TREND & INNOVATION NETWORK 2: AUTOMATION & ROBOTICS

D.T2.2.3 - A report on 10 TTTDMs for Automation & Robotics

Version 4.0

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Document Control

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RE	Restricted to a group specified by the consortium	
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29.12.2021	2.0	MCR	Consolidated Draft
30.12.2021	3.0	MCR	Draft ready to be issued to PRO
	4.0	PRO	Draft ready to be issued to PP

This project is co-financed by the European Regional Development Fund through Interreg Central Europe.

Executive Summary

Project Overview

CEUP 2030 aims to generate stable innovation networks which foster better understanding on **C**entral **E**urope Advanced **M**anufacturing and Industry **4.0** ("**CAMI4.0**") topics, to generate improved knowledge resource exchange on these technologies leading to an upgraded framework for policy-making and implementation.
Ultimately CEUP 2030 creates and tests a common method to promote improved knowledge dissemination to policy-making stakeholders using a collaborative exchange framework based in physical and digital-methods. These methods and the technology show-cases disseminated within these method structures are harvested from existing, high-quality innovation know-how in the CE area.
The project focuses on:

- Identifying the highest-quality innovation know-how in the CE Area, on the CAMI4.0 Topics.
- Enhancing skills capabilities and knowledge of people in charge of local, regional, and (trans)national RTI Policies, associated to the CAMI4.0 Topics.
- Creating a sustainable structure for awareness-raising and shared-sustainable RTI knowledge resource use to enhance policy decision support.
- Anticipating and fast-tracking policy / strategy policy pilot actions to promote a joint RIS3 for CAMI4.0 Excellence in CE/EU.

Work Package and Activity Overview

The overall objective of WPT2 is to upgrade and establish strong partnerships around the 4 main CAMI4.0 topics in order to raise awareness and ensure a shared sustainable responsibility on using RTI knowledge resources in CE/EU for enhancing policy decision support. This will be pursued by establishing sustainable structures of stakeholders called Trend Innovation Networks (TIN) as well as practicable, efficient policy tools, the so-called Policy Intelligence Dashboard (PID). Both those instruments will be exploited by the partners to select and channel appropriate decision-relevant information out of the daily big data cloud, assess it and provide understandable knowledge in a compact and high-quality format.

Practically speaking, in each partner region a TIN will be established and it will work on future foresight, technology trend monitoring, scouting. These activities will also feed the PID with the gained data to produce Tech Radars and other insights able to support decision making.

The specific activity which is of relevance for this document is Activity A.T2.2, which is related to the establishment, development and upgrade of Trend and Innovation Networks (TINs) in CE regions.

Scope of Document & Deliverable Summary

This report provides a summary of the results from all 10 TTTDMs (TINs Tech and Trend Dialogue Meetings) about the CAMI4.0 topic "Automation & Robotics" (A&R). In addition, this document provides an overview about the way these meeting were held and the methodology that was used to complete the Deliverable D.T2.2.3.

Audience

This document is addressed to all the project partners that will be involved in the organisation of TTTDM, following the suggested methodology and exploiting the results of these workshops to further contribute to the project development.

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Change Control Procedure & Structure

The Deliverable Responsible, PROFACTOR GmbH (PRO/PP2), created this result report which is hosted on the Project's common repository in the appropriately named deliverable folder (CEUP2030).
The document is under project deliverable change control protocols whereby Partners are requested to give feedback on the Draft Version according to the timing proposed in the final section of this document. Feedbacks will be incorporated, and the Final Version will be issued by PRO.

At any time, partners that believe a project methodology should change, should submit the request to the Deliverable Responsible (PRO/PP2) to consolidate feedback from other partners, and then further integrate and disseminate the final agreed changes. A new version of the document should be created and recorded in the document's "Document History" table.

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Abbreviations

Abbreviation	Explanation
AF	Application Form
IPS	Intelligent Production Systems
AI	Artificial Intelligence
A&R	Automation and Robotics
CAMI4.0	Central European Advance Manufacturing and Industry 4.0
PLL	Policy Learning Lab
PP	Project Partner
RIS3	Regional Innovation Strategy for Smart Specialisation
S3	Smart Specialisation Strategy
TIN	Trend & Innovation Networks
IWU	Fraunhofer Institute of Machine Tools and Forming Technology
KIT	Karlsruhe Institute of Technology
PBN	Pannon Business Network Associations
PTP	Pomurje Technology Park
HAMAG	Croatian Agency for SMEs, Innovations and Investments
AFIL	Lombardy Intelligent Factory Association
SIIT	Intelligent Integrated Systems Technology SIIT
PIA	Association Industry 4.0 Austria
KPT	Krakow Technology Park
PRO	PROFACTOR GmbH
TTTDM	TIN Tech and Trend Dialogue Meetings

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1. Introduction

The purpose of this report is to provide stakeholders a detailed understanding of the Automation & Robotics' Trend & Innovation Network (TIN) Development & Activities which took place during the lifecycle of CEUP 2030. The report explains the development of the network, and the onward delivery of a series of 10 expert workshops held by the 10 partners, which were aimed at facilitating the discussion of technical contents, fostering the matchmaking among participants and promoting future-oriented discussion about the development of Automation & Robotics in the partner's territorial area.

1.1. Background

1.1.1. On the project CEUP2030

The European Union is the world's biggest exporter of manufactured goods, and is a global market leader for high-quality products. Central Europe's manufacturing sector is a fundamental component of the EU economy with a large amount of high-value innovation know-how in the area of advanced manufacturing and industry 4.0. These two areas are critical for maintaining Central Europe's competitive edge and high employment rate in this economic sector. However, organisations within this eco-system lack sufficient cooperation & structure to really add-value; limiting the competitive potential of connected regions.

CEUP 2030 aims to generate stable innovation networks which foster better understanding on **C**entral Europe **A**dvanced **M**anufacturing and **I**ndustry **4.0** ("**CAMI4.0**") topics, to generate improved knowledge and resource exchange on these technologies leading to an upgraded framework for policy-making and implementation. The purpose of CEUP 2030 is to improve policy-making, by exploiting and upstreaming available outputs and results from excellent work delivered in the programming period 2014 to 2020, to create new recommendations for policies and strategies to enhance Central Europe's Advanced Manufacturing and Industry 4.0 capacities.

1.1.2. On TINs

1.1.2.1. Description and Goals

The **Trend & Innovation Networks are communities of stakeholders** established/anchored around the 4 main topics of CAMI4.0: Intelligent Production Systems, Automation & Robotics, Smart Materials and Artificial Intelligence (Refer to D.T1.1.1 and D.T.1.1.2 for detailed description of CAMI4.0 topics).

Each PP established a TIN for each CAMI 4.0 area, inviting representatives of the triple-helix who **discussed and shared trend and innovation foresights** on the targeted topics. Those communities built on the stakeholders involved in PLL in WPT1 and were enriched with key experts identified by each partner.

Although TINs have been arranged as a digital community, 40 regional meetings (**TTTDM - TINs Tech Trend dialogue meetings**) were organised fostering interregional connection and with the aim to build on the inputs collected during PLL to generate relevant inputs for a future robust policy implementation in the form of technical reports on technologies trend for WPT3. Accordingly, PPs organised 4 workshops focused on TINs topic and/or sub-topics starting from November 2020 and by November 2021. Due to the activities slow-down caused by COVID-19 consequences these meetings have been organised in a longer timeframe and held in a virtual form.

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Besides their regional configuration, TINs also had an interregional dimension thanks to action of PPs that guaranteed connections among the different network exploiting the synergies that emerged during TINs development. In particular, PPs contributed and fostered the identification and development of use-cases in each network that can be concretely implemented in flagship projects involving partners from different regions, either PPs or their stakeholders. By the end of CEUP2030, each TIN guaranteed the generation of 5 use-cases contributing to increase the amount of funds leveraged based on project achievements.

As an output of CEUP2030, Trend and Innovation Networks for CAMI4.0 strongly contributed in the generation of stable innovation networks which were designed to foster a better understanding, generate improved knowledge and exchange on new technologies relevant for Central Europe Advanced Manufacturing and Industry 4.0 and raise awareness on RTI knowledge resources to enhance policy decision making. Accordingly, the methodology and the processes of the TINs enabled for one side the exchange of good practices and available knowledge among stakeholders at regional and interregional level and on the other side the generation of professional inputs for future policies improvement.

1.1.2.2. Specific objectives and outputs

CEUP2030 Trend and Innovation Networks are one of the main outputs of the project and they are meant to:

- Generate improved knowledge and exchange on new technologies relevant for Central Europe Advanced Manufacturing and Industry 4.0;
- Set-up stable innovation networks of stakeholders, where to generate new project ideas and foster interregional cooperation
- Enhance policy making fostering a better understanding of stakeholders' needs and related priorities as well as highlighting existing knowledge gaps of the institutions

In line with these strategic goals and with expected project results, a set of detailed objectives to be pursued by each TIN has been defined, including concrete activities to be implemented by each partner, as well as more strategic actions to be conducted in cooperation with all the partnerships:

> **Trend and Innovation Network Workshops**

In order to foster the discussion on trend and innovation foresight on the targeted CAMI4.0 topics, **40 TTTDM - TIN Tech Trend Dialogue meetings will be organised by CEUP2030 partners involving the regional stakeholders identified in the community**. TTTDM represent the main instruments that TINs should exploit to deliver the outcomes expected and meet the objectives set. TTTDM are envisaged as workshops that will be organised not only with the aim to discuss technical contents and foster the matchmaking among participants, but they will also address key challenges and barriers that might be overcome with the support of institutions. Indeed, the targeted audience will include participants from the triple-helix to be engaged in the discussion, with the aim to generate inspiring content both for the definition of new flagships projects as well as for the definition of strategic policy guidelines to be transferred to policy makers at different levels.

A dedicated paragraph (4.3. TTTDM Methodology) has been elaborated to describe in details the requirements connected to these meetings, complemented with a proposal of methodology to be implemented by partners in the organisation of the workshops.

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- **Roadmaps Tips**

Leveraging on the outcomes of TTTDM, partners should elaborate a list of recommendations for policy makers, to be taken into account in WPT3 and eventually further developed during RIS3 Round Table. These policy recommendations could be elaborated from the preliminary inputs derived from PLL as well as from the discussions that are engaged during the TTTDM. More in details, they should be finalised to elaborate suggestions for improving industrial policies, based on the main needs and priorities highlighted by stakeholders participating in TINs and related to the development and uptake of specific technologies in the targeted CAMI4.0 area.

- **Use-cases and Flagship projects**

Project partners will have the opportunities to exploit TINs and TTTDM to foster the identification and development of use-cases that can be turned into flagship projects involving CEUP2030 partners and or their stakeholders. Each TIN, based on the topics and sub-topics identified and building on the competences and knowledge available in the participating regions, is expected to identify 5 use-cases in alignment with what has been pre-defined in WP1 Harvesting for the different CAMI4.0 topics.

Interregional cooperation and connections among the regional communities have to be ensured by project partners involved in the TINs, making sure that their stakeholders can grasp all the opportunities coming from the TINs and more in particular ensuring their participation in relevant use-cases or flagship projects. To support this action, partners can also constantly look for funding opportunities coming from interregional or EU programmes. To this end, open calls connected to EU projects as well as new INTERREG calls can be considered.

- **Community Building**

While establishing and reinforcing the connection among the ecosystems in the different regions, project partners will set-up cooperation mechanism to ensure long term sustainability of TINs. This will allow to continue activities beyond the project lifetime focusing on the implementation of flagship projects and fostering the cooperation also at institutional level, supporting policy maker in improving existing schemes and eventually designing new cooperation opportunities.

1.1.3. On the CAMI Topic Automation & Robotics (A&R)

Automation and Robotics (A&R) support the "Factory of the Future" and enables realising efficient, effective production processes ranging from nano scale processes over collaborative robotic systems to complex adaptive production systems. The CEUP 2030 TIN objectives for A&R is to promote dialogue and exchange with policy makers, and enable network sustainability. Furthermore, the working group will support a series of technical objectives including: (1) Training for Stakeholder Knowledge & Upskilling, (2) Technology Network Connection for Enhanced Future Foresight, (3) Research and Development on the identified sub-topics, (4) Technology Transfer to Non-Industrial Applications, and (5) Pilot Actions for Infrastructure and Knowledge sharing.

This TIN in CEUP 2030 has 5 specific sub-topics in the following areas:

- **Robotic and Assistive Systems** which refers to the support of human beings in a volatile, richly varied and highly flexible production.

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- **Machine Vision - Zero Defect Manufacturing for Automation** which refers to hindering defective parts during the processes through quality controls.
- **Augmented and virtual reality, visualization** which refers to Systems with higher-value perception and assistance options, Smart devices and tools and Collaborating robots.
- **Simulation and Modelling, Flexible Production Systems** which refers to the design and engineering of software for decentralized and distributed socio-technical production systems.
- **Robots for non-Industrial Applications, Man machine collaboration** which refers to non-industrial Applications such as agriculture or medical robots have a high potential to transfer industrial solutions into other domains.

1.2. Key Definitions and Concepts

CAMI4.0: This acronym stands for "Central Europe Advanced Manufacturing and Industry 4.0", and is a short hand reference for all of the thematic topics and sub-topics which the Partnership have used to frame the technology / content discussions within the project.

Trend & Innovation Networks: The Trend & Innovation Networks (TINs) are thematically focused working groups, comprised of the Partners and their key regional stakeholders. Together this innovation network is used to gather foresight on challenges and opportunities which emerge in the chosen technology areas, and across the territorial area's manufacturing sector. Together this network should be ideating on, developing, and then implementing a number of models to promote transnational cooperation (in the form of use-cases, see below).

Policy Instruments: Policy Instruments are the subsidy and or support tools and structures which exist to promote advanced manufacturing or industry 4.0. This can be a funding scheme, a subsidized service, equipment or infrastructure finance program, or another form of support tool looking to promote advanced manufacturing. These can exist at different territorial levels, but are usually promoted by a government / policy making organization, or an organization which has a mandate to deliver an instrument

Strategy Implementation Blueprint: This is a named output of the project, also called "CEUP 2030 Strategy Upgrade and Boost" (O.T1.2), which connects lessons learnt from stakeholder engagement discussions with a joint strategy built from PP experiences and insight across other initiatives (projects / regional actions). This strategy will be supported by 10 practical use-cases (see: policy instrument use cases/ use case portfolio)

Policy Instrument Use-Cases & the Use-Case Portfolio: The 10 Use Cases (10 portfolios, 4 actions/PP), are the output of D.T1.3.3 **(by February 2021),** and should be good examples of results or experiences from each PPs in this programming period, which showcase how to use these instruments and in an understandable, how policy instruments create specific positive motion to support organizations in engaging with the CAMI4.0 topics.

RIS3 Alignment Instrument Pilot Projects: By WPT3 PPs should have evidence of starting/enabling 20 new regional RIS3 Alignment Instrument Pilot Projects (2/PP) **(by September 2021),** where they aim to showcase how specific policy instrument action can improve regional S3 support for chosen CAMI4.0 topics. These pilot projects should be built

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from the "Policy Instrument Use Cases" identified at the end of WPT1. They also are the project's primary tool to demonstrate sustainability of idea, and ongoing monitoring for the achievement of the CAMI4.0 Vision & Objectives.

Common Policy Use Cases: In WPT2 and WPT3 emerges the idea of the coordinated "alignment" of policy instruments. This is a key area of discussion which should occur between PPs (in CAMI4.0 Working Groups, aka TINs in WPT2) and their stakeholders (In RIS3 Round Tables, in WPT3). By the end of the project PPs operating across the 4 CAMI4.0 Topics create 4 common policy use-cases **(By February 2022),** where the stakeholders involved in each CAMI4.0 working group (TIN) agree a plan to align activities for the coming programming period.

Policy Implementation Framework: This is a named project output, also called "CEUP 2030 Policy Framework – Synergizing CE/EU Policies and Strategies for CAMI4.0 Excellence" (O.T3.2), which is the final strategic output of the project. It presents a combined view of the project's results – specifically a vision and objectives for each CAMI4.0 topic, with a signed capitalization agenda showing the support of a diverse group of stakeholders (including Policy- Relevant stakeholders), and implemented through the formation and initiation of RIS3 Alignment Instrument Pilot Projects (See definition above). This should be achieved by February 2022, and must showcase the pilot projects and common policy use-cases.

1.3. Purpose of the document

Each PP organized a TTTDM on A&R TIN, according to its role, with the specific objective to collect regional expertise and capabilities on the specific topic, to foster the creation of a regional community and to share best practices. This document reports on the 10 TTTDM held by the partners on A&R and provide insights on how to build upon these 10 TTTDM.

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2. Objectives and Responsibilities

The Trend & Innovation Networks were organised as digital communities of stakeholders anchored around the 4 main topics of CAMI4.0: Intelligent Production Systems, Automation & Robotics, Smart Materials and Artificial Intelligence. These topics have been selected in the framework of CEUP2030 project, since they have been recognised as the most strategic topics to be developed in the Central Europe area to maintain the competitiveness of Advanced Manufacturing stakeholders and further develop their knowledge and competences. More in details, each CAMI4.0 topic has also been specified in term of sub-topics to clearly identify the contents to be discussed and developed within the network.

This report focuses mainly on the topic "Automation & Robotics", which is led by the CEUP2030 partner PRO-Profactor. TIN Leaders are responsible to guide the definition of the TIN specific objectives as well as supervise actions implemented by the group of partners involved ensuring that, by the end of the project, TINs goals and the targets have been met.

CEUP2030 partners all contributed to the development of TINs by establishing a regional network in the different CAMI 4.0 areas, inviting representatives of the triple-helix who contributed discussing and sharing trend and innovation foresights on the targeted topics.

2.1. Automation & Robotics Objectives

Specific objective regarding the Topic of Automation & Robotics have been defined in the table below:

Table 1. A&R Objectives (Source: DT1.3.2, CEUP2030, 2020)

Number	Objective Name	Objective Description
1	Training for Stakeholder Knowledge & Upskilling	Promoting training on the topic of robotics and assistive systems, generally for stakeholders who lack knowledge & access to information about these technologies (leveraging the infrastructure and expertise of each stakeholder and the transnational network)
2	Technology Network Connection for Enhanced Future Foresight	Leverage existing technology networks to promote discussion and future foresight on technology topics
3	Research and Development on the identified sub-topics	Promoting research & future foresight on the topic of human- robot collaboration and assistive systems in industrial environments (other technical research projects also feasible depending on connected interests)

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4	Technology Transfer to Non- Industrial Applications	Promoting transfer of robotics and automation knowledge to non- industrial applications
5	Pilot Actions for Infrastructure and Knowledge sharing	Generating pilot actions and coordinated use cases which promote infrastructure and knowledge sharing

2.2. Stakeholders

2.2.1. Partners

With regards to this activity, all partners took a role in delivering an expert workshop associated to Automation and Robotics.

Table 2. Partners of CEUP2030 (Source: Author generated, CEUP2030, 2021)

Name of the partner	Abbreviation	Country
1- KRAKOWSKI PARK TECHNOLOG ICZNY	KPT	Poland
2- PROFACTOR GmbH	PRO	Austria
3 - Verein Industrie 4.0 Österreich	PIA	Austria
4- Fraunhofer Gesellschaft zur Förderung der angewandte n Forschung e.V. für das Fraunhofer Institut für Werkzeugmaschinen und Umformtechnik (IWU)	IWU	Germany
5- Karlsruher Institut für Technologie	KIT	Germany
6- Associazione Fabbrica Intelligente Lombardia	AFIL	Italy
7 - SIIT S.c.p.a. Sistemi Intelligenti Integrati Tecnologie	SIIT	Italy
8 - Pomurski tehnološki park	PTP	Slovenia
9 - Pannon Gazdasági Hálózat Egyesület	PBN	Hungary
10 - Hrvatska agencija za malo gospodarstv o, inovacije i investicije	HAMAG	Croatia

2.2.1. Partners' Role and activities

According to the definitions developed in T2.2 and considering the heterogeneity of CEUP2030 consortium as well as the regional priorities, partners are classified with different roles in the TINs based on their competences, knowledge, and potential stakeholders' interest:

- **Leader:** partner in charge of guiding the development of the TIN, making sure that all the partners involved contribute to the definition of objectives and strategy and comply with the requirements. Leaders will take care of ensuring alignment among regional communities, organising periodic meetings and making sure synergies are properly

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exploited. Finally, the leader of the TIN will also be the responsible of writing the TIN deliverable reporting on the meetings organised by the group and the main achievements.

- **Core**: partners in this role are considered the main contributors to the TIN contents. They have well developed knowledge and competences in the field and through the organisation of TTTDM they are going to present regional best practices as well as building the basis for interesting use-cases to be developed with other partners or their stakeholders.
- **Learner**: partners who do not have a grounded experience in the field , though the field itself might be one that is of significance to the strategic priority of the region. Learners can therefore also leverage the expertise of other PPs and TINs of other regions to improve their competences and knowledge, exchanging with leader and core partners and eventually organising meetings and raising their overall competence with their support.

Furthermore, the Partners took the following roles, detailed in Table 3, within Automation and Robotics TIN working group structure. These roles have been chosen to optimally address technology and content relevant competencies within the CEUP 2030 partnership:

Table 3. A&R TIN Structure (Source: DT1.3.2, CEUP2030, 2021).

Working Group Members	
Leader: PROFACTOR (PRO)	
Core Member	**Learner**
☒ Krakow Technology Park (KPT) ☒ Karlsruhe Institute of Technology (KIT) ☒ Intelligent Integrated Systems Technology (SIIT) ☒ Pannon Business Network Association (PBN) ☒ Lombardy Intelligent Factory Association (AFIL)	☒ Association Industry 4.0 Austria (PIA) ☒ Fraunhofer Institute for Machine Tools and Forming Technology (IWU) ☒ Pomurje Technology Park (PTP) ☒ Croatian Agency for SMEs, Innovations and Investments (HAMAG)

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2.2.2. Participants

The graph below shows the number of participants per partners who attended the expert workshops. In total 449 stakeholders from 7 countries attended the 10 A&R TTTDMs held between March 2021 and November 2021.

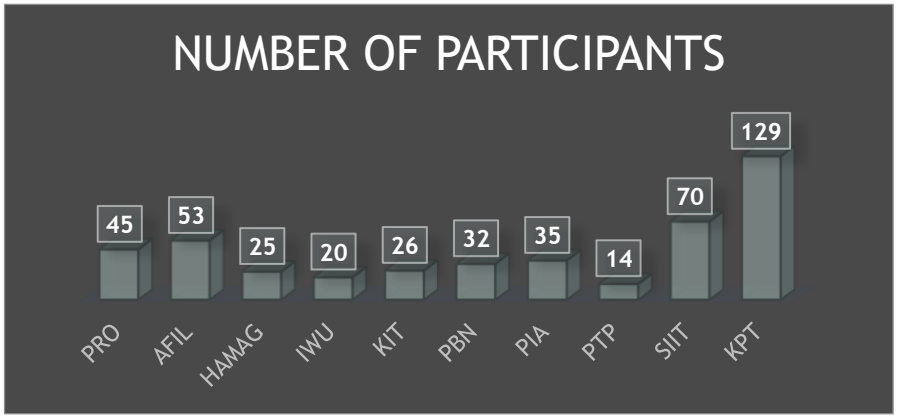

Figure 1 - Number of TTTDM A&R participants per partner (Source: Author generated, CEUP2030, 2021)

The graph below showcases the representation of target groups per partners.

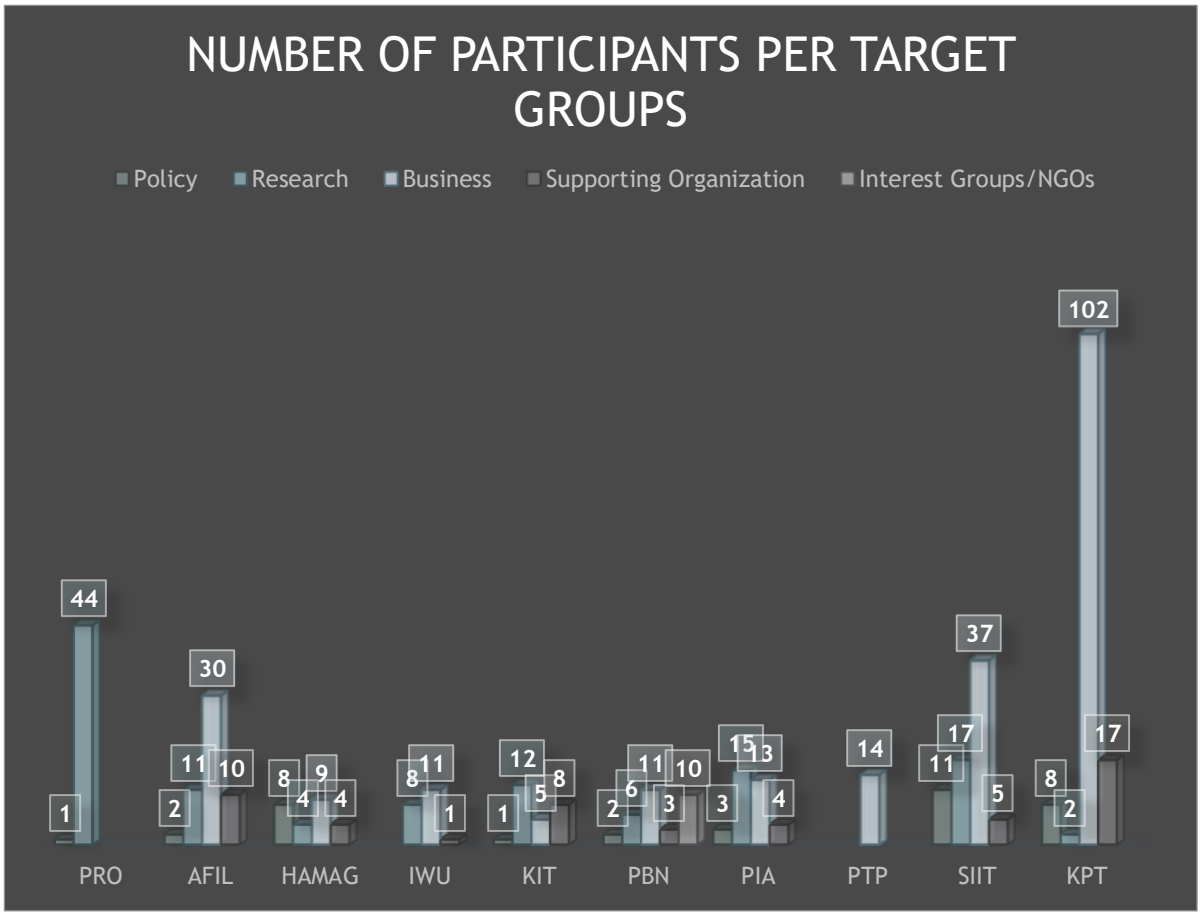

Figure 2 - Number of TTTDM A&R participants per target group per partner (Source: Author generated, CEUP2030, 2021)

The graph below provides an overview of the target's groups represented:

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Figure 3 – Total Number of TTTDM A&R participants per target groups (Source: Author generated, CEUP2030, 2021)

Most of the participants were represented by businesses, research centres and universities dealing with A&R solutions and innovations. This was a positive result considering the objective of TTTDMs, i.e. to build and strengthen a stable network of interested stakeholders working on the topic. The industrial presence was also strengthened by business support organizations who will share the outcomes to their associates, increasing the overall impact of TTTDMs also externally to participating stakeholders. Finally, representatives of local, regional and national institutions participated to each TTTDM in order to improve their knowledge on the topic, collect needs and barriers, explain current availability and start discussing new supporting tools.

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3. Methodology

3.1. Data Collection

Harvesting from the cross-section of projects was a key enabling activity of CEUP 2030, to which every PP was asked to contribute. It was important that PPs worked to review the organisation's past projects with the goal to prioritise the capitalization of knowledge and know-how gained from a cross-section of good practice projects. Partners were asked to review their Result Portfolio and filter for results which would add value to CAMI4.0. This review and filtration of results, with the purpose of capitalising knowledge within CEUP 2030 is the associated definition of the term "harvest".

The PPs have provided good practices as an inspiration for the TINs that have been collected in D.T2.1.2., where a complete overview of partners contributions is available as well as a detailed analysis of the results.

In the process of creating this document, the harvested good practices were analysed and inspiring points were highlighted to define guidance for TINs set-up ad TINs orchestration that will be presented in the following table:

Table 4. TIN Structure (Source: DT2.1.2, CEUP2030, 2020)

TINs set-up	TINs orchestration (organisation of TTTDM)
• Mixture of a top down and a bottom up approach when setting TINs up • Ensure long term sustainability defining a clear plan for the next 2-3 years • Define the role of each partner in contributing to the different TINs • Plan regular online meetings to connect regional networks at interregional level • Set-up and continuous update of stakeholders' database to monitor their involvement in the networks	• Identify wide target groups and facilitate the long-term participation of stakeholders in this network • Allow flexibility in the workshop structure • Focus on a specific topic or sub-topic • Include different perspectives to involve different stakeholders having different interest • TTTDM structure should have different sessions organised to achieve diverse objective (*i.e. technical panel to present specific applications + round table with experts to address challenges and foster the interactions among different type of stakeholders + matchmaking session to favour the establishment of fruitful collaborations*)

3.2. Implementation

As anticipated in the objective sections, 10 TTTDM for Automation & Robotics (40 in total for all 4 CAMI4.0 topics) area have been organised. The meetings were expected to be organised targeting regional stakeholders. Differently from PLL, TIN Tech Trend Dialogue Meetings were expected to have a larger audience (around 30 people) and so they have been conducted more in the form of a seminar rather than a co-creation session.

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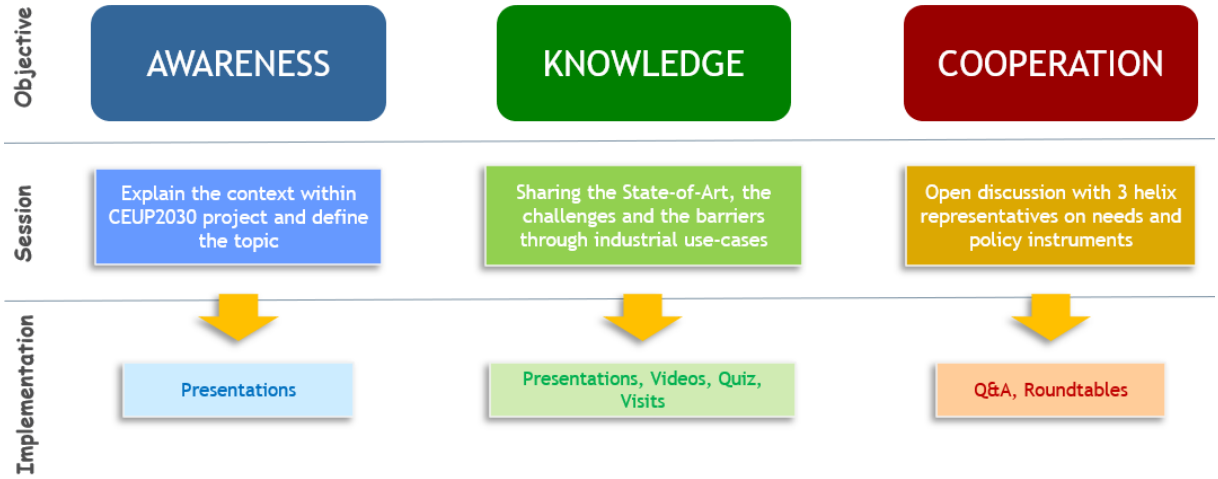

Figure 4: General structure of AI TTTDMs (Source: Report on AI TTTDM, CEUP2030, 2021)

All the TTTDMs despite the topic they addressed had to follow the same structure. Therefore, three main objectives were raised during the report on the TTTDM on AI: Awareness Raising, Knowledge Exchange and Cooperation Enhancement.

The partners designed their events to meet these three objectives, and built agendas which facilitated both detailed and strategic/general overviews about Automation and Robotics. All partners had to issue an agenda regarding their TTTDM:

Figure 5 - Agenda of IWU

(Source: IWU, CEUP2030, 2021)

Robotics for Humans –
Sichere und leistungsstarke Robotik für menschennahe Aufgaben

Donnerstag, 22. Juli 2021 – online Microsoft Teams
09:00 – 12:00 Uhr

09:00 Uhr	Begrüßung, Projektvorstellung und Rahmen Linda Weisheit, Fraunhofer IWU
09:05 Uhr	Technik-Test und Kennenlernen
09:15 Uhr	Menschennahe Robotik – Ein noch unsichtbarer Markt Linda Weisheit, Fraunhofer IWU
09:45 Uhr	Erfahrungsaustausch
10:00 Uhr	**Kaffeepause**
10:15 Uhr	Forschung am Fraunhofer IWU: Motivation, Vision, Aktueller Stand Wilhelm Wockenfuß, Lukas Boxberger, Fraunhofer IWU
11:15 Uhr	Diskussion: Potentiale und Herausforderungen
11:45 Uhr	Ausblick: Netzwerk
12:00 Uhr	Feedback und Ende der Veranstaltung

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CEUP 2030
Technology & Trend Dialog Meeting

Date	**Tuesday, 27.07.2021, 13:00 – 15:30**
Venue	The event will be **virtual** and the link will be forwarded to all registered participants
Registration	The participation to the Technology and Trend Dialog Meeting is free of charge. Registration should be made via e-mail to amal.charles@kit.edu or clarissa.marquardt@kit.edu.

13:00	Welcome and Introductions
13:05	CEUP 2030 Trend and Innovation Networks in Automation and Robotics.
13:15	Expert Talk *„Wertstromkinematik - a vision for innovative, versatile production of the future„* Dr. Steffen Scholz , Karlsruhe Institute of Technology (KIT)
13:45	Expert Talk *„User-centered design and development of high performance Robotics technology"* Stephan Quade, Franka Emika GmbH – The Robotics Company
14:20	Expert Talk „ Manufacturing in the Horizon Europe Work Programme ‚Digital, Industry and Space" Dipl. -Ing Jens Korell, Project Management Agency Karlsruhe (PTKA)
14:50	Interactive Brainstorming and Ideation session
15:20	Closing

We are looking forward to hearing your ideas for new projects and avenues where the network can collaborate on to solve new challenges.

CEUP2030 (CE 1662) is a project financed by Interreg Central Europe that started in March 2020 and comprises 10 project partners from 7 European countries, namely Germany, Poland, Austria, Italy, Slovenia, Croatia and Hungary. CEUP 2030 strives for excellence in policy making on Industry 4.0/Advanced Manufacturing in within regions in Central Europe, since the understanding of new technologies varies among the academia, industry and governments. CEUP 2030 enhances the CE innovation eco system by establishing a sound Trend & Innovation Network scheme working on 4 common CAMI4.0 topics and set policy pilot actions for improving the innovation landscape with the RIS3 Round Tables. Furthermore, trainings in the Policy Learning Labs & the elaborated tech radars (in the Policy Intelligence Dashboard) also increase the innovation capacity.

Figure 6 - Agenda of KIT

(Source: KIT, CEUP2030, 2021)

This project is co-financed by the European Regional Development Fund through Interreg Central Europe.

Figure 7 - Agenda of PIA

(Source: PIA, CEUP2030, 2021)

Österreichische Gesellschaft für Mess-, Automatisierungs- und Robotertechnik (GMAR) und Plattform Industrie 4.0

Tech Trend Dialogue #2: Robotics

18. Mai 2021, 10:00-12:00

online via Zoom; https://us02web.zoom.us/j/84310116036?pwd=aVVN2R6dWhOVUZR5npuczhLNHJYZz09

Ziel des Interreg-Projekts CEUP 2030 ist es, Stakeholder im Bereich Industrie 4.0 zu vernetzen und über neue Entwicklungen in verschiedenen Themenbereichen zu informieren. Das Format der „Tech Trend Dialogues" soll dabei helfen: Ziel der vier geplanten Workshops ist es, zu vier unterschiedlichen Industrie 4.0-Themen neue Produkte/Aktivitäten mit Relevanz für die (österreichische) Industrie aufzuzeigen und einen Austausch dazu zu ermöglichen.

Der zweite Tech Trend Dialogue findet zum Thema „Robotics" statt. Ziel des Events ist es, über neue Produkte und Projekte bzw. Initiativen und Organisationen in diesem Bereich sowie deren Potenzial für die Industrie zu informieren. Unter anderem sollen dadurch auch Herausforderungen und Barrieren zum Thema sichtbar gemacht werden - als Input für potenzielle Politik-Instrumente.

In ihren Inputs greifen die Vortragenden diese Zielsetzung auf und stellen ihre Herangehensweisen und Erfahrungen vor.

10:00 **Begrüßung und Vorstellung CEUP 2030**

10:05 **Input 1 | Dipl.-Ing. Dr. Andreas Pichler, CTO bei Profactor und Präsident der GMAR**

Als CTO von Profactor und als Präsident der GMAR verfügt Hr. Pichler sowohl über fachspezifisches Wissen als auch über einen Überblick zum Status Quo rund um Messtechnik, Automatisierungstechnik und Robotertechnik in Österreich.
Hr. Pichler wird in seinem Input die GMAR und deren Aktivitäten kurz vorstellen.

10:20 **Input 2 | DI Dr. Mathias Brandstötter, stellvertretender Direktor des Instituts für Robotik und Mechatronik der Joanneum Research und Vorstandsmitglied der GMAR**

Neben seiner Rolle als stellvertretender Direktor des Instituts für Robotik und Mechatronik der Joanneum Research engagiert sich Hr. Brandstötter im Vorstand der GMAR als Leiter des Fachbereichs Robotik.
In seinem Vortrag wird Hr. Brandstötter auf folgende Aspekte eingehen:

- Who is Who: Querschnitt der österreichischen, angewandten Forschung und industrienahen Entwicklung im Bereich Robotik
- Aktuelle Themen: Welche Themen sind aktuell für die Industrie relevant, wer sind potenzielle Partner und in welchen Bereichen sind diese aktiv?
- Industrierelevante Projekte in Österreich und Aktivitäten der GMAR-Mitglieder

10:50 **Input 3 | Konstantin Mautner-Lassnig, CEO/Co-Founder, ARTI – Autonomous Robot Technology GmbH**

Das steirische Startup ARTI fokussiert sich auf Software-Entwicklung im Bereich der Robotik – für autonome Transport-Roboter im Industriebereich werden KI-basierte Lösungen angeboten. Als Gründer von ARTI wird Hr. Mautner-Lassnig das Unternehmen vorstellen:

- Vorstellung des Unternehmens und des Produktportfolios
- Aktuelle Projekte und Use Cases
- Herausforderungen und Ausblick auf zukünftige Entwicklungen

11:20 **Input 4 | Michael Zillich, CTO, Blue Danube Robotics GmbH**

Dem Bereich der Mensch-Roboter-Kollaboration hat sich das Team der Blue Danube Robotics GmbH verschrieben. Mit AIRSKIN gibt man Robotern eine Außenhaut und ermöglicht so den Einsatz von Industrieroboter ohne Schutzzäune. Hr. Zillich ist Mitgründer und CTO des Unternehmens und wird in seinem Input folgende Themen adressieren:

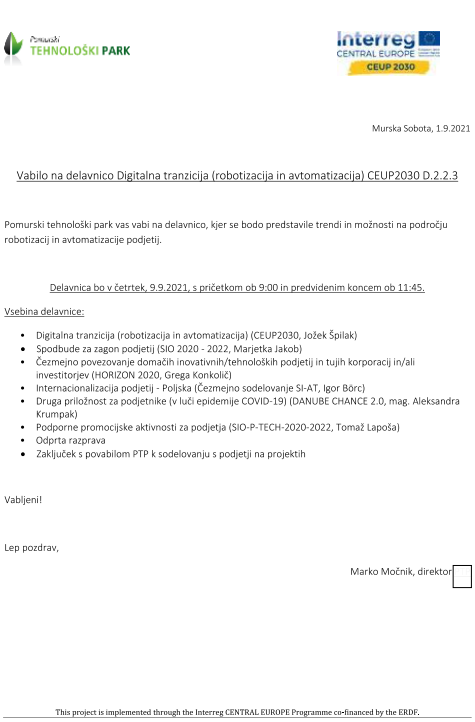
- Vorstellung des Unternehmens und des Produktportfolios
- Schutzzaunlose Robotik als Maßnahme zur Produktivitätssteigerung für die Industrie
- Umgang mit Sicherheit und Zertifizierungen bei der Zusammenarbeit von Mensch & Roboter

11:50 **Diskussion**
Offene Fragerunde mit Vortragenden und Publikum

12:00 **Ende der Veranstaltung**

Link zur Teilnahme: https://us02web.zoom.us/j/84310116036?pwd=aVVN2R6dWhOVUZR5npuczhLNHJYZz09
Meeting-ID: 843 1011 6036 | **Kenncode:** 679038 | **Telefon-Einwahl** via +43 72 011 5988 oder +43 120 609 3072

Verein Industrie 4.0 Österreich – die Plattform für intelligente Produktion I www.plattformindustrie40.at
Mariahilfer Straße 37–39 I 1060 Wien I T: +43/1/588 39-75 I E: office@plattformindustrie40.at I ZVR-Zahl: 829608522



Pomurski TEHNOLOŠKI PARK

Murska Sobota, 1.9.2021

Vabilo na delavnico Digitalna tranzicija (robotizacija in avtomatizacija) CEUP2030 D.2.2.3

Pomurski tehnološki park vas vabi na delavnico, kjer se bodo predstavile trendi in možnosti na področju robotizacij in avtomatizacije podjetij.

Delavnica bo v četrtek, 9.9.2021, s pričetkom ob 9:00 in predvidenim koncem ob 11:45.

Vsebina delavnice:

- Digitalna tranzicija (robotizacija in avtomatizacija) (CEUP2030, Jožek Špilak)
- Spodbude za zagon podjetij (SIO 2020 - 2022, Marjetka Jakob)
- Čezmejno povezovanje domačih inovativnih/tehnoloških podjetij in tujih korporacij in/ali investitorjev (HORIZON 2020, Grega Konkolič)
- Internacionalizacija podjetij - Poljska (Čezmejno sodelovanje SI-AT, Igor Börc)
- Druga priložnost za podjetnike (v luči epidemije COVID-19) (DANUBE CHANCE 2.0, mag. Aleksandra Krumpak)
- Podporne promocijske aktivnosti za podjetja (SIO-P-TECH-2020-2022, Tomaž Lapoša)
- Odprta razprava
- Zaključek s povabilom PTP k sodelovanju s podjetji na projektih

Vabljeni!

Lep pozdrav,

Marko Močnik, direktor

This project is implemented through the Interreg CENTRAL EUROPE Programme co-financed by the ERDF.

Figure 8 - Agenda from PTP

(Source: PTP, CEUP2030, 2021)

Considering the contents, these 10 TTTDMs had to focus on the specific CAMI4.0 topic "Automation & Robotics" or its related sub-topics and they had to be structured to facilitate the discussion of technical contents and foster the matchmaking among participants. Moreover, with the aim to exploit these events to feed WPT3 activities, partners were also strongly suggested to address key challenges and barriers that might be overcome with the support of institutions, for example through the organisation of round tables with stakeholders involved representing diverse types of organisation.

The partners had a varied audience representing the triple-helix attend the sessions. As described in the Stakeholder section of this report, we provide some images to show how the partner's stakeholders attended the session. Some of the TTTDM were held physically including physical study visits as planned and others online due to the COVID pandemic.

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Figure 9 - PTP Physical Attendance

(Source: PTP, CEUP2030, 2021)

Figure 10 - KPT Physical Attendance

(Source: PIA, CEUP2030, 2021)

Figure 11 - PBN Online Attendance

(Source: PBN, CEUP2030, 2021)

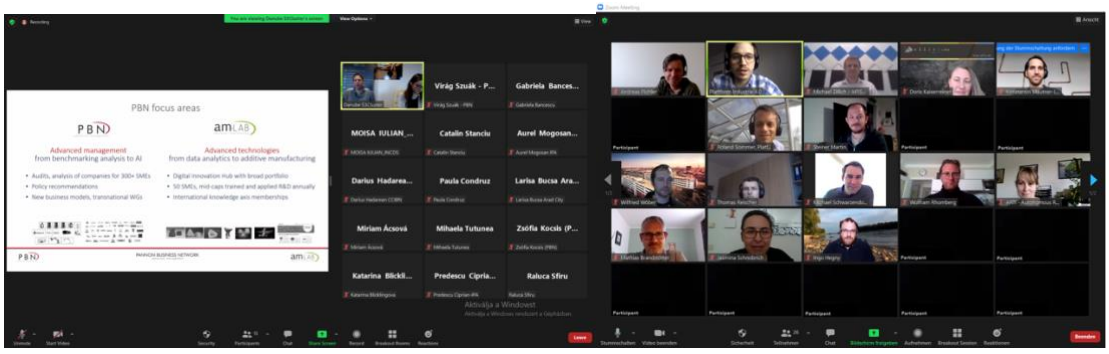

Figure 12 - PIA Online Attendance

(Source: PIA, CEUP2030, 2021)

3.3. Methodologies used

Within the TTTDM structure, partners were expected to build in a co-creation atmosphere to ensure that foresight was appropriately gathered from the attending experts, and feedback could be ensured from the remaining participants. Due to the COVID-19 Pandemic, the sessions were held entirely virtually, which was a challenge sighted by many of the Partners. In Figure 13, an overview of the methodologies utilised in the TTTDMs is provided.

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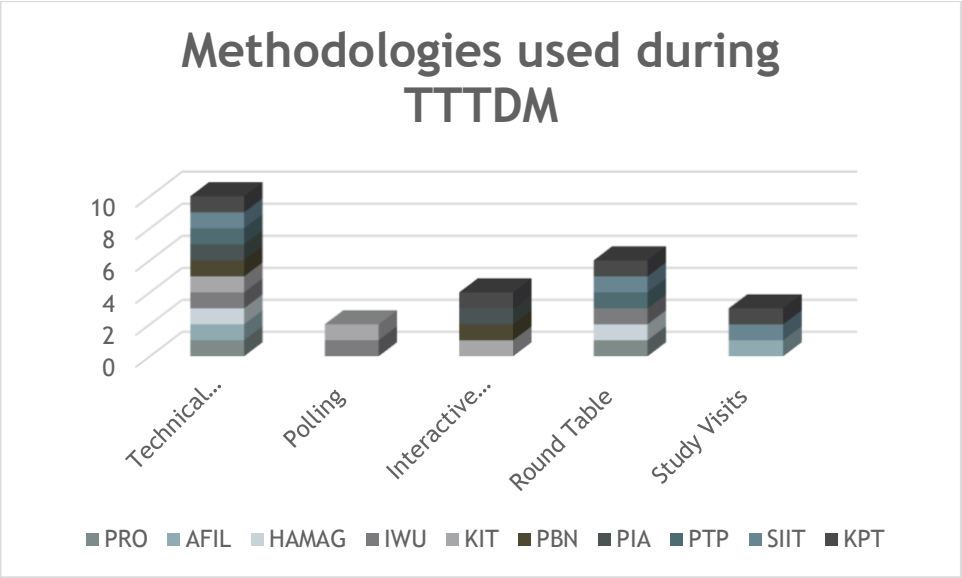

Figure 13 - Methodologies used (Source: Author generated from A&R TTTDM reporting, CEUP2030, 2021)

Table 5. Methodologies used (Source: Author generated from A&R TTTDM reporting, CEUP2030, 2021)

Expert Presentation	Polling	Interactive discussions/ Q&A sessions	Round Table	Study Visits
10	2	4	6	3

First a session of introduction enabled all the stakeholders to understand the context of the project CEUP2030, of the ecosystem and the framework of the TTTDMs. A special reference to A&R topic was presented. During this initial phase, PPs clarified the scope of the meeting to the participants and explained the structure of the event and the expected outcomes of each session. Furthermore, if the following technical discussion was sufficiently strong and focused, the introduction has been used also to provide a regional perspective on the current expertise and capabilities of attending stakeholders.

Therefore, the introduction through presentations increased the awareness of participants on the specific topic of Automation and Robotics (A&R) and providing common understanding on the terminology of the concepts used. PPs had the responsibility to provide not only a clear vision of CEUP2030 project in terms of objectives, tasks and expected outcomes but also to define a strong base in term on terminology understanding to facilitate further exchanges. It was even more relevant for this topic as the understanding can vary a lot depending on the territories and sectors.

The introduction was then followed by a technical panel. PPs had to find interesting and relevant experts on the topic to showcase their progress and to provide an overview of the current context of A&R. During this time, talking experts:

- Provided an overview of the ecosystem on A&R at different levels (regional, national and European) providing insights on their progress and main challenges that need to be overcome.
- Demonstrate what are the future trends and challenges. The objective of this part was to convince the audience of the usefulness and cruciality of fostering this topic as it increases efficiency and productivity especially for businesses.

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- Share Best Practices and showcase initiatives to illustrate on the ongoing proposed solutions and experiments in the field of A&R. Sharing these best practices enabled participants to see how to overcome or cope with challenges. For instance, one of the challenges raised was about the necessity to raise awareness on the benefits of Industry 4.0 in general and more specifically on A&R especially for SMEs.

Therefore, the expert panel aimed at increasing the audience's knowledge on the specific topic of A&R. The audience was indeed able to hear from specialists and experts on the field from different perspectives as the PPs had to invite different types of stakeholders to talk. In order to have a fruitful and efficient session, presentations should have included different perspectives, both technical providers and end-users, and should have been strongly linked to industrial ecosystem giving concreteness to the topic.

Real application examples and risk analysis have been showed through experts' presentations but also through study visits. The study visits, when possible, highlighted the current trends in A&R and enabled the participants to understand the relevancy of fostering the topic of A&R.

Finally, interactive discussion sessions or Q&A Sessions were held at the end of the TTTDMs for two main reasons:

- Asking the relevant questions raised by the qualitative presentations given by the experts
- Facilitate the creation and strengthening of a network around the topic of A&R.

Therefore, the TTTDM promoted the cooperation between all participants despite their type (Policy Makers, Businesses, Higher Education and Research Centres, BSO…) or their country of origin. The overall objective was to enhance synergies between the audience, and to align not only knowledge and understanding but also needs and interests in the topic of A&R.

3.4. Reporting

In order to build on the outcomes of TTTDM and to generate useful insights for the projects, a detailed reporting of the meetings had to be elaborated by each partner. **Therefore, each PP had to create a report of each TTTDM including the following aspects**:

- List and description of attending stakeholders
- Description of the TTTDM including methodologies used
- Summary of the outcomes and key achievements
- Key lessons learned
    - *For stakeholders: potential collaboration on strategic topics, priorities-gap-barriers for technologies development and updates*
    - *For PP: improvements for upcoming TTTDM, recommendations to be highlighted for RIS3 Round Table in WPT3, potential flagship projects to be developed*

Besides reporting requirements, communication is another important and strategic task to be implemented in CEUP2030. Therefore, PPs were recommended to collect as many contents as possible from the workshops (i.e. pictures, video content-if feasible-, meeting notes, flipcharts and presentations). Thanks to this materials, relevant contents for CEUP2030 communications have been elaborated and disseminated through the project

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communication channels. In particular, while during the event social media posts can be exploited to share real-time updates on TTTDM, reports and other media contents can be included in dedicated articles that can be published after the meetings.

3.5. Results analysis

To build this report, 10 events (TTTDM) on A&R were studied (1 per partner). First, information was collected in the templates that can be found in the Annex. Then the data was compiled in an Excel sheet to compare and codify the collected results. A first analysis of the answers towards the held TTTDMs was elaborated. Every question has been treated independently and an overall conclusion has been made at the end.

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4. Results

4.1. Overview of the TTTDM

This section reports on a specific summary of the key results each partner was able to discern from the TTTDM they organized. Below is a table resuming the TTTDM on A&R that were held by the partners in 2021.

Table 6. Summary of the A&R TTTDM (Source: Author generated, CEUP2030, 2021)

PPs	TTTDM A&R	TIN Role	Total No. Participants	Summary of the event
PRO	10-11th June 2021	Lead	45	Objective: Enable young researchers to present their work in the topic of Automation & Robotics especially on sensors technologies. Methodology: Introduction, Experts Presentations & Round Tables Speakers: TU Wien, TU Graz, Innsbruck University, AAU Klagenfurt, FH Kärnten, GMAR, FH Technikum Wien.
KPT	23rd September 2021	Core	129	Objective: Bringing together representatives of technology suppliers and receivers to initiate business discussions. Methodology: Moderated discussion, presentation of the start-ups, award ceremony, study visit. Speakers: KPT, ASTOR
KIT	27th July 2021	Core	26	Objective: Promoting new topics of Automation and Robotics in manufacturing such as collaborative robotics. Methodology: Expert presentation, polling, interactive discussions. Speakers: KIT, Franka Emika GmbH – The Robotics Company, Project Management Agency Karlsruhe.
SIIT	18th March 2021	Core	70	Objective: Raise awareness on three main topics: Industry and automation, security, logistic with the intervention of the triple helix to create a connecting line showing what are the need, how to face them and what has been done. Methodology: Introduction, Technical round tables, virtual visit of SIIT robotic labs. Speakers: SIIT, UNIGE, Liguria Region, Confindustria, FILSE, National Clusters

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PBN	18th November 2021	Core	32	Objective: Foster future cooperation on A&R topic through a TTTDM in English to reach a broader audience. Methodology: Introduction, thematic sessions, Q&A sessions Speakers: PBN, am-LAB
AFIL	14th July 2021	Core	53	Objective: Collect the interest and needs of industrial stakeholders on A&R technologies and create a contact point among the triple helix representatives. Methodology: Visit to the technological areas of MADE Competence Centre, Experts' presentation, Speakers: MADE, AFIL, Lombardy Region, DIH Confindustria, Politecnico di Milano, Cluster LE2C, Di Pavia University, Fluid-o-Tech, STMicroelectronics, Sistema Moda Italia, Ori Martin, Tenova, Tenaris, Tecnoalimenti
PIA	18th May 2021	Learner	35	Objective: Showcase different initiatives, businesses and approaches on A&R technologies and create connections between participants and speakers. Methodology: Presentation, Q&A, short discussions about needs and policy instruments Speakers: Profactor, Jonneum Research Institut for Robotic and Mechatronics, Automous Robot Technology GmbH, Blue Danube Robotics GmbH
IWU	30th September 2021	Learner	20	Objective: Showcase the potentials of human-oriented robotics in the future and initial approaches for the realisation of safe and at the same time powerful robots. Methodology: Presentations, Round Table discussion and exchange, Interactive tools Speakers: IWU, medical sector
PTP	22nd July 2021	Learner	14	Objective: Discuss what companies in the field of A&R can expect in the future European directive. Methodology: Presentations and discussion Speakers: PTP, Public Administration, Businesses, Research Centres.

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HAMAG	7th October 2021	Learner	25	Objective: Exchange best practices and highlight challenges in the A&R in Croatia as well as its impact on the national economy and science. Methodology: Technical panel, Round Table Speakers: HAMAG, INETEC, Gideon Brothers, Laboratory for Robotics and Intelligent Control Systems, University of Zagreb, Ministry of regional development and European funds.

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4.1.1. Technologies and Applications discussed

Each partners talked more precisely about specific topics included in Automation & Robotics.

The partners discussed specific topics they decided to foster inside the topics of A&R. These specific topics are gathered in the following table:

Partners' Name	Topics addressed
PRO	• An augmented reality user interface for operating a mobile robot in analogue planetary research • Heteromatic Robots on Mars: Ethics of going Outer Space - Networking Hybrid Performances within Heterotopias. Building a Research Case • Control algorithm of a Mobile Robot Based on the Principal Component Analysis • Distributed Collaborative State Estimation: Joint Observations for Reliable Autonomous Navigation in Swarms • A dynamic sensor interpreter for robotic systems • A Review of 3D Representations Robustness to Real-World Noise • In Situ Calibration Method for Robot Mounted, Total Force/Torque Sensors • Object Placement in a Unknown Environment as Part of a Pick-and-Place Pipeline • Open Loop Robot Control using Deep Q- Learning • Machine-made Coil Winding with a Collaborative Industrial Robot • Proficiency Testing for Contact Force Evaluation in Collaborative Robot Systems
KPT	• Polish investment zone • Digital transformation • Integration of Start-ups and SMEs • Industry 4.0
KIT	• Collaborative Robotics • Innovative, versatile production of the future • User-centered robotics
SIIT	Automation and Industry 4.0 • Robotic • Artificial intelligence • IoT

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	ICT and monitoring: • Machine learning • Digitalization • Smart grids • Digital communities Logistic and transport • Mobility planning • Smart process • Data analysis
PBN	3D technologies: • Product development and prototyping • Business animation creation IoT • 3D scanning, 3D printing and reverse engineering Extended Reality • Real-time display of manufacturing data series on the shopfloor • AR gamification application development • AR applications supporting machine maintenance and component visualization • AR content applications for printed materials Robotics: • Design and manufacture tailor-made grippers and accessories to collaborative robot workflows using 3D technology • Integration of various branded robots into a single operational management platform • Industrial, collaborative and mobile robot coordination and complex task development • Support in application of robots into conventional production lines
AFIL	• Digital backbone • AI • Hybrid Cloud • 5G • Collaborative robotics • Intelligent worker assistance systems • Digital twin

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	• Virtual commissioning • Lean 4.0 • Quality 4.0 • Product traceability • IoT • Industrial cyber security • Smart monitoring & control • Smart maintenance • Logistics 4.0
PIA	• Importance of robotics for Austrian science and industry/ Robotics innovations from Austria • Mobile robotic systems • Outdoor printing robot • Robotics in conjunction with AI • Teaching robots intelligent skills with the help of software • Challenges of using robots outdoors • Risk Management
IWU	• Medical sector • Service robots
PTP	• Digital transition • Incentives for starting a business • Cross-border integration • Internationalization of companies
HAMAG	• 3D technologies in robotics • Robotics applied in agriculture, warehouses and logistics, nuclear plants, power plants and electrical distribution

When analysing the 10 TTTDMs, there were clusters of technological topics which emerged as the key focus of the expert speakers who were presenting. This provided us insights into the key issues faced by the TIN Automation and Robotics, and also a deeper understanding that many experts do not see a single technology-future, mainly a series of tools which can be used jointly to solve foreseen challenges.

5 sub-topics have been defined for A&R:

- **Robotic and Assistive Systems** which refers to the support of human beings in a volatile, richly varied and highly flexible production.

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- **Machine Vision - Zero Defect Manufacturing for Automation** which refers to hindering defective parts during the processes through quality controls.
- **Augmented and virtual reality, visualization** which refers to Systems with higher-value perception and assistance options, Smart devices and tools and Collaborating robots.
- **Simulation and Modelling, Flexible Production Systems** which refers to the design and engineering of software for decentralized and distributed socio-technical production systems.
- **Robots for non-Industrial Applications, Man machine collaboration** which refers to non-industrial Applications such as agriculture or medical robots have a high potential to transfer industrial solutions into other domains.

In Figure 14, we can see the sub-topics mentioned by each partner's TTTDM.

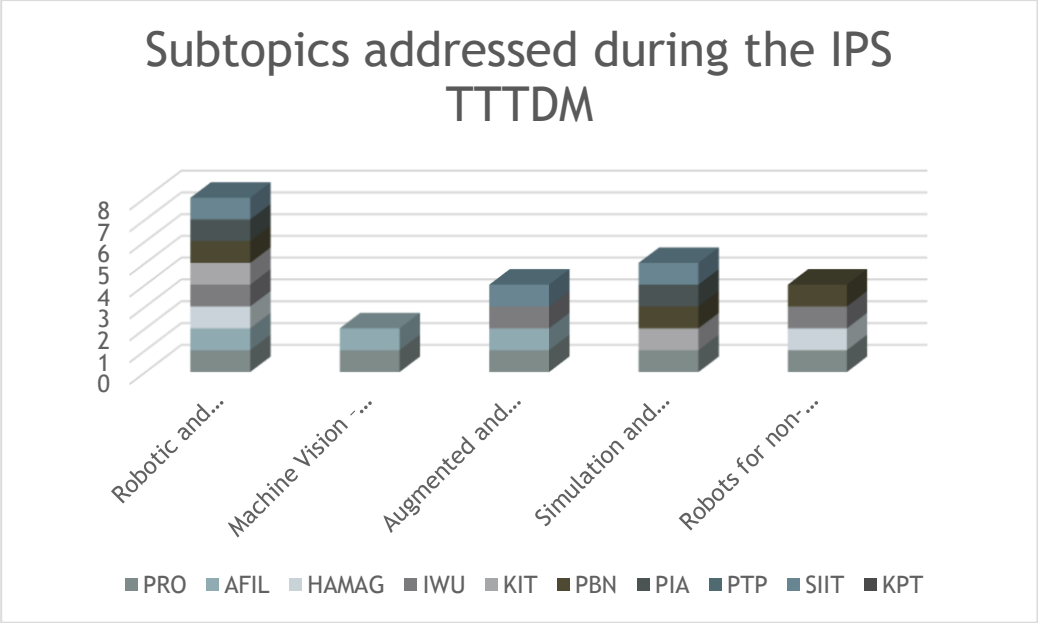

Figure 14 - Topics mentioned during the TTTDM (Source: Author generated from A&R TTTDM reporting, CEUP2030, 2021)

*this graph miss the information from KPT and PTP (more information need to be delivered to be able to identify the sub-topics addressed during the TTTDM: ppt presentation or details about the presentations delivered and topics discussed)

Table 7. Topics mentioned during the TTTDM (Source: Author generated from A&R TTTDM reporting, CEUP2030, 2021)

Robotic and Assistive Systems	Machine Vision - Zero Defect Manufacturing for Automation	Augmented and virtual reality, visualization	Simulation and Modelling, Flexible Production Systems	Robots for non-Industrial Applications, Man machine collaboration
8	2	4	5	4

To understand the context of these finding, here is a table gathering the main insights from the agendas of the TTTDM held on A&R:

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Table 8. Topics addressed during A&R TTTDM (Source: Agenda from A&R TTTDM, CEUP2030, 2021)

Name of the Partner	Topics addressed through presentations from experts
PRO	"An augmented reality user interface for operating a mobile robot in analog planetary research" "Heteromatic Robots on Mars: Ethics of going Outer Space - Networking Hybrid Performances within Heterotopias. Building a Research Case" "Control algorithm of a Mobile Robot Based on the Principal Component Analysis" "Distributed Collaborative State Estimation: Joint Observations for Reliable Autonomous Navigation in Swarms" "Multi-Sensor Fusion for Resilient State Estimation" "A dynamic sensor interpreter for robotic systems" "A Review of 3D Representations Robustness to Real-World Noise " "How does the type of exploration-noise affect returns and exploration on Reinforcement Learning benchmarks?" "In Situ Calibration Method for Robot Mounted, Total Force/Torque Sensors" "Collision Avoidance in Human-Robot-Collaboration Environments" "Modular Functionality Upgrade Analysis of a Search and Rescue Robot" "Myopic Approaches for a Real World Palletizing Problem" "Canonical Robot Command Language Plugin Framework" "Monocular vision based 3D pose estimation for enhanced cyclist safety" "Machine learning guided geometric analysis and pose estimation" "Robots in Intelligent Transportation Systems " "Object Placement in a Unknown Environment as Part of a Pick-and-Place Pipeline " "Open Loop Robot Control using Deep Q-Learning " "Machine-made Coil Winding with a Collaborative Industrial Robot "Proficiency Testing for Contact Force Evaluation in Collaborative Robot Systems " "A Web-based Simulation and Programming Environment of Industrial Robots for Education" "Semantic and structural analysis of road-side guardrails from color and stereo depth data"

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	“Evaluation of educational robotics activities with online simulations” “Drive Model Estimation Using Visual Odometry for the Autonomization of Remote Controlled Vehicles” Model-Based Identification of Mechanical Hazards in Human-Robot Collaboration”
KPT	Digital transformation - how is it? KPT ScaleUp Demo Day - presentation of startups participating in the sixth edition of the KPT ScaleUP acceleration program
KIT	“A vision for innovative, versatile production of the future” “User-centered design and development of high performance Robotics technology” “Manufacturing in the Horizon Europe Work Programme ,Digital, Industry and Space”
SIIT	“Road Map Next Generation Liguria (the support of the territory)” “National Network of the Clusters (the National references)” “Virtual Visit Laboratories 3 IR SIIT (the coworking laboratories)”
PBN	“Hungarian DIH (am-LAB) » 3D printing” “CGI animation” “3D scanning” “AR technology” “Robotics solutions”
AFIL	“Lombardy Region's policies and initiatives on advanced manufacturing issues” “The Circular Economy Roadmap of Lombardy Region” “The DIH and the proposal of the Lombardy ecosystem for a "European DIH" manufacturing” “Towards AI-based Predictive Maintenance practice” “Batteries for electric vehicles” “Smart Components” “Scrap Park 4.0” “Smart plastics and composites” “Secure and Sustainable Food Manufacturing”
PIA	“Who is Who: cross-section of Austrian applied research and industry-related development in robotics.”

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	"Current topics: Which topics are currently relevant for industry, who are potential partners and in which areas are they active?" "Industry-relevant projects in Austria and activities of GMAR members." "Software development in the field of robotics - AI-based solutions are offered for autonomous transport robots in the industrial sector." "Guard-fence-less robotics as a measure to increase productivity for the industry" "Dealing with safety and certifications in human & robot collaboration."
IWU	"Human-oriented robotics - A still invisible market"
PTP	"Digital transition" "Incentives for Start-ups" "Cross-border networking between domestic innovative/technological companies and foreign corporations and investors" "Internationalisation of enterprises" "Second chance for entrepreneurs"
HAMAG	"Development and application of complex robotic systems for material monitoring" "AI & 3D vision powered industry 4.0" "Review of current research of the Laboratory for Robotics and Intelligent Control Systems"

Therefore, we can see that the 4 sub-topics were highly discussed with some added topics pulled out from the other CAMI 4.0 Topics such as AI and Smart Materials through 3D printing.

Moreover, Partners within the TIN A&R defined specific objectives they wanted to foster during the implementation of their TTTDM:

1. Training for Stakeholder Knowledge & Upskilling which refers to promoting training on the topic of robotics and assistive systems, generally for stakeholders who lack knowledge & access to information about these technologies (leveraging the infrastructure and expertise of each stakeholder and the transnational network)
2. Technology Network Connection for Enhanced Future Foresight which means leveraging existing technology networks to promote discussion and future foresight on technology topics
3. Research and Development on the identified sub-topics which was defined as promoting research & future foresight on the topic of human- robot collaboration and assistive systems in industrial environments (other technical research projects also feasible depending on connected interests)
4. Technology Transfer to Non- Industrial Applications which refers to promoting transfer of robotics and automation knowledge to non- industrial applications
5. Pilot Actions for Infrastructure and Knowledge sharing which means generating pilot actions and coordinated use cases which promote infrastructure and knowledge sharing)

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All of these objectives were therefore pursued during the 10 TTTDM on A&R. The first objective: "Training for Stakeholder Knowledge & Upskilling" was well addressed during the TTTDM and especially during the study visits that were held physically and remotely. The experience developed by SIIT showcased the adaptation of Partners towards the pandemic as they organized a study visit even though the TTTDM was held online. They had to find solutions to foster the understanding of the infrastructure and to showcase the training opportunities available. Therefore, study visits were really relevant to provide opportunities on the potential of all the territories on developing solutions including A&R technologies. Also, plenary sessions enabled the partners to talk about this objective as PRO did during the presentation on "Evaluation of educational robotics activities with online simulations".

Regarding the second technical objective: "Technology Network Connection for Enhanced Future Foresight", the TTTDM organized by HAMAG can be mentioned as they implemented a Round Table after their technical panel which included stakeholders from all the triple helix (2 SMEs, 1 University and 1 Policymaker) to showcase the different connections between all the types of stakeholders and emphasize the following need:

- All the stakeholders have a crucial role to play in the development of the ecosystem in A&R to foster territorial competitiveness; and
- Understanding and defining everyone's role should facilitate future cooperation and foster the development and implementation of A&R technologies.

The third objective: "Research and Development on the identified sub-topics" was well addressed by PRO, IWU and PIA as they addressed the cooperation between Robots and Human. The TTTDM held by IWU was particularly interesting as they focused on the use of A&R technologies in the medical sector where the robots enable less errors on well planned situation but need the cooperation with human as every situation is different in the medical sector, adaptation is key, and the question of life is at stake. It is therefore very interesting to question the place of the robots regarding humans as it can improve the quality and efficiency of some processes but should always be thought as a coded machine for which it can hard to face unexpected situation. It would be interesting to look at this cooperation in a lot of different sectors, and develop these principles further in relation to Industry 5.0.

The fourth objective "Technology Transfer to Non- Industrial Applications" was well addressed by HAMAG which talked about the use of Robots in the field of agriculture, and as already described, by IWU who discussed the relevancy of A&R for the medical sector.

Finally, the last technical objective addressed, "'Pilot Actions for Infrastructure and Knowledge sharing", was well addressed by all the partners during the Technical Panels and the Round Tables. Indeed, all the partners invited speakers to talk about their view on A&R and to identify the current needs and challenges in the field of A&R. This session was mainly followed by a Round Table which enabled the speakers and the audience to engage the discussion on how to face these challenges and raise awareness on best practices and solutions.

Below in Figure 15 to 16, you can see some examples of such subjects which were discussed presentations and exchanges:

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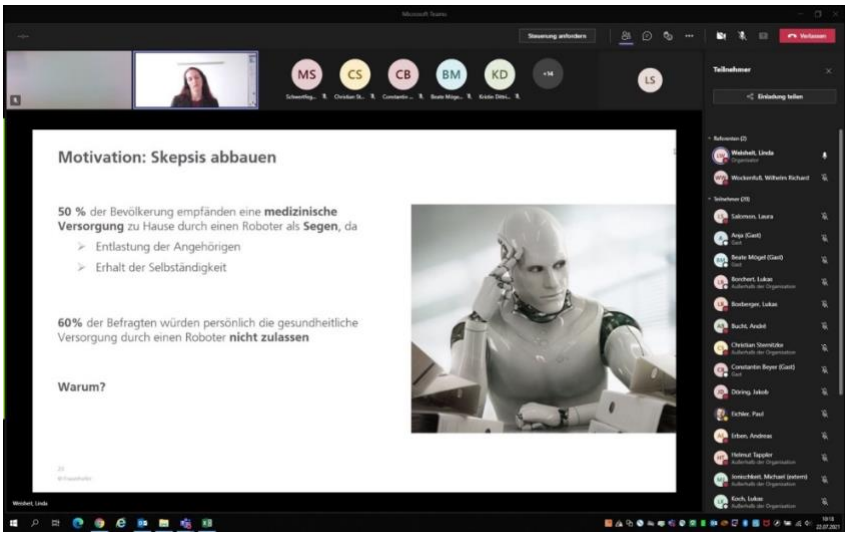

Figure 15 - Presentation from IWU (Source: IWU, CEUP2030, 2021)

Figure 16 - Presentation from PBN (Source: PBN, CEUP2030, 2021)

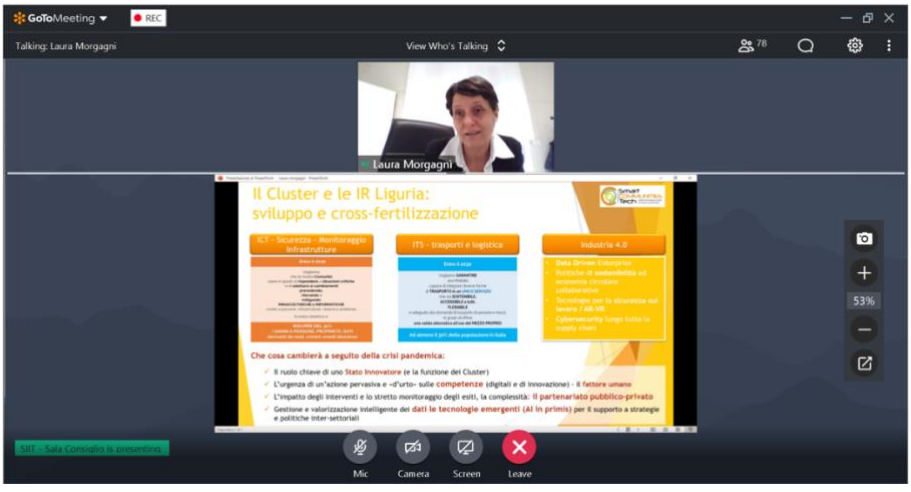

Figure 17 - Presentation from SIIT (Source: SIIT, CEUP2030, 2021)

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Figure 18 – Study Visit from AFIL (Source: AFIL, CEUP2030, 2021)

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4.1.2. Key Outcomes of the TTTDMs on Automation & Robotics

Robotics is considered a key technology for Industry 4.0. For many regions it is now a priority. such as for the Malopolska region (presented during the TTTDM held by KPT). An excellent ecosystem regarding the topic of A&R was presented during the 10 TTTDM. Indeed, PRO and HAMAG highlighted the great resources especially in terms of researchers and students in A&R available in the region. Therefore, these TTTDM raised awareness of current regional competences mainly targeting industrial stakeholders and SMEs. HAMAG also showcased excellent collaboration and initiatives between SMEs and universities.

Half of the TTTDMs were held online (IWU, KIT, PBN, PIA, SIIT) and half physically (PRO, AFIL, HAMAG, PTP, KPT). The online events highlighted their capacity to reach stakeholders from outside the region and from different sectors. However, in terms of number of participants, the physical events didn't seem to be harder to join compared to the online ones. To illustrate this statement, in average, physical events had an average of 53 participants while online events had an average of 37 participants.

The first main outcomes from the 10 TTTDMs held on A&R lies in the great connection created between different types of stakeholders to foster cooperation and enhance the ecosystem of this topic in Central Europe. Indeed, these TTTDM represented a great opportunity for all types of stakeholders associated to the topic to engage conversation and foster future cooperation. The speakers had the chance to share their experience and highlight their current vision on the topic and the TTTDM brought together representatives of technology suppliers and receivers which enable them to exchange.

Second, TTTDM raised awareness on needs and challenges identified by all the stakeholders on the topic of A&R. Here is a short list of the primary aspects raised on this subject

- Differences between territories and types of organization (especially between large enterprises and SMEs) in terms of development of A&R have been identified which makes it harder for Policymakers to define support initiatives and especially funding as the needs are different
- Service providers need to develop qualitative services
- Robotics demands an excellent logistic network and supply. Unlike in software or in AI industry, in robotics production, robot transport is essential or 'must have' prerequisite. HAMAG noticed that logistic is very expensive and therefore they ask governments to support through funding and investments.
- Some countries such as Croatia experience brain drain. Therefore, HAMAG through its TTTDM asked governments to develop strategies and incentives to keep talents inside the country.
- Capacities to answer European calls should be fostered through cooperation with successful organization and exchange of knowledge and best practices.
- Administrative barriers for the implementation of European projects should be addressed to encourage all types of stakeholders and especially Businesses including SMEs to respond to open calls issued by the European Commission.
- Encourage Businesses and especially SMEs to engage projects on the topic of A&R. In this objective, further initiatives should focus on showcasing the benefits it can bring to Businesses and especially to SMEs.

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- Emphasize the impact of public funding strengthen by a tight monitoring of the results.

The main challenge that was raised by multiple partners was the need to increase adjusted support initiatives from Policymakers and increase their interest on the specific topic of A&R.

Third, the study visits organized by a few partners, online or physically fostered the building of trust, and enabled the audience to experience the capacities of this topic. It showcased the benefits of investing in this topic through local and inter-regional collaborations. Therefore, the TTTDM held by AFIL raised the need of further investments both public and private in the topic of Automation and Robotics.

Regarding the content, three special interests were raised:

- The use of Artificial Intelligence in the field of Automation and Robotics
- The development of collaborative Robotics
- The use and capacities offered by 3D Printing.

These topics are interesting to mention as two of them are crossing other CAMI 4.0 Topic: AI and Smart & Advanced Materials and should be fostered in both TIN groups.

Finally, it is crucial to foster this type of event to keep all the stakeholders informed and to foster the network on the topic of A&R. In this objective, DIHs and clusters should be included and could even play a role in the diffusion of the information and make sure the network stay connected. Also, thanks to discussions during the TTTDM, new small groups, based on preferences and interests, can be created to engage conversation on cooperation and new project proposals to be submitted. Therefore, enhancing and replicating this type of event is crucial to bring together and connect stakeholders which are working in similar field. They also enable conversations with Policymakers and foster common understanding on the needs and challenges in the field of A&R.

Table 9. Main outcomes (Source: Author generated from A&R TTTDM reporting, CEUP2030, 2021)

OUTCOMES	BENEFITS
Identification of regional expertise and competences	Thanks to multiple presentations and experts talks, speakers were not only able to present their innovation and challenges but also to connect to specific stakeholders which whom they can create common projects and submit projects proposals. It was also a great opportunity for the full audience to build a common understanding of the topic and understand the current ecosystem: its needs, challenges, current and future trends.
Foster a common understanding on A&R between regions and territories in Central Europe	As seen earlier, one of the biggest challenge lies in the fact that needs and challenges are different between territories and countries. As CEUP2030 represent 7 countries, it is therefore very relevant to foster common projects and initiatives aimed at enhancing knowledge sharing in the topic of A&R. The overall objective is to create a harmonized ecosystem with a common understanding of the topic Automation & Robotics. Creating a common ecosystem should enable the partners to have a broader network with common needs and challenges and therefore to enhance cooperation to find solutions to these challenges.

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Raise awareness on the benefits brought by fostering the A&R topic and especially targeting SMEs	One of the objectives of the TTTDM was to foster the understanding of the ecosystem. It includes SMEs which are sometimes more reluctant to change and therefore need more support to engage transformation and projects on Robotics. Therefore, expert's presentations and study visits were very much appreciated to showcase the potential cooperation. They should also be supported by Policymakers
Raise awareness on key challenges and needs	As seen above in the text, a few challenges have been identified in the topic of A&R. Indeed, not only the TTTDM raised awareness on the benefits of fostering the topic of Automation & Robotics and showcasing the already existing offers and innovation, the TTTDM were also aimed at raising awareness on key challenges and needs. Raising challenges enabled the speakers to express them and to talk with other speakers and with the audience to see how they could be faced. Highlighting these challenges also enabled the Policymakers and the Research Centres to understand the market needs and develop appropriate support initiatives or infrastructures.
Identify the special interests	5 subtopics for A&R have been identified (sorted out from the most discussed one to the less attractive one during the TTTDM): 1) Robotic and Assistive Systems; 2) Simulation and Modelling, Flexible Production Systems 3) Augmented and virtual reality, visualization; 4) Robots for non-Industrial Applications, Man machine collaboration; 5) Machine Vision – Zero Defect Manufacturing for Automation. Therefore, a special interest for Robotic and Assistive Systems have been identify with at least 8 partners inviting speakers on the sub-topic. Moreover, specific interests inside the subtopics have been identified and could be fostered through future initiatives: 1) The use of Artificial Intelligence in the field of Automation and Robotics; 2) The development of collaborative Robotics; 3)The use and capacities offered by 3D Printing.
Foster the network	These TTTDMs represent a strong opportunity to build and strengthen the networking and widening the audience and the participating members of these communities. Partners mentioned the effectiveness of this type of exchange and therefore acknowledged the need of regular conversations on specific topics such as A&R. It is even more relevant for A&R compared to other topics as the differences between regions and countries are considerable and therefore exchanges on best practices, initiatives and projects should be fostered to create a network working on the same definition of A&R.

4.1.3. Key Lessons Learned

The main lessons learnt are summarized below followed by two more detailed sections which showcase the strengths and weaknesses identified during the 10 TTTDM held on the topic of A&R from a methodological perspective and from a content point of view.

One of the most important lessons learned from these TTTDM is that Automation & Robotics, along with AI, has great potential in Central Europe. Therefore, cooperation between all types of stakeholders and especially among the triple helix should be fostered to coordinate efforts and facilitate the submission of common projects on the topic of A&R. Events such

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as the TTTDM are crucial to foster exchanges between stakeholders from the triple helix. All of them have an important role to play to enhance the development of the topic of A&R in Central Europe. Involving different types of stakeholders enable deeper and more fruitful conversation as they bring different insights and point of view to the discussion. A greater integration of the SMEs and the policymakers in particular, should be fostered.

Also, the place of the human being in the increasing importance of robotics in the industrial field has been discussed and should still represent a debate and a constant interrogation while the topic of A&R is developed.

Finally, industrial companies (Large enterprises, SMEs, Start-ups) require support to enhance the competitiveness of the ecosystem on the topic of A&R.

4.1.3.1. Methodology and Organization of the TTTDMs

To build upon these 10 workshops, it is crucial to identify the strengths and weaknesses of the events. The table below summarizes these observations:

Table 10. Strengths & Weaknesses of the organization of TTTDM (Source: Author generated from A&R TTTDM reporting, CEUP2030, 2021)

Strengths	Weaknesses
• The physical events enabled the partners to build more trust thanks to face-to-face meetings and to showcase more easily experiments. • Study visits were hold both during physical and online TTTDM. The Study visits were a great way to showcase the support infrastructure available and the experiment developed in the field of A&R • Experts presentations enabled the speakers to present themselves to the ecosystem and to foster relevant connections in the objective to create cooperative projects. • TTTDM by enabling relevant connections between all types of stakeholders emphasized the creation of a common understanding on A&R topic and on the future strategy that needs to be developed. • The Triple Helix was well represented during the TTTDM especially the Businesses and Research centres • Q&A sessions and interactive discussions were implemented in at least 4 TTTDM and represented a great opportunity for the audience	• Online events didn't enable the partners to reach more stakeholders than physical ones as the average number of participants for physical events was higher than online ones. Partners should try to identify why. It can be explained by the fact that KPT hold a physical TTTDM with a lot more participants compared to the other partners. Also, communication and language of the TTTDM should be studied to see if it had an impact on the number of attendees. • Policy Makers should be more involved in future events. Some TTTDM didn't involve any of them which is problematic as it has been observed that they have to develop appropriate supporting initiatives targeting market needs. Therefore, Policymakers have to be aware of the needs and challenges faced by Industrial to be able to develop appropriate support opportunities • Q&A sessions and interactive discussions should be implemented in all the future events and especially in physical events as it fosters trust.

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to be more involved and engage conversation with the speakers. • Most of the TTTDM were hold in national languages which enables more SMEs to participate.	• Most of the TTTDM were hold in national language and not in English which hinders the participation of a broader audience.

4.1.3.2. Content of the TTTDMs

Table 11. Strengths & Weaknesses on TTTDM contents (Source: Author generated from A&R TTTDM reporting, CEUP2030, 2021)

Strengths	Weaknesses
• It is nowadays not possible to imagine modern production plants without robotic arms and therefore • The 5 subtopics were addressed in at least 2 TTTDM each. The most attractive one was Robotic and Assistive Systems followed by Simulation and Modelling, and then flexible production systems. • The TTTDM were very diverse in the topics addressed. For instance, IWU focused its TTTDM on Automation and Robotics in the medical sector. This diversity showcases the great opportunities offered by this topic and highlight why this topic should be fostered as it can be applied in a lot of different sectors and application. • A link between all the CAMI 4.0 topics has been defined as Robotics is linked to Smart Materials through printing technologies for instance, to Artificial Intelligence through human robots for instance, to Intelligent Production Systems through the use of Robots in manufacturing plants for instance.	• A lack of interest for Machine Vision – Zero Defect Manufacturing for Automation has been identified. • More Policymakers should be involved to develop appropriate supporting measures. • If it is necessary to highlight the current needs and challenges faced by the ecosystem and especially by firms, it is important that available support initiatives and especially funding opportunities are also shed in light. Problems needs to be presented as well as the solutions to them.

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5. Discussion and Recommendations

This section provides insights on how to build upon the TIN activities and events to foster cooperation. The A&R TTTDM events showcased the relevancy of communication to foster common understanding towards the subject of A&R, specifically, and at times, generally for Industry 4.0. The following graph showcase the main ideas to be fostered in future actions to enhance the changing process towards digitalization.

5.1. Key Takeaways regarding the TTTDMs

The figure below provides the 5 key takeaways identified thanks to the 10 TTTDM:

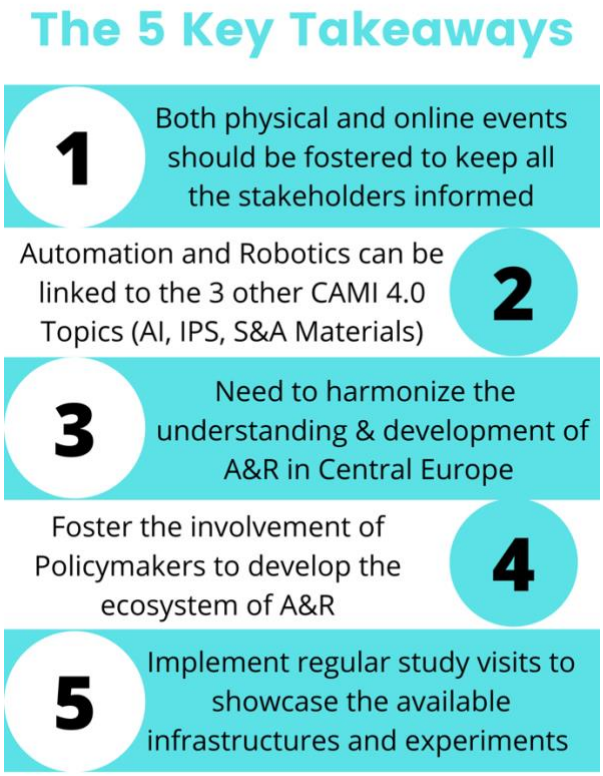

Figure 19 - 5 Key Takeaways (Source: Author generated from A&R TTTDM reporting, CEUP2030, 2021)

5.2. Connection to Flagships project

The A&R TTTDMs were also aimed at supporting the definition, development and submission of the A&R flagship projects. For each topic including A&R, a total of 5 flagship projects meaning 2 flagship projects per partner in 2 of the 4 CAMI4.0 topics was planned to be defined. PRO coordinated the activities within the partnership and it was anticipated that the TIN leader together with the identified core partners AFIL, HAMAG, IWU, KIT & PBN will be defining and submitting A&R flagship projects.

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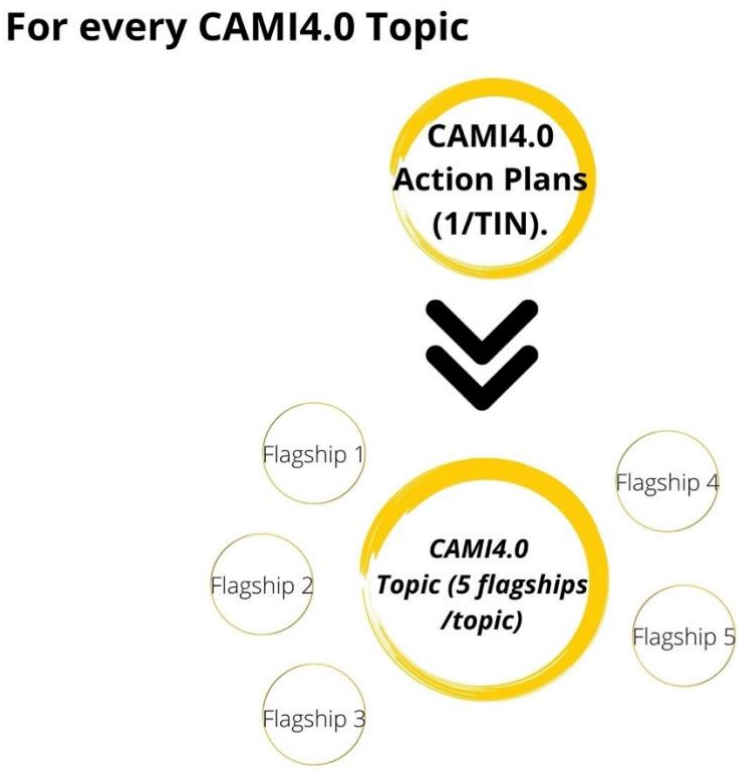

Figure 20 - Actions to deliver 5 Flagships project/ TIN (Source: DT3.3.1, CEUP2030, 2021)

The table below summarize the Flagship/ Use Case from Partners included in the TIN A&R:

Table 12. A&R Use Cases/ Flagships (Source: DT1.3.3, CEUP2030, 2020)

Partners' Name	Flagship/ Use-Case name	Short description	Policy Instrument
PRO	From Existing H2020 Projects to HEU Projects	HEU (Horizon Europe) is the research programme of the EU member states. The Work Programme 2021-2022, 7th Digital, Industry and Space lists the future topics concerning robotics, AI and automation.	Horizon Europe
AFIL	Innovation Days on Robotics and Automation	This use-case is focusing on raising awareness on key aspects and sub-topics related to Robotics and Automations among companies and their employees.	Private and Public Funding
HAMAG	Adriatic multifunctional smart buoys - INTERREG Italy - Croatia HUB	The aim is to fully recover Adriatic sea flora and fauna as well as to maintain clean and healthy environment necessary for the fishery	INTERREG Europe Italy-Croatia

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		and tourism thanks to underwater communication and aquatic robotics	
IWU	SmartTool.connect Phase 2	The main capability of the system is the smart tool holder, which recognizes the wear progress of the tool and predicts exactly the required set-up time for a new tool.	Institutional Financing via the Fraunhofer Cluster of Excellence Cognitive Internet Technologies.
KIT	Stable Connected and Collaborative Robotics	Development of a production cell of interlinked robotic teams that are able to collaborate and are force sensitive	Horizon Europe
PBN	Demo production line	A demo production line will be established at am-LAB (the digital innovation hub connected to PBN). It is a manufacturing unit with online, remote access to broaden the services related to SME-development; trainings; development of digital competencies.	Horizon Europe Program European Institute of Technology - Innovation Action calls Digital Europe Program - Digital skills development Interreg Europe Program, Interreg Central Europe Program, Danube Transnational Program Cross-border cooperation opportunities -

5.3. To build upon the Common Policy Use Case in A&R

The TTTDMs together with the definition & implementation of the flagship projects have provided the partners with great insights into how to build their Common Policy Use Case in A&R as shown in the figure below. Indeed, we observed a great common interest on Robotic as it can be linked to the other CAMI 4.0 topics. Most of the partners addressed at least one of the other CAMI4.0 topic in their TTTDM on A&R. It could therefore be interesting to link different CAMI4.0 topic to develop the Common Policy Use Case. An interesting outcome is however the lack of focus on Machine Vision – Zero Defect Manufacturing that could therefore be fostered through future actions. Finally, a very interesting outcome was the important disparities between territories in this topic and therefore future actions could also search to mitigate these differences by enhancing knowledge and technologies transfer between countries and territories.

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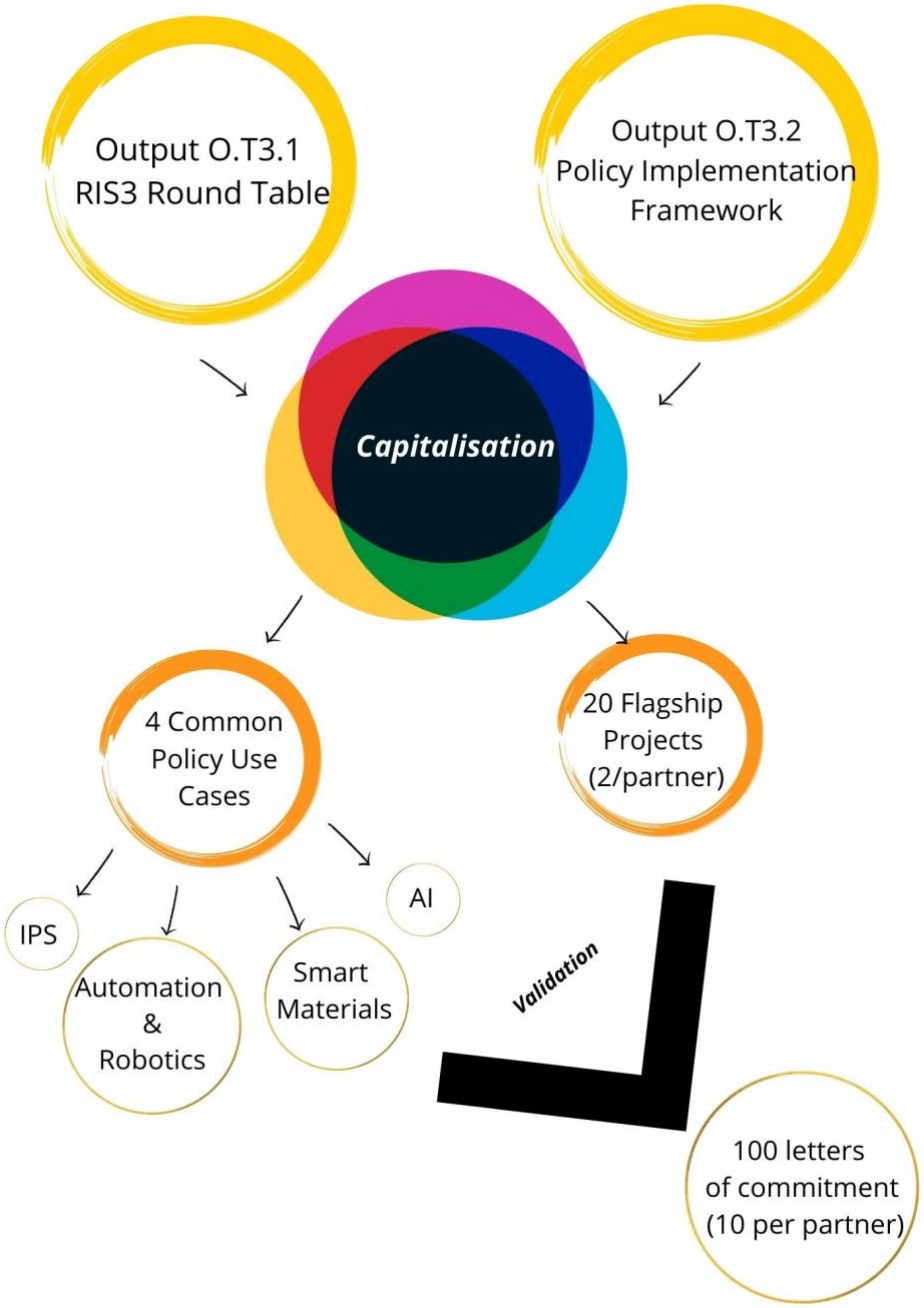

Figure 21 - Overview of WPT3 (Source: DT.3.3.1, CEUP2030, 2021)

To build the Common Policy Use Case as part of WPT3 activities, not only should the members of the A&R TIN look at the TTTDM results and other flagships but also acknowledge each other resources and capabilities. These resources and competencies have been summarized in the table below:

Table 13. A&R TIN Strengths & Resources (Source: DT1.3.3, CEUP2030, 2020)

Partner Name	Resources and Capabilities for A&R	Strengths and Competencies for A&R
PRO	• Robotic Lab • 3d printing Lab using robots	• Human Robot collaboration • Physical assistance using robots

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	• Various robots and test facilities • DIH for robotics	• X ROB – Robot programming without deeper knowledge • Implementation of Robotics into Factories
AFIL	• Awareness creation and innovation scouting: organization of meetings and events in the field of Automation & Robotics, mainly thematic workshops for increasing awareness on the topics involving key players of the network. • Support in project ideas generation and funding opportunity monitoring: e.g., SMART4CPPS Project (dealing with Cyber Physical Systems in Production) has been created within an AFIL working Group, supported by regional funding. • Road mapping: identification of stakeholders needs and priorities in the field of Automation & Robotics. • Regional and Interregional ecosystem Building and networking on the topic. • Facilitate access and connection with innovation infrastructures, mainly from core players in the AFIL network, both industrials and academia	• Wide consolidated network. In particular, many AFIL members are leaders in Automation and Robotics field, both from the industrial side (e.g., ABB, Smart Robots, Scaglia Indeva, Cosberg) as well as from the academia (e.g., Politecnico of Milan, STIIMA- CNR, University of Bergamo, University of Brescia). • In addition, AFIL has many links with interregional partners and initiatives dealing with Automation & Robotics, at a national and European levels (e.g., Vanguard Initiative, ADMA Initiative, S3Platforms, I4MS). • AFIL has been involved in some projects (Interregional and regional) addressing Automation & Robotics solutions, where its main goal was focused on disseminating the developed solutions. In particular: ○ BEinCPPS – Business Experiments in Cyber Physical Production Systems ○ SMART4CPPS – Smart Solutions for Cyber Physical Production Systems
HAMAG	• Connection with all the relevant stakeholders who are in charge of Automation & Robotics in Croatia as Faculty of Mechanical Engineering and Naval Architecture • Cooperation with successful SMEs • Regional ecosystem building and networking on the topic	• Transnational networks with partnering institutions - EEN partner
IWU	• E3-Research Factory for Resource Efficient Production containing among other things: ○ Sensitive robotics for complex assembly tasks ○ Human-robot interaction systems ○ Knowledge-based process control based on artificial intelligence	• In assembly engineering we react to the increasing number of variants by investigating novel and economically efficient technologies. One main research topic comprises the development of production systems with a high degree of flexibility and autonomy. In our research factory “Resource-Efficient Production” we

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	○ Flexible technologies for handling, fixtures and joining ○ Application-specific and cost optimized robot systems ○ Software for intelligent automation of planning and developing tasks, including their optimization ○ Bionic lightweight construction of joining systems	represent essential manufacturing stages of car body production. Furthermore, we thoroughly analyze complete solutions for future automotive applications and test them under realistic conditions of production.
KIT	• Multiple Industrial KUKA Robots in our printing labs • Multiple Franka Emika Collaborative Robots in our I4.0 3D Printing pilot line • Larger KIT infrastructures include numerous Industrial robots of various sizes	• Energy Efficient Robotic Path planning

PBN	• Available technologies for Robotics and autonomous systems at am-LAB: MiR 100 ; UR 3; Panda Robot
	• Available technologies for augmented and virtual reality, visualization: Microsoft Hololens; Microsoft Hololens 2
	• Available technologies for indoor logistic services with drone: DJI Mavic 2 Pro
		• 3D Modelling
		• Industrial robotic solutions and demonstration applications
		• Collaborative robotic solutions and demonstration applications, Human- Machine Interaction
		• Unique gripper and equipment development processes
		• Vision and sensor based robotic solutions and demonstration applications
		• Indoor logistic services with unique drone applications
		• AMR – Automated Logistic solutions and demonstration applications
		• Industrial Robotic applications
		• Extended reality:
		  • Mobile device applications IOS and Android
		  • Extended reality marketing applications
		  • Gamification
		  • Hololens 1 and Hololens 2 applications

Moreover, 5 specific sub-topics were pulled out in this topic A&R as mentioned in the Section Results:

- **Robotic and Assistive Systems** which refers to the support of human beings in a volatile, richly varied and highly flexible production.

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- **Machine Vision - Zero Defect Manufacturing for Automation** which refers to hindering defective parts during the processes through quality controls.
- **Augmented and virtual reality, visualization** which refers to Systems with higher-value perception and assistance options, Smart devices and tools and Collaborating robots.
- **Simulation and Modelling, Flexible Production Systems** which refers to the design and engineering of software for decentralized and distributed socio-technical production systems.
- **Robots for non-Industrial Applications, Man machine collaboration** which refers to non-industrial Applications such as agriculture or medical robots have a high potential to transfer industrial solutions into other domains.

These subtopics should be fostered to define the Common Policy Use-Case including the strong interest for Additive Manufacturing based on hybrid process chains. Finally, the Common Policy Use Case should acknowledge the SWOT made regarding the A&R sector:

Table 14. SWOT on A&R CAMI 4.0 Topic (Source: DT1.3.2, CEUP2030, 2020)

Strengths	Weaknesses
1. Infrastructure availability across the PP region; 2. Partner's network of robotics & automation stakeholders is extensive (lots of ability to influence through other stakeholders); 3. Strong technical PPs in the group & a keen interest in the topic area's future development; 4. Extensive experience in EU projects & technical projects on robotics and automation;	1. Limited technical knowledge or experience on aspects of the technology (for some PPs); 2. Limited political power to influence policy instrument development; 3. Limited time in which to do the aforementioned influencing; 4. Human resource limitations (for some PPs).
Opportunities	**Threats**
1. KTP create a common structure and tailored financial instruments to support SMEs implement automation and robotics. 2. PRO technical research projects on AI human robotics systems and real time collaboration 3. PIA generating a network for infrastructure facility sharing 4. KIT technical research project on universal machines 5. AFIL create bespoke training and best practice sharing to promote cultural	1. Sustainability of the network; 2. Political changes (new responsible peoples within policy-influencing stakeholders of the project); 3. Delays of new subsidy programmes (caused by COVID 19, or other programming start delays).

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acceptance and uptake for robotics technologies 6. PTP applied research on pick & place robotics in the agricultural sector (cross-sector collaboration)	

All of this knowledge should enable the TIN A&R flagship group to define and implement their flagships projects and to define their Common Policy Use Case aimed at strengthening the Central Europe Ecosystem around A&R solutions.

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6. Conclusion and Next Steps

6.1. Conclusion

To conclude, this report showcases the added value brought by the implementation of the 10 TTTDM on the topic of A&R. Therefore, the purpose of this document was the reporting of the TTTDM in A&R aimed at creating and fostering a common understanding of the ecosystem in A&R solutions. Particularly, the TTTDMs organized by PPs have been detailed in terms of methodology, participating stakeholders, outcomes, and lesson learned.

In summary, 449 stakeholders from 7 countries were involved in expert workshops on Automation and Robotics. The workshops were held half online and half physically, and utilised plenary presentation, round-tables, and study visits to promote a co-creative atmosphere which allowed live discussion on the challenges and opportunities facing the central European manufacturing eco-system. The experts discussed issues on the future of A&R integrating all the stakeholders from the triple helix, including SMEs. The TTTDM's validated that the sub-topics chosen by the partnership are relevant for the future of Automation and Robotics.

6.2. Next Steps

Partners need first to acknowledge all the progress made on Automation and Robotics thanks to the experts' presentations and the study visits included in the TTTDM, the definition and submission of their flagships and the exchanges especially with the A&R TIN.

Partners should also consider the TIN objectives which were: (1) Training for Stakeholder Knowledge & Upskilling, (2) Technology Network Connection for Enhanced Future Foresight, (3) Research and Development on the identified sub-topics, (4) Technology Transfer to Non-Industrial Applications, and (5) Pilot Actions for Infrastructure and Knowledge sharing.

They now must engage in strong discussions within the TIN to commonly define their Common Policy Use Case. This Common Policy Use Case should emerge from common understanding of the needs and challenges raised during the TTTDM and the definition of the flagship projects. This common Policy Use Case should also have the role of strengthening the network around A&R solutions.

If your organisation is interested to collaborate with the TIN on Automation & Robotics, please contact the TIN Leader, PROFACTOR GmbH, to learn how to get involved. You can also contact the Lead Partner, Krakow Technology Park, and follow CEUP 2030 on its social media channels (LinkedIn) and its website, to learn more about what the other TINs are doing to advance Advanced Manufacturing and Industry 4.0 in Central Europe.

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7. Annex

TTTDM Reporting Template	
Name of the PP	Choose your PP Name
TTTDM Type (CAMI4.0 topic, regional/interregional), Date and Location	[Free Text Response]
Description of the TTTDM	[Free Text Response]
Methodologies applied in the TTTDM and description of the methodologies	[Free Text Response] 1) 2) 3) …
Which technologies and/or applications were discussed in the TTTDM?	
How many stakeholders participated in the TTTDM?	
Which Triple Helix stakeholder group did the participants belong to? (add number of participants)	___ policy ___ research ___ business ___ Supporting Organisations
Which EU project(s) was synergically involved in the TTTDM, if any?	

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Key Outcomes of the TTTDM and description	
Which lessons learned do you have as a project partner (a) and which lessons learned emerged for participants (b)?	
Hyperlink to picture and video content of the PLL	
General Summary of the TTTDM	

This project is co-financed by the European Regional Development Fund through Interreg Central Europe.

1.1. Reporting Template

TTTDM Reporting Template	
Name of the PP	PRO
TTTDM Type (CAMI4.0 topic, regional/interregional), Date and Location	CAMI4.0: Automation and Robotic Workshop 10.-11.06.2021, Haus der Ingenieure, ÖIAV Festsaal, Eschenbachgasse 9, 1010 Vienna
Description of the TTTDM	The Austrian Robotics Workshop 2021 was held on two days the 10th of June 2021 and the 11th of June 2021. Description of the 1st day: 1- Introduction of the Austrian Robotics Workshop 2021 given by Wilfried Kubinger (FH Technikum Wien). Furthermore, the importance of the Workshop and its main topics have been explained. The introduction was ended by a presentation of the "Democratization of Industrial Cobot Technology" by Sebastian Schlund (TU Wien) 2- After the introduction the first session of presentations about Mobile Robotics started. Topics such as augmented reality user interfaces, heteromatic robots and control algorithm of a mobile robots were discussed and presented. 3- After the lunch break a keynote by Stephan M. Weiss (AAU Klagenfurt) on "Multi-Sensor Fusion for Resilient State Estimation" was given. 4- After the keynote the second presentation session on sensor technology started. It covered topics such as dynamic sensors for robots, 3D representation robustness and calibration methods for robots. This session ended with an outlook given by Lisa-Marie Faller (FH Kärnten). 5- The last presentation session was focusing on student papers concerning the topics covered in the Austrian Robotics Workshop 2021

	6- After the last presentation an open discussion session with researchers, developers and company representatives where held focusing on the main topics but also on the Network format "Meeting High Potentials" 7- The closing speech of day 1 was done by Wilfried Kubinger (FH Technikum Wien) Description of the 2nd day: 1. Starting with a keynote given by Christina Olaverri-Monreal (JKU Linz) on "Robots in intelligent Transportation Systems" 2. After keynote the first session on Sensing & Industrial Robots started. It included presentations about object placement in a pick and place pipeline, open loop robot control, machine maide coil winding and proficiency testing. 3. After a short coffee break the second student paper presentation session stared. 4. Finalized was the event by the "Best paper awards and by a closing ceremony held by Wilfired Kubinger (FH Technikum Wien)
Methodologies applied in the TTTDM and description of the methodologies	The methodology for this event was planned to be as impactful as possible. The introduction highlighted the importance Robotics within the industries especially focused on sensor technology within robotic systems. Technical panels were held by presentations of current technology concerning Automatization and Robotic especially sensor technology. Various stakeholders gave presentations on this topic. The round tables were held in form of discussion about the topics covered in the presentations. This gave the possibility to all the stakeholders to engage and to raise opinions for further investigation.
Which technologies and/or applications were discussed in the TTTDM?	• An augmented reality user interface for operating a mobile robot in analog planetary research

	• Heteromatic Robots on Mars: Ethics of going Outer Space - Networking Hybrid Performances within Heterotopias. Building a Research Case • Control algorithm of a Mobile Robot Based on the Principal Component Analysis • Distributed Collaborative State Estimation: Joint Observations for Reliable Autonomous Navigation in Swarms • A dynamic sensor interpreter for robotic systems • A Review of 3D Representations Robustness to Real-World Noise • In Situ Calibration Method for Robot Mounted, Total Force/Torque Sensors • Object Placement in a Unknown Environment as Part of a Pick-and-Place Pipeline • Open Loop Robot Control using Deep Q-Learning • Machine-made Coil Winding with a Collaborative Industrial Robot • Proficiency Testing for Contact Force Evaluation in Collaborative Robot Systems
How many stakeholders participated in the TTTDM?	45
Which Triple Helix stakeholder group did the participants belong to? (add number of participants)	__1_ policy _44_ research ___ business ___ Supporting Organisations
Which EU project(s) was synergically involved in the TTTDM, if any?	CEUP2030
Key Outcomes of the TTTDM and description	The outcome were app. 10 high level talks from researchers (also from students) about Robotics

	and automation. So young students had the opportunity to learn how to present and how to organize scientific talks. Additional output were some videos about the key notes to address a broader community
Which lessons learned do you have as a project partner (a) and which lessons learned emerged for participants (b)?	a) Its important for young researchers to have such a possibility to present their work b) Its important for young researchers to present their work guided by experienced coaches
Hyperlink to picture and video content of the TTTDM	https://youtu.be/xT8ORO_8hrM
General Summary of the TTTDM	
The ARW takes place every year and for CEUP2030 it was a good opportunity to do their TTTDM here.	

1.1. Reporting Template

TTTDM Reporting Template	
Name of the PP	AFIL
TTTDM Type (CAMI4.0 topic, regional/interregional), Date and Location	CAMI4.0: Automation and Robotic, regional 14/07/2021 Made Competence Centre Industry 4.0, Milano
Description of the TTTDM	The event was organized in three main sessions: 1- A session reserved to associates where AFIL presented its activities, among which CEUP project. 2- A 1-hour tour of the 6 technological areas of MADE Competence Centre Industry 4.0, on collaborative robotics, smart systems, digital twins and automation, virtual design, traceability, etc. 3- An open session where AFIL presented the collaboration with Lombardy region on Advanced Manufacturing, its inter-regional activities (CEUP2030) and the arising local interests to build specific innovation communities.
Methodologies applied in the TTTDM and description of the methodologies	The most important part of the event was the visit to the technological areas of MADE Competence Centre. The active participation during the tour, the contact with the innovative developed solutions in terms of Robotics and Automation and the live demonstrations represented the key points of the TTTDM. This interactive approach ensured a significant involvement of participants, increasing their interests and stimulating the direct interaction with researchers and experts. The physical event has been strongly appreciated after the pandemic emergency and allowed to consolidate a network of stakeholders to be furtherly involved in future on the topic. The visit has been supported also by frontal lectures, both in the morning and afternoon sessions, useful to explain the context. In this case, the applied methodology was based on the combination of i) project description, in terms of main objectives, ii) institution involvement

	through the remote speech of Lombardy Region representative (Ass. Sala) iii) explanation of inter-regional possibilities of cooperation and iv) collection of industrial interests on the topic to highlight its relevance at local level.
Which technologies and/or applications were discussed in the TTTDM?	During the visit, different use-cases has been shown and explained, with particular attention to robotics and automation. Live demonstrations of developed technologies were related to: • Digital backbone • AI • Hybrid Cloud • 5G • Collaborative robotics • Intelligent worker assistance systems • Digital twin • Virtual commissioning • Lean 4.0 • Quality 4.0 • Product traceability • IoT • Industrial cyber security • Smart monitoring & control • Smart maintenance • Logistics 4.0
How many stakeholders participated in the TTTDM?	53
Which Triple Helix stakeholder group did the participants belong to? (add number of participants)	2 policy 11 research 30 business 10 Supporting Organisations
Which EU project(s) was synergically involved in the TTTDM, if any?	During the presentation of AFIL activities AI REGIO, Pimap+, Admantex2i, Eur3ka and TranS4MErs projects have been cited.
Key Outcomes of the TTTDM and description	The main outcome of the TTTDM was the growth of awareness of current regional competences at the service of industrial stakeholders. SMEs need to be supported towards the implementation of Advanced Manufacturing solutions based on innovative robotics and automated technologies.

	The visit was aimed at highlighting the benefits and the relevance of CAMI4.0 through local and inter-regional collaborations, de-risking private investments and promoting innovation. Other outcomes are: - The direct interactions between the interested stakeholders and the Competence Centre able to support their transition towards CAMI4.0 technologies. - The valorisation of institutional support through policies and regional programmes aimed at supporting the development of CAMI4.0 topics. - The visibility of currently existing excellences and best practices implemented at industrial level.
Which lessons learned do you have as a project partner (a) and which lessons learned emerged for participants (b)?	The TTTDM was very useful to collect the interest and the needs of industrial stakeholders on Robotics and Automation technologies. It also acts as contact point among the triple-helix representatives. The significant participation at the physical event confirmed the importance of a direct discussion among participants, stimulating the development of a strong network ok interested actors. For participants, the TTTDM represented the opportunity to test and verify already existing best practices and solutions, encouraging them to think to specific applications on their business. The institutional speech on policy and future opportunities also highlighted the interest of the region to support them on the adoption of CAMI4.0 technologies.
Hyperlink to picture and video content of the TTTDM	Alfresco
General Summary of the TTTDM	
The TTTDM has been organized as physical event at MADE Competence Centre Industry 4.0 (Milano) through the live demonstration of robotic and automation solutions applied to manufacturing processes. The participants, mainly industrial stakeholders, had the opportunity to discuss the topic with experts, to test real applicative use-cases and to know the planned strategy of Lombardy region on Advance Manufacturing area.	

1.6. Reporting Template

TTTDM Reporting Template	
Name of the PP	HAMAG
TTTDM Type (CAMI4.0 topic, regional/interregional), Date and Location	A&R TTDM; regional, Zagreb, 7 October 2021; 9.30 – 11.30 am Hotel Capital. Zagreb
Description of the TTTDM	Our two-hour TTTDM hosted two representatives of SMEs, one of the universities and one of the policy makers, covering all triple helix group: two top Croatian SMEs in the A&R field: INETEC Ltd and Gideon Bros Ltd; Laboratory for Robotics and Intelligent Systems at the Faculty of electronic and computing, University of Zagreb – LARICS, and Head of the strategic planning and development at the Ministry of regional development and EU funds. They gathered to exchange the best practices and to highlight challenges in the A&R in Croatia as well as its impact on the national economy and science. The meeting was divided into two parts. The first part was assigned to the Technical Panel where industrial application of A&R was presented by the INETEC Ltd https://www.inetec.hr/, the Gideon Bros Ltd https://www.gideonbros.ai/ and university laboratory for robotics - LARICS. The INETEC presentation was about development and application of the complex robot systems for the surveillance of materials, specifically, about the usage of robots in maintenance of nuclear plants. The Gideon Bros. Ltd presentation was about AI & 3D vision powered industry 4.0. Their presentations were followed by an overview of the 16 ongoing projects running at the LARICS laboratory and its equipment. The LARICS is placed at the faculty of electronic and computing, University of Zagreb https://larics.fer.hr/, and presentation was held by prof Dr Zdenko Kovačić, the Head of the laboratory. The Round Table was held in the second part of the meeting. Participants included above mention SMEs, LARICS and Mr Luka Novosel, the Head of the Sector for strategic planning and development management at the Ministry of the regional development and EU funds. The aim was to discuss the best practices, challenges and opportunities to bring together all

	ecosystem stakeholders in robotics to benefit their own businesses as well as to benefit national economy. The round table was moderated by prof Nikola Mišković of the University Zagreb, Faculty of electrical engineering and computing who is an expert in the field of robotics.
Methodologies applied in the TTTDM and description of the methodologies	1) Technical Panel lasted 45 minutes The INETEC's presentation was about the robots in the maintenance of the nuclear plants. The Gideon Bros. presented a usage of robot in a warehouse where robot in its work and walk around the warehouse can recognise any kind of an obstacle, whether it is a human or an object and then avoids it or walk around it instead of clash with it. The point of this type of product is to develop a robot who is able to make decisions rather than only follow instructions. Their presentations were followed by an overview of the 16 ongoing projects worth over 1.5 million Euros which have been running at the LARICS laboratory for A&R at University of Zagreb, Faculty of electronic and computing, https://larics.fer.hr/. The presenter was prof Dr Zdenko Kovačić, the Head of the laboratory. Professor Kovačić presented usage of the robots in the LARICS projects in agriculture, i.e. in vineyards where robot reaches the grapevine plants on the very steep terrains, which are common in the southern and northern parts of Croatia. The robot cuts buds on the plants and spraying them with anti-fungicides. Another application of the robots (WATCHPLANT project) is to use the plant juices as a source of energy). AERIAL-CORE project aims to develop a drone which can prevent the migrating birds to land on the electrical wires. This makes a power cut off, so deployment of robot resolves this issue. 2) Round Table lasted 60 minutes There were five participants: 2 SMEs, 1 university and 1 policy maker. The moderator was Prof Nikola Mišković, an expert in the field of A&R and works at the faculty of electrical engineering, University of Zagreb. The round table participants discussed the current trends in the A&R in Croatia and globally, business opportunities and source of funding for stats up and established SMEs, ongoing and to be

	calls national and EU and so far, results and practices in transfer technology from universities to SMEs. Another topic was the role of the government in the support and development of the logistic support for the A&R SMEs as well as the foreign investments. There were a few experienced Croatian engineers who had been working for global A&R and national companies and they expressed their views about advantages and challenges and future trends as well as the impact of this industry on the global economy.
Which technologies and/or applications were discussed in the TTTDM?	3D technologies in robotics Robotics applied in agriculture, warehouses and logistics, nuclear plants, power plants and electrical distribution
How many stakeholders participated in the TTTDM?	There were 4 stakeholders covering all triple helix actors: SMEs, governmental bodies, and university. Namely the participants were: 1. INETEC Ltd https://www.inetec.hr/en/products/robotics/ 2. GIDEON BROS ltd https://www.gideonbros.ai/ 3. LARICS, Laboratory for robotics and intelligent systems, University of Zagreb, Faculty of electrical engineering, https://larics.fer.hr/ 4. Ministry of regional development and EU funds https://europeanevaluation.org/ministry-of-regional-development-and-eu-funds-croatia/ 5. HAMAGBICRO www.hamagbicro.hr
Which Triple Helix stakeholder group did the participants belong to? (Add number of participants)	8 policy 4 research 9 business 4 supporting Organisations
Which EU project(s) was synergically involved in the TTTDM, if any?	**N/A**

Key Outcomes of the TTTDM and description	Advantages: - Croatian key advantages in robotics are excellent engineers and students, i.e. human resource - Many expert groups in this area at University of Zagreb and other universities in Croatia - University laboratories are main source of creative ideas and research - CRTA – Reginal centre for robotics, recently open at Faculty of engineering and Naval engineering, University of Zagreb - Excellent collaboration between SMEs and university. Most of the SMEs owners and start -ups are ex – students of the national universities Challenges: - Companies are not equally spread over all regions. Almost 80 percent of the business and laboratories are located in the Zagreb or surrounding area - Companies are still project oriented instead of the product oriented. That means they are based on offering a cheap expert labour instead of developing high-tech product which is the case of the big players in this field in EU and globally. Therefore, it is essential to make transition from project to product company. There are IT companies in Croatia which are role models in that respect, such are Photo math Ltd and Infobip Ltd, so their example could be followed. - Robotics demands an excellent logistic network and logistic supply. Unlike in software or in AI industry, in robotics production, robot transport is essential or 'must have' prerequisite. Logistic network is very expensive so government should support this with its funding and investments. - Freelancers are better paid if they work for international companies then Croatians'. Therefore, the national companies experience brain drain. Government should make a strategy how to keep national experts in Croatia. - It will be 400 million Euros assigned from the EU funds to address development and investment in SMEs in smart specialisation and Industry 4.0 for the upcoming years, and these funds should be of help. However, the

	absorption capacity is still an obstacle to take advantage of this fund. - Administrative barriers for the implementation of EU projects are still present, especially in the field of public supply, the procedures are quite complicated and therefore make delays in project implementation.
Which lessons learned do you have as a project partner (a) and which lessons learned emerged for participants (b)?	Lesson learned: Along with AI, robotic is the most important global industry and it will be in the near future. Therefore, its impact on the national economy is huge. Croatia's main advantage is excellent experts - engineers, students and professors in this field. The cooperation between SMEs and academia is very good. On the other hand, government investment in science and research are the biggest obstacles and should be addressed (currently 0.7 % of the GDP Is assigned for the science and research). Absorption of the EU funds should be improved as well, the main problems are administration and bureaucratic obstacles or regulation. Government also needs to ensure fund or invest into logistic network which are needed for the A&R SMEs and big companies.
Hyperlink to picture and video content of the PLL	https://www.facebook.com/HAMAG.BICRO/posts/1668923622822977

General Summary of the TTTDM

The technical presentation and round table discussion were informative and gave a great overview on the current state of the affairs in robotics in Croatia. Apart from the round table participants, the discussion was open for the audience, and we heard opinions and suggestions from a few industry experts who work for national and international high-tech companies.

The discussion at the Round Table developed around questions:

- How can we encourage and support development of A&R in Croatia?
- Which are the main barriers that are impending adoption and integration of advanced solutions?
- What existing policy instruments have been implemented aiming to increase the leading position of Croatia in A&R?

1. TTDM Automation & Robotics

1.1. Reporting Template

TTTDM Reporting Template	
Name of the PP	IWU
TTTDM Type (CAMI4.0 topic, regional/interregional), Date and Location	TIN / CAMI4.0 topic: Automation and Robotics Regional, online Thursday, 22.07.2021
Description of the TTTDM	It is no longer possible to imagine our world without robots. They are increasingly penetrating new areas, such as medical technology. Even in everyday life, little helpers assist us with vacuuming or cutting the lawn. Most of the robotics currently in use is made up of rigid limbs and defined joints. This limits their usability, especially for very complex tasks and tasks that require direct, safe contact with humans, for example in everyday life and care. In order to qualify robots for use in human-oriented fields of application, new approaches are needed that no longer focus only on range, payloads and precision, but also on safety, flexibility and acceptance. Continuum robotics in combination with innovative structural concepts, specifically applied sensor technology and newly conceived movement mechanisms show ways of closing the gap between high-performance but potentially dangerous industrial robotics and safe but low-performance soft robotics. In the online workshop, the potentials of human-oriented robotics in the future will be examined and initial approaches for the realisation of safe and at the same time powerful robots will be presented. It offers users and industry representatives the opportunity to discuss the potentials and challenges of this new and forward-looking field of robotics in direct conversation with experts from research and development, and invites you to help shape the future of research for human-oriented robotics and to work out a joint development strategy. Through intensive

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	exchange between industry, research and users, we can succeed in gaining a decisive lead in this forward-looking field of robotics application.
Methodologies applied in the TTTDM and description of the methodologies	1) impulse presentations & best practices 2) showcasing of pilot solutions 3) round table discussion and exchange 4) interactive tools like Mentimeter and Conceptboard as well as other questionnaire tools
Which technologies and/or applications were discussed in the TTTDM?	The usage of robotics operating close to human beings are especially discussed. In order to qualify robots for use in human-oriented fields of application, new approaches are needed that no longer focus only on range, payloads and precision, but also on safety, flexibility and acceptance. Continuum robotics in combination with innovative structural concepts and newly conceived movement mechanisms show ways of closing the gap. The usage of service robots were especially highlighted in the medical sector.
How many stakeholders participated in the TTTDM?	32 registered participants / 21 attended
Which Triple Helix stakeholder group did the participants belong to? (add number of participants)	__0_ policy __8_ research _11__ business __1_ Supporting Organisations
Which EU project(s) was synergically involved in the TTTDM, if any?	The event was majorly focussed on discussion with the Triple Helix Stakeholders. There was no other specific EU project involved.

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Key Outcomes of the TTTDM and description	The participants working in the medical sector had to chance to explain their experience with robots and could elaborate on what they would consider a helping innovation and what not. One enlightening example from the nursing everyday life was that it is important that "medicine shelf-robots" must have a very long battery life and be fast on the corridors. If they need more assistance, charging time or the nurse has to wait for the robot to arrive in the patient's room, such system fail to be used. On the other hand it was shared that patients who received walking assistance by robotic systems often liked the entertaining experience more than normal treatment or exercise. Practical considerations like hygiene, security against misuse, safety for patience, optics and interpersonal interaction have to be properly thought of, too. It is therefore crucial to develop such novelties in very close coordination with the actual needs and considerations from the care sector. This only works with close and frequent interaction.
Which lessons learned do you have as a project partner (a) and which lessons learned emerged for participants (b)?	(a) As project partner we learned and noticed even more how many aspects have to be considered depending on where the robotic system should help in human oriented sectors. The processes which are to be done by the robot are often highly complex and changing. Close industry contact and exchange is needed to be able to automatize such helping robot tasks. (b) Participants had an interactive space to share what their needs and expectations are and they were able to learn about the current state of the art and ongoing research and development activities. The participants could discuss and compare their experience with other people's views and experience with assisting robots.
Hyperlink to picture and video content of the PLL	Screenshots and evidence uploaded in the respective folder in Alfresco
General Summary of the TTTDM	

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Continuum robotics in combination with innovative structural concepts, specifically applied sensor technology and newly conceived movement mechanisms show ways of closing the gap between high-performance but potentially dangerous industrial robotics and safe but low-performance soft robotics. In the online workshop, the potentials of human-oriented robotics in the future was examined and initial approaches for the realisation of safe and at the same time powerful robots were presented. It offered users and industry representatives the opportunity to discuss the potentials and challenges of this new field of robotics in direct conversation with experts from research and development, and invites to help shape the future of research for human-oriented robotics and to work out a joint development strategy. The workshop goals were achieved by impulse presentation of research results, state of the art comparison and open discussion in a round table approach to include market perspectives and experience to foster the exchange character.

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1.2. Agenda

Robotics for Humans –
Safe & high-performance robotics for tasks close to human beings

Thursday, 22. Juli 2021 – online Microsoft Teams
09:00 – 12:00 h

09:00 h	Welcome Linda Weisheit, Fraunhofer IWU
09:05 h	Interactive tool -test and introduction round
09:15 h	Robotics close to human beings – a still invisible market Linda Weisheit, Fraunhofer IWU
09:45 h	Experience exchange
10:00 h	**Coffee Break**
10:15 h	Research at Fraunhofer IWU: Motivation, vision, status quo Wilhelm Wockenfuß, Lukas Boxberger, Fraunhofer IWU
11:15 h	Discussion: potentials and challenges
11:45 h	Outlook: networking
12:00 h	Feedback and end of the event

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1.1. Reporting Template

TTTDM Reporting Template	
Name of the PP	PRO
TTTDM Type (CAMI4.0 topic, regional/interregional), Date and Location	Regional – TTTDM on A&R – 27 July – Karlsruhe (Virtual)
Description of the TTTDM	This TTTDM was the second one conducted by the KIT and was on the topic of Automation and Robotics, for which PRO is TIN leader and is the TIN 2. This TTTDM consisted of expert presentations and a virtual panel discussion on the topic of promoting new topics of Automation and Robotics in manufacturing, such as collaborative robotics. The TTTDM also had a presentation from the national contact point of Germany in the field of EU programmes. Both from the perspective of SMEs, large industry and academia.
Methodologies applied in the TTTDM and description of the methodologies	1) Expert Presentation 2)Polling 3)Interactive discussions
Which technologies and/or applications were discussed in the TTTDM?	**The technologies discussed include** **1. Collaborative Robotics** **2. Innovative, versatile production of the future** **3. User centered robotics**
How many stakeholders participated in the TTTDM?	28 (+4 KIT internal)
Which Triple Helix stakeholder group did the participants belong to? (add number of participants)	__1_ policy __12_ research ___5 business __8_ Supporting Organisations

Which EU project(s) was synergically involved in the TTTDM, if any?	**Synergy**
Key Outcomes of the TTTDM and description	The TTTDM brought together different people belonging to the region as well as from outside, From different sectors and people presented varied points of view on the topic of Challenges in the field of implementing advanced robotics practices in manufacturing, such as the integration of collaborative robotics. The topic of how SMEs can also benefit from CAMI 4.0 topics was also discussed. Additionally the EU point of view on this topic was also discussed with the current pertinent calls
Which lessons learned do you have as a project partner (a) and which lessons learned emerged for participants (b)?	(a) As a project partner, it was encouraging to see that this topic remains very relavant and that coming developments have only increased enthusiasm within topics of robotics. (b) Participants were also able to meet likeminded individuals who might participate in projects. Also with the presentation from the national contact point, information regarding current calls in the topic and the tips on achieving the goals were also transferred
Hyperlink to picture and video content of the PLL	-

General Summary of the TTTDM

The KIT TTTDM of topic A&R was conducted on the 27th of July and consisted or participants and audience from the triple helix stakeholder group (Research, Industry and Policy). Expert presentations were made on three topics, one focussed on the Wertstromkinematik project – a vision for innovative versatile production of the future, one focussed on the creation of user catered design of high performance robotics and the final talk gave an overview of the landscape of manufacturing topics in the Horizon Europe work programme – Digital, Industry and Space. The expert presentations were followed by a panel type discussion where each expert was asked to give comments on certain topics followed by discussions on each topic with the audience. All considered the event was a massive success, response was positive and participants as well as organisers are looking forward to conducting the follow up events as part of CEUP 2030.

1.1. Reporting Template

ACTIVITY 2.2 TTTDM of PBN_ 18th November 2021_ Automation and Robotics

TTTDM Reporting Template	
Name of the PP	PRO
TTTDM Type (CAMI4.0 topic, regional/interregional), Date and Location	CAMI4.0: Automation and Robotics 18/11/2021, On-line (Zoom)
Description of the TTTDM	1- The already achieved and envisaged activities of the CEUP project were presented, focusing on the activities in the CAMI4.0 topics. Since it was a joint event with the DanubeS3Cluster (Danube project), a short introduction about that project was also introduced. 2- The current focus areas as well as future plans of PBN/am-LAB were introduced 3- The competencies of am-LAB (including the flagship projects defined in the CEUP) were also presented to provide insight into the business opportunities of different digitalization solutions. 4- Creation a sense of continuity and belonging in the attending stakeholders, in view of involvement in future project activities.
Methodologies applied in the TTTDM and description of the methodologies	The methodology for this event was planned to be as fruitful as possible. The introduction highlighted the results and still envisaged activities of the CEUP project, so participants could gain insight about project outcomes. We also presented the current focuses and main works of PBN/am-LAB as well as future plans were also introduced in order to establish contacts based on the preferences and interest of the participants. The introductory part was followed by specific thematic presentations by am-LAB experts, so attendees could get to know use-cases and results in each thematic topic. In the end of each thematic session,

	participants had the possibility to ask from the experts so detailed questions could be also discussed. In the end of the meeting participants expressed their appreciation towards the meeting and the organisation, and they also highlighted that they could widen their knowledge in the technologies thanks to the thematic sessions
Which technologies and/or applications were discussed in the TTTDM?	***3D technologies:*** • Product development and prototyping • Business animation creation IoT • 3D scanning, 3D printing and reverse engineering ***Extended Reality*** • Real-time display of manufacturing data series on the shopfloor • AR gamification application development • AR applications supporting machine maintenance and component visualization • AR content applications for printed materials ***Robotics:*** • design and manufacture tailor-made grippers and accessories to collaborative robot workflows using 3D technology • integration of various branded robots into a single operational management platform • industrial, collaborative and mobile robot coordination and complex task development • support in application of robots into conventional production lines
How many stakeholders participated in the TTTDM?	**32 participants all together**
Which Triple Helix stakeholder group	• Public Authorities: 2

did the participants belong to? (add number of participants)	• Interest groups including NGOs: 10 • Higher education and research: 4 • Education/training centre and school:2 • Large Enterprise:3 • SME:8 • BSO:3
Which EU project(s) was synergically involved in the TTTDM, if any?	DanubeS3Cluster (Interreg Danube Programme)
Key Outcomes of the TTTDM and description	The main outcome was the exchange among different stakeholder groups. The main guidelines that emerged were: - Participants could be informed about the most relevant activities of the project and cooperation possibilities were also presented - Participants can be informed about the focus areas of PBN/am-LAB - Participants can be informed about the services and competencies of a local DIH (am-LAB) - New networks can be established (or even new project proposals can be submitted) with PBN and participants, based on their preferences and interests.
Which lessons learned do you have as a project partner (a) and which lessons learned emerged for participants (b)?	a) Involving different types of actors in one meeting made possible a deeper conversation and more fruitful. (cooperation activities might be enhanced) b) The need to develop an offer for improving digital competence
Hyperlink to picture and video content of the TTTDM	Alfresco D.T2.2.3

General Summary of the TTTDM

Participants could be informed about CAMI4.0 topics, they expressed their interest in future cooperations, and involvement in the project. Since the workshop was held in English and attendees joined the workshop from several countries, further international cooperation might be also enhanced.

1.1. Reporting TTTDM, Robotics, May 18th 2021

TTTDM Reporting Template	
Name of the PP	PRO
TTTDM Type (CAMI4.0 topic, regional/interregional), Date and Location	Robotics, regional, 18.05.2021, online
Description of the TTTDM	The TTTDM was framed as a "Tech Trend Dialogue" in which a certain CAMI 4.0 technology is discussed and showcased from different perspectives – in this case, "Robotics" (as part of the CAMI 4.0 topic Automation & Robotics)
Methodologies applied in the TTTDM and description of the methodologies	1) Presentation of CEUP 2030 2) Presentations + Q&A of initiatives and companies in the area of robotics 3) Short discussion about needs and policy instruments
Which technologies and/or applications were discussed in the TTTDM?	Robotics from different perspectives (Academic view, start-up perspective)
How many stakeholders participated in the TTTDM?	35
Which Triple Helix stakeholder group did the participants belong to? (add number of participants)	3 policy 15 research 13 business 4 Supporting Organisations
Which EU project(s) was synergically involved in the TTTDM, if any?	No other EU project involved

Key Outcomes of the TTTDM and description	See summary below
Which lessons learned do you have as a project partner (a) and which lessons learned emerged for participants (b)?	In general, the TTTDM are a great opportunity to showcase different initiatives, businesses and approaches of the CAMI 4.0 technologies. For participants, it was a good opportunity to present themselves towards policy makers, industrial partners and specialized research and to show their willingness and the possibilities for cooperation.
Hyperlink to picture and video content of the PLL	Link to Alfresco Folder

General Summary of the TTTDM

Robotics is considered a key technology for Industry 4.0 - it is practically impossible to imagine modern production plants without robotic arms. Currently, there are around 3 million industrial robots in use worldwide.

Industrial robots have also arrived in Austrian manufacturing; in 2018, over 40% of all Austrian production companies with more than 20 employees were already using them (European Manufacturing Survey 2018).

"Automation & Robotics" is one of the focus topics of the Interreg CE project CEUP 2030, in which PIA is a project partner. The aim of the project is the exchange of different actors in Central Europe on Industry 4.0 topics. In the 2nd "Tech Trend Dialogue" within the project, robotics was therefore taken up and discussed as an important topic. In order to bring as much expertise as possible into the discussion, Plattform Industrie 4.0 cooperated with the Austrian Society for Measurement, Automation and Robotics (GMAR) in planning and implementing the event.

Scientific expertise and robotics competence in Austria

An introduction to the topic and information on the status quo regarding the automation technology and robotics was provided by Andreas Pichler, CTO of the non-university research company Profactor and President of GMAR. As a key enabling technology (KET), robotics is important for many technological developments (e.g. Artificial Intelligence, AI) and socially relevant topics (e.g. in relation to the achievement of various SDGs).

Mathias Brandstötter, Deputy Head of the Institute for Robotics and Mechatronics at Joanneum Research in Klagenfurt and member of the GMAR board, then explained what is actually happening in Austria. One of the GMAR's goals is to maintain an overview of

activities and innovations in the field of robotics and to draw attention to the importance of robotics for Austrian science and industry.

In his presentation, Mr. Brandstötter took up numerous examples of the use of industrial robots in Austrian production. For example, they are used in order picking, in packaging or in "bin picking". Mobile robotic systems are also developed and used in Austria. For example, an outdoor printing robot is being produced in Tyrol that can paint pictures and lettering over large areas on roads, meadows or ski slopes.

Mr. Brandstötter also introduced various research institutions that are active in the field of robotics in Austria. Robotics systems can also be tested and tried out in various pilot factories, e.g. at the Technikum Digital Factory of the FH Technikum in Vienna. Researchers are also increasingly looking at robotics in conjunction with AI; for example, a project at Joanneum Research is trying to predict robot failures in spot welding applications with the help of AI.

Robotics innovations from Austria

Functioning robots require the optimal interaction of hardware and software. Konstantin Mautner-Lassnig at the Styrian start-up ARTI is particularly concerned with the latter. ARTI's goal is to teach robots intelligent skills with the help of software.

In presenting his company, Mr. Mautner-Lassnig addressed, among other things, the challenges of using robots outdoors. Robots need to understand their environment, and teaching them this is one of the topics ARTI is working on. For example, outdoor robots must recognise objects independently, find suitable routes or - an important topic especially when dealing with people - develop an understanding of the scenery around them.

The company Blue Danube Robotics, which was founded in 2013 by four graduates of TU Wien, focuses on hardware. Michael Zillich is CTO there and works on the further development of the product AIRSKIN. This is an outer skin for industrial robots that enables their safe use without protective fences.

In his input, Mr. Zillich presented the technology behind AIRSKIN and went into the possibilities that arise through using the product in human-robot collaboration. Finally, Mr. Zillich addressed the topic of risk management - the fact that AIRSKIN is a product with multiple safety certifications is of great importance for its use in practice.

1.1. Reporting Template

TTTDM Reporting Template	
Name of the PP	PRO
TTTDM Type (CAMI4.0 topic, regional/interregional), Date and Location	Regional – TTTDM on AR – 9th September 2021, Pomurje Technology Park
Description of the TTTDM	Pomurje Technology Park (from this point on PTP) successfully conducted workshop TTTDM on Automation and Robotics. The companies and support organizations debated the possibilities in the field of automation and robotics in the future European perspective
Methodologies applied in the TTTDM and description of the methodologies	The workshop was organized "in person". The red thread of the workshop was what companies in the field of automation and robotics can expect in the future European directive. Finally, we discussed with companies what problems they face in the field of automation and robotics, and what they expect from the state and from the European Union.
Which technologies and/or applications were discussed in the TTTDM?	At the workshop we presented and discussed: • Digital transition (robotization and automation) (CEUP2030, Jožek Špilak) • Incentives for starting a business (Marjetka Jakob) • Cross-border integration of domestic innovative / technological companies and foreign corporations and / or investors (Grega Konkolič) • Internationalization of companies - Poland (Igor Börc) • Second opportunity for entrepreneurs (in the light of the COVID-19 epidemic) (Aleksandra Krumpak, M.Sc.) • Supporting promotional activities for companies (Tomaž Lapoša) • Open discussion

	• Conclusion with the invitation of PTP to cooperate with companies on projects
How many stakeholders participated in the TTTDM?	14
Which Triple Helix stakeholder group did the participants belong to? (add number of participants)	___ policy ___ research 14 business
Which EU project(s) was synergically involved in the TTTDM, if any?	DIH2 (H2020)
Key Outcomes of the TTTDM and description	It is important that companies operating in similar fields work together and are connected, as this makes it easier to transfer knowledge to decision-makers. Strong regional companies acting as a core competency need to be surrounded by like-minded companies, laboratories with a certain infrastructure where members can test. A wider network means more testing options.
Which lessons learned do you have as a project partner (a) and which lessons learned emerged for participants (b)?	We identified the need for greater integration of the SMEs and decision-makers. Another important finding is that there is a big gap in the transition to Industry 4.0, because many SMEs use only technology that is not even digitized and the question is how to digitize machines that still benefit companies or how to show the benefit to these companies after digitizing machines and linking these machines in value chains.
Hyperlink to picture and video content of TTTDM	Alfresco
General Summary of the TTTDM	

Pomurje Technology Park (from this point on PTP) successfully conducted workshop TTTDM on Automation and Robotics. The companies and support organizations debated the possibilities in the field of automation and robotics in the future European perspective

1.1. Reporting Template

TTTDM Reporting Template	
Name of the PP	PRO
TTTDM Type (CAMI4.0 topic, regional/interregional), Date and Location	CAMI4.0: Automation and Robotic 18/03/2021, Genoa (on-line)
Description of the TTTDM	The morning was organized in 5 different timeslots: 1- An introduction about the territory and the possibilities it offers, with few presentations from SIIT (introducing the CEUP project), University of Genoa, Liguria region representative, FILSE representative and industry representative. 2- A technical round table about national cluster (Industry 4.0. Transport, smart communities and aerospace) 3- A session sharing the most relevant activities of the research infrastructures (Industry and automation, security, logistic) 4- A virtual visit of SIIT robotic labs. 5- Conclusions
Methodologies applied in the TTTDM and description of the methodologies	The methodology for this event was planned to be as impactful as possible. The introduction highlighted the present need in Liguria Region towards Industrial development; the explanation and discussion were led by regional policy makers. On this line, the two technical time slots of the day were organized around three main topics (Industry and automation, security, logistic) that were faced both from the perspectives of the academy and of the industry. To conclude the day there was a showcase of the technical developments that are taking place in the SIIT lab. The strategy behind this was to have a connecting line that shows what are the need (policy makers and the academy), how they are going to be faced (industry and cluster) and what is being done practically (the laboratory)

Which technologies and/or applications were discussed in the TTTDM?	Automation and Industry 4.0 • Robotic • Artificial intelligence • IoT ICT and monitoring: • Machine learning • Digitalization • Smart grids • Digital communities Logistic and transport • Mobility planning • Smart process • Data analysis
How many stakeholders participated in the TTTDM?	70
Which Triple Helix stakeholder group did the participants belong to? (add number of participants)	__11_ policy __17_ research __37_ business __5_ Supporting Organisations
Which EU project(s) was synergically involved in the TTTDM, if any?	Outcome from FairSTATIONS, RE4, DigitBRAIn and CAxMan were presented as case studies during the technical sessions.
Key Outcomes of the TTTDM and description	The main outcome was the exchange among different stakeholder groups. The main guidelines that emerged were: - The relevancy of clusters and the key role of state - The need for a strong action on digital competence - The impact of public funding and a tight monitoring of the results - Valorisation of emerging technologies to support strategies and policies among sectors

Which lessons learned do you have as a project partner (a) and which lessons learned emerged for participants (b)?	a) Having a larger attendance by the policy makers made possible a deeper conversation and more fruitful. b) The need to develop an offer for improving digital competence
Hyperlink to picture and video content of the TTTDM	Alfresco

General Summary of the TTTDM

Differently from the two PLLs, this session saw the involvement of a larger number of policy makers and academic representatives causing the conversation to face multiple aspects.

1.1. Reporting Template

TTTDM Reporting Template	
Name of the PP	PRO
TTTDM Type (CAMI4.0 topic, regional/interregional) , Date and Location	CAMI 4.0. – Automation and Robotics regional meeting **23.09.2021** Physical meeting (Astor Robotic Centre0
Description of the TTTDM	The meeting was part of the conference "Let's meet in Polish Investment Zone" organized by KPT on 23rd of September. It gathered representatives of industry, start-ups, regional authorities and supporting organisations. It was divided into 4 main parts: 1. Moderated discussion 2. Presentation of the start ups 3. Award Ceremony 4. Study visit and presentation of the Factory of the future
Methodologies applied in the TTTDM and description of the methodologies	1) Presentations of solution providers and their use cases 2) moderated panel discussion with representatives of different target groups 3) Study visit 4) Q&A session
Which technologies and/or applications were discussed in the TTTDM?	- **Automation and robotics**
How many stakeholders participated in the TTTDM?	129
Which Triple Helix stakeholder group did the participants belong to? (add number of participants)	8 policy 2 research 102 business 17 Supporting Organisations

Key Outcomes of the TTTDM and description	1. Bringing together representatives of technology suppliers and receivers gave a good possibility for initiating business discussions 2. Automation & robotics is priority technological area in the region of Malopolska, many interesting use cases and best practices appear 3. Increased interest of policy makers from the region in supporting the digitilisation
Which lessons learned do you have as a project partner (a) and which lessons learned emerged for participants (b)?	1. Industrial companies still requires professional support in auditing their technological readiness and match them with potential technology suppliers 2. Digital innovation hubs give a spectrum of possibilities for both technology suppliers and receivers
Hyperlink to picture and video content of the PLL	Alfresco
General Summary of the TTTDM	
The meeting was very successful and highly attended by representatives of business, administration and supporting organisations. Many interesting contacts and possibilities for cooperation have been initiated. The interest in presentation of factory of the future exceeded the expectations, what proves that the automation and difitalization of industry is developing	