Robotics4EU

Boosting Wider Adoption of Robotics in Europe

Deliverable D3.4

Knowledge transfer and capacity building in inspection and maintenance of infrastructure

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Deliverable 3.4

Knowledge transfer and capacity building in inspection and maintenance of infrastructure

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Table of Abbreviations and Acronyms

Abbreviation	Meaning
AI	Artificial Intelligence
DIHs	Digital Innovation Hubs
I&M	Inspection and maintenance
MAM	Maturity Assessment Model
WP	Work Package

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1 Executive Summary

WP3 “Empowerment of responsible robotics community” aims to broaden and empower the responsible robotics community by transferring knowledge and sharing good practices about non-technological aspects of robotics and their impact.

To further investigate the challenges identified in the project’s Needs Analysis deliverable, covering ethical, legal, socioeconomic, cyber-security, data protection, privacy, diversity, and inclusive engagement issues - Civitta Estonia and Civitta Lithuania organised six thematic workshops for inspection and maintenance (I&M) community. Workshops were organised in close collaboration with other robotics projects, including RIMA Network[1], RI4EU[2] and other robotics stakeholders with access to the I&M application area in robotics.

Five out of six workshops in online format, with the final workshop being in-person during the European Robotics Forum 2022 in Rotterdam, the Netherlands. Workshops attracted representatives from academia, industry, regulatory bodies, media and the citizens. Along with insightful presentations and discussions among speakers, these events successfully served as a platform for networking and establishing connections in the robotics community for the I&M field.

[1] Robotics for inspection and maintenance, https://rimanetwork.eu
[2] European Robotics Digital Innovation Hubs for EU, https://ri4eu.eu/

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2 Introduction

The acceptance of robotics in the inspection and maintenance is tightly intersected with the attitude of target groups: workforce, inspectors, legislators and general public.

Workshops, from which five out of six were online and one in-person during the European Robotics Forum in Rotterdam, have attracted **209 participants** in total. The audience of participants included representatives from academia, industry, regulatory bodies, and media and the general public.

Workshops were designed around the five types of non-technological challenges to the widespread adoption of robots in society, identified by the previous Robotics4EU activities: ethical challenges; legal challenges; data protection, and data management; socio-economic challenges and challenges related to education and engagement.

Following the overall objectives of community building events, identified in the deliverable "D3.1. Methodology of community building and knowledge transfer events"[3], the inspection and maintenance workshops agenda were focused on three main goals:

- To raise awareness regarding non-technological aspects of robotics and enable knowledge transfer and good practices sharing
- To strengthen and empower EU robotics community in Inspection and Maintenance field
- To collect inputs for the maturity assessment model design and content

Along with the insightful presentations and discussions among speakers, events served as a platform for networking and establishing connections among the robotics in the inspection and maintenance community. Also, workshops were designed to map the issues and topics to be used by the maturity assessment model, to provide useful resources to the community and to inform other activities in the project, for example, policy advocacy report.

Civitta Estonia and Civitta Lithuania organised six workshops, each dedicated to discussing a specific non-technological challenge related to robotics' impact on society.

[3] D3.1. Methodology of community building and knowledge transfer events https://www.robotics4eu.eu/publications/deliverable-3-1-methodology-of-the-community-building-and-knowledge-transfer-events/ , Section 3.2. "Objectives and Outcomes"

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3 Approach

Workshops, aimed at the knowledge transfer and capacity building in inspection and maintenance of infrastructure, were organised by Civitta Estonia and Civitta Lithuania. These workshops, as part of the WP3 "Empowerment of responsible robotics community", followed the overarching methodology, prepared by WP leader, AFL, aiming at ensuring consistency during the organisation and implementation of events across the 4 priority areas.

Overall approach of the methodology[4] is based on two key principles - collaboration and interactivity (see Figure 1). In short, the aim of this methodology was to set up workshops in a way that would allow participants to communicate with each other, discuss and express their views or even to take some practical steps in the further collaboration.

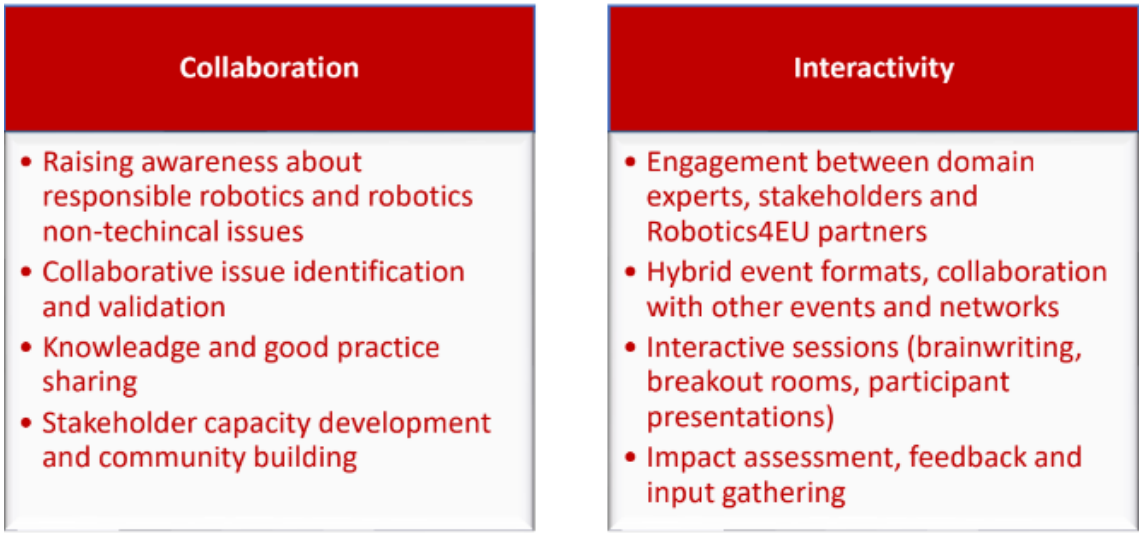

Figure 1 Approach to community building and knowledge sharing events

To ensure the implementation of these principles - attracting community and stakeholders - workshops were organised in cooperation with the stakeholders in the domain: Robotex, RIMA Network, RI4EU, European Robotics Festival and others (see section 5.4).

The methodology provided the guidelines on workshop topics, agenda structure and building blocks of the workshops that will be discussed below in this section. Detailed methodology of workshops' organisation is presented in the deliverable "D3.1. Methodology of community building and knowledge transfer events"[5].

[4] D3.1. Methodology of community building and knowledge transfer events https://www.robotics4eu.eu/publications/deliverable-3-1-methodology-of-the-community-building-and-knowledge-transfer-events/
[5] *ibid*

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3.1 Selection of topics

Workshops were thematically-centred based on identified challenges related to non-technological impact of robotics. The selection of workshops' topics was based on several inputs:

- "Robotics community, citizens and policy makers needs analyses" (Deliverable 1.2.[6]). During this analysis, the project team identified 5 main issue areas: socio-economic, ethical, data, legal and education and engagement, as presented in Figure 2. The needs analysis allowed us to choose the most relevant issues identified by the stakeholders, who participated in the survey. The insights from the needs analysis also guided the brainwriting session design and discussions. We aimed to spread awareness in the community about the identified issue areas. Also, simultaneously, gathering feedback and insights from the workshops on these issues, we were building on the knowledge that will inform the other steps in the project. Figure 1 Main issues areas identified in D1.2. "Robotics community, citizens and policy makers needs analyses".

Socio-Economic Analysis	Ethics	Data
• Fear of tech unemployment • Loss of worker autonomy • Rising inequality in earnings • Rising skill gaps and skill depreciation • Uneven distribution of wealth • Insufficient protection of worker rights (gig-economy) • Policy issues • Geographical disparity • Digital divide • Environmental problems	• Safety and security at the workplace • Lack of responsibility and accountability • Lack of transparency & liability • Infringements of traditional and cultural norms and values • Gender inequality • Insufficient protection of the minority groups • Human rights abuse • Negative impact on peace	• Surveillance issue • Lack of informed consent • Lack of data control and • Lack of contestability • Vulnerability of cyber physical systems • Cyberwarfare (social & political manipulation) • Data theft (network security) • Unbalanced power in data ownership

Legal	Education and Management
• Intellectual property infringement • Lack of global governance • Lack of and lag in regulatory development • Lack of GDPR compliance • Unclear and unharmonized regulations (inconsistent set of rules for human-machine cooperation) • Lack of legal rights awareness related to data and technology	• Insufficient public engagement • Lack of methods and empowerment • Education issues (lack of resources, knowledge availability and informal science education) • Inequality in development (education sector not following trends fast enough) • Lack of trust in science • Insufficient empowerment of the general public

Figure 2 Main issues areas identified in D1.2. "Robotics community, citizens and policy makers needs analyses"

[6] D1.2. "Robotics community, citizens and policy makers needs analyses" https://www.robotics4eu.eu/publications/deliverable-1-2-robotics-community-citizens-and-policy-makers-needs-analyses/

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- The preliminary topical guidelines and relation to non-technological issues areas were defined in "D3.1. Methodology of community building and knowledge transfer events"[7]
- The topics were adapted to match the inputs of the participants to the workshops, identified during the brainwriting sessions and discussions.

3.2 Workshops' format and agenda

First 5 workshops were conducted online, while the last one took place in Rotterdam, the Netherlands. Online workshops were facilitated using Butter[8] platform, which enables integration with other tools necessary for the workshop to be effective and engaging, in online format.

All workshops followed standardised agenda format, provided in the earlier mentioned methodology. Minor adjustments were made, depending on the topic and speakers (explained in detail in section 3.4). The model of workshops includes three phases – Initiation, Ideation and Discussion. Adaptation of the model for the workshops in this task are presented in Table 1. Detailed agendas of each workshop are presented in Annex 2.

Phase	Agenda items
Initiation	- Welcome word - Presentation of the Robotics4EU project - Presentation of Maturity Assessment Model - Presentation of the workshop (theme, agenda, speakers) - Brainwriting session
Ideation	- Presentation / discussion with expert(s) - Break-out room sessions and discussions
Discussion	- Participants engagement: discussion and Q&A - Feedback survey

Table 1 Model agenda for the workshops

Organising group team members opened the workshops by introducing the topic, agenda and presenting the Robotics4EU project. Important part was the Maturity Assessment Model presentation, delivered by one of the Robotics4EU team members, providing context for brainwriting session activity. The following brainwriting session aimed to involve the participants in the process of proposing and identifying the most important issues and challenges related to the theme of the workshop. More information and results of the brainwriting session are presented in section 5.

[7] D3.1. Methodology of community building and knowledge transfer events https://www.robotics4eu.eu/publications/deliverable-3-1-methodology-of-the-community-building-and-knowledge-transfer-events
[8] https://www.butter.us/

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PRESENTATION AND DISCUSSION WITH EXPERTS

The workshop then progressed with presentations from the experts from the discussion topic field. Speakers were experts in different fields of I&M, AI and robotics, and representing different sectors: academia, industry, regulation entities. Each workshop had 3-5 speakers with their presentations lasting from 10 to 20 minutes. The presentations were followed by 5 minutes for the questions.

PANEL DISCUSSION AND Q&A

The input for the panel discussion was received from the audience, in the form of their questions to the particular speaker or the short ad-hoc presentations. The discussion usually took 20 - 30 minutes. The discussion involved gathering the inputs. participants' and experts' views on the Maturity Assessment Model.

In addition, at the end of each workshop, participants were invited to get in touch with the Robotics4EU team for the collaboration opportunities. Participants took an active role and shared about their involvement in the robotics community with the intention of broadening the network and networking.

FEEDBACK SURVEY

At the very end of the workshop, participants were asked to express their feedback. More details can be found in section 5.4.1

3.3 Communication and participants attraction

To reach to the I&M community and to maximise the engagement of the audience, substantial efforts were devoted to communication activities. The organising partner, CIVITTA together with communications partner, LOBA, identified and executed the communication and dissemination activities through various channels: mailing lists, newsletter, website, social media, partner's networks.

The intense collaboration with community stakeholders - RIMA network and RI4EU - was established to ensure that the invitation to workshops have reached the relevant parties in the community.

3.4 Deviations in methodology

Section 3 provides elaborate information on how the methodology was followed. However, there are some deviations in I&M workshops compared to the D3.1 Methodology. The methodology, created at the beginning of the project, was adjusted to ensure the specifics of the field - break-out room sessions proved to be not suitable addition to the Inspection and Maintenance workshops for two reasons:

- The Inspection and Maintenance topic requires a specific knowledge and good technical understanding of the field. Thus, the engagement of participants revolved around the expert presentations, prepared in advance. To alleviate the engagement gap, the experts were asked to prepare the discussion questions and agenda allowed the sufficient time for the discussion. To ensure the sufficient inputs were generated for the Maturity Assessment Model, the experts were intentionally invited from the different stakeholders' groups and sectors: industry representatives, scientists, policy researchers.

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- The Inspection and Maintenance community is rather small and the technically specific topic makes it rather challenging to attract the general audience to the topic (including, students from universities). Thus, the number of attendees of the workshops did not allow the organisers to split the participants into several groups. All-group discussion was more suited and brought more value to the all-participating parties.

The key outcome for the workshops were to obtain the insights and views of various participants and facilitate the discussion about the societal aspects of the robots in inspection and maintenance. These insights informed further Robotics4EU activities. The transferability of the results will be presented in section 5.

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4 Overview of the workshops

The following section will present an overview of each workshop. The overview of the speakers' presentations, the analysis of participants and speakers' profiles are included. The expert presentations and discussions, presented in section 4 are aimed at spreading awareness regarding non-technological aspects of robotics and enable knowledge transfer and good practices sharing in the community. Also, these insights and recommendations provide valuable insights on the specificity of the inspection and maintenance field for the further project tasks.

4.1 Workshop #1 "How can we do better? Data, autonomy and AI Solutions in I&M Robotics"

	Robotics4EU I&M Workshop #1
Event type	Online workshop
Priority area related to the event	Inspection and maintenance
Event theme	**How can we do better?** **Data, autonomy and AI Solutions in I&M Robotics**
Organising partner	CIVITTA Lithuania, CIVITTA Estonia
Other associated parties	Robotex International
Date of the event	5th of November, 2021
Location of the event	Virtual meeting, Butter platform
Number of participants	31
Description of participant profiles	Scientific community (44%), industry (32%), general public (6%), and non-governmental organisations (31%) and others (17%)
Event abstract	This workshop covered the issue of data, autonomy and AI in I&M robotics. It was held as a part of Robotex International — the largest robotics festival in Tallinn, Estonia.

Table 2 Workshop #1 summary

The first workshop took place on the 5th of November, 2021, and was co-hosted by Robotex International — the largest robotics festival in Tallinn, Estonia. This workshop was promoted on the website of the festival and through its social networks: Facebook and LinkedIn. The aim of this cooperation was to attract more participants to the event.

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Figure 3 Visual of the workshop "How can we do better? Data, autonomy and AI Solutions in I&M Robotics"

4.1.1 Participants

31 participants attended the workshop, mainly from the scientific community; the industry; the general public, and non-governmental organisations. There were over 20 different countries represented with 12.5% of participants from Greece, followed by Estonia (10.7%), Spain (8.9%) and Italy (8.9%).

While registering to the event, participants were asked what their expectations were from the workshop. Participants were interested in networking opportunities, learning about the state of the art in AI and Robotics, and getting to know new solutions.

Below are few examples of input answers (direct quotes) considering the expectations of the participants:

"To learn if it is possible to understand which trajectories AI and Robotics should take for a given sector of application in order to truly benefit the future of humanity without having to curb, revert or undo developments"

–

"As a researcher I want to engage with the professionals in policymaking to see how new robotic technologies can be further used in different fields and researched from a foresight point of view."

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4.1.2 Speakers

Didem Gürdür Broo is a Marie Skłodowska-Curie Fellow at Stanford University. She focuses on Human-centred and Sustainable Cyber-physical Systems.

Jonathan Cacace is an enthusiastic R&D developer of advanced robotic applications. In 2018 he published his first book about robotics programming using ROS: Mastering ROS for Robotics Programming - Second Edition, edited by Packt Publishing.

Marko Orsag is an Associate professor at the University of Zagreb Faculty of Electrical Engineering and Computing. He has been involved as a researcher in various projects financed by the government and industry. In 2011/2012, he worked as a visiting researcher at the Drexel University, Philadelphia, USA as a recipient of the Fulbright exchange grant.

4.1.3 Summary and takeaways of the workshop

The workshop covered benefits, challenges and potential solutions regarding data, autonomy, and AI solutions in robotics in I&M. It was noted that the infrastructure operators are interested in the technology, which provides a strong incentive for its development. In addition, the domain has a long-standing tradition of embracing new technologies. Considering the challenges, related to the data management, the problematic aspects were identified:

- Collection of data in a sustainable way (80% of collected data is unstructured and unused by people);
- Sharing of data (with whom and how much);
- Trusting data (quality and bias);
- A volume of data;
- Decision-making with data (human's role and autonomy).

The existing challenges cannot be solved only through technological measures. The mindset of people has to encompass three dimensions:

- System mindsets;
- Futuristic mindset;

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- Design mindset (design thinking processes).

Discussion among participants and experts offered potential strategies in approaching the identified problems and putting above mentioned mindsets into practise:

- Reconsidering the organisational structures – the data should be a core of design, development, cooperation and integration;
- Defining better processes: data management procedures for better data availability, accessibility, quality, heterogeneity and longevity.
- Improving the digital capabilities: data analytics, AI, emerging technologies, interoperability;
- Focusing on cybersecurity, as a critical point in the field;
- Acknowledging the need of specific data management measures for specific applications.

This workshop has been recorded and can be accessed on YouTube. Also, speakers' presentations are available here.

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4.2 Workshop #2 “Robots: Friends or Enemies? Social Impact of Robotics in Inspection and Maintenance”

	Robotics4EU I&M Workshop #2
Event type	Online workshop
Priority area related to the event	Inspection and maintenance
Event theme	Robots: Friends or Enemies? Social Impact of Robotics in Inspection and Maintenance
Organising partner	CIVITTA Lithuania, CIVITTA Estonia
Other associated parties	RIMA Network
Date of the event	26th of January, 2022
Location of the event	Virtual meeting, Butter platform
Number of participants	31
Description of participant profiles	Scientific community (65%), industry (11%), general public and others (24%)
Event abstract	Workshop tackled the problem of interactions between robots and humans. How to evaluate the real impact of Robotics on our society? How to decide if robots are hazardous and may complicate human lives? To what extent does society accept rapidly progressing robotic technologies?

Table 3 Workshop #2 summary

The second workshop took place on the 26th of January, 2022, and was co-organised in collaboration with RIMA Network.

4.2.1 Participants

There were 31 participants at the workshop. A total of 65% represented the scientific community – professors at various universities and employees of the research centres. About 11% of registered participants represented the robotics industry: SMEs and startups specialising in production of the robotic solutions.

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During registration, participants were also asked which country they represent. Thus, there were 23 various countries, mostly the members of the EU. The most popular entries were Germany and the UK.

The registration survey was made through EUSurvey. The screenshots of the survey are attached in Annex 1.

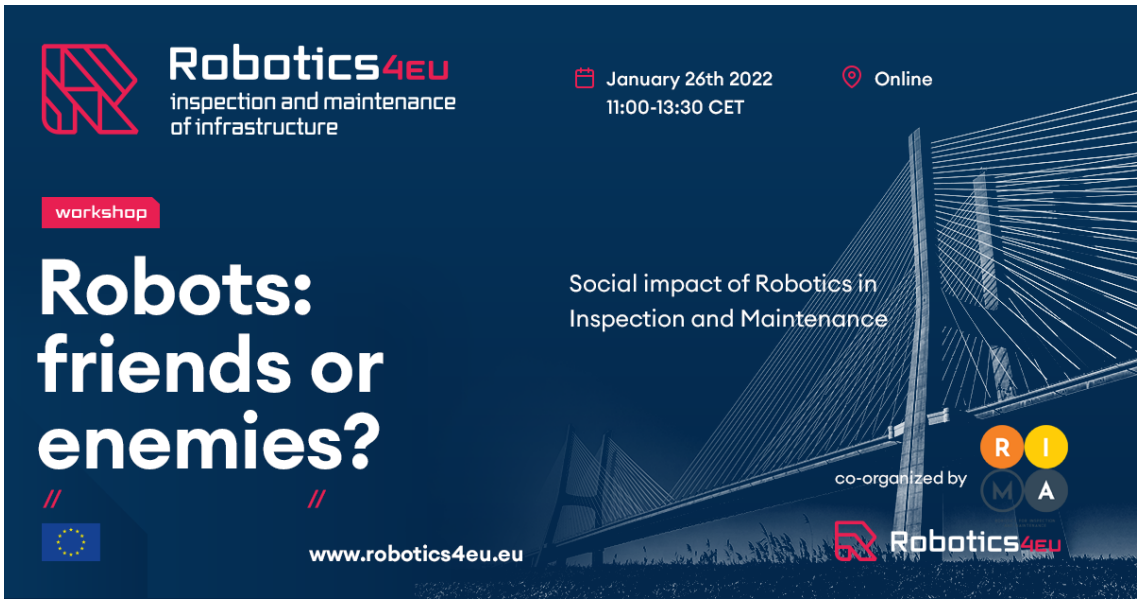

Figure 4 The visual of the workshop "Robots: Friends or Enemies? Social Impact of Robotics in Inspection and Maintenance"

4.2.2 Speakers

Roberto V. Zicari is an affiliated professor at the Arcada University of Applied Science, Helsinki, Finland, and an adjunct professor at the Seoul National University, South Korea. He leads a team of international experts who defined an assessment process for Trustworthy AI, called Z-Inspection®.

Maarit Sandelin works as the European Network Manager specialising on the Robotic Innovation at SPRINT Robotics. She works on promoting the development, the availability, and application of robotics techniques in technical inspection and maintenance of capital-intensive infrastructure.

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Alberto Ortiz Rodriguez is a professor of Computer Engineering, University of the Balearic Islands. He has led several Spanish and European projects on mobile robotics, image processing/analysis and pattern recognition/machine learning.

Thomas Ellwart currently works at the Department of Psychology / Business Psychology, Universität Trier. Thomas does research in Organisational Psychology and Applied Psychology. Current projects are on autonomous digital systems (robots, software agents) in teams at the workplace.

4.2.3 Summary and takeaways of the workshop

Roberto V. Zicari opened the presentation by enlisting four main fundamental principles in the AI Framework:

- Respect for human autonomy
- Prevention of harm,
- Fairness,
- Explicability.

Also, 7 main requirements of the EU towards the trustworthy AI: accountability; societal and environmental well-being; diversity, non-discrimination and fairness; transparency, privacy and data governance, technical robustness and safety. However, it was discussed that these frameworks do not perfectly account for the evolving nature of the technologies and are not contextualised according to various domain peculiarities. To account for the specific application cases, Roberto V. Zicari presented the idea of socio-technical scenarios.

Maarit Sandelin stressed that COVID-19 has been increasing businesses' interest in robotic solutions. A total of 88% of businesses worldwide plan on adopting robotic automation into their infrastructure to increase efficiency and safety. This tendency is changing the value chain, the employment relations. Regulation and skills gaps were mentioned as some of the barriers to robotics adoption:

- Robotic adoption should not be communicated as a black-or-white situation regarding job loss (either position is occupied by a robot or by a person). Talking about displacement of jobs, Maarit stated that it will continue and 85 million jobs will be displaced by 2025, but 97 million jobs may appear due to new division of work between humans and machines. However, reskilling is an essential aspect in the attempts to navigate technological unemployment;

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- The importance of recruiting more female professionals in the field of I&M was noted as well.

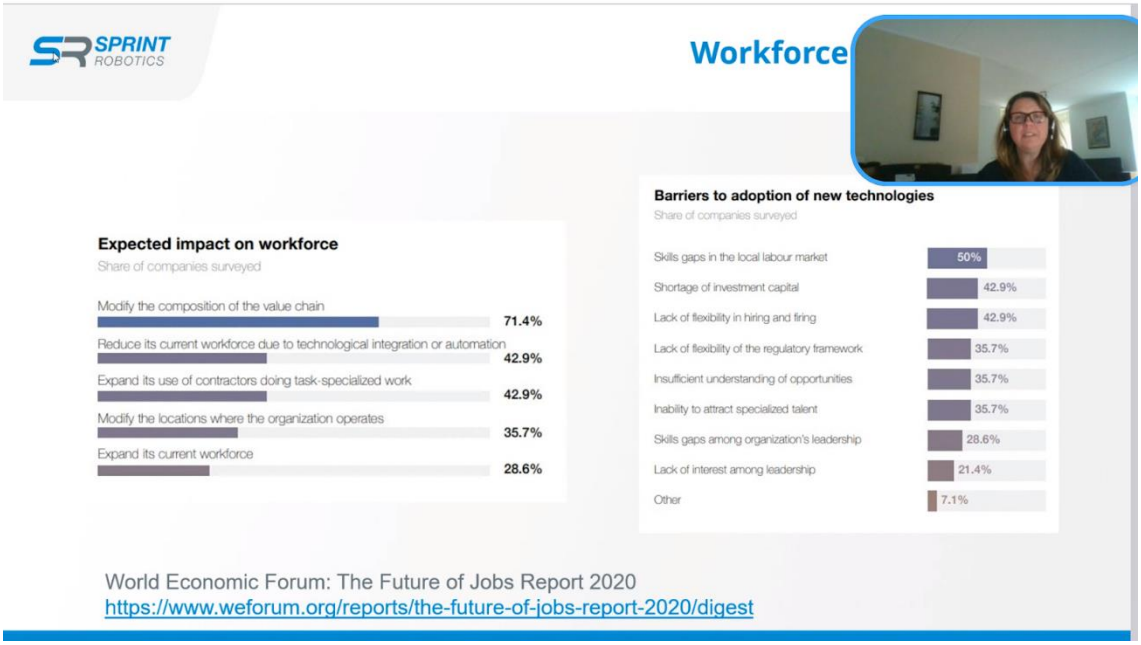

Figure 5 Screenshot from Maarit Sandelin's presentation

Thomas Ellwart noticed that there is a need to define the criteria for the terms “friends” and “enemies”. He introduced the requirements for functional/dysfunctional Human-Robot-Collaborations:

- Functional Human-Robot-Collaboration facilitates the proper execution of the tasks, protects health and increase safety, promote individual well-being, develop skills and human abilities, avoid under/overload demands, isolated works, task hindrances, etc
- Dysfunctional Human-Robot-Collaboration causes exclusion of humans for safety reasons, reduced possibilities to apply and train skills, responsibilities to react in case of failures or disturbances, and low-quality residual tasks.

In the dysfunctional Human-Robot-Collaboration, humans are excluded from the task performance, but they are still in charge of system malfunctioning. Overtrust of robots is as dangerous as mistrust.

The elaborated overview of the workshop can be found in the article, published by Robohub. This workshop has been recorded and can be accessed on YouTube. Also, speakers’ presentations are available here.

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4.3 Workshop #3 “Boosting innovations and maximising societal impact. Role of Digital Innovation Hubs (DIHs) in I&M Robotics”

	Robotics4EU I&M Workshop #3
Event type	Online workshop
Priority area related to the event	Inspection and maintenance
Event theme	Boosting innovations and maximising societal impact. Role of Digital Innovation Hubs (DIHs) in I&M Robotics
Organising partner	CIVITTA Lithuania, CIVITTA Estonia
Other associated parties	RIMA Network
Date of the event	23rd of February, 2022
Location of the event	Virtual meeting, Butter platform
Number of participants	59
Description of participant profiles	Scientific Community (58%), industry (24%), general public and others (18%)
Event abstract	To address the non-technological impact of robotics, this workshop explored the role of Digital Innovation Hubs (DIH’s) in communicating between the different stakeholders in robotics in I&M. DIHs communicate with a variety of stakeholders, in particular with the SMEs and experiments which develop the robotics solutions.

Table 4 Workshop #3 summary

The third workshop took place on the 23rd of February and was co-organised by RIMA Network. The event took place online and was facilitated through the Butter online platform.

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4.3.1 Participants

There were 59 participants attending the workshop. A total of 58% represented the scientific community and about 24% of registered participants represented the robotics industry.

During registration, participants were also asked which country they represent. Thus, there were 29 various countries, mostly the members of the EU. The most popular entries were Lithuania, Bulgaria, India, and Germany. The registration survey was made through EUSurvey.

In general, registered participants were interested in networking opportunities, learning about the latest developments in the robotics industry and understanding DIH role in the industry.

Below are few examples of input answers (direct quotes) considering the expectations of the participants:

"Knowing the possibilities of application of robots in real life cases and lessons learned for future applications"

"Cooperation with DIHs"

"Networking, new ideas, funding opportunities"

"Extend my horizon and get info about the EU robotics agenda"

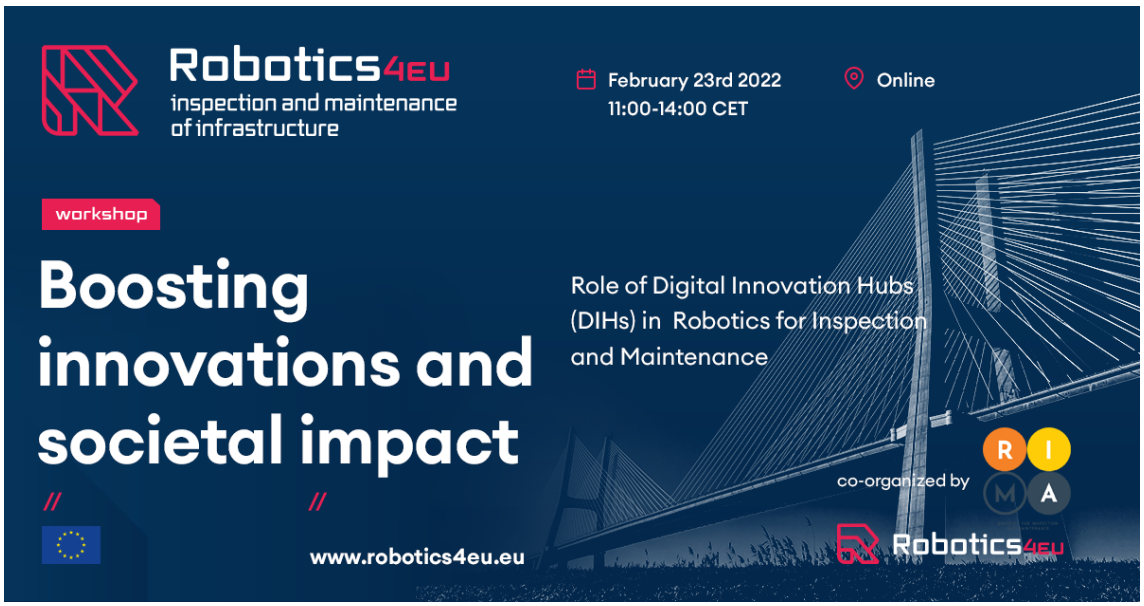

Figure 6 The visual of the workshop "Boosting innovations and maximising societal impact. Role of Digital Innovation Hubs (DIHs) in I&M Robotics"

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4.3.2 Speakers

Ebert van Vonderen, Project Manager at Prototyping & Innovation Centre, Technical University of Kosice.

Ladislav Vargovcik, Director at Prototyping & Innovation Centre Technical University of Kosice.

Christophe Leroux, Manager European Affairs in Robotic at the French Alternative Energies and Atomic Energy Commission (CEA) Coordinator of RIMA Network.

Maria Roca, Senior Project Manager at FundingBox, working to foster the access of SMEs to EU innovations and EU projects opportunities and boost their competitiveness.

Roi Rodríguez de Bernardo, Head of Deep Tech Ecosystems at FundingBox and Director of AI and Cloud Ecosystem Development in Spain at Huawei.

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4.3.3 Summary and takeaways of the workshop

To address the non-technological impact of robotics, this workshop explored the role of Digital Innovation Hubs (DIH's) in communicating between the different stakeholders, in particular with the SMEs and experiments which develop the robotics solutions. The bottleneck is the adoption of robotics to market – no real connection between industry and research organisations. RIMA Network directs its efforts to establish a network of DIHs (currently, it connects 13 DIHs), focussing on robotics in I&M, fund SMEs to support experimentation, set up courses to facilitate the uptake of technologies and develop new skills, and inform people of funding opportunities for business development.

From the perspective of DIH's provided services in terms of the societal aspects of robotics, RIMA's representative Christophe Leroux explained that ethical and safety aspects are considered in facilitated experimentation. In practice, ethical assessment is conducted for each experimentation involving experts in the field of ethics. Daily, RIMA's work includes mentorship on ethical issues and guidelines. Further, in the case of AI, ethical aspects are evaluated in all EU-funded projects.

Maria Roca emphasised data management for SMEs as a main bottleneck. The difficulty lies in the hindrances to sharing data with other companies.

Zooming in to the topic of robotics in inspection and maintenance, the socio-economic aspect of adoption was analysed. Christophe Leroux explained that there is attractiveness for robotics adoption to specific operations because there is not much fear of losing jobs. Robots are seen as supporting their work, for example, deploying robotics in explosive, dangerous and hazardous environments. Robots are not taking away jobs but taking away the danger. Christophe Leroux also emphasised that there is a growth in the domain of AI robotics in inspection and maintenance, and the main issues are related to trust and safety.

The elaborated overview of the workshop can be found in the article, published by Robohub. This workshop has been recorded and can be accessed on YouTube. Additionally, speakers' presentations are available here.

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4.4 Workshop #4 "How to make sure regulation helps and not hinders I&M robotics? Policy issues in Robotics for Inspection and Maintenance"

	Robotics4EU I&M Workshop #4
Event type	Online workshop
Priority area related to the event	Inspection and maintenance
Event theme	How to make sure regulation helps and not hinders I&M robotics?
Organising partner	CIVITTA Lithuania, CIVITTA Estonia
Other associated parties	RIMA Network.
Date of the event	23rd of March, 2022
Location of the event	Virtual meeting, Butter platform
Number of participants	33
Description of participant profiles	Scientific community (62%), industry (24%), general public and others (14%)
Event abstract	This workshop, co-organised with RIMA network, was set to discuss how cooperation among regulators and the robotics community can be fostered and what are the most pressing legal challenges for the I&M robotics.

Table 5 Workshop #4 summary

The fourth workshop took place on the 23rd of March, 2022, and was co-organised by RIMA Network. The event took place online and was facilitated through the Butter online platform.

4.4.1 Participants

There were 33 participants at the workshop. 62% of the registered participants represented the scientific community, 24% represented the industry. In general, registered participants were interested in networking opportunities, learning about the state of the art in AI and Robotics and social impact, legal aspects and regulation. Below are few examples of input answers (direct quotes) considering the expectations of the participants:

"Learn about how regulation currently hinders, and how it now and in the future can help I&M robotics"

"Being aware of the non-technical aspects regarding robotics for I&M"

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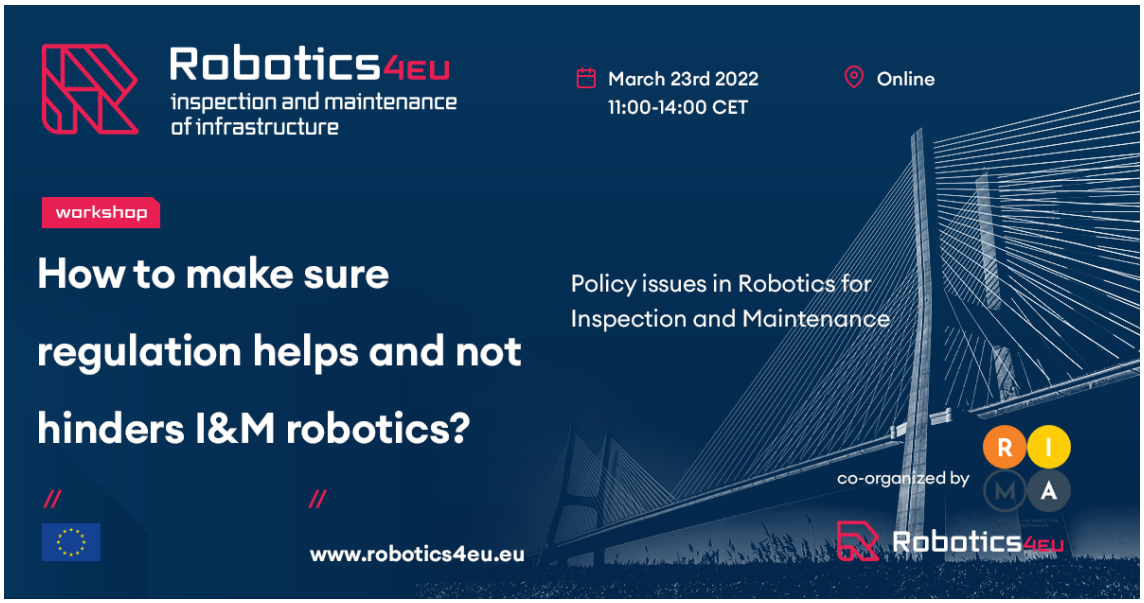

Figure 7 Visual of the workshop "How to make sure regulation helps and not hinders I&M robotics? Policy issues in Robotics for Inspection and Maintenance"

4.4.2 Speakers

Maarit Sandelin works as the European Network Manager specialising on the Robotic Innovation at SPRINT Robotics. She works on Promoting the development, the availability, and application of robotics techniques in technical inspection and maintenance of capital-intensive infrastructure.

Peter Voorhans, TES Technical Support Principal, Global Improvement Leader at The Dow Chemical Company.

Dr. Carlos Cuevas Garcia is a postdoctoral researcher at the Department of Science, Technology and Society of the Technical University Munich, Germany. His research examines diverse formats of collaboration between different specialists, academic disciplines, communities of practice, humans and machines.

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4.4.3 Summary and takeaways of the workshop

The aim of the workshop was to identify the main ways for cooperation among regulators and the robotics community and what are the most pressing legal challenges for the I&M robotics.

Speakers highlighted three main aspects of robotics importance in inspection and maintenance: safety, efficiency and costs. Firstly, robotic solutions allow for reducing the fatalities and risks of accidents in the environments of heights, confined spaces or under-water. Secondly, the preparation work for inspection and maintenance (shutting down the facilities, clearing and cleaning the spaces, air sampling, getting the permits) is not required for inspection and maintenance done by a robot. The bureaucracy – applying and waiting for permits – is reduced as well.

However, the integration of robots faces barriers in two main dimensions: differences in cross-border standards and acceptance of robotics by inspectors. Main problems identified were:

- The regulatory framework for acceptance in robotics is disastrous at the global level;
- Robotic inspections are not always allowed based on regulations or interpretation of the regulation;
- A different interpretation of regulations causes issues for service and technical providers.

To boost the integration of robots into inspection and maintenance, the Europe-wide acceptance and legislation of robots are needed. Different legislation and regulations across borders mean that in each country, inspection must be performed by local certified inspectors.

From the educational perspective, the training of inspectors was tackled. During the discussion it was highlighted that inspectors training should involve robotics training, so the inspectors would understand the advantages and consequences of the integration of robotics and could advocate themselves for the uptake of robotics.

Dr Carlos Cuevas Garcia has evaluated the policy goals and results, following the cycle of the projects, as policy instruments.

Speaking of ways to improve the policy process, besides technical progress (for example, going beyond technological readiness level from 2 to 5), other metrics of success should be considered, e.g.:

- How well do roboticists' teams and maintainers work together?
- How do robots empower maintainers?
- How does the team co-create a vision of the whole inspection process (service logistics, transporting, unloading, fixing robots, etc.)?

Dr Carlos concluded by suggesting a couple of policy recommendations:

- We must explore the learning trajectories of different types of stakeholders involved in sequences of I&M robotics projects;

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- We have to learn how to provide maintenance to innovation networks and repair innovation policy instruments by better identifying their contradictions, fragilities and vulnerabilities;
- This requires close and durable engagement between I&M experts, roboticists, project coordinators, policymakers, regulators, and sociologists of technology.

The elaborated overview of the workshop can be found in the article, published by Robohub. This workshop has been recorded and can be accessed on YouTube. Additionally, speakers' presentations are available here.

4.5 Workshop #5 "Communicating innovation: What can we do better?"

	Robotics4EU I&M Workshop #5
Event type	Online workshop
Priority area related to the event	Inspection and maintenance
Event theme	Communicating innovation: what can we do better?
Organising partner	CIVITTA Lithuania, CIVITTA Estonia
Other associated parties	RIMA Network, RI4EU
Date of the event	25th of May, 2022
Location of the event	Virtual meeting, Butter platform
Number of participants	30
Description of participant profiles	Scientific community (34%), industry (19%), public officials (31%), general public and others (46%)
Event abstract	The workshop explored how the innovation uptake should be supported by effective communication of innovations: by explaining the benefits, tackling risks and fears and openly communicating the challenges ahead, taking them closer to the general public.

Table 6 Workshop #5 summary

The fifth workshop took place on the 25th of May, 2022 and was co-organised by RIMA Network and RI4EU. The event took place online and was facilitated through the Butter online platform.

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Figure 8 Visual of the workshop "Communicating innovation: What can we do better?"

4.5.1 Participants

There were 30 participants at the workshop. A total of 33% represented the scientific community, about 10% of registered participants are policy makers; 20% of participants represented the industry- SMEs and startups specialising in production of the robotic solutions.

In general, registered participants were interested in learning about communication in the robotics domain, understanding which direction does robotics and education go and learning more about robotics in general, and finding networking opportunities.

Here are a few examples of input answers (direct quotes) considering the expectations of the participants:

"Get tips on how to better communicate robotics in order for citizens to feel assured"

"Interesting examples of successful communication campaigns"

4.5.2 Speakers

Marta Palau Franco, project officer at euRobotics. She is an electronics engineer, oceanographer, and project officer at euRobotics aisbl where she works on projects on Digital Innovation.

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Carlos Matilla Codesal, CEO and co-founder of FuVeX. FuVeX is a start-up whose mission is to replace manned helicopters with long-range drones in power line inspection and other aerial data capture operations.

Juan Antonio Pavón Losada, PRISMA Lab (DIETI - University of Naples Federico II) Project Manager Assistant at PRISMA Lab in the Department of Electrical Engineering and Information Technology at the University of Naples Federico II.

4.5.3 Summary and takeaways of the workshop

The workshop explored how the innovation uptake should be supported by effective communication of innovations: by explaining the benefits, tackling risks and fears and openly communicating the challenges ahead, taking them closer to the general public.

Marta Palau Franco presented how social context and perception can affect how we communicate innovative technologies. An example of the change in perception of drones was used: the public's perception changed radically, comparing 2014 and 2022 due to the changes in context: going from military-surveillance use to others such as logistics, entertainment, inspection & maintenance, etc.

Intentional engagement with the audience requires a good understanding of the different communication contexts (i.e., social, physical, cultural) and their perception or future expectations of the technology. However, communication of innovative technology is changing the social and cultural context, contributing to smoother (and safer) adoption of the technology.

Juan Antonio Pavón Losada advice on building trust with stakeholders and communicating in crisis situations. His main idea was that trust needs to be built by consistent communication to overcome crisis situations. The trust absorbs the impact of the crises. Further, the practical example of the successful communication of innovative robotics solutions in inspection & maintenance was presented by FuVex - a start-up whose mission is to replace manned helicopters with long-range drones in power line inspection.

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Consistent communication helps to build trust with stakeholders. Trust is key in crisis situations especially related to I&M.

The elaborated overview of the workshop can be found in the article, published by Robohub. This workshop has been recorded and can be accessed on YouTube. Also, speakers' presentations are available here.

4.6 Workshop #6 "Policy issues in Robotics for Inspection & Maintenance"

General information	**Robotics4EU sixth inspection and maintenance of infrastructure workshop**
Event type	Physical workshop
Priority area related to the event	Inspection and maintenance
Event theme	Policy issues in Robotics for Inspection & Maintenance
Organising partner	CIVITTA Lithuania, CIVITTA Estonia
Other associated parties	European Robotics Forum
Date of the event	29th of June, 2022
Location of the event	European Robotics Forum 2022, Rotterdam, the Netherlands
Number of participants	25
Description of participant profiles	Scientific community (50%), industry (32%), general public (18%).
Event abstract	One of the essential factors for the adoption of robotics in inspection and maintenance is the regulatory landscape. This workshop covered regulation of robotics in the I&M, with a focus on AI regulation and its impact on the field of I&M.

Table 7 Workshop #6 summary

The sixth workshop took place on the 29th of June, 2022, in Rotterdam, the Netherlands, during the European Robotics Forum.

4.6.1 Participants

There were 25 participants at the workshop. Half of the participants represented the scientific community; the rest represented industry (32%) or general public (18%).

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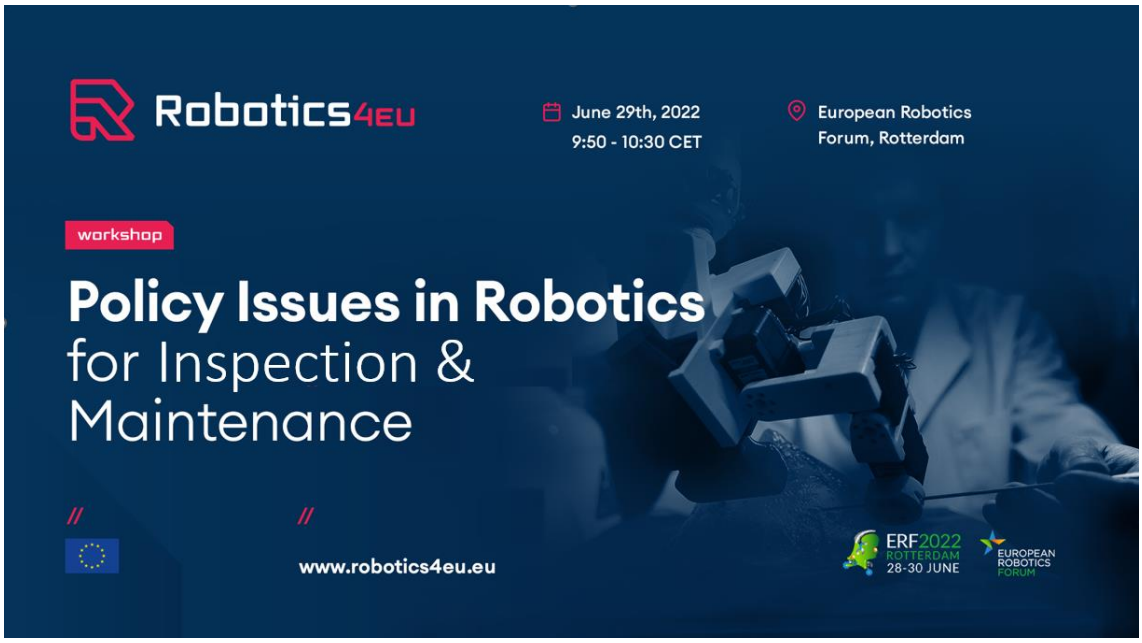

Figure 9 Visual of the workshop "Policy issues in Robotics for Inspection & Maintenance"

4.6.2 Speakers

Dr Agnes Delaborde has been a research engineer at LNE (the French national laboratory for metrology and testing) since 2017, following 5 years of experience at CNRS and 2 years at the Sorbonne. She is specialised in the analysis of the impact of new technologies on human users.

Mr Konstantinos Loupos, Head of R&D (INLECOM), holds an MBA (Hellenic Open University, GR), an M.Sc. in Microelectronics Systems Design (University of Southampton, UK) with distinction and an M.Eng. in Electronic and Electrical Engineering (University of Manchester, UK).

4.6.3 Summary and takeaways of the workshop

The workshop covered regulation of robotics in the I&M, with a focus on AI regulation and its impact on the field of I&M.

Agnes Delaborde structured her presentation around the question, "As a manufacturer, what can I do to guarantee that I put a compliant AI-driven robot on the market?" and introduced the main horizontal and vertical policies. All of these policies highlight

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competitiveness and protection. Agnes concluded that the regulation development is on a sound track with a uniform and coherent strategy. The underlying idea is not to hold back innovation and competitiveness. Also, to move towards creating normative tools for industry.

Konstantinos Loupos emphasised that with Robotics and AI, an element of intervention is entering the inspection and maintenance. AI and environmental perception support decision making, and robots can execute the task of targeted interventions.

It was emphasised that more trust must be invested in the industry and pilot opportunities created. Funding is needed to provide solutions' proof of the value to the public. The discussion by experts and workshop participants has tackled this issue further, highlighting that when we talk about trust, it depends on what kind of mistake rate we consider. For example, there are 1.3 million deaths on roads each year worldwide, or 2000 cases of deaths because of doctors' mistakes in surgeries. If we establish a mistake rate of 0 by default for robots, that's a high mark for trust.

While speaking about liability, it is important to identify if the outcome or resources and needs are considered. For the full liability of outcomes, the robot must be evaluated to not miss anything and perform better than humans. If resources and needs are considered, then it is cooperation, and the liability issues are decided by the integrity manager. It was emphasised that for liability, not only regulation frameworks need to be developed, but also the internal rules, procedures and particular environments in the facilities.

The presentation of speakers can be accessed here.

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5 Key event outcomes and transferable results

The six workshops explored the thematic dimensions, experts and participants' views on the societal aspects in the field of robotics in inspection and maintenance. Following the main goals, identified in the introduction, this section aims to present and summarise how the content presented in the workshops and insights gathered will inform the further activities of the Robotics4EU project.

5.1 Participants' survey

At the beginning of the workshop, participants were asked to evaluate the following statements by choosing among these options: fully disagree – disagree – I don't know – agree – fully agree. Below is an overview of the answers of the participants:

Statement #1: I interact with robots in my work environment

The evaluations of the statement were diverse. Roughly half of the participants agreed that they interact with robots in their work environment, while half said that they do not.

Statement #2: I interact with robots in my home/personal environment.

Most participants indicated that they use robots in their home or personal environment. The exception was the participants in the workshop "Robots: Friends or Enemies? Social Impact of Robotics in Inspection and Maintenance". The majority indicated that they do not use robotics in their environment. The audience at the European Robotics Forum 2022 was the most uniform in agreeing that they interact with robots in their environment, which was expected considering the event's topic and target audience.

Statement #3: I believe I am aware of the main non-technical issues that the robotic industry faces.

In all the workshops, most of the respondents indicated that they are aware of the main non-technical issues of robotics. However, some of the respondents of the "Boosting innovations and maximising societal impact. Role of Digital Innovation Hubs (DIHs) in I&M Robotics" workshop and "Policy issues in Robotics for Inspection & Maintenance" workshop in ERF have indicated that they do not know if they are aware of the issues. This hesitancy might be related to the target audience of the workshops - both workshops were organised in the industry framework (DIHs community and ERF).

Statement #4: I believe that various aspects of robotics are discussed sufficiently in the public discourse.

The majority of respondents agreed the robotics aspects are not discussed sufficiently in the public discourse. However, the respondents of the workshop "Boosting innovations and maximising societal impact. Role of Digital Innovation Hubs (DIHs) in I&M Robotics" were the exception - one-third of respondents indicated that various aspects of robotics are discussed sufficiently.

Statement #5: Technological progress is more important than social progress.

Social progress was indicated to be more important than technological progress by the majority of workshop participants. However, a couple of respondents of the workshop

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"Boosting innovations and maximising societal impact. Role of Digital Innovation Hubs (DIHs) in I&M Robotics' indicated that technical progress is more important (~15%). In comparison, a significant number of people (15-20%) of respondents in the mentioned "Boosting innovations and maximising societal impact" workshop and "Policy issues in Robotics for Inspection & Maintenance" workshop indicated that they do not know the answer. It might also be interpreted that by choosing "I do not know", they wanted to suggest that they see the progress in technological and social spheres of equal importance.

The answers to Impact assessment statements gave the better understanding for the speakers and facilitators of the workshop about the audience: their engagement level with technology, preferences and knowledge of the non-technical issues. This information provided the input and guidance for the workshop discussions.

5.2 Brainwriting session outcomes

After the Participants' survey questions were finalised, some open questions were presented to the participants. These questions aim to assess the level of knowledge of participants on non-technological challenges in robotics adoption as well as initiate discussion and get input on perceived main issues. Below is the list of questions asked:

- What are, in your opinion, the main socio-economic issues in the adoption of robotic solutions in the I&M industry?
- What are, in your opinion, the main ethical issues in the adoption of robotic solutions in the I&M industry?
- What are, in your opinion, the main legal issues in the adoption of robotic solutions in the I&M industry?
- What are, in your opinion, the main issues regarding data management in the adoption of robotic solutions in the I&M industry?
- What are, in your opinion, the main issues regarding the educational and engagement processes in the adoption of robotic solutions in the I&M industry?

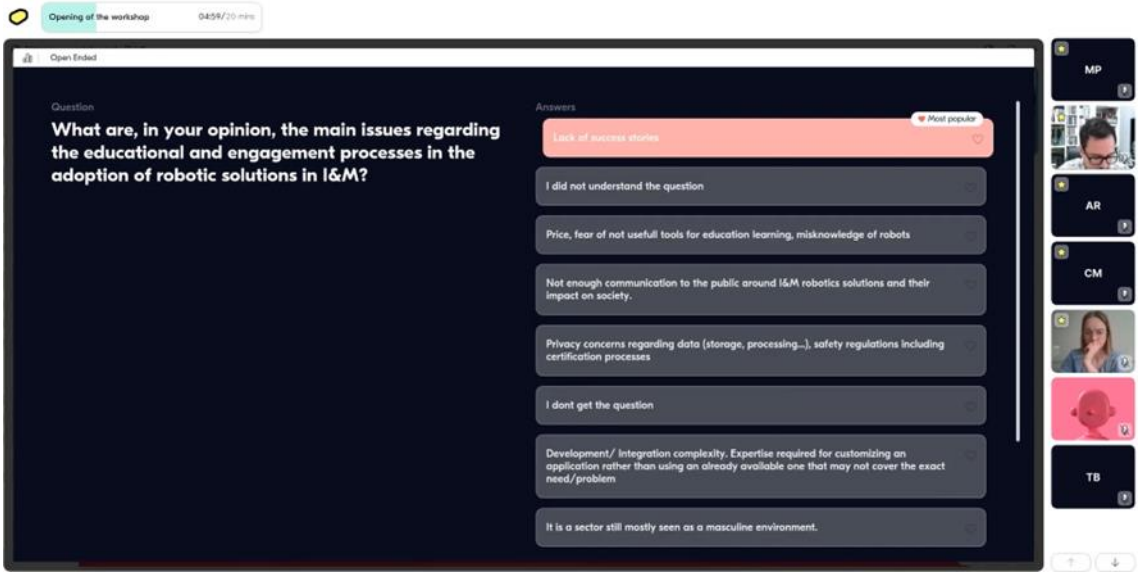

Figure 10 Screenshot from the Brainwriting session of the workshop "Communicating innovation: what can we do better?

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During the workshop on the topic "How can we do better? Data, autonomy and AI Solutions in I&M Robotics" the most relevant socio-economic issue that participants indicated was changes in labour structure – the question of robots replacing humans. Other topics mentioned in regards to the ethical and legal challenges were: trust in robots and safety, standardisation issues, adaptability, robots' dependability and reliability. Speaking of the data management domain, data privacy and surveillance were identified as the topics of concern.

As the second workshop "Robots: Friends or Enemies? Social Impact of Robotics in Inspection and Maintenance" focused on the human-robot-collaborations in the field of inspection and maintenance, a lot of issues raised in the brainwriting session were connected to the issue of acceptance of robots by the inspectors. To ensure the acceptance from one of the main target groups - inspectors, the need for proper introduction and training was identified by the participants, stressing that inspectors need to be aware of the solutions to trust robots' capabilities to do inspection work. Also, the fear of unemployment in certain groups in society was mentioned as an issue.

Related to the trust issue, the ethical dimension of the responsibility in case of the failure was mentioned several times. As well, the need for human oversight was marked. Interestingly, the importance of the context was signified for the evaluation of ethical issues. It has been repeated in the discussion by experts, that one-size-fits-all solutions for intelligent robots cannot be relied on. Connected to the changes in labour structure, the workers' dignity issue was raised, emphasising the need to enhance the dignity of workers in relation to the introduction of robots.

The participants answered that the main legal issues are accountability (most popular answer), responsibility and liability issues. Participants raised a question of who decides that collaborative human-robot maintenance work is safe enough? Who is responsible in case of malfunctions: worker, company, etc? It is evident that these questions, even though widely discussed in the AI and robotics community, still need to be addressed and discussed further in such community-wide formats. In addition, the issue of the regulation lagging behind innovation was pointed out.

The third workshop "Boosting innovations and maximising societal impact. Role of Digital Innovation Hubs (DIHs) in I&M Robotics" focused mainly on the socio-economic impact of robotics in I&M. Thus, in regards to adoption of robotics, the lack of knowledge of the potential manufacturing SMEs, the cost and difficulty to use, limited robustness of robots and economic profitability were mentioned as hurdles.

Importantly, a lot of attention was paid to the changes in labour structure, in regards to the effect of robotics adoption on the regular workers and their professional skills, and general fear of robots taking over jobs. Connected to that, the further social stratification was actualized as well.

In relation to the changes in labour structure, the educational matters were highlighted. The gap between the educational programmes and companies' needs and steep learning curve are contributing to the problem of the lack of trained personnel.

From the ethical dimension, the questions of responsibility of the robots' judgements, safety and liability, lack of awareness and prejudiced opinions were mentioned.

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The workshop "How to make sure regulation helps and not hinders I&M robotics? Policy issues in Robotics for Inspection and Maintenance" brough to the attention policy-related questions. Speaking of the issues in the policy field, the most pressing problem was lack of communication between experts in the community.

For the data management domain, the issues of lack of standardised practices to produce and interpret digital data about infrastructure state was mentioned, in the context of the huge amounts of data that robots produce. The issue of proper encryption was mentioned.

From the educational point of view, the lack of an established training framework was discussed, including the access to suitable training courses/materials for inspectors, and lack of communication between industry and educational Institutes. The workshop participants touched on the issue of communication with the general public and the importance of forming public discourse.

Gender inequality, privacy issues, racial groupings of robots with AI were mentioned in ethical perspectives. As for legal issues, the certification procedures, relation with existing legal frameworks were discussed. The suitability of the current legal framework to AI/Robotics was questioned.

The last online workshop of the series on inspection and maintenance "Communicating innovation: What can we do better?" focused on communication and awareness raising. The lack of success stories and misconception of robots was highlighted. Going into more details, the fact that the sector is seen mainly as masculine environment has been noted.

The overall pool of brainwriting sessions answers is summarised by the frequency of the identified topics in the table below:

Issue area	Challenges
Socio-economic challenges	Changes in labour structure and fear of unemployment, user acceptance, costs of installing robots, trust in the robot
Ethical challenges	Responsibility and liability issues, privacy issues, bias and prejudice, impacting dignity of human workers, gender equality, social stratification
Legal challenges	Standardisation issues, safety, liability and accountability, lack of regulation
Data management	Cyber security, data management and interpretation, encryption, certification procedures, privacy, surveillance issues.
Educational and Engagement processes	Lack of training in robotics for inspection, lack of awareness, lack of communication with the general public, inequality of access, lack of collaboration between industry and educational institutes, lack of success stories.

Table 8 Brainwriting session outcomes

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5.3 Inputs for Maturity Assessment Model

One of the essential parts of the workshop's introduction was the Maturity Assessment model presentation, for which the discussions aimed to provide transferable insight as feedback to. At the beginning of the workshops, the MAM was presented by project partner LNE. After 2 organised workshops, the partner made a pre-recorded video which was shown during the workshops and was accessible to the participants after the workshop (which was also used then in other thematic workshops of Robotics4EU for efficiency reasons). The presentation of the model was serving these goals:

- Building the awareness in the community on the development of the model so that future introduction of it already had some recognition;
- Providing context for the importance of the participants' engagement for the design of the model, making sure that wider communities of stakeholders were enrolled in the discussion of the topics feeding into the MAM One of the aims to structure the workshops in the collaborative approach was to ensure that the community and stakeholders could provide their ideas and insights that could serve as the inputs for the MAM.

The transferable insights and feedback for maturity assessment model, gathered from the workshops are three-fold:

- Insights, coming from the topic presentations by experts and discussions in the workshops. These content-related insights serve as context information and inform the MAM on the specificity of the field of inspection and maintenance. These inputs are presented in section 4;
- Brainwriting sessions, discussions and polls, identifying the most relevant issues in the predefined issue areas (socio-economic, ethical, legal, data management, educational and engagement processes);
- Direct discussion with participants and experts provided feedback on the Maturity Assessment model's thematic areas. The following section will summarise the main take-aways from these engagements for the workshops organised for inspection and maintenance.

During the discussion part of the workshops, participants were asked if they think that there is a need for a tool for assessing the maturity of a robotics solution and its suitability for adoption. The answers of participants have gravitated towards the positive side "fully agree" and "agree", with a considerable part stating that they do not know ("I don't know"). This is partly to be expected, as the MAM represents something novel for most participants.

During the discussions, the notable recommendations were presented by experts and participants:

- Aiming to design a model that would be valid in a long-term perspective, the involvement of the users and market is crucial;
- Developers and engineers of the model must focus on ability of the automated system to be sustainable and adaptable to the changing environment, and reliable over time;
- It was noted that the Maturity Assessment Model should be domain-specific. Robot assisting the healthcare is very different from a robot replacing mine

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workers. Thus, it is quite difficult to transfer knowledge obtained in the healthcare sector to inspection and maintenance;
- Concerning the requirement of the model to account for domain specificity, it was suggested to create an interdisciplinary working group focused on several domains and attempting to assess societal readiness levels of the solutions.

5.4 Community building

One of the difficulties in organising workshops to broaden and empower the responsible robotics community in inspection and maintenance was to identify the relevant people - both in search of the right experts for the topics identified and while attracting participants to the workshops.

To strengthen and empower the EU robotics community in the Inspection and Maintenance field, workshop organisers made sure to include a wide range of organisations from robotics in the inspection and maintenance, as well as general robotics community. First, it allowed the experts from the robotics projects to engage in the workshops together with the social researchers, thus encouraging collaboration and advocacy of the social aspects of robotics in the technical community. Secondly, the robotics community was invited to participate in the workshops. The engagement strategy has included a wide range of organisations. The list of organisations and our engagement activities is presented in the table below:

COMMUNITY STAKEHOLDERS	**ENGAGEMENT ACTIVITIES**
RI4EU (RODIN)	• R4EU was cross-disseminating information with RI4EU on digital channels, including social media, newsletter and the project website; • Co-organised workshop “Communicating innovation: what can we do better?” in May 2022 (together with RIMA Network). Marta Palau Franco from RI4EU was a speaker at the workshop; • Additionally, RI4EU, as CSA supports 5 innovation actions (RIMA, TRINITY, DIH2, DIH-HERO, agROBOfood) in 4 application areas and the information about Robotics4EU workshops was disseminated via mailing lists in this network.
RIMA Network	• Maarit Sandelin (SprintRobotics), Christophe Leroux, Juan Antonio Pavón Losada and Peter Voorhans were speakers at the workshop, representing RIMA network • Cross-dissemination on social media and on the websites was constant for all workshops.
euRobotics	• Marta Palau Franco, project officer at euRobotics, participated as the speaker in one of the workshops; • R4EU organised a last workshop on I&M at the European Robotics Forum 2022. Forum is organised by euRobotics. Thus, some people from the network of

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	euRobotics that attended the forum, engaged in the workshop "Policy issues in Robotics for Infrastructure & Maintenance ".
BugWright2 project	• The project representatives reached out to the R4EU in search of the members of the Innovation Board. • Dr. Alberto Ortiz Rodriguez presented their project at the workshop “Robots: Friends or Enemies? Social Impact of Robotics in Inspection and Maintenance and Dr. Thomas Ellwart spoke about human-robot interactions from a physiological perspective.
Robohub	• Daniel Carrillo-Zapata, the Managing Editor of https://robohub.org/ reached out to us and offered to publish the summaries of our workshops. • 4 publications were created, presenting the summaries of the workshops.

During the organisational activities, we realised that the community in I&M is smaller and more challenging to reach compared to other priority sectors in Robotics4EU. Even though we ensured that we reached out and involved the overarching and prominent organisations and projects in the field of robotics in inspection and maintenance, the amount of people attending was not as expected. To address this, the project partner has made an extra effort to organise an additional workshop, sixth, to reach the raised goal in terms of the reach and further contribute to building and connecting the I&M community. The last workshop on communication was targeted specifically on the issue of making the field of robotics in inspection and maintenance and its social impact more prominent and visible in the larger robotics and social impact of the robotics community.

During the workshops, specific actions were taken to encourage the participants to introduce their involvement in the field and reach out to the project team for the collaboration opportunities: chat facilitation with the invitations to share their background, open-mic time for questions and comments on the topics presented, follow-up emails for participants indicating further involvement opportunities in the Robotics4EU project. Furthermore, the network partners (RIMA Network, RI4EU, Robotex, euRobotic) were engaged in the search for the relevant experts.

Several participants reached out to the project team, indicating that the workshops enhanced their understanding of the field and gave them insights into the engagement opportunities.

5.4.1 Feedback survey

At the end of the workshops, participants were asked to identify if they agree with the statement **“This workshop helped me improve my understanding of the issues robotics faces.”** Below is the consolidated overview of the answers, comparing the feedback of the workshops.

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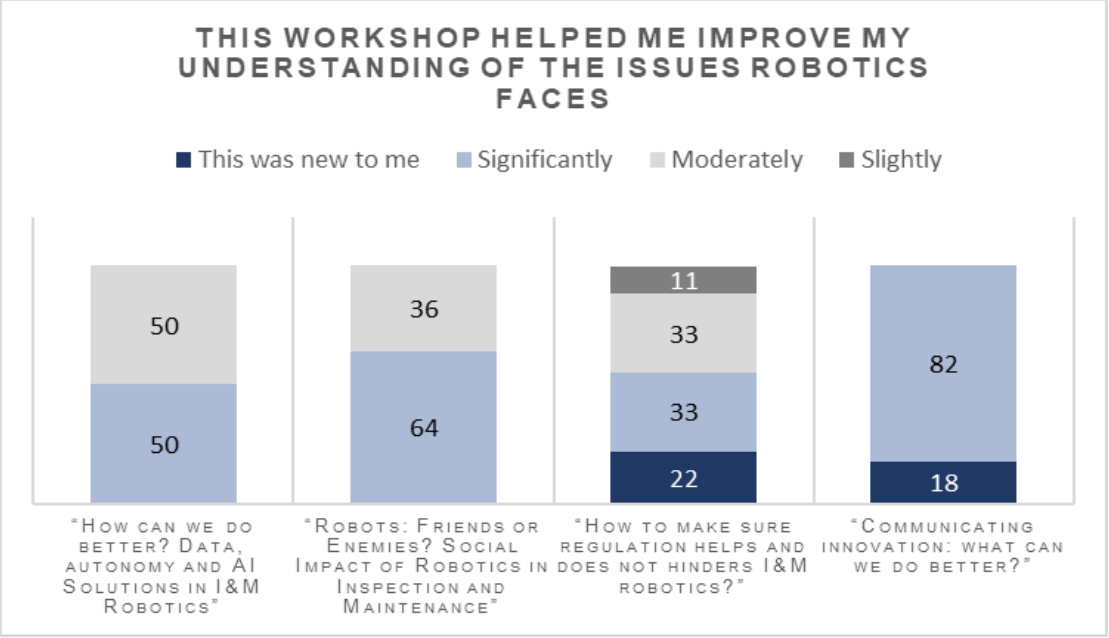

Figure 11 Results of the feedback question, % of respondents

The majority of participants stated that their understanding was enhanced after the workshop. Workshop "Communicating innovation: what can we do better" was evaluated the most positively regarding new understanding (100% of respondents identified that information was new to them or it significantly improved their understanding).

The feedback from two workshops was not measured due to the technical limitations (time limitation and software issues).

5.4.2 Publicly available resources

The workshops have provided valuable materials for further community use. The most relevant outputs are shared on the platform and accessible to the community:

- The recordings of the experts' presentations during the workshops are uploaded to the Robotics4EU YouTube channel. The links to these recordings are shared on the Robotics4EU website. Also, these recordings will be shared on the AI4Demand platform.

Figure 12 Screenshot of the workshop recording on YouTube

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- The summaries of the workshops are shared on the Robohub website. The articles are online and accessible for the community;
- The main findings from the discussed topics will be shared in the format of the report on the topic of social aspects of robotics in Inspection and Maintenance in AI4Demand platform;
- After each of the workshops, the participants were contacted with the follow-up letter, providing the presentations of the speakers from the previous workshop, sharing the link to recording, article on the summary and invitation to engage with the R4EU activities further (depending on the time, it would be a invitation to the next relevant event). This activity aimed to further engage the community on the topic and provide the relevant resources for them.

5.5 Inputs to policy advocacy report

During the workshops, especially, a couple dedicated to policy issues in the field of robotics in inspection and maintenance, several topics reoccurred, related to the issues that can be tackled by police initiatives. The elaborate analysis and further research on these topics will be presented in the D4.4. Responsible robotics advocacy report. The summarised list of most relevant topics is presented:

- **Safety And Security.** The aim of the policy initiatives is to enhance the trust in I&M robotics. One of the areas where the policy needs to focus is cyber security and investment to its enhancement.
- **Changes In Workforce / Labour Market.** The policies shall further focus on evaluating the effects of automation on the workforce and tackling the skill gap. On the other hand, in light of the fear of unemployment, I&M can be mentioned as a sector, where the benefits for the automation are seen much clearer than the drawbacks of the reduction in the workforce. However, the acceptance of automation by inspectors is crucial and proper learning access to the human-robot collaboration enhancement must be provided.
- **Standardisation.** Differences in cross-border standards for I&M robotics is an issue that has to be tackled by EU-level and international policies.
- **Communication and Engagement.** Acceptance of robotics is related to the stories that are shared publicly. In light of the widely-spread narrative of technological unemployment, robots' autonomy and malevolence, there is a need to boost the communication of positive stories on robotics applications. That involves I&M robotics, as the trust in them has to be built with consistency.
- **Funding and Investment.** Considering the highly specific situations and working environment, policy initiatives are seen as enablers to create more trust in I&M robotics, by revising the requirements for pilots and improving the investment climate.

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6 Conclusions

Five online and one on-site workshops were successfully organised as a part of the WP3 “Empowerment of responsible robotics community” T3.4 Knowledge transfer and capacity building in inspection and maintenance of infrastructure. The workshops attracted 209 participants.

Workshops covered a range of topics, including data issues, ethical considerations, communication and commercial uptake of robotics, policy and regulation. Workshops focussed on engaging and gathering the inputs on these topics from participants. From the brainwriting sessions, aimed at facilitating the ideation on the most pressing non-technological issues in robotics in inspection and maintenance, the most repeated issues are:

- Changes in labour structure. Apart from mentioning the fear of robots replacing humans and fear of losing jobs, as the main hurdle for the robotics adoption, participants also identified the specific issues of the robot and human inspector collaboration situation and its impact on the inspector’s skills, responsibility and dignity.
- Responsibility and accountability. These issues were most frequently mentioned in the context of the failure or malfunctions by robotics, need for human oversight and clear responsibility and accountability structure in place.
- Data management and privacy. Cyber Security threats, the lack of standardised practices for data management, encryption and infrastructure were mentioned several times. Interestingly, the issue of privacy in regards to the robotics in inspection and maintenance was not mentioned frequently. It might signal that the audience see the field of I&M as highly technical and not involved in the public domain to be concerned about privacy issues.

One of the main learnings of the workshops from the experts’ presentations and topical discussions is that technological unemployment issue, which is very much relevant in the other focus areas of the project (agile production, agriculture), is approached from a different perspective in the Inspection and Maintenance area. The loss of jobs should be seen not as a threat, but as the eradication of hazardous job functions. Moreover, it has been mentioned that there are more jobs to be created than eradicated. These experts’ insights show the mismatch between the audience reaction and focus on the fear of job loss. However, the skill gap issue that opens up as the workers in Inspection and Maintenance have to re-qualify, is still an important question, mentioned both by experts and participants.

Another recurrent issue in experts’ discussions was related to the safety and trust of the robotics in I&M. Since the inspection and maintenance robots are deployed in strategic infrastructure objects, the high threshold of safety and reliability is applied. Thus, to enhance the adoption, more incentives need to be created through financing and pilot opportunities.

People are aware of the non-technological issues in robotics; however, they still identify that more communication on the topic should be taking place with an intentional focus on non-technological issues. The experts’ opinion broadens this idea – the trust in robotics has to be built to counter the negative stories that are common in the mass

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communication sites. Naturally, there is a tendency to depict the negative consequences in the media with more focus. However, there is a need to tell success stories and the benefits of robotics in the field, to build trust and acceptance.

The insights from the audience engagement and the experts' discussions are mapped and serve as a context for the further elaboration of the Maturity Assessment Model. The brainwriting sessions answers to 5 thematic issue areas provide the specific insights on the Inspection and Maintenance field. These insights serve as inputs in the MAM criteria's design. Further, from the discussions with experts and participants on the need of such a model, emphasise that the model needs to be valid in a long-term perspective and consider that different domains require different approaches to the issue areas.

One of the key outcomes of the workshop is strengthening the community of robotics in inspection and maintenance. Reaching out to the fragmented networks of stakeholders and inviting them to the workshops resulted in networking opportunities. However, even though reaching to the main stakeholders in the field, the workshops attracted a limited number of participants. We draw the conclusions that the field is rather small, and the attempts to bring the community together are crucial, however, demanding persistent communication. Aiming to serve the community further, we have ensured that the outputs of the workshops are accessible to the participants and shared in the robotics community platforms (AI4Demand, Robotics4EU website).

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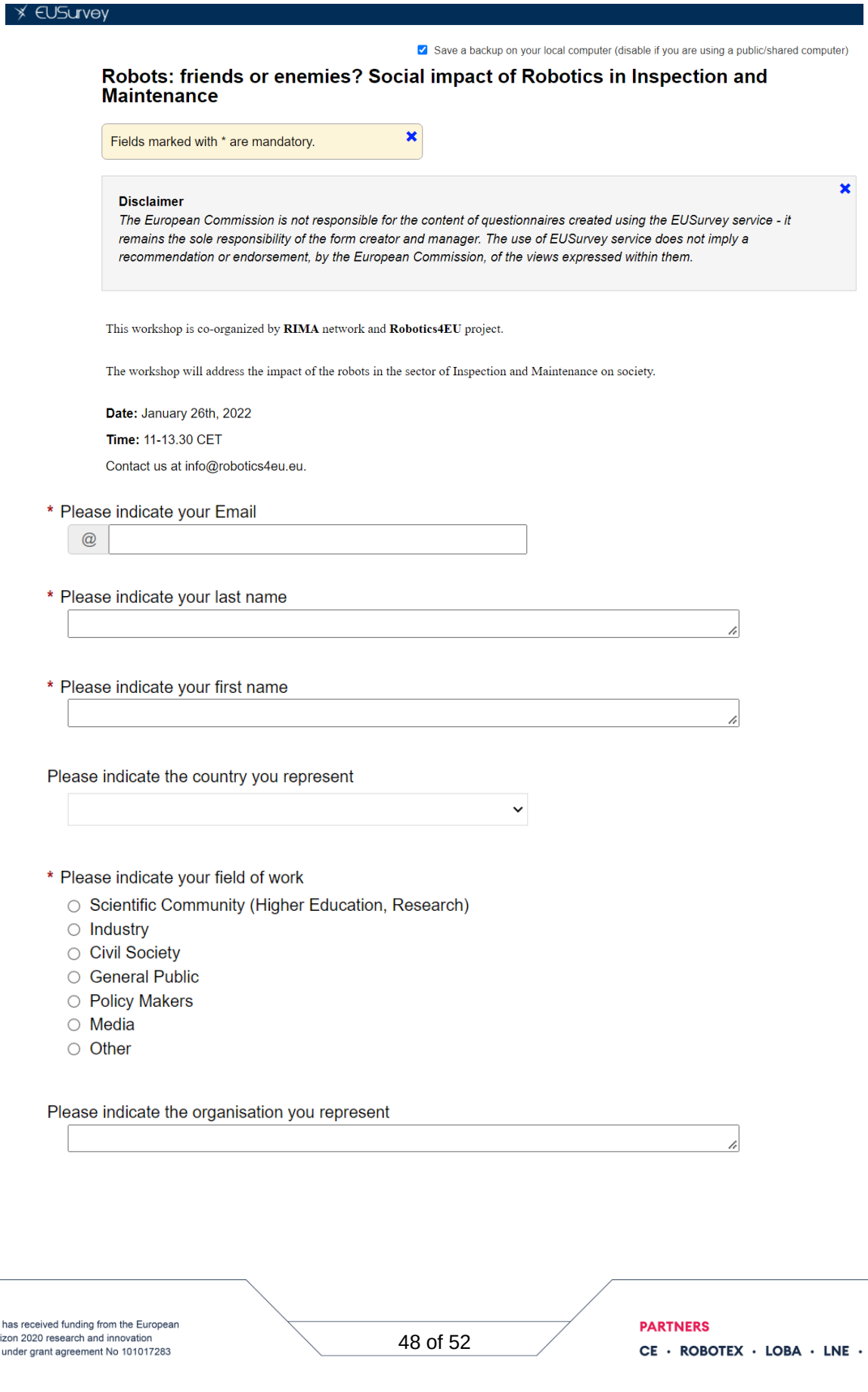
7 Annexes

7.1 Annex 1 – Screenshot of registration form



EUSurvey

Save a backup on your local computer (disable if you are using a public/shared computer)

Robots: friends or enemies? Social impact of Robotics in Inspection and Maintenance

Fields marked with * are mandatory.

Disclaimer

The European Commission is not responsible for the content of questionnaires created using the EUSurvey service - it remains the sole responsibility of the form creator and manager. The use of EUSurvey service does not imply a recommendation or endorsement, by the European Commission, of the views expressed within them.

This workshop is co-organized by **RIMA** network and **Robotics4EU** project.

The workshop will address the impact of the robots in the sector of Inspection and Maintenance on society.

Date: January 26th, 2022

Time: 11-13.30 CET

Contact us at info@robotics4eu.eu.

* Please indicate your Email

@

* Please indicate your last name

* Please indicate your first name

Please indicate the country you represent

* Please indicate your field of work

- Scientific Community (Higher Education, Research)
- Industry
- Civil Society
- General Public
- Policy Makers
- Media
- Other

Please indicate the organisation you represent

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Please indicate the organisation you represent

*

I agree to participate in this event under the conditions set. Show

Submit

7.2 Annex 2 – Workshop Agendas

Figure 13 Agenda of the Workshop "How can we do better? Data, autonomy and AI Solutions in I&M Robotics"

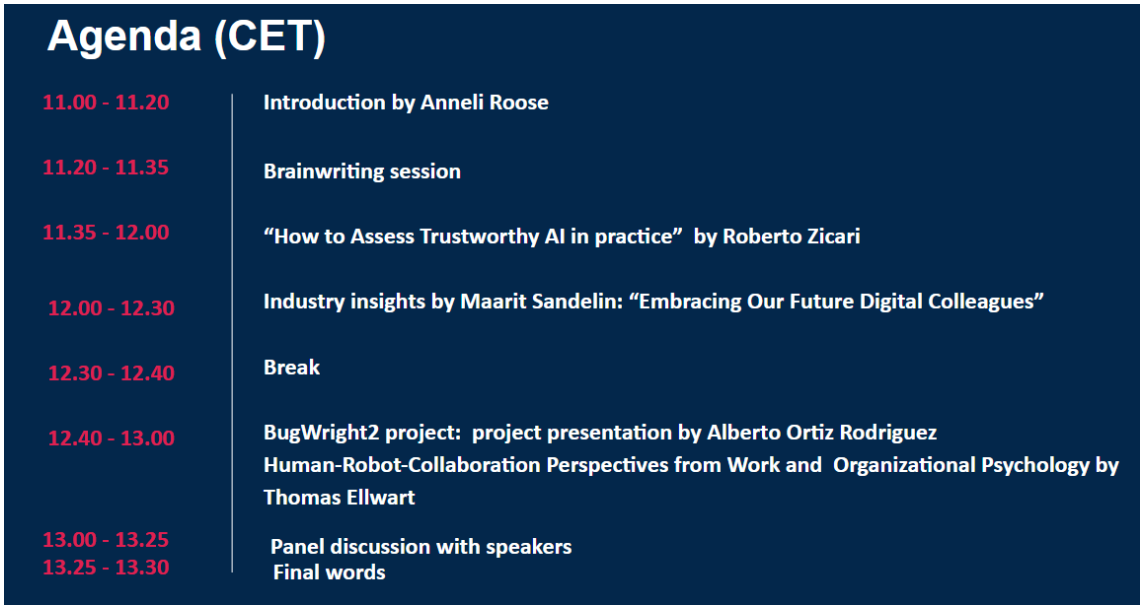

Figure 14 Agenda of the Workshop "Robots: Friends or Enemies? Social Impact of Robotics in Inspection and Maintenance"

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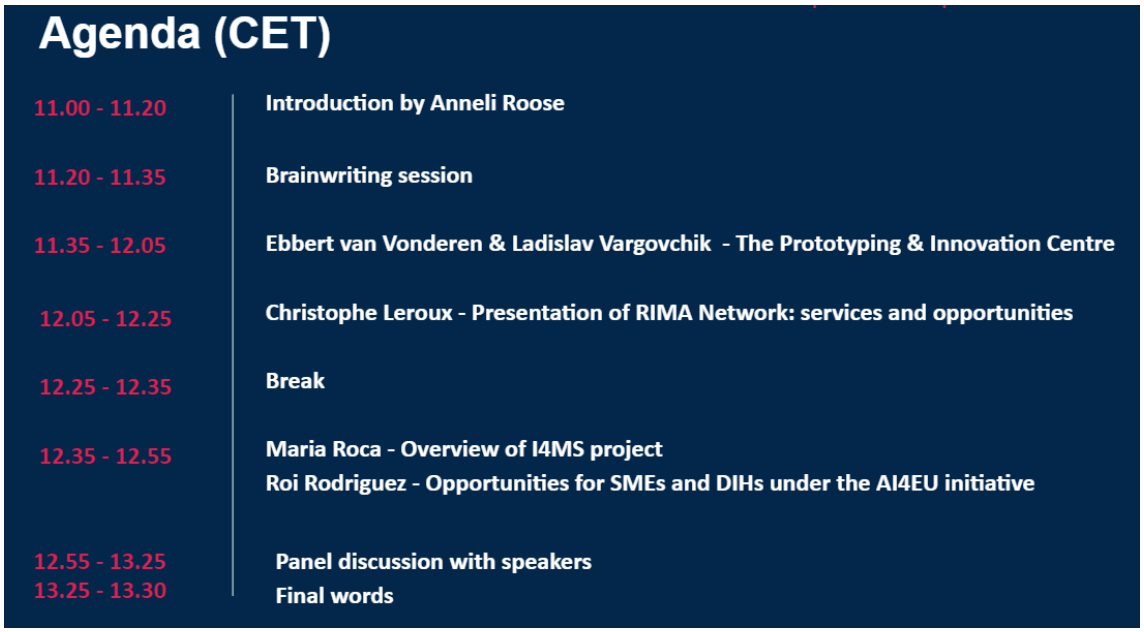

Figure 15 Agenda of the Workshop "Boosting innovations and maximising societal impact. Role of Digital Innovation Hubs (DIHs) in I&M Robotics"

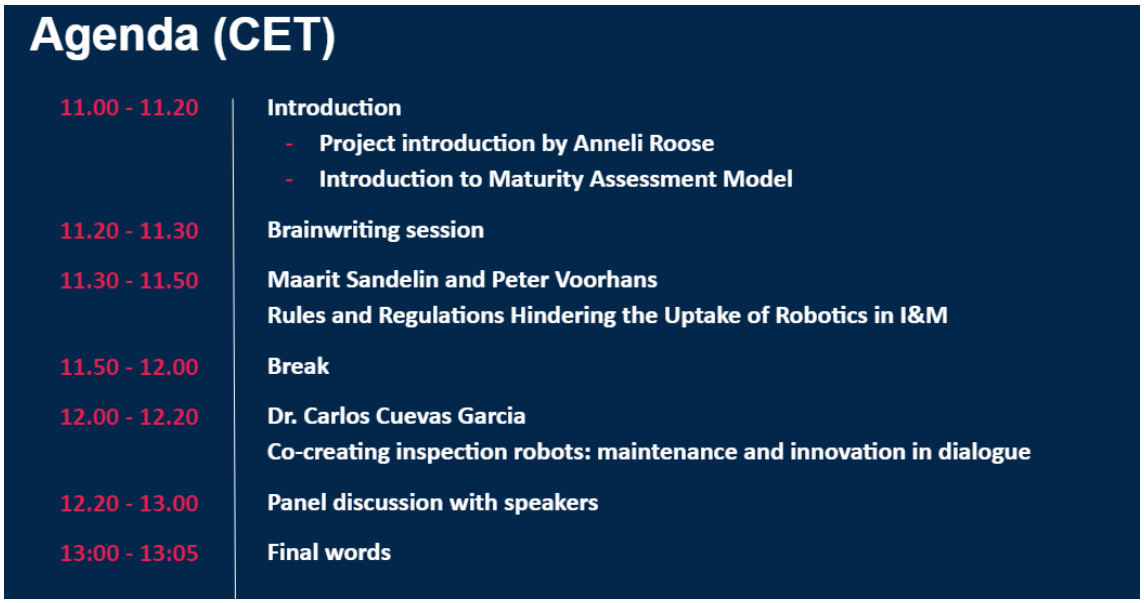

Figure 16 Agenda of the Workshop "How to make sure regulation helps and not hinders I&M robotics?"

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Figure 17 Agenda of the Workshop "Communicating innovation: What can we do better?"

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