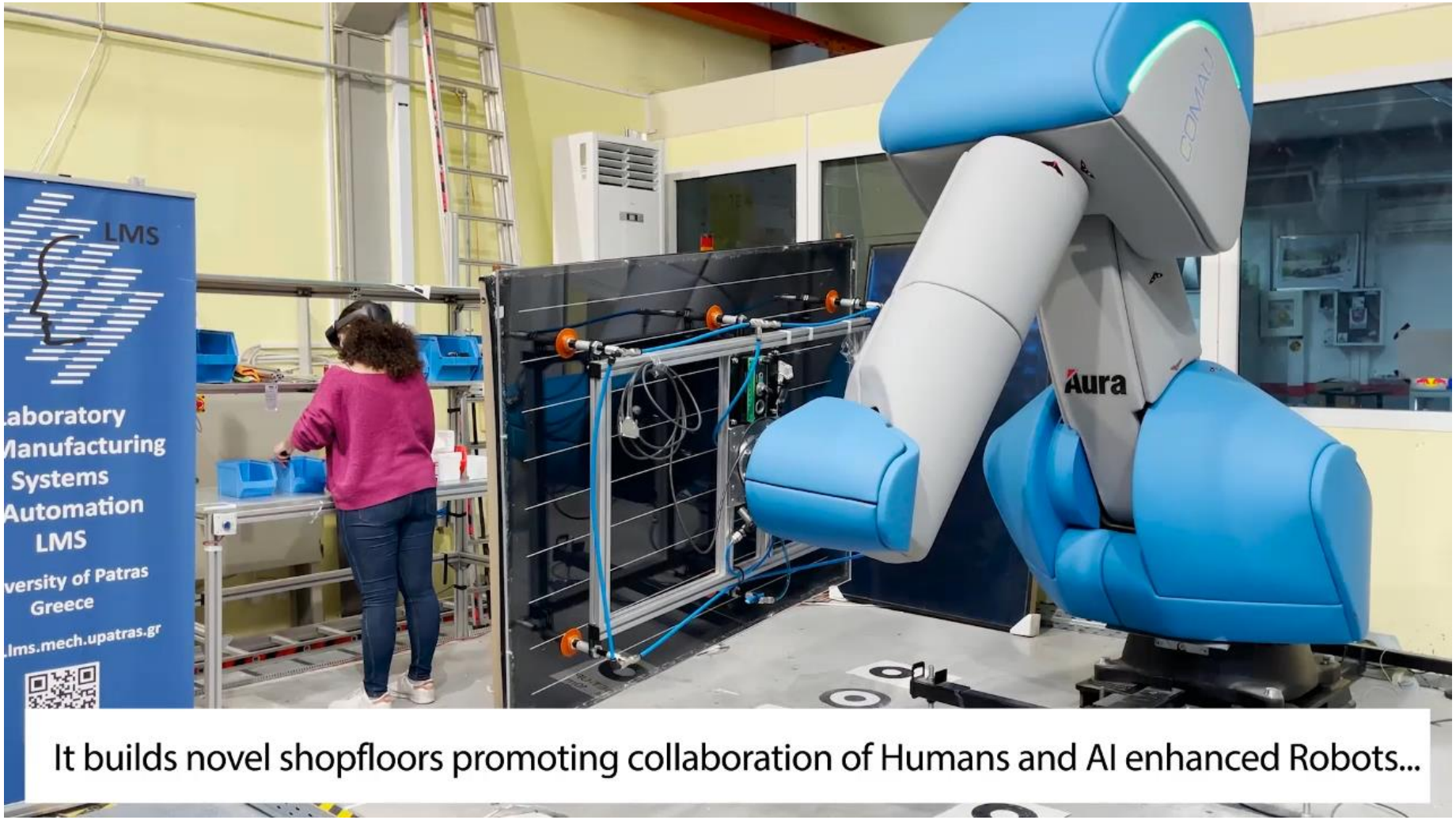
- Material usage
  - Defines stiffness / accuracy
  - Affects Investment Cost
- Product structure
  - Defines complexity / flexibility
  - Affects reusability
- Energy consumption
  - Defines performance
  - Affects Running costs

Sustainability Aspects

- Lightweight materials
- Simplified/ modular structure
  - Fewer components
  - Compact devices
  - Reusable parts
- New actuation and control principles: get more from the same energy input

Product sustainability

Products made by robots (and humans)



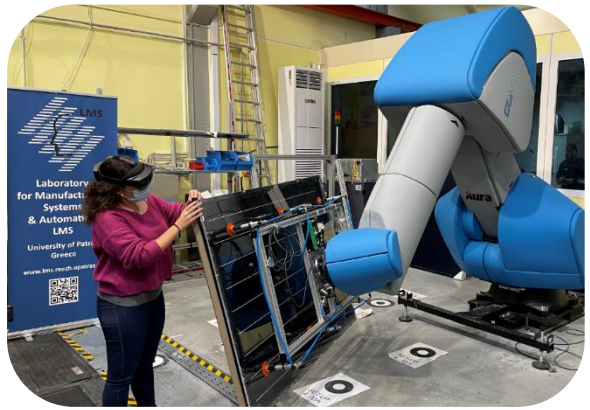
Process sustainability

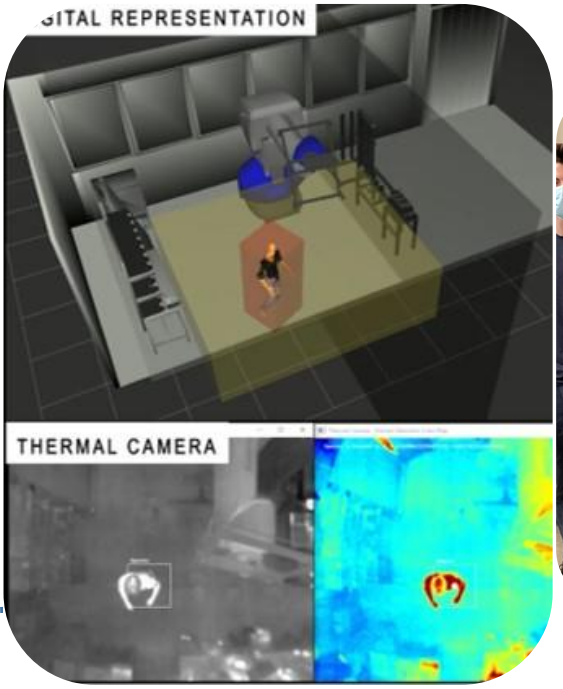
Social sustainability

- **Reduction** of **physical/cognitive load**
  - **Employ** operators with **special restrictions**
  - **Improve** operator **wellbeing** and **satisfaction**
- Attractive industrial environments to **young** and **aged** personnel
- Promote **gender equality** in manufacturing
- **Improvement of safety**
- Optimization of operational phase → **cost efficient products made in EU**

Process sustainability

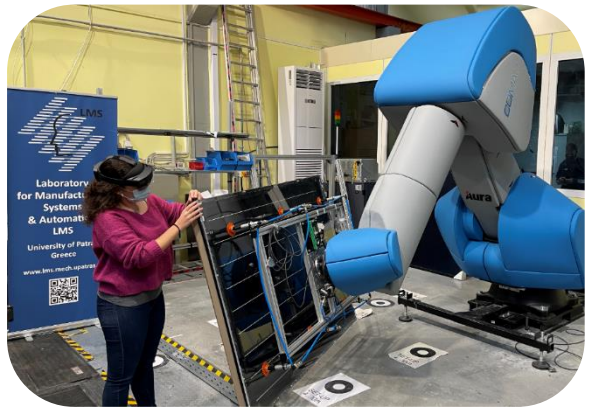
Social sustainability

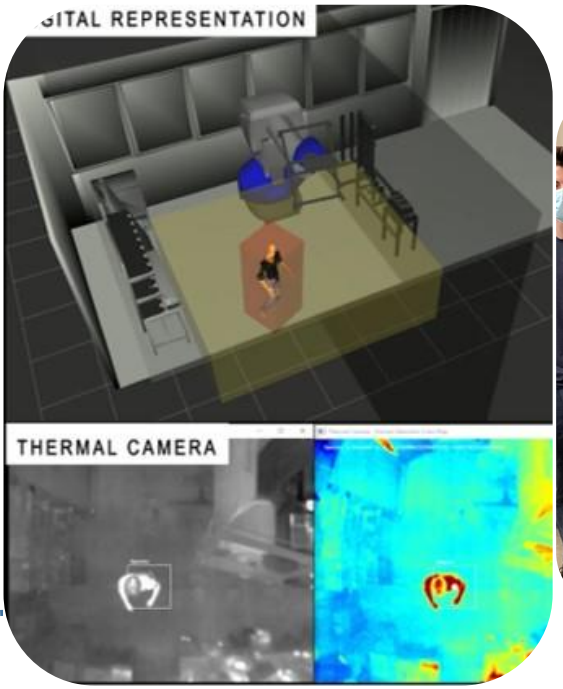




Process sustainability

Social sustainability



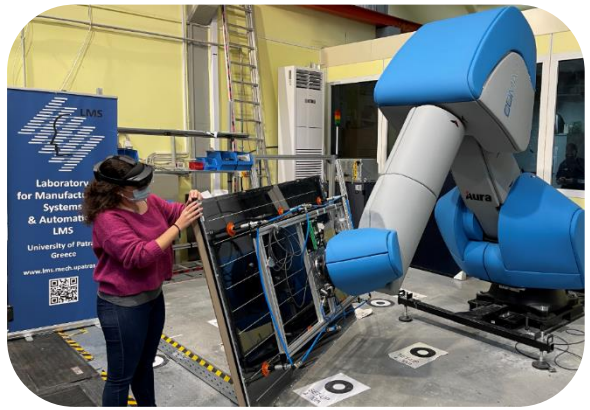


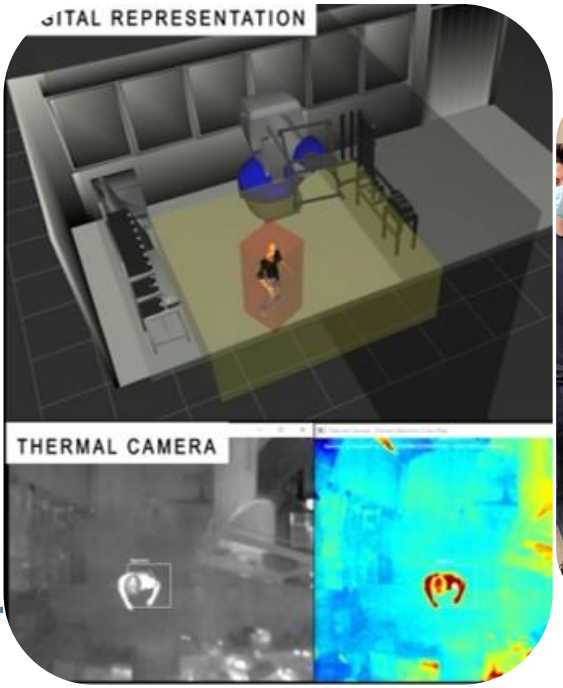
Environmental sustainability

- Use cases from **sectors** that have **large ecologic footprint**
- **reduction of single purpose machines** in future assembly plants
- **optimization of consumables** usage/reduction of **energy consumption**
- **reduction of waste/scrap**

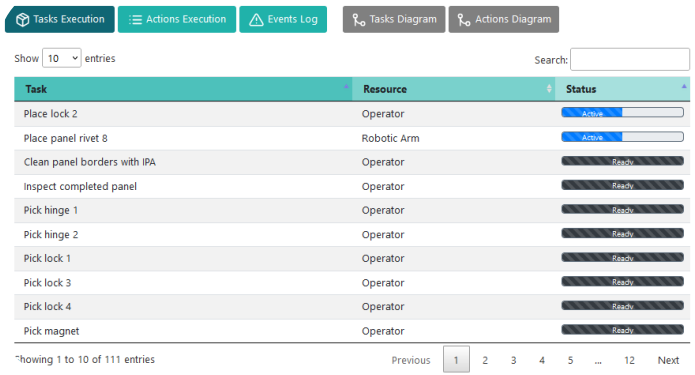
Process sustainability

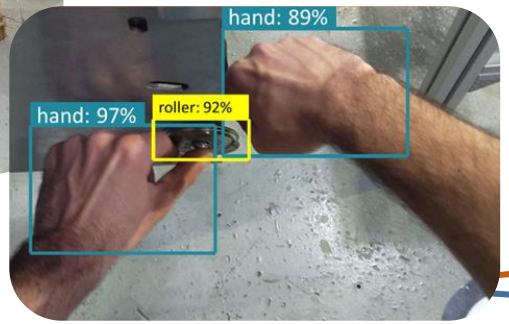
Social sustainability





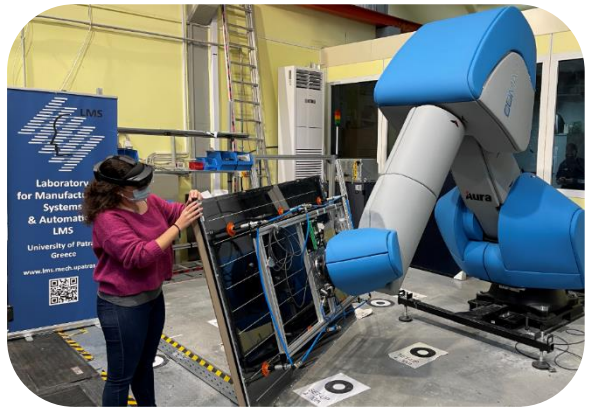
Environmental sustainability

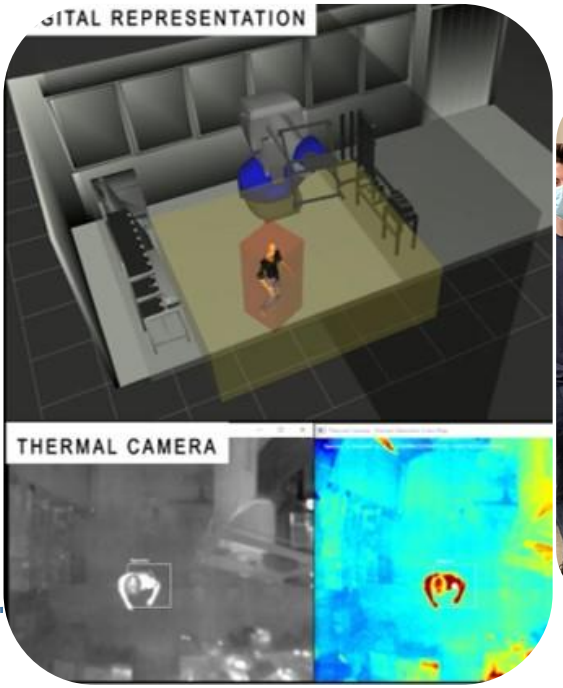




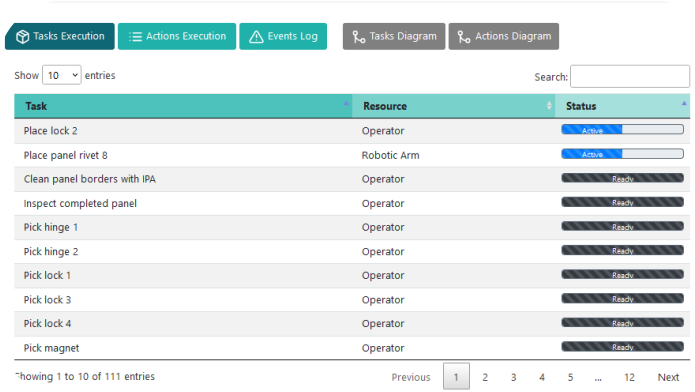
Process sustainability

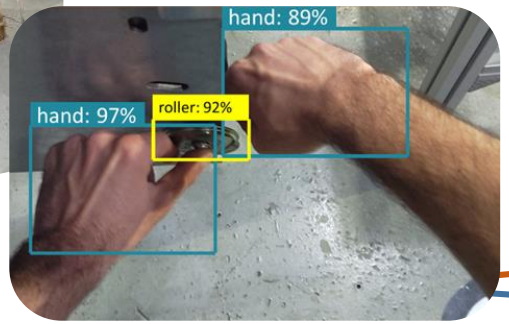
Social sustainability





Environmental sustainability



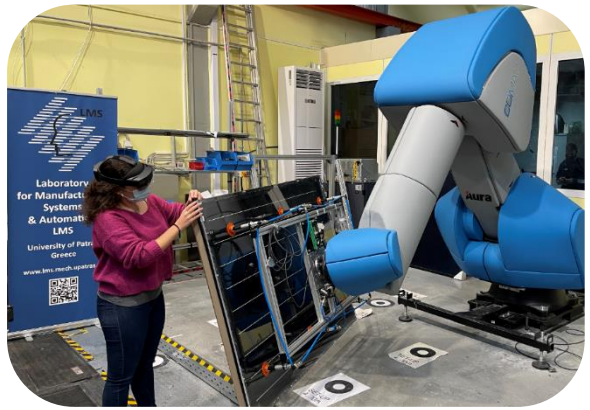


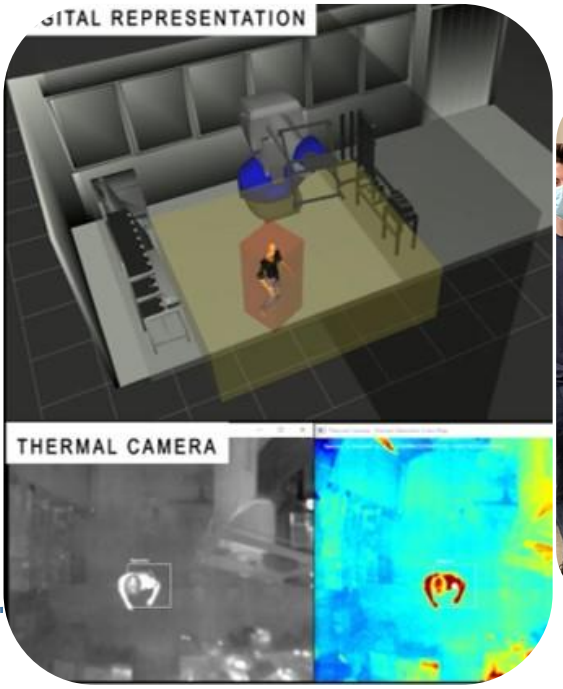
Economic sustainability

- reduction of **physical changes costs**
- robot **operation** and **programming by non experts**
- **plug & produce modules** – supportive **ICT infrastructure**
- reduction of **downtime – workload balance**
- **no** need for **physical barriers**

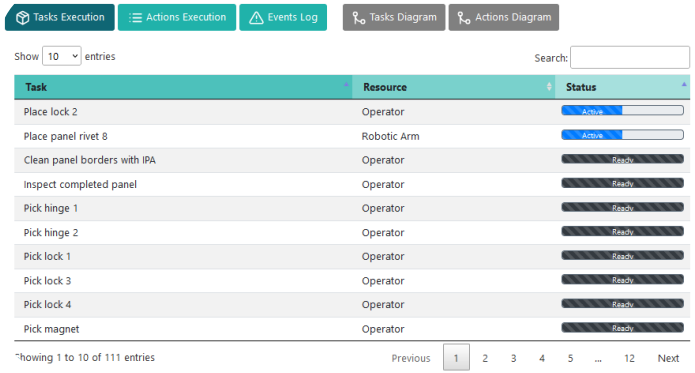
Process sustainability

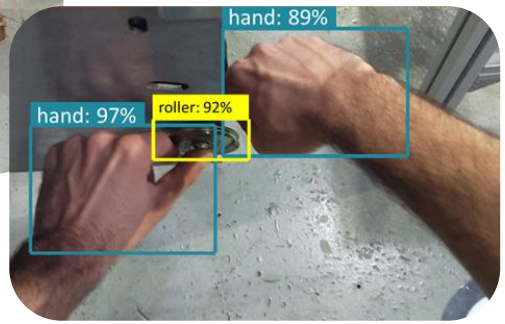
Social sustainability



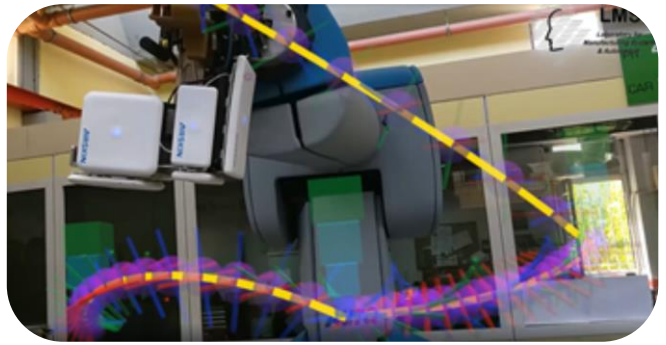


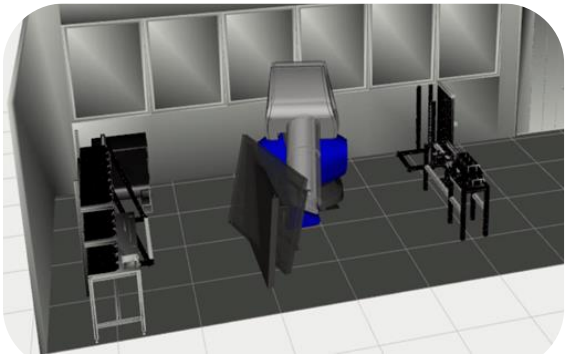
Environmental sustainability





Economic sustainability





System sustainability

Savings through the ability to change completely the structure and operation of a complete system …

... rigid flow line structures employing model-dedicated handling/transportation

… with fixed control logic

... signals-based tasks sequencing requiring high manual effort for changes

… autonomous, exchangeable and mobile production units

… highly interactive robotic structures

... random production flows

… integrated by an open architecture

Sustainability not as an index but as a design parameter!

LMS

Laboratory for
Manufacturing Systems
& Automation

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Robotics for Environmental Sustainability?

Damien SALLÉ
Coordinator of Robotics & Automation
damien.salle@tecnalia.com

2022

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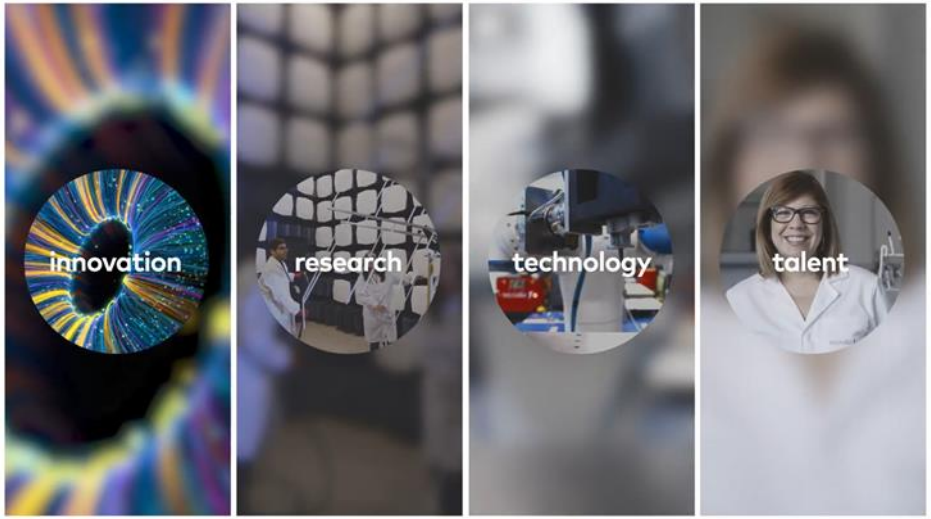
Creating Growth : Improving Society

- **Largest applied research and technological Centre in Spain**
- A European benchmark: 1st Private organization in Spain in H2020
- 114M€ Income: 49% Private contracts; 29% competitive public funding (31/12/2020)
- Member of the Basque Research and Technology Alliance.
- 1472 People on Staff;

https://youtu.be/g3VNuZzXYKc



Transform technological research into prosperity

ROBOTICS In TECNALIA: a KEY ENABLING TECHNOLOGY

Some Success Stories videos:
2021: https://youtu.be/UMIcb_h08mQ
2020: https://youtu.be/n8H4Dx8mYvQ

DRONES

COLABORATIVE ROBOTS

MOBILE MANIPULATORS

REHABILITATION DEVICES

MAQUINAS

SERVICE ROBOTS

AUTOMATED VEHICLES

INDUSTRIAL ROBOTS & SYSTEMS

CABLE ROBOTS

BANCOS DE ENSAYO

DUAL-ARM ROBOTS

MEDICAL ROBOTS

MARINE ROBOTS

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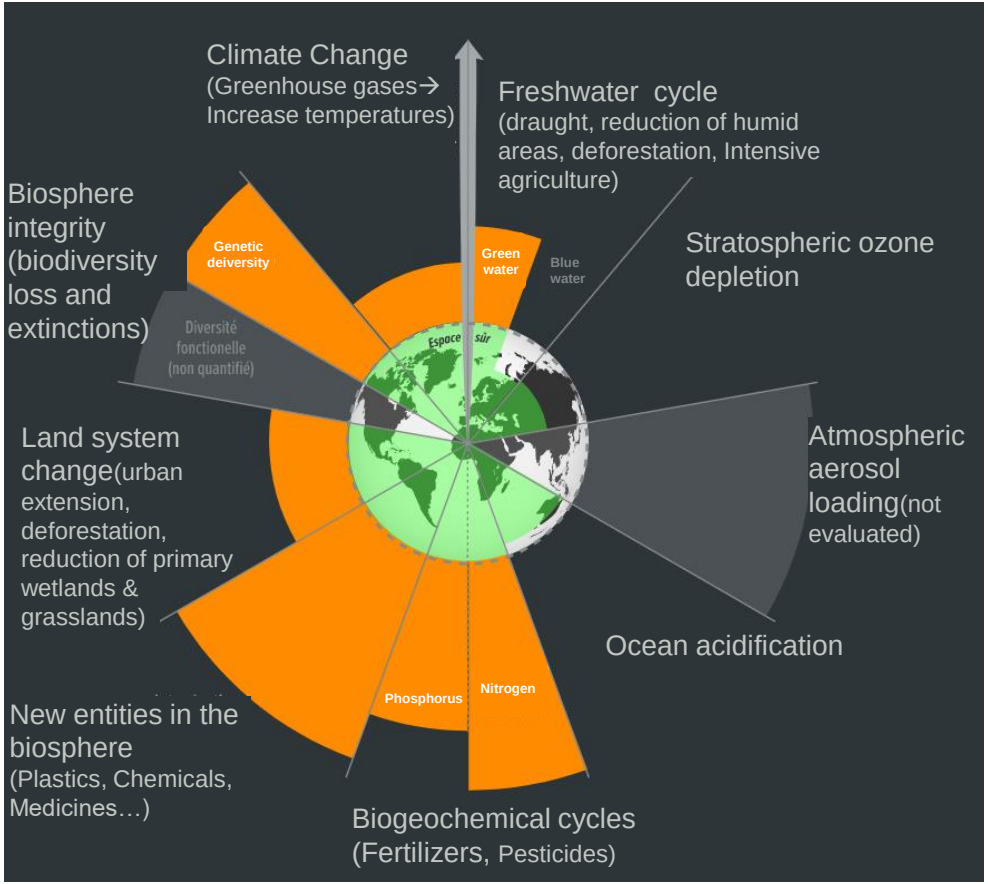
02

Robotics for Sustainability

Clear need to do something!

We already passed 6 of the 9 planet limits (Stockholm Resilience Centre)



➔VERY HIGH STRESS ON THE BIOSPHEE DUE TO HUMAN ACTIVITIES

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03

Can Robotics Contribute?

→ TECNALIA Initiative:
CIRCULAR ROBOTICS

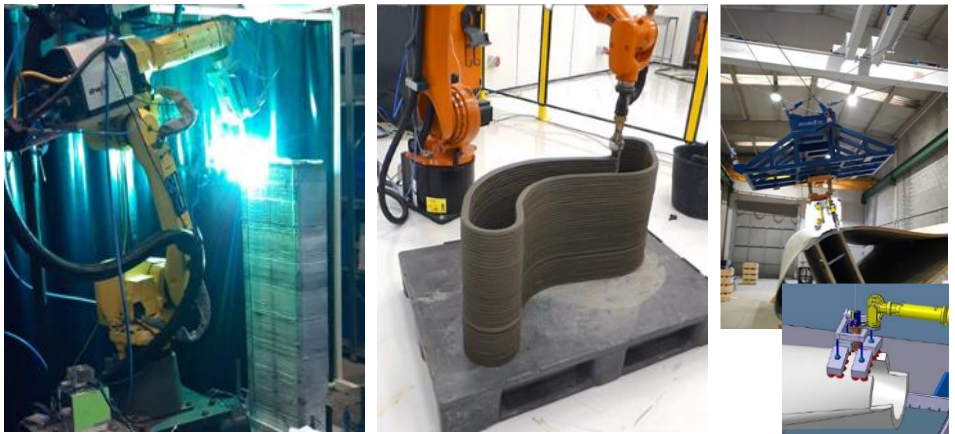
CIRCULAR ROBOTICS – 4 Lines

Removal

Sorting

Dismantling

Repair/Process



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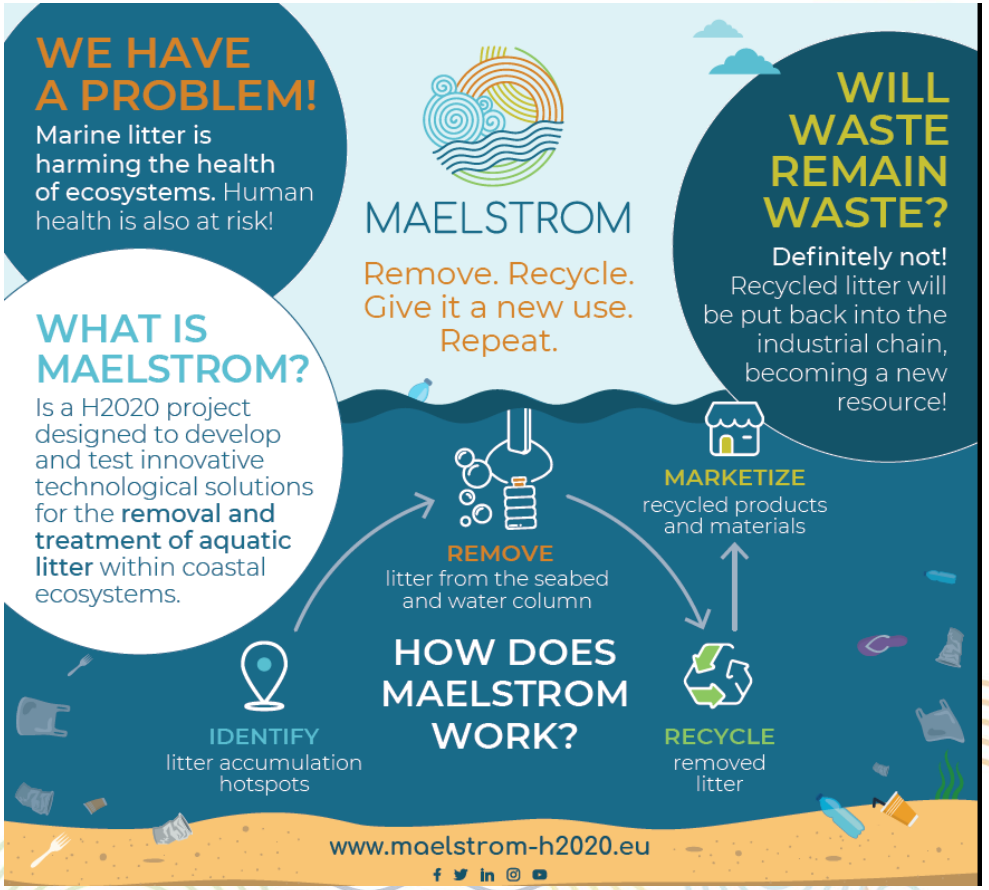
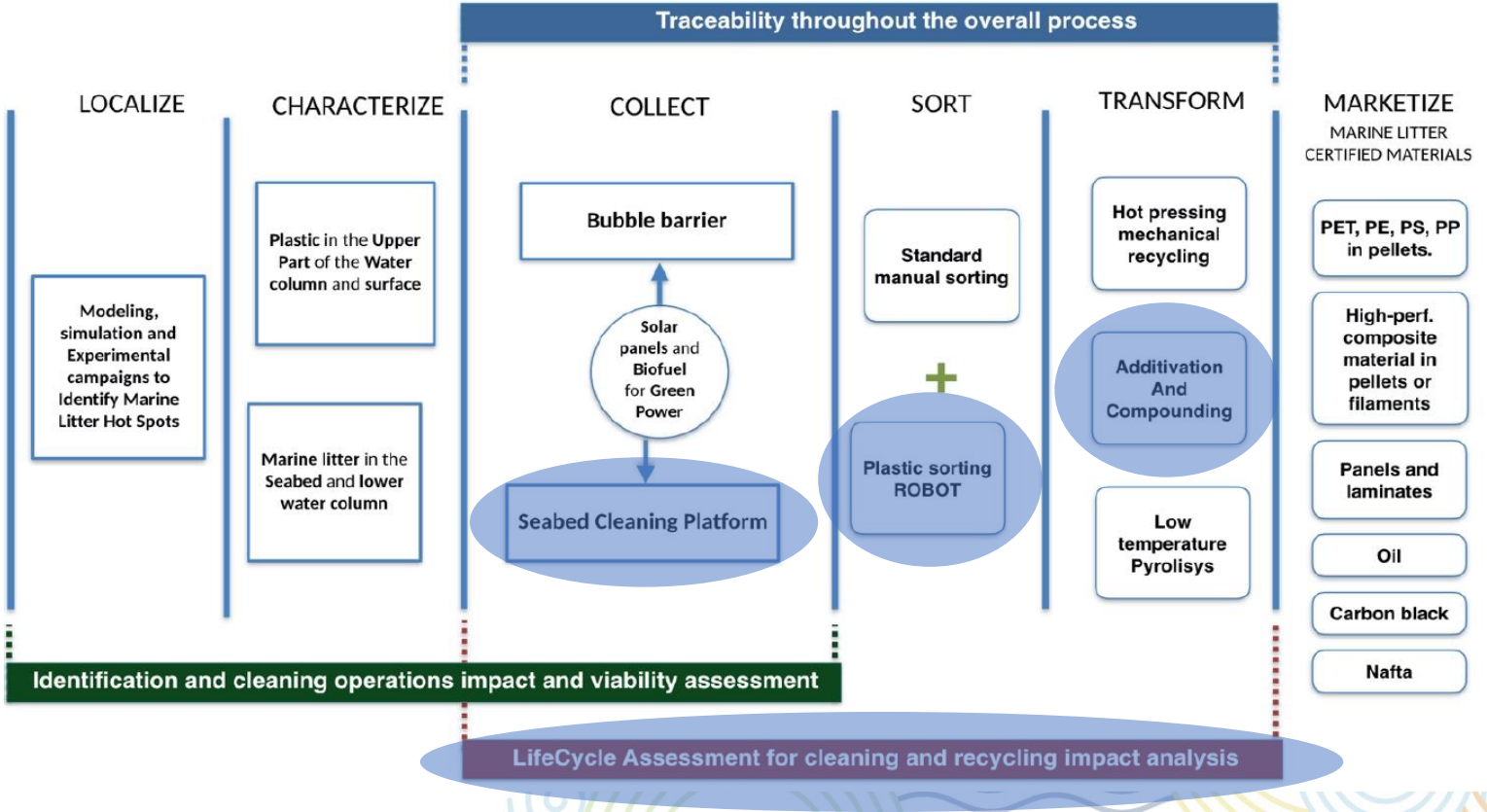
03

MAELSTROM Project

MAELSTROM H2020 : WE HAVE A PROBLEM!

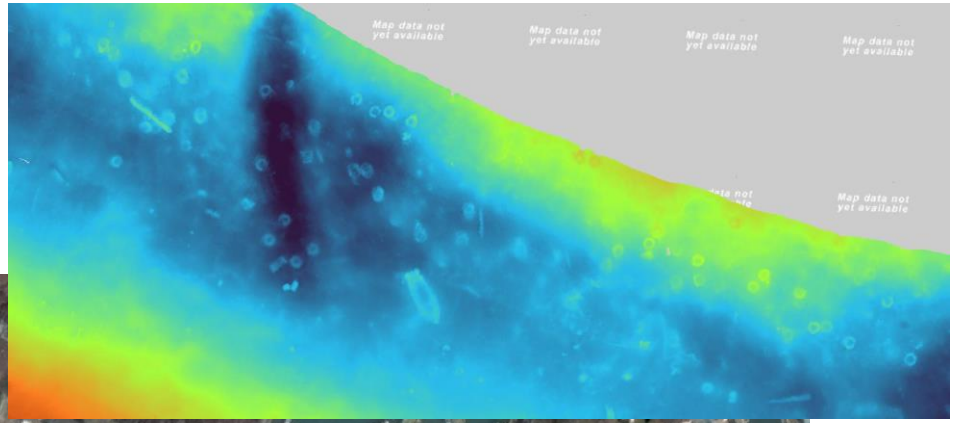


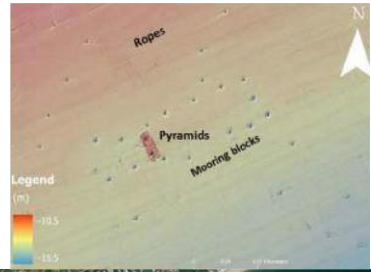
Maelstrom overall Concept and Tecnalia's role

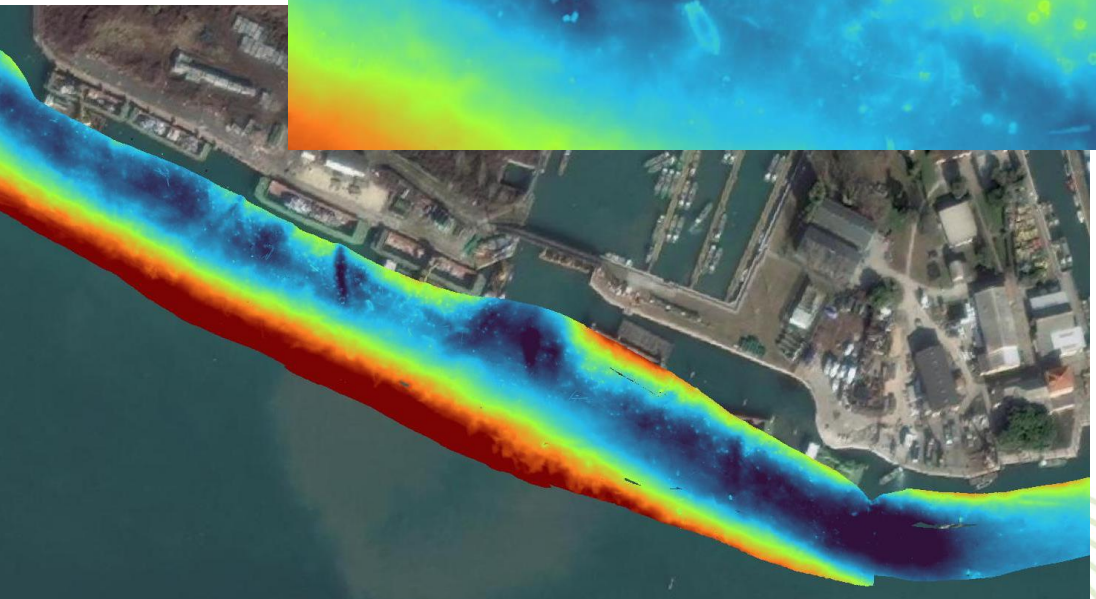


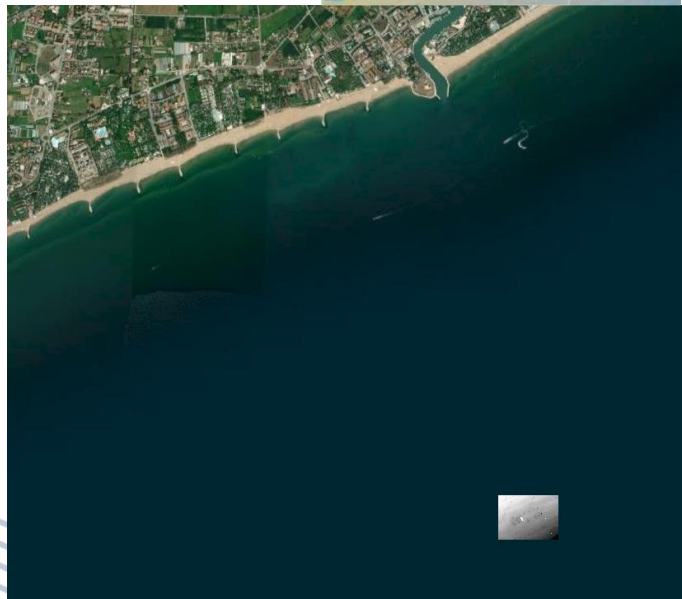
Co-funde
the Euro

Marine Litter HotSpot in Venise Lagoon & Coast





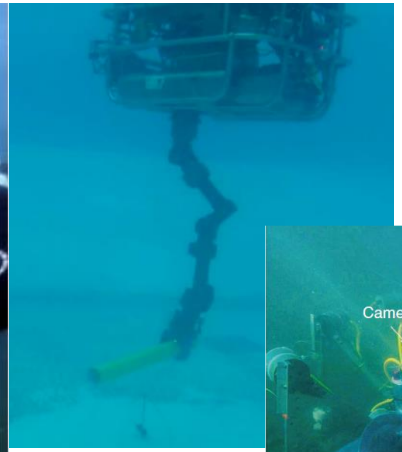


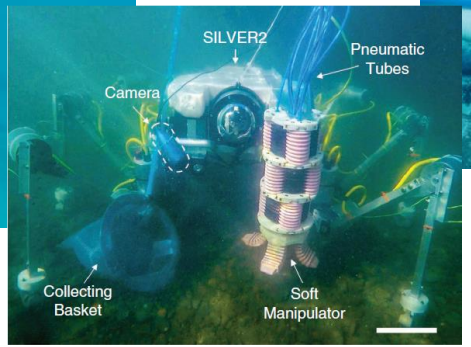


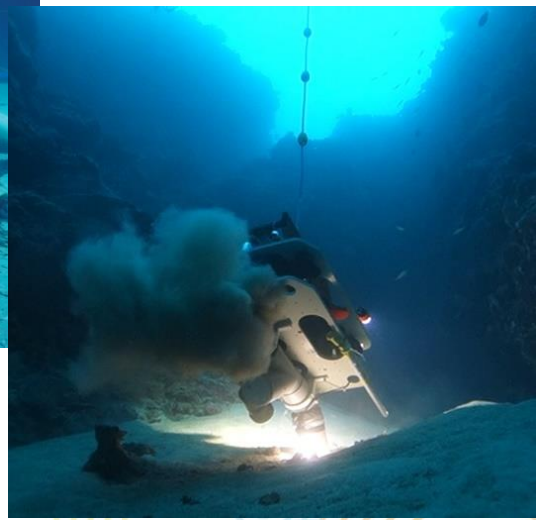
Current solutions

⇒ Target: Removing marine litter on the seabed, efficiently and selectively to minimize the negative impact on the ecosystem

⇒ Current solutions are not sufficiently efficient or scalable



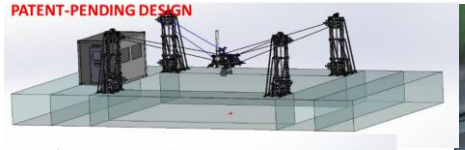


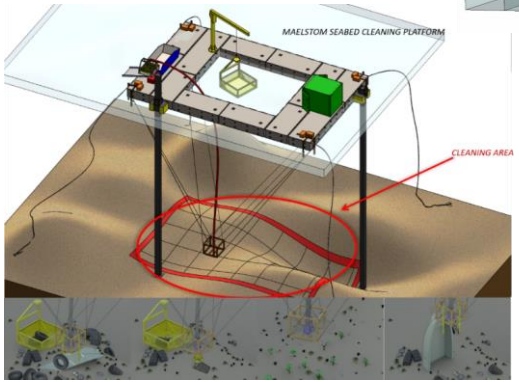


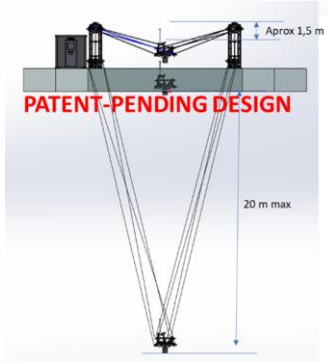
Co-funded by the European Union

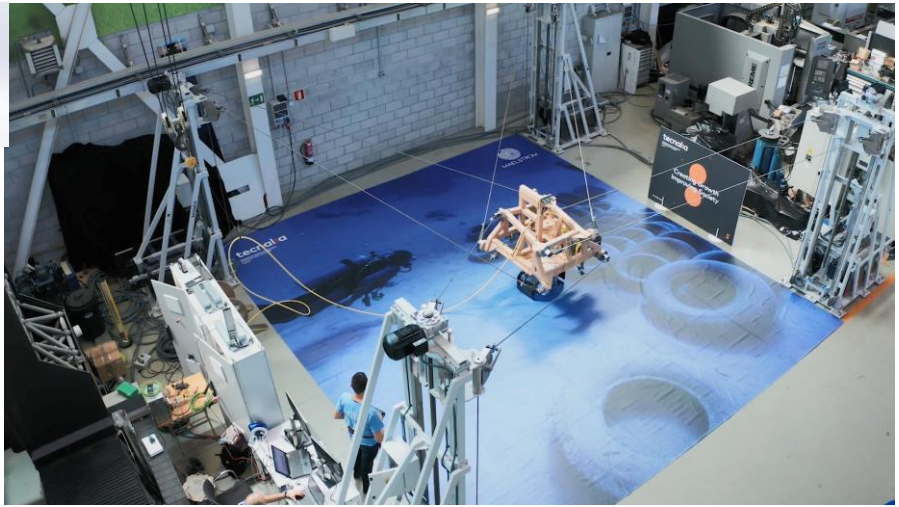
REMOVAL OF MARINE PLASTICS ON THE SEABED

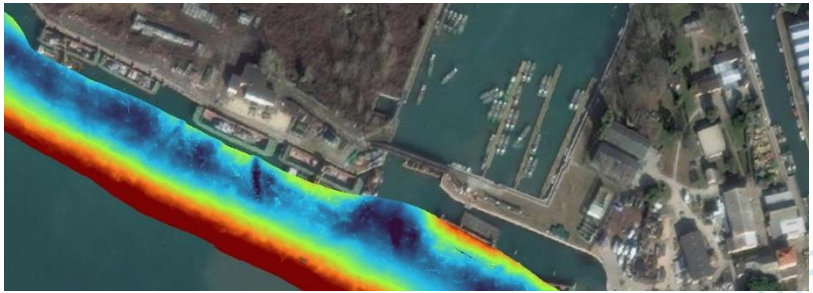
ROBOTIC SEABED CLEANING PLATFORM FOR MARINE LITTER REMOVAL:
a cable robot suspended from a floating platform with different tools: dredge & gripper

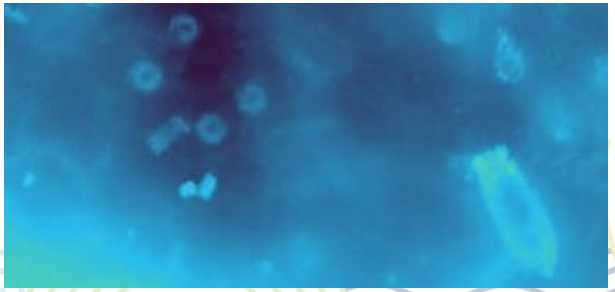












STEP 3 : RECYCLE

The removed litter will go through advanced recycling processes which will allow the regenerated materials to re-enter the industrial supply chain. Examples are chemical precursors, polymers and other materials useful for industrial purposes.

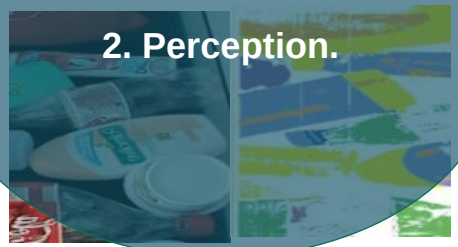
Co-funded by
the European Union

AI-driven Robotic system to segregate waste material and increase purity, recyclability and value

Plastics from Marine Litter, Construction waste, Electronics, Textile…

2D - 3D – Multispectral - Perception

2. Perception.

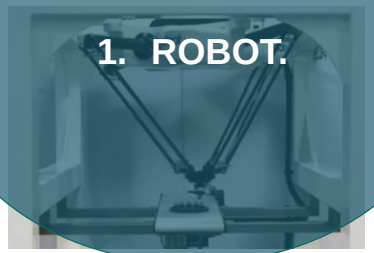


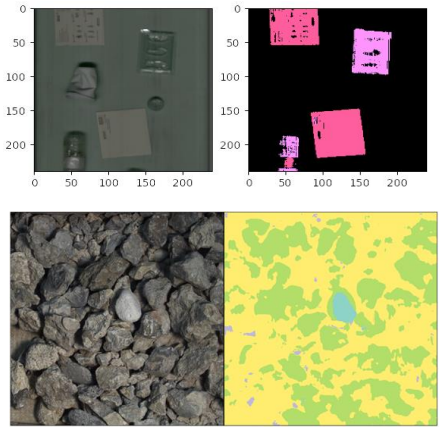
Deep Learning

3. AI for Waste identification

Pick and Place Robot

1. ROBOT.





REMOVE. RECYCLE. RE-USE. REPEAT.

JOIN US!

www.maelstrom-h2020.eu

Co-funded by the European Union

MAELSTROM

Smart technology for MArinE Litter SusTainable RemOval and Management

Thank you for the attention

Co-funded by the European Union

Creating Growth

Improving Society

EUROPEAN ROBOTICS FORUM

ERF2022 ROTTERDAM 28-30 JUNE

ERF 2022 Workshop
Application of Robotics in Sustainability and Environmental aspects
Construction / Infrastructure

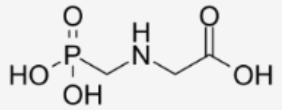
- Maintenance of Railway Infrastructures in a Sustainable Way -

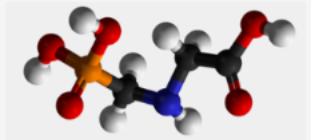
28th June 2022

Contact:
Javier Sánchez-Cubillo
jscubillo@zenialabs.com
ZeniaLabs
Automation Intelligence

Maintenance of Railway Infrastructures in a Sustainable Way

Current method





- Maintenance of Railway Infrastructures currently done with the use of Glyphosate
- Classified by the European Union as "dangerous for the environment" and "toxic to aquatic organisms"

Alternatives:

ESMERA
BOOSTING ROBOTICS INNOVATION

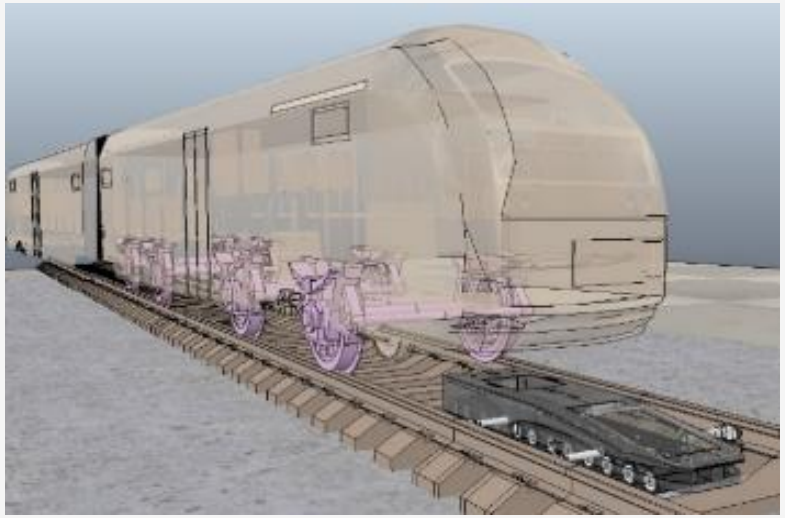
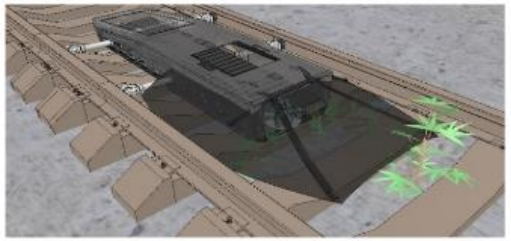
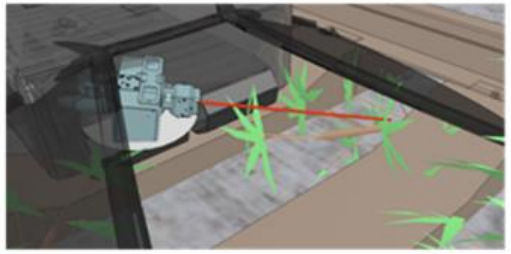
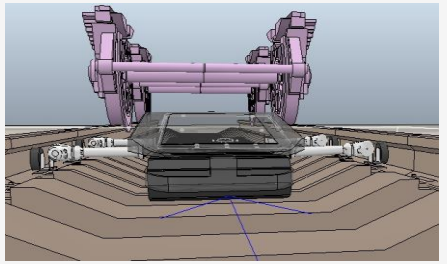
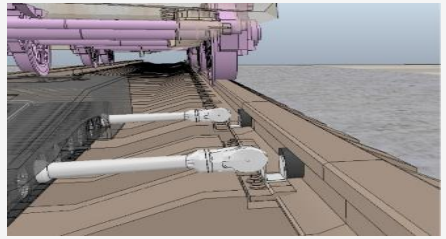
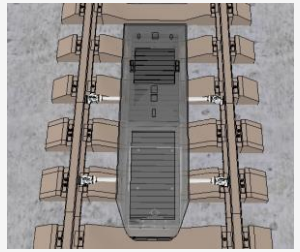
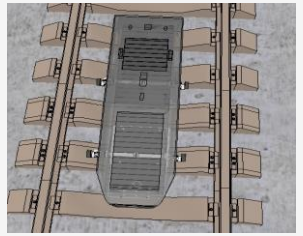
Grant Agreement 780265

ROVER4RT

Robotic prototype ROVER4RT:

RObotic VEgetation Removal system FOR Railway Tracks

'A robotic system for detection and management of vegetation between railway tracks'

Partners: ZeniaLabs Automation Intelligence, tecnalia Inspiring Business, EXOM engineering, ALPHALASER

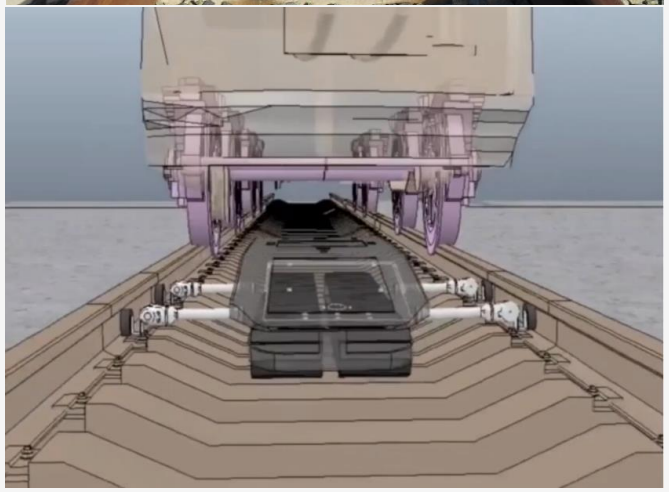
Maintenance of Railway Infrastructures in a Sustainable Way

1. Robotic & AI weed detection and removal

By heating the plants' internal water and prevent further growth

2. Coexistence robot - train

The robot works underneath the trains passing overhead



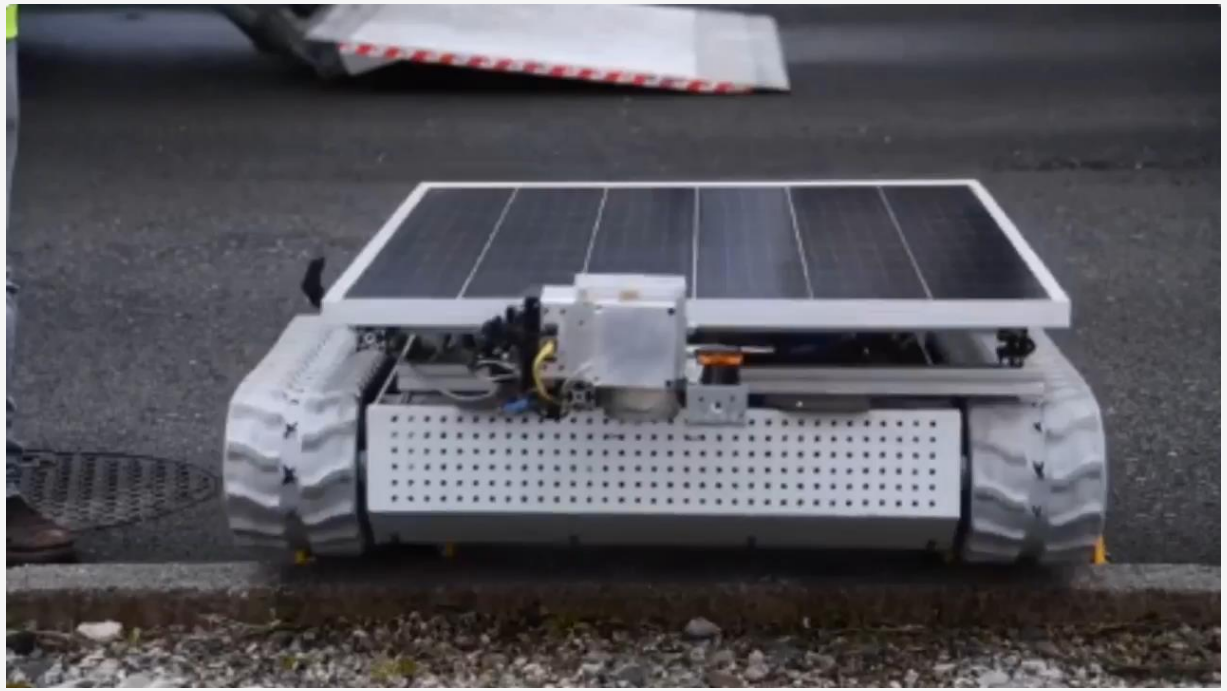
Maintenance of Railway Infrastructures in a Sustainable Way

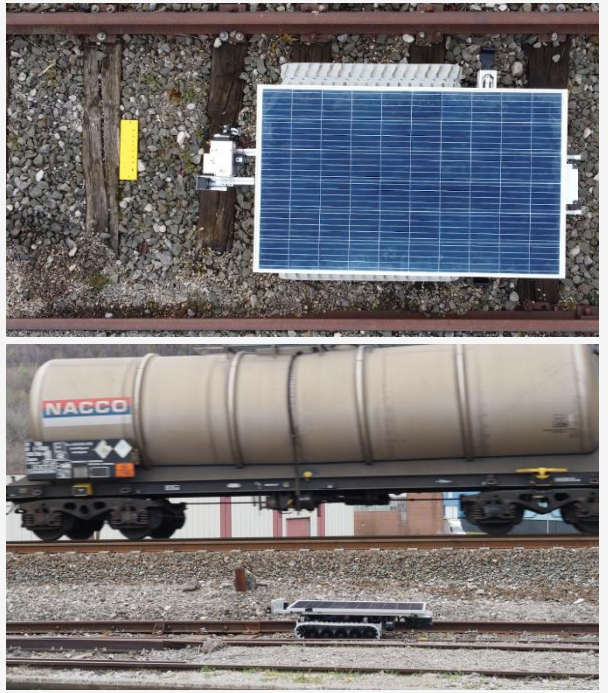
1. Robotic & AI weed detection and removal

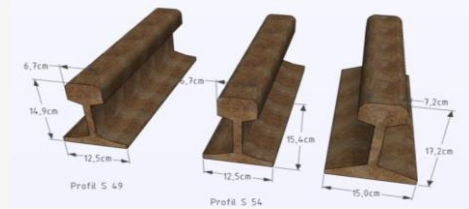
2. Coexistence robot – rail traffic

- Detection and management of vegetation between railway tracks – Issue: Slower than current operation
- An alternative to glyphosate herbicide
- Inspection and monitoring activities
- Intelligent detection, geolocation of weeds through Computer Vision and AI
- Engaging / disengaging of the robot to the railway tracks (trains passing overhead). Equivalence to ‘fixed’ infrastructure ítems (Eurobalises)
- It is possible to locate robot anytime, anywhere and get inspected data from it. GNSS location. Communication with control center.

3. Autonomy and Navigation







- 2,5-3 hours of work with Li-Ion Batteries of 3,5-4 Ah. Is this sufficient?
- Daily performance of elimination between 17.280 and 120.960 plants per day
- Velocity of the robot up to 5km/h
- Teleoperated or autonomous operation
- Regulatory barriers

Summary / Discussion

- What is the required performance of the robot to be viable / competitive?
- Is it an asssistance tool or can it completely take over certain tasks?
- Business model game changer – glyphosate is used twice a year. Robot daily?
- How to take care of insfrastructure ítems (cables, Eurobalises)
- Different robot types for different track types / sizes?
- Communication with train system ERTMS. Noticing time of incoming train?
- What is the mínimum working capacity (time → battery packs) for the robot being useful for clients.
- Who is the final client of the robot (Railway operators? Maintenence companies? Glyphosate producers?)
- What is the mínimum daily performance of the robot to be competitive?
- Is the robot usable / applicable to other sectors (e.g Agriculture → elimination of weeds / preservation of crops)

Autonomous Inspection of Wind Turbine Blades

AeroWind

Stjepan Bogdan
University of Zagreb
Faculty of Electrical Engineering and Computing
LARICS – Laboratory for Robotics and Intelligent Control Systems

Experiment coordinator Paolo Brianzoni, Helvetis

Motivation

Sustainable energy production in EU –

Europe now has **236 GW of wind capacity**

116 GW of new wind farms over the period from 2022-2026

40% renewable energy target

Hundreds of thousands of wind turbine blades inspected yearly in Europe and around the world.

- executed by manually controlled UAVs,

- slow (20-30 mins per turbine),

- inaccurate (skilled piloting required),

- costly (2-3 persons involed),

- require complex coordination and logistics.

Sustainable inspection and maintenance

Phase 1

Fully autonomous inspection with Unmanned Aerial Vehicle (UAV) of non-operational turbine.

Phase 2

Fully autonomous inspection with Unmanned Aerial Vehicle (UAV) of ***operational turbine***.

Vision (Phase 1)

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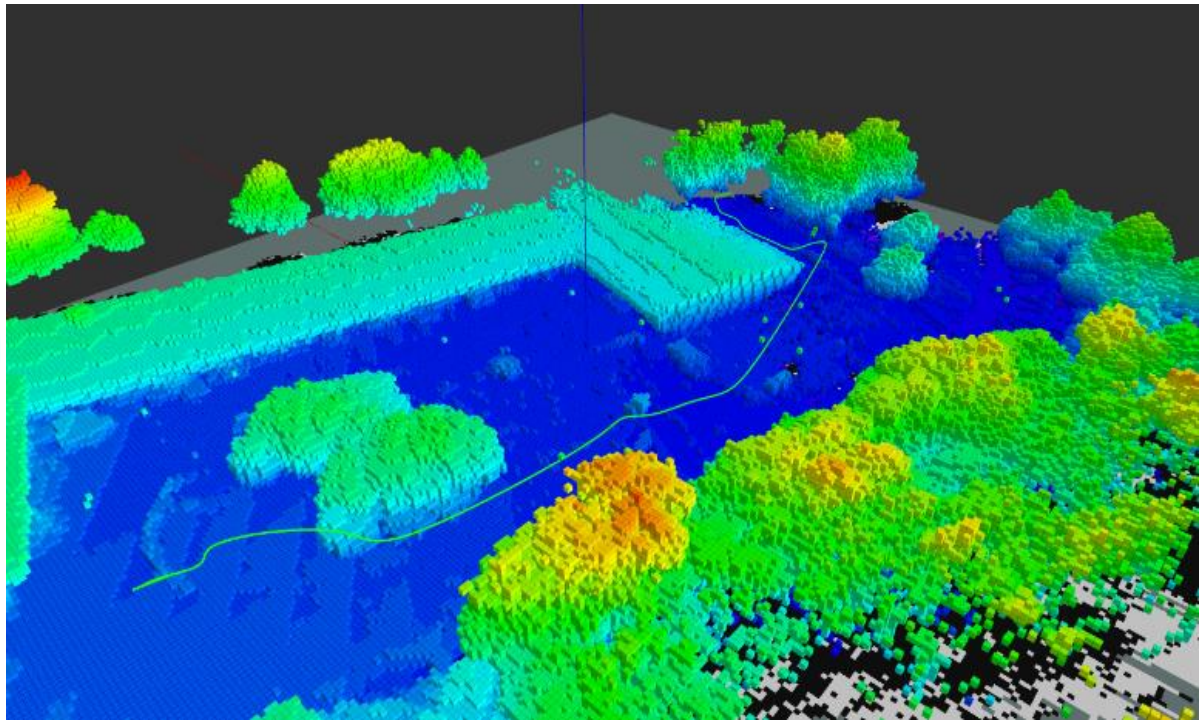
HORIZON 2020

UAV integration and localization software implementation

Custom design



Octomap and collision free pre-planned reference trajectory

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Demonstration of the system functionality *(March 2021)*

Initial flights in November 2020

Pometeno brdo wind farm – Koncar d.d.

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Demonstration of the system functionality *(March 2021)*

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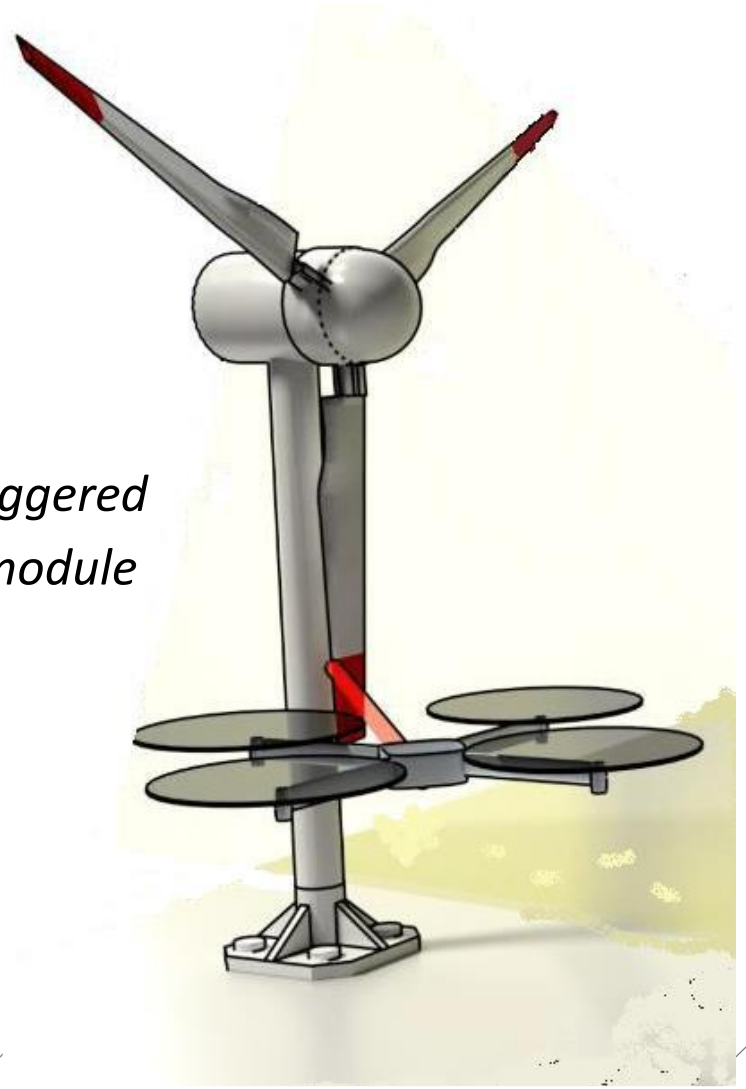
HORIZON 2020

Phase 2

Fully autonomous inspection with Unmanned Aerial Vehicle (UAV) of ***operational turbine***.

laser-beam triggered blade capture module



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AeroWind demonstrator *(Phase 2, January 2022)*

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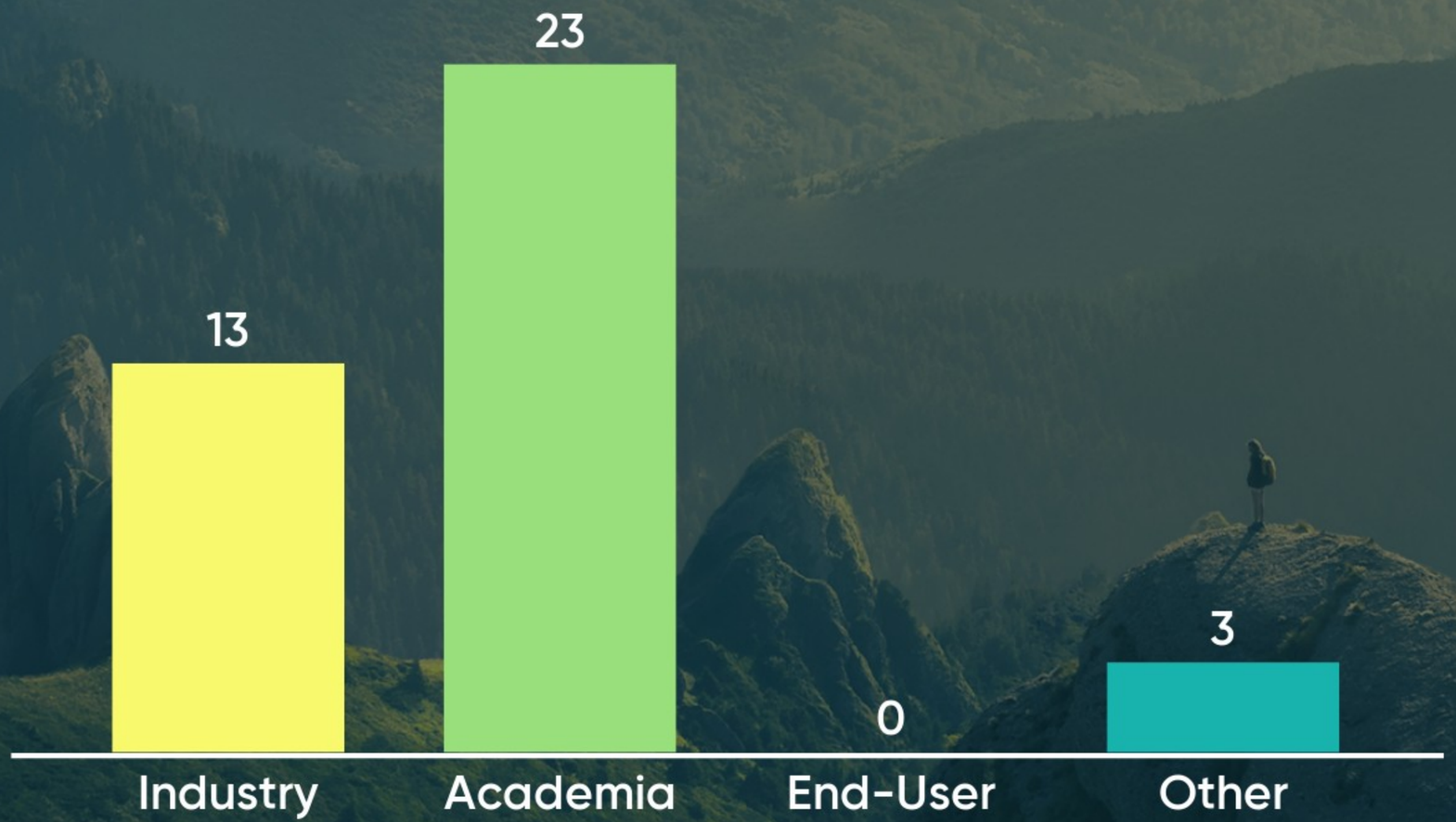
THE FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION
HORIZON 2020

Thank you.


Mentimeter
Instructions
24

Where are you from?

Mentimeter



39

What does Sustainability mean for you?

Mentimeter

39


Mentimeter
Strongly disagree
Sustainability is part of my work
3.2
Strongly agree
45


Mentimeter
Thank you!