TREND & INNOVATION NETWORK 1: INTELLIGENT PRODUCTION SYSTEMS

D.T2.2.2 - A report on 10 TTTDMs for Intelligent Production Systems

Version 6.0

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6.12.2021	2.0	MCR	Definition of the structure of the document
12.12.2021	3.0	MCR	First Draft
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11.01.2022	6.0	KIT	Final version ready to be issued integrating PP feedback
21.01.2022	7.0	KIT	Deliverable finalised and issued

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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 "Intelligent Production Systems" (IPS). 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.T2.2.2.

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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.

Change Control Procedure & Structure

The Deliverable Responsible, KIT –Karlsruhe Institute of Technology (KIT/PP5), 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 KIT.

At any time, partners that believe a project methodology should change, should submit the request to the Deliverable Responsible and the Work Package Leader (KIT/PP5) 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
R&A	Robotics and Automation
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 Intelligent Production System's Trend & Innovation Network 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 intelligent production systems 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 PLLs 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 Intelligent Production Systems (IPS)

An intelligent production system (IPS) is a system with the cognitive ability to deliver efficient interaction within a distributed industrial production environment, where humans and objectives collaborate in complex processes along the entire value-creation chain. (Uhlmann, Hohwieler, Geistert, 2017: 1) The Intelligent Production Systems TIN aimed to include different interconnected topics that required to be investigated together in order to achieve a holistic development of the entire production system.

This TIN in CEUP 2030 has 4 specific sub-topics in the following areas:

- **Smart Sustainable Manufacturing**
- **Production in the domain of big data**
- **Additive Manufacturing based hybrid process chains**
- **Scalable Flexible Manufacturing**

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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 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

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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 IPS TIN, according to its role, with the specific objective to collect regional expertise and capabilities on the topic IPS, 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 IPS 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 "Intelligent Production Systems", which is led by the CEUP2030 partner KIT – Karlsruhe Institute of Technology. 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. IPS OBJECTIVES

Specific objective regarding the Topic of Intelligence Production Systems have been defined in the table below:

Table 1. IPS Objectives (Source: DT1.3.2, CEUP2030, 2020)

Number	Objective Name	Objective Description
1	Flagship-Projects	Identification and analysis of upcoming project calls, and for the development of relevant use cases and demonstrator ideas within the four main subtopics for creating project proposals and consortiums together with the PP and stakeholders.
2	Transregional network building	Usage of national and regional policy makers to find out current links between regions and establish new ones.
3	Active participation	Establishing a way to have constant dialog and communication between PP, Stakeholders within the TIN so as not to lose momentum.
4	Workshops Organisation	Organisation of the dedicated workshops as required by the projects

In addition to the project orientated objectives provided above, the working group of IPS has determined it will focus on the megatrend of sustainability, and keep the thematic focus area of IPS and its sub-topics orientated around this trend.

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2.2. Stakeholders

2.2.1. Partners

With regards to this activity, all partners took a role in delivering an expert workshop associated to Intelligent Production Systems.

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 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.

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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 the Intelligent Production Systems TIN working group structure. These roles have been chosen to optimally address technology and content relevant competencies within the CEUP 2030 partnership:

Table 3. IPS TIN Structure (Source: DT1.3.2, CEUP2030, 2021).

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

2.2.2. Participants

The graph below shows the number of participants per partners who attended the expert workshops.

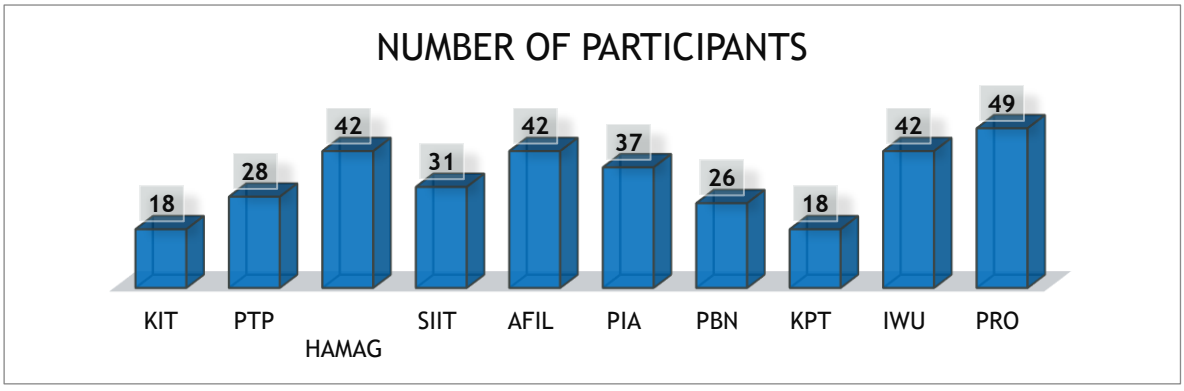

Figure 1 - Number of TTTDM IPS participants per partner (Source: Author generated, CEUP2030, 2021)

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

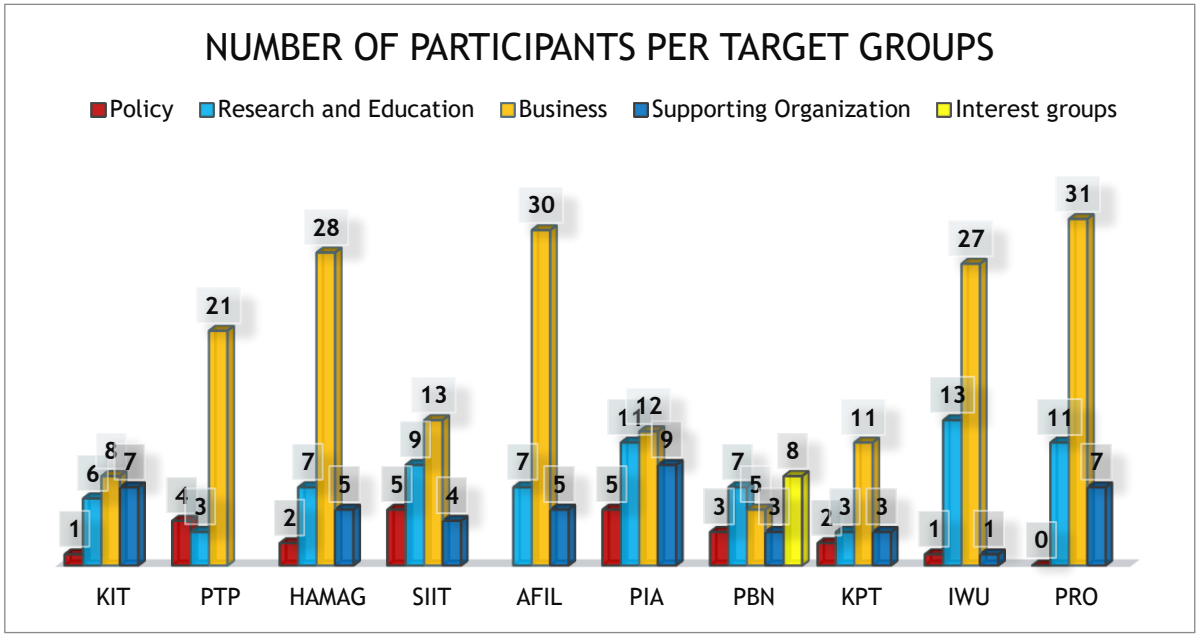

Figure 2 - Number of TTTDM IPS participants per target group per partner (Source: Author generated, CEUP2030, 2021)

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

Figure 3 - Total Number of TTTDM IPS participants per target groups(Source: Author generated, CEUP2030, 2021)

Most of the participants were represented by businesses, research centres and universities dealing with IPS 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 Intelligent Production Systems (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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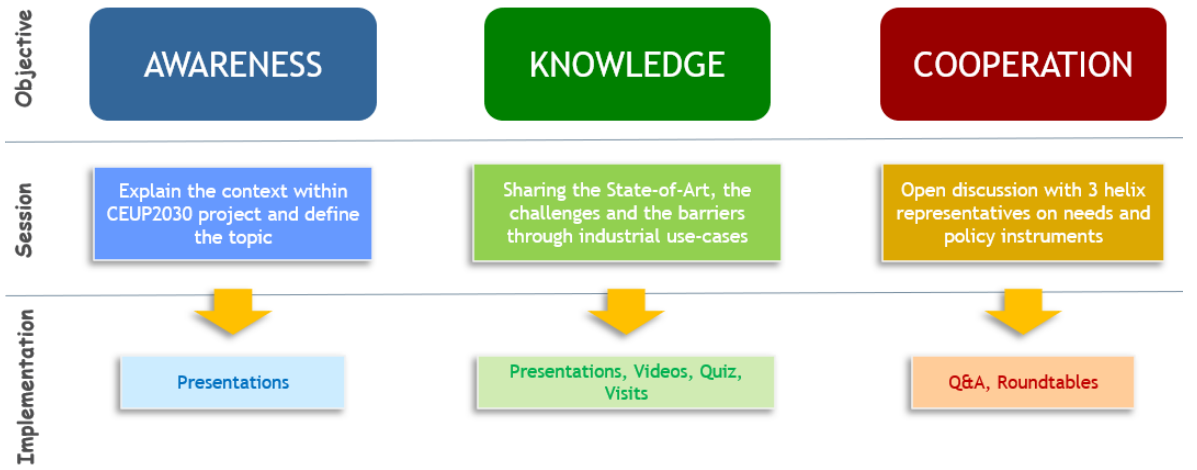
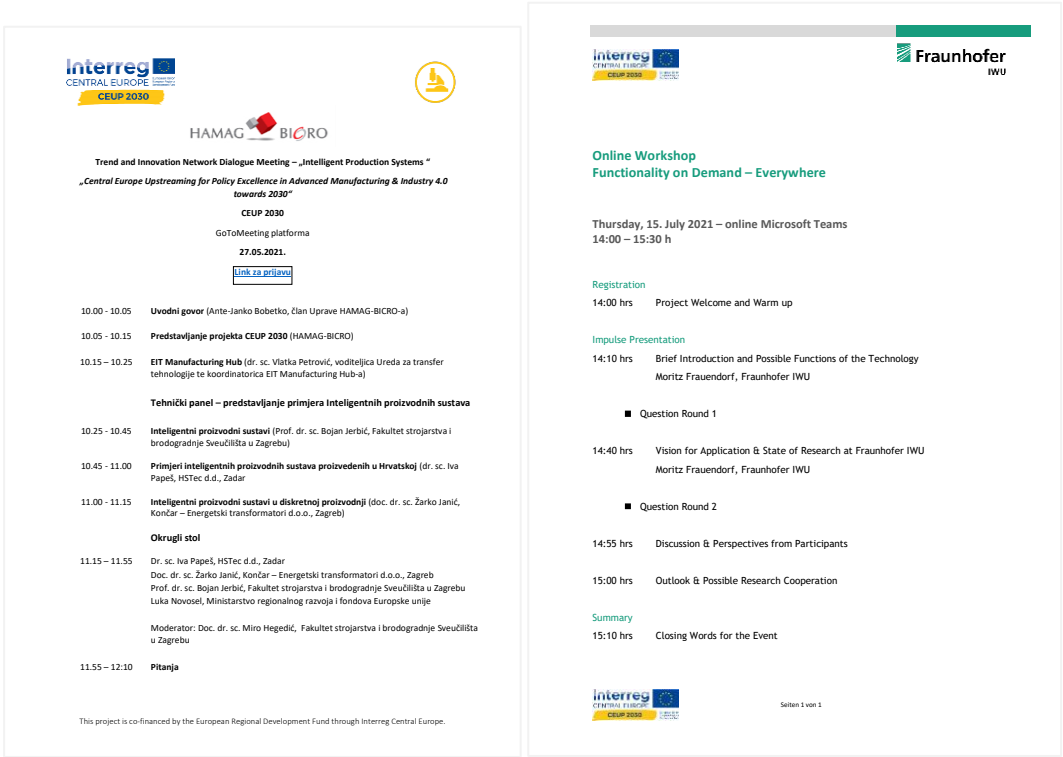


Figure 4: General structure of AI TTTDMs (Source: Report on AI TTTDM, CEUP2030, 2021)

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 Intelligent Production Systems. All partners had to issue an agenda regarding their TTTDM:



HAMAG BICRO

Trend and Innovation Network Dialogue Meeting – „Intelligent Production Systems "

„Central Europe Upstreaming for Policy Excellence in Advanced Manufacturing & Industry 4.0 towards 2030"

CEUP 2030

GoToMeeting platforma

27.05.2021.

Link za prijavu

10.00 - 10.05	**Uvodni govor** (Ante-Janko Bobetko, član Uprave HAMAG-BICRO-a)
10.05 - 10.15	**Predstavljanje projekta CEUP 2030** (HAMAG-BICRO)
10.15 – 10.25	**EIT Manufacturing Hub** (dr. sc. Vlatka Petrović, voditeljica Ureda za transfer tehnologije te koordinatorica EIT Manufacturing Hub-a)
	Tehnički panel – predstavljanje primjera Inteligentnih proizvodnih sustava
10.25 - 10.45	**Inteligentni proizvodni sustavi** (Prof. dr. sc. Bojan Jerbić, Fakultet strojarstva i brodogradnje Sveučilišta u Zagrebu)
10.45 - 11.00	**Primjeri inteligentnih proizvodnih sustava proizvedenih u Hrvatskoj** (dr. sc. Iva Papeš, HSTec d.d., Zadar
11.00 - 11.15	**Inteligentni proizvodni sustavi u diskretnoj proizvodnji** (doc. dr. sc. Žarko Janić, Končar – Energetski transformatori d.o.o., Zagreb)
	Okrugli stol
11.15 – 11.55	Dr. sc. Iva Papeš, HSTec d.d., Zadar Doc. dr. sc. Žarko Janić, Končar – Energetski transformatori d.o.o., Zagreb Prof. dr. sc. Bojan Jerbić, Fakultet strojarstva i brodogradnje Sveučilišta u Zagrebu Luka Novosel, Ministarstvo regionalnog razvoja i fondova Europske unije Moderator: Doc. dr. sc. Miro Hegedić, Fakultet strojarstva i brodogradnje Sveučilišta u Zagrebu
11.55 – 12:10	**Pitanja**

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Fraunhofer IWU

Online Workshop
Functionality on Demand – Everywhere

Thursday, 15. July 2021 – online Microsoft Teams
14:00 – 15:30 h

Registration
14:00 hrs Project Welcome and Warm up

Impulse Presentation
14:10 hrs Brief Introduction and Possible Functions of the Technology
Moritz Frauendorf, Fraunhofer IWU

- Question Round 1

14:40 hrs Vision for Application & State of Research at Fraunhofer IWU
Moritz Frauendorf, Fraunhofer IWU

- Question Round 2

14:55 hrs Discussion & Perspectives from Participants

15:00 hrs Outlook & Possible Research Cooperation

Summary
15:10 hrs Closing Words for the Event

Seiten 1 von 1

Figure 5 - Agenda of HAMAG (left) and Agenda of IWU (right) (Source: HAMAG & IWU respectively, CEUP2030, 2021)

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Figure 6 - Agenda of PIA (left) and PTP (right) (Source: PIA & PTP, CEUP2030, 2021)

Considering the contents, these 10 TTTDMs had to focus on the specific CAMI4.0 topic "Intelligent Production Systems" 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 type of organisation.

The partners had a diverse audience representing the triple-helix attend the session. As described in the Stakeholder section of this report, we provide some images to show how the partner's stakeholders attended the session. All events were held online, so key tools which were utilised were Microsoft Teams and Zoom:

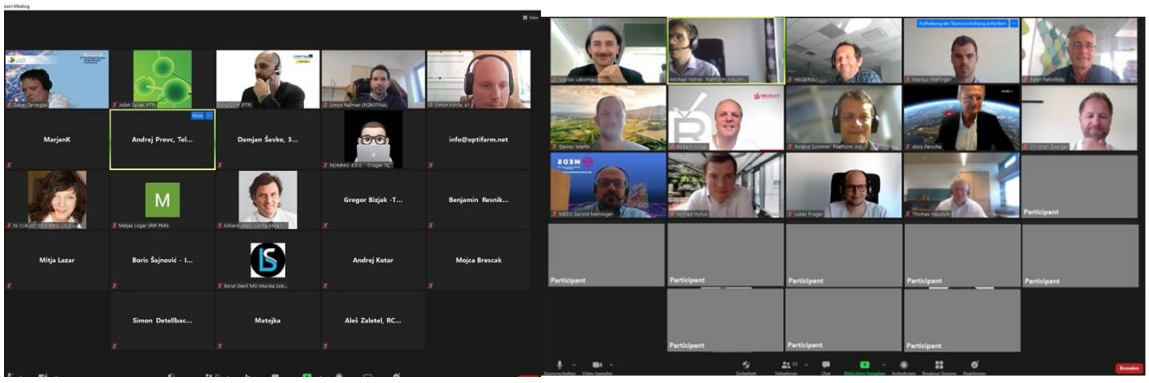

Figure 7 - PTP Attendance (left) and PIA attendance (right) (Source: PTP & PIA, CEUP2030, 2021)

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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 8, an overview of the methodologies utilised in the TTTDMs is provided.

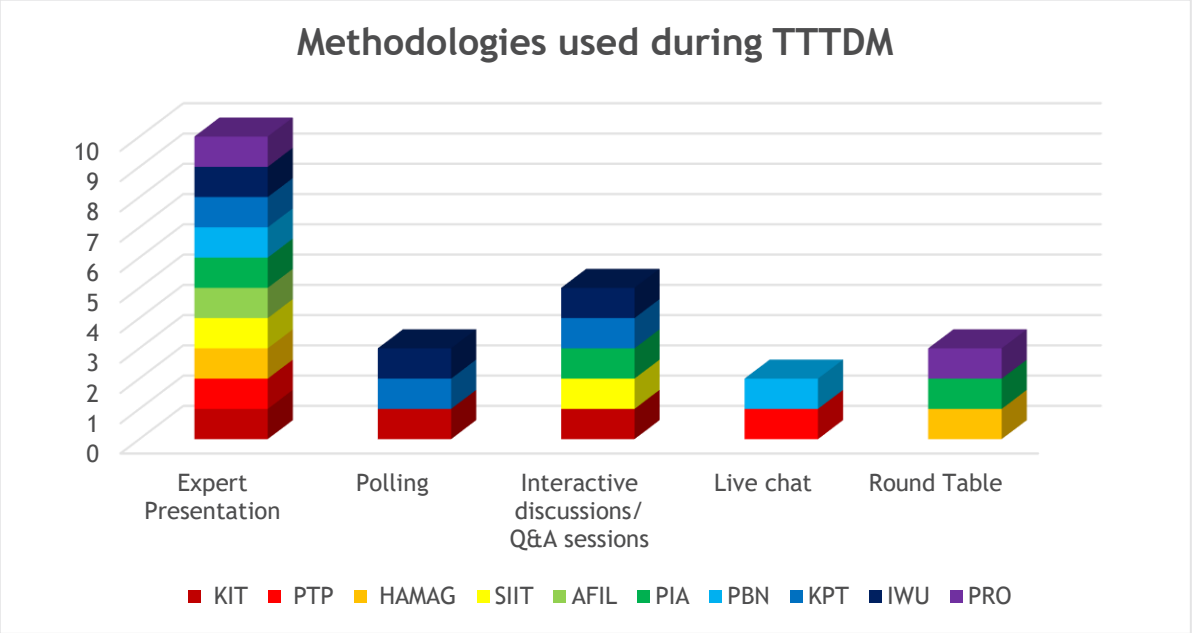

Figure 8 - Methodologies used (Source: Author generated from IPS TTTDM reporting, CEUP2030, 2021)

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

Expert Presentation	Polling	Interactive discussions/ Q&A sessions	Live chat	Round Table
10	3	5	2	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 IPS 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 Intelligent Production Systems (IPS) 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.

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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 IPS. During this time, talking experts:

- Provided an overview of the ecosystem on IPS at different levels (regional, national and European) providing insights on their progress and main challenges that need to be overcome. For instance, a specific need in trainings for employees working in and with Industry 4.0 was point out during the TTTDM held by HAMAG.
- Demonstrate what are the future trends and challenges regarding the application of IPS innovative solutions. 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.
- Share Best Practices and showcase initiatives to illustrate on the ongoing proposed solution on the field of IPS. 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 IPS especially for SMEs according to PTP.

Therefore, the expert panel aimed at increasing the audiences knowledge on the specific topic of IPS. 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 include different perspectives, both technical providers and end-users, and should be strongly linked to industrial ecosystem giving concreteness to the topic. Real application examples and risk analysis have been showed. Furthermore, to make the technical panel more interesting and interacting, videos were shown during the presentation, quizzes were proposed and also a virtual lab tour was conducted.

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 IPS

Therefore, this final session promoted the cooperation between all participants despite their type (Policy Makers, Businesses, Higher Education and Research Centres, BSO…), their countries as it was online and available for further places. The overall objective of this interactive session was to enhance synergies between the audience to align not only knowledge and understanding but also needs and interests in the topic of IPS.

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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 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 IPS 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 what the partners were able to pull out from the TTTDM they organized.

Below is a table resuming the TTTDM on IPS that were held by the partners in 2021. All of them were held online due to the COVID-19 pandemic.

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

PPs	TTTDM IPS	TIN Role	Total No. Participants	Summary of the event
KIT	18th March 2021	Lead	18	Objective: Promoting innovation and digitalisation in manufacturing Methodology: Expert presentations and a virtual panel discussion Speakers: Both from the perspective of SMEs, large industry and academia.
PTP	18th February 2021	Learner	28	Objective: Foster awareness on innovative Internet of Things/ Industry 4.0 and overcome the gap in the transition of SMEs to Industry 4.0. Methodology: Discussions, workshops. Speakers: Pomurje Technology Park (PTP) and Strategic Development Innovation Partnership Smart Cities and Communities (SRIP PMiS) and technology providers (companies, members of SRIP PMiS).
HAMAG	27th May 2021	Learner	42	Objective: Present the concept of IPS, its impact on manufacturing and share Best Practices. Discussion stressed an importance of infrastructure (big data collection, wi-fi network, servers, data etc.), lean systems and database connection as preconditions for the intelligent production systems deployment, collaboration with academia and requirements for financial instruments and calls designed for high tech SMEs. Methodology: Introduction on CEUP2030, Presentation of Croatian EIT Manufacturing Hub, Technical panel, Round table, Questions. Speakers: Croatian EIT Manufacturing Hub, Department of robotics at Faculty of Mechanical engineering and Naval Architecture, University of Zagreb, Croatian companies such as HighSpeed

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				Tech -HSTec Ltd, Končar -power transformers Ltd, a consultant at Ministry of regional development and EU funds.
SIIT	16th July 2021	Learner	31	Objective: Provide insights on Data management in Urban Mobility with industrial and practical cases Methodology: Introduction on the territory in IPS, Presentations from Companies on potential Applications, Discussions. Speakers: SIIT and Companies (AlgoWatt, Trafficlab, On Air, CNR, Aitek).
AFIL	22nd July 2021	Core	42	Objective: Highlight the importance and the current challenges of Additive Manufacturing as Intelligent Production System by showcasing real applications of Additive Manufacturing in SMEs and Large Enterprises. This could help SMEs and research centresto invest in CAMI4.0 technologies and solutions, de-risking private investments and boosting the development and implementation of ideas in a collaborative context, mixing regional capabilities and competences Methodology: Introduction on IPS, AFIL and CEUP2030, Presentation of 5 industrial use-case, Discussion on Vanguard Initiative activities on Additive Manufacturing, Q&A session. Speakers: AFIL and Higher Education and Research Centres (Università di Pavia and Politecnico di Milano) and Companies (ABB, Streparava, GFM, Camozzi, Tenova)
PIA	15th June 2021	Learner	37	Objective: Showcase different initiatives, businesses and approaches in IPS. Methodology: Presentation of CEUP 2030, Presentations of initiatives and companies in the area of robotics and Q&A, Short discussion about needs and policy instruments Speakers: Companies (EOS, Cubicure GmbH, MEDS, Miba, TietoEVRY, Lixtec)
PBN	17th November 2021	Core	26	Objective: Enhance the exchange among different stakeholder groups on IPS. Methodology: Presentation of CEUP2030 focusing on IPS, Introduction of DanubeS3Cluster, Presentation of Future plans of PBN/am-LAB,

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				Presentation of the Flagships projects in IPS, Q&A Sessions. Speakers: PBN/am-LAB
KPT	30th September 2021	Core	18	Objective: The meeting took place in frame of the inaugurating conference of the Vanguard Initiative in the topics of efficient production system and artificial intelligence Methodology: Presentation of CEUP2030, External Panel in AI field, Presentation of use cases, Q&A sessions Speakers: Brainport, Polish Academy of Sciences, AFIL
IWU	15th July 2021	Learner	42	Objective: Raise awareness on additive manufacturing processes with which individual functional elements (sensors, actuators, conductive tracks, antennas) can be applied to complex and very large 3D components in variable locations without additional tooling, template and assembly effort. This workshop offered industry representatives and users the opportunity to discuss the economic and technological potential of the technology in direct dialogue with experts from research. Methodology: Presentations on different aspects of functional printing, polling & discussion Speakers: Experts from research
PRO	29th November 2021	Core	43	Objective: 7 high level talks from researchers and industries discussing the status quo of the technology and future shaping products should showcase the necessity to invest in IPS. Methodology: Introduction highlighted the importance between Robotics and AI within intelligent production systems, Expert Presentations, Round Table & Discussions. Speakers: National Administration, Companies (SRW, ROWA Automation GmbH, STÄUBLI TECSYSTEMS GmbH, KUKA Deutschland Gmbh, Schmachtl GmbH & Universal Robots (Germany) GmbH

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4.1.1. Technologies and Applications discussed

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 Intelligent Production Systems, 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.

4 sub-topics have been defined for IPS:

- **Smart Sustainable Manufacturing**
- **Production in the domain of big data**
- **Additive Manufacturing based hybrid process chains**
- **Scalable Flexible Manufacturing**

In Figure 9, we can see the sub-topics mentioned by each partner's TTTDM.

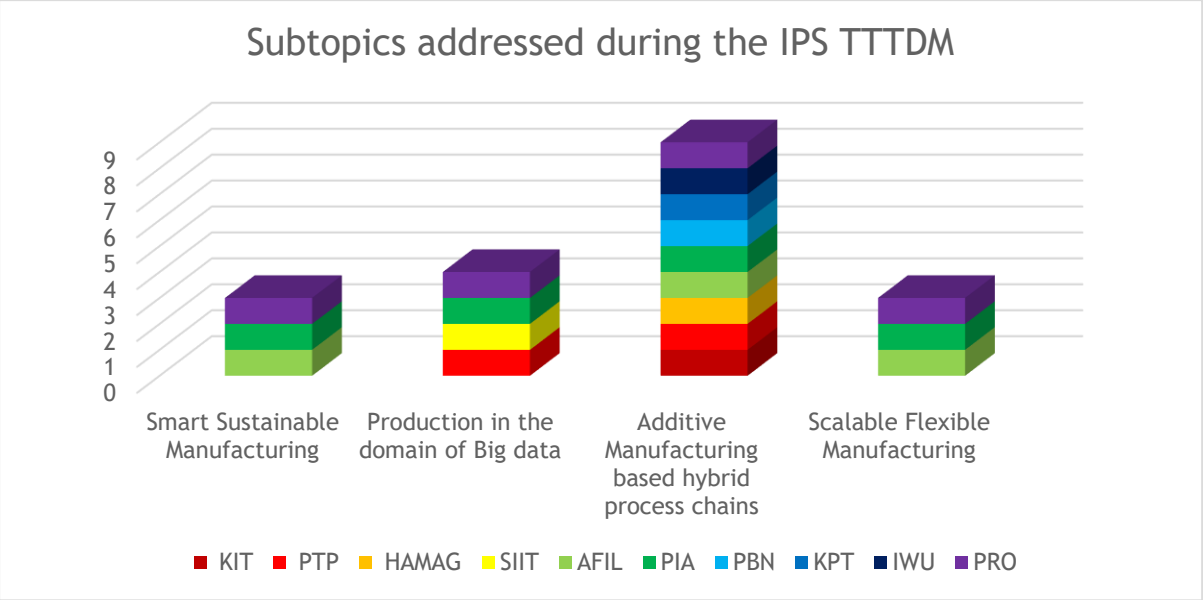

Figure 9 - Topics mentioned during the TTTDM (Source: Author generated from IPS TTTDM reporting, CEUP2030, 2021)

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

Smart Sustainable Manufacturing	Production in the domain of big data	Additive Manufacturing based hybrid process chains	Scalable Flexible Manufacturing
3	4	9	3

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

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

Name of the Partner	Topics addressed through presentations from experts
KIT	„Industry 4.0 – State of the art, standardisation and use cases „ Dr. Dominik Rohrmus , Labs Network Industrie 4.0 „Towards High Resolution Multi-material Inkjet Printing“ Dr. Steffen Scholz, Karlsruhe Institute of Technology (KIT) „Advanced Manufacturing - Advances in the automotive industry“ Aileen Hofer, Mercedes-Benz AG
PTP	NOMNIO d.o.o. - NOMNIO SMART WATER SYSTEM Optifarm - ICT Horizontal Network - Open system for digitalization of municipalities - Presentation of the open single mobile application IIBA - Innovative IoT (Internet of Things) / Industry 4.0 solutions Iskratel d.d. - Digitalization Smart City Solutions Telekom Slovenije d.d.- IoT services for municipalities, including city card and e-supply 3PORT d.o.o. - Ensuring constant air quality Robotina d.o.o. - Connecting machines, people and processes A1 - Solutions for the digital transition of the economy and society
HAMAG	Presentation of examples of Intelligent Production Systems Intelligent Production Systems (Prof. Bojan Jerbić, PhD, Faculty of Mechanical Engineering and shipbuilding University of Zagreb) Examples of intelligent production systems manufactured in Croatia (Dr. Iva Papeš, HSTec d.d., Zadar Intelligent production systems in discrete production (assistant professor Žarko Janić, PhD, Končar - Energetski transformatori d.o.o., Zagreb)
SIIT	Presentations on: Data-driven planning for use der MaaS services Big Data: traffic analysis and innovative solutions Data driven statistical models for forecasting mobility data L.M. and simulation models oriented to Maas planification Deep learning and traffic monitoring for data collection
AFIL	Thematic Priorities and Interests of Lombardy in Additive Manufacturing - Additive Manufacturing for mass and sustainable production Luigi Semeraro - ABB

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	- Additive Manufacturing for the customization and functionalization of parts Renato Cotti Piccinelli - Streparava - Additive Manufacturing for the recovery of worn parts with high added value Francesco Stortiero - GFM - Additive Manufacturing for the production of large parts Mirco Chiodi - Camozzi - Processes for the production of powders Enrico Malfa - Tenova - Opportunities from the Vanguard network - The 3DPrinting Pilot Bianca Maria Colosimo - Politecnico di Milano
PIA	Dr. Marius Lakomiec, Team Manager Digital AM Solutions at EOS ' Decentralized manufacturing: Opportunities & Challenges ' Digital manufacturing: Automation and software in the additive manufacturing environment. ' Practical examples, insights into EOS and various projects from the industry. Dr. Markus Pfaffinger, COO, Cubicure GmbH ' Stable process windows - the interaction of process and material. ' Scalable additive manufacturing - from single part to series production ' Application example of hot lithography Gerold Meininger from MEDS and Gunther Hager from Miba ' Need for wireless condition monitoring in a moving system (Miba). ' The idea, the patent and the implementation (Miba and meds) ' Technical key points (meds) and business case (Miba) Peter Netolitzky, CRM Lead Solution Consultant at TietoEVRY addressed how smart products can be linked with smart services (e.g. predictive maintenance) and how product development can be designed with the help of data. Lukas Prager, Management Assistant, lixtec - dynamic light solutions ' Current challenges: Climate targets, light pollution ' Demand-responsive street lighting as a solution: application areas, technologies ' Smart product lixtec sensor solutions: Description of solutions, empirical values, outlook

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PBN	3D printing (Boldizsár Könczöl- computer science engineer) CGI animation (Boldizsár Könczöl- computer science engineer) 3D scanning (Ferenc Tolner-Production and Innovation manager) AR technology (Ádám Takács, Electric engineer & Innovation manager) Robotics solutions (Patrik Haraszti-Robotics Technician)
KPT	The Vanguard Initiative as a cooperation tool on the European agenda - Wim de Kinderen, Brainport Can cooperation with the Vanguard bring tangible results? - dr Maciej Guzik, Polish Academy of Sciences Cooperate with the Vanguard Initiative. About pilot projects - Giacomo Copani, AFIL Domenico Guida, ART-ER
IWU	Vision for Application & State of Research at Fraunhofer IWU - Moritz Frauendorf, Fraunhofer IWU
PRO	Austria Wirtschaftsservice Gesellschaft mbH - Jasmin Moradzadeh, - "Emergence, Objectives and Offerings of the Austrian Marketplace for Artificial Intelligence". ABB AG & SRW Automation & Service GmbH - Andreas Stummer (SRW) - "Virtual commissioning with a "batch size 1" automation" ROWA Automation GmbH - Hermann Wallner - "Simulation / digital twin" STÄUBLI TEC-SYSTEMS GMBH ROBOTICS - David Kittl - "The robot system as a central mechatronic link in modern manufacturing" KUKA Germany GmbH - Benjamin Todt - "Automated gas-shielded welding: robotics in small and medium-sized businesses and the skilled trades" Schmachtl GmbH & Universal Robots (Germany) GmbH Florian Hamza - "Flexible welding with lightweight robots". PROFACTOR GMBH - Christian Wögerer - "Can a humanoid robot help and motivate people?"

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 Robotics.

For each sub-topic identified regarding IPS, key presentations were given:

- **Smart Sustainable Manufacturing.** For instance, AFIL experts mentioned Mass and Sustainable Production, PIA's experts talked about energy saving and reducing light pollution.
- **Production in the domain of big data.** For instance, SIIT's experts focused on MaaS services, PTP mentioned the use of Data through Internet of Things (IoT), PRO's experts talked about digital twins and simulation.

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- **Additive Manufacturing based hybrid process chains.** This subject is the most mentioned one as 9/10 partners directly mentioned it through the intervention of their experts. For instance, KIT's experts mentioned Inject Printing, PBN's expert talked about 3D Printing, PRO's experts observed the use of Robotics in Modern Manufacturing.
- **Scalable Flexible Manufacturing.** For instance, AFIL's experts talked about Additive Manufacturing for the customization and functionalization of parts, PIA's experts about Scalable additive manufacturing from single part to series production.

Through this virtual environment, the speakers provided plenary presentations on cutting edge topics in the area of Intelligent Production Systems, as described previously. Below in Figure 10 to 18, you can see some examples of such subjects which were discussed presentations and exchanges:

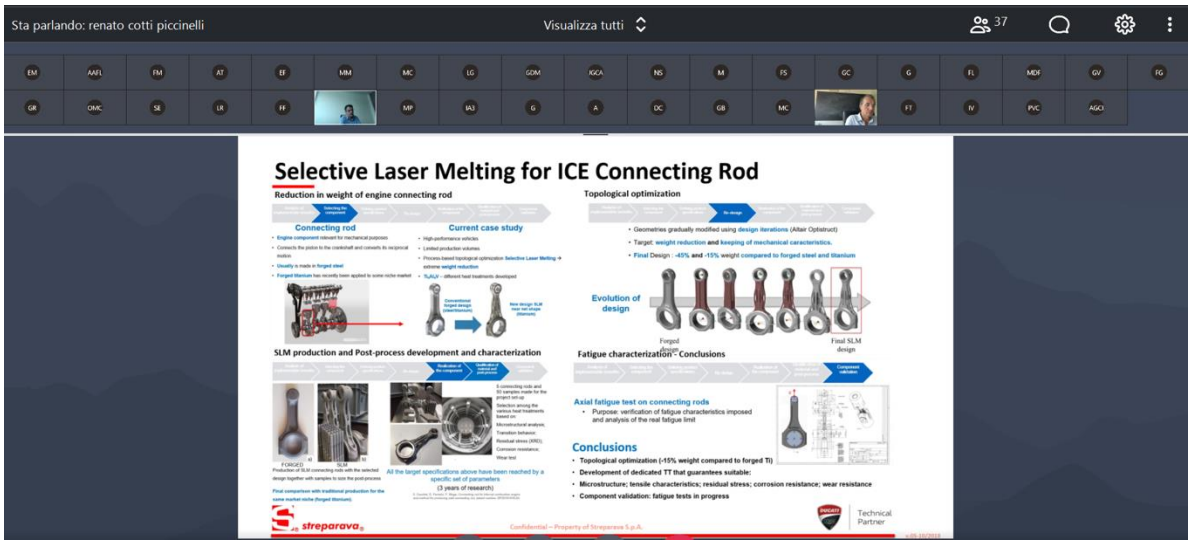

Figure 10 - Presentation from AFIL (Source: AFIL, CEUP2030, 2021)

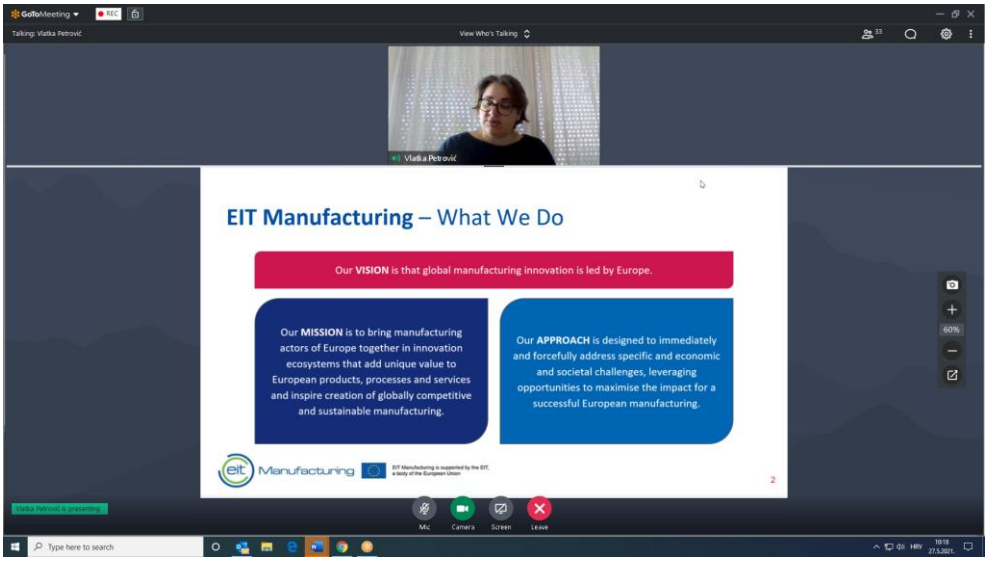

Figure 11 - Presentation from HAMAG (Source: HAMAG, CEUP2030, 2021)

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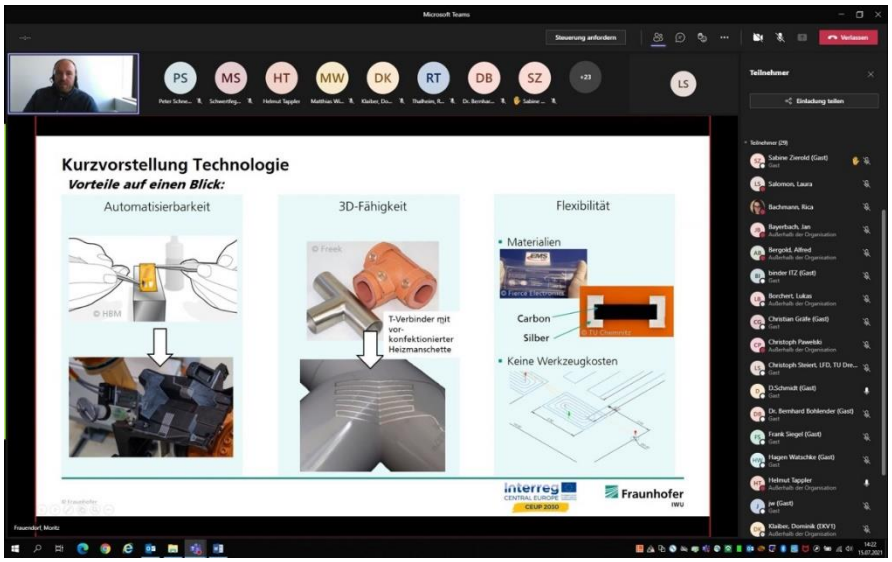

Figure 12 - Presentation from IWU (Source: IWU, CEUP2030, 2021)

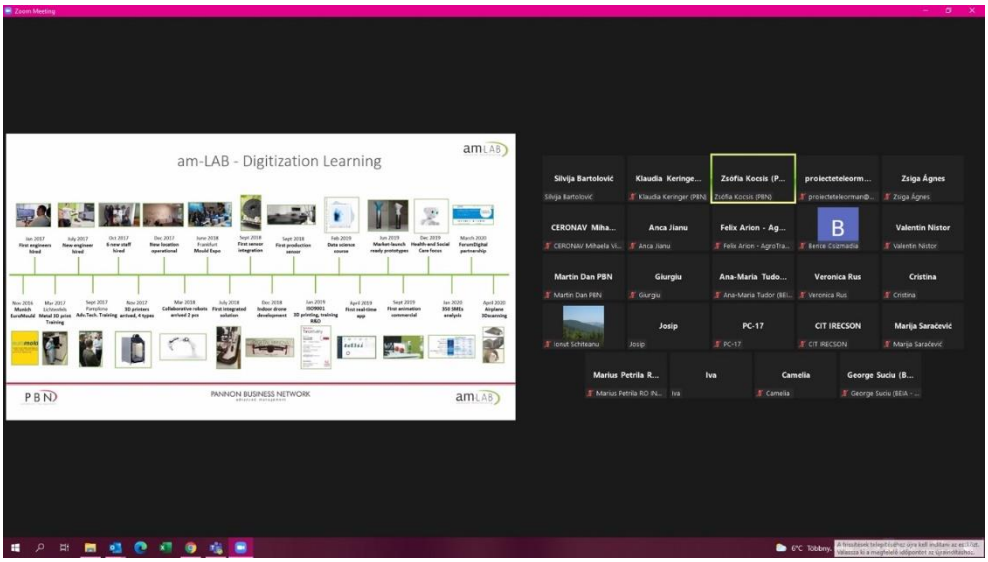

Figure 13 - Presentation from PBN (Source: PBN, CEUP2030, 2021)

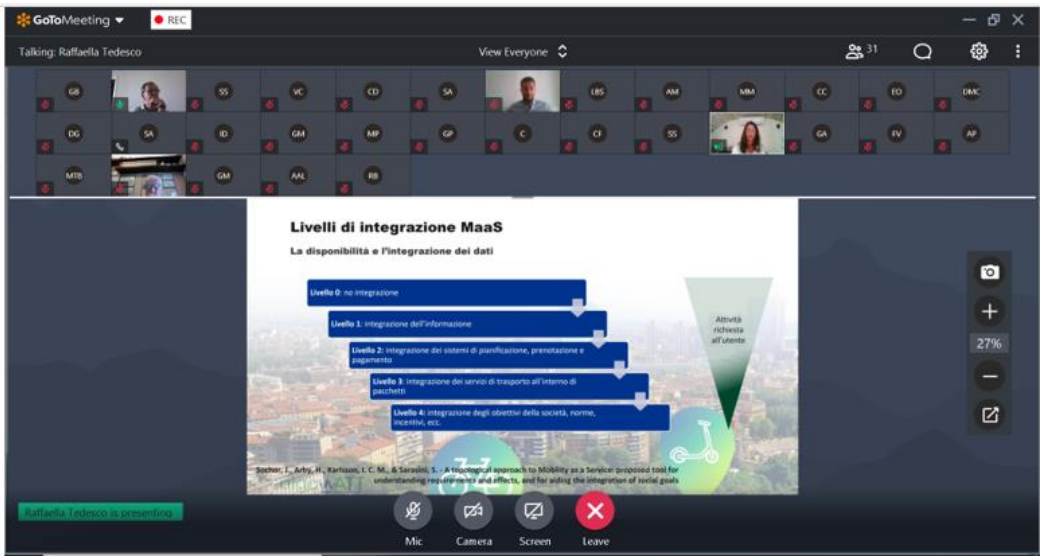

Figure 14 - Presentation from SIIT (Source: SIIT, CEUP2030, 2021)

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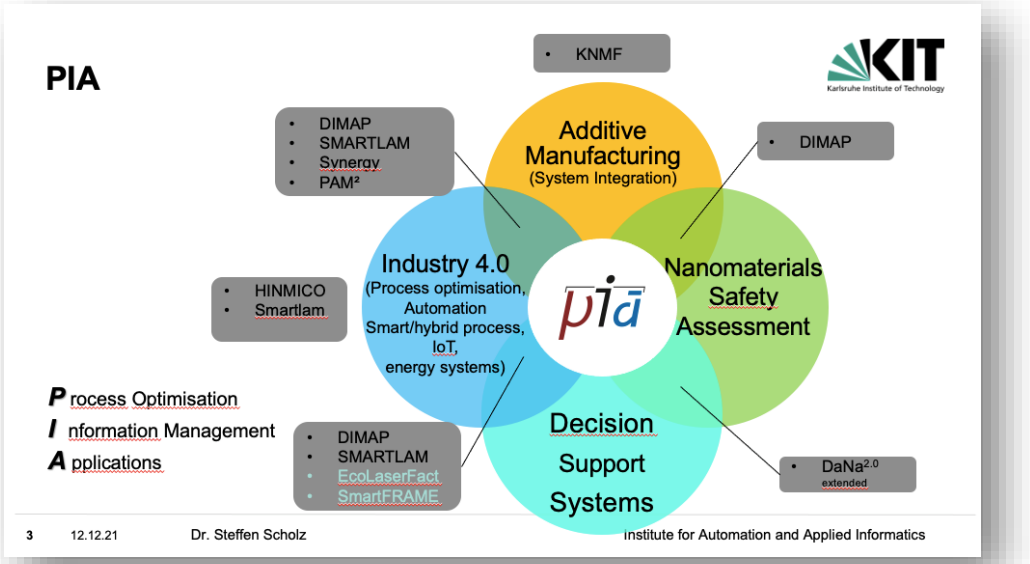

Figure 15 - Presentation from KIT (Source: KIT, CEUP2030, 2021)

4.1.2. Key Outcomes of the TTTDMs on IPS

The TTTDMs created a space for reflection and also a forum to identify needs to foster in future cooperation projects.

First, most of the partners thought that their TTTDM enabled a better understanding of the full ecosystem and enhanced future cooperation. Indeed, for instance HAMAG expressed the need to emphasize the link between SMEs and Academia and AFIL the link between Research and Industrial Actors. Therefore, mainly partners are willing to strengthen relationships between different types of stakeholders and raise awareness on potential cooperation between them on IPS solutions.

Building on the previous statement, a need to support SMEs especially in their transition to Industry 4.0 and towards IPS solutions integration (PTP) including digitalization, was also identified. Therefore, SIIT raised an interest of fostering the acceptance of Industry 4.0 and raise awareness on IPS topic. Also, SMEs should have access to more financial instruments to encourage them to start the changing process. In this objective, HAMAG mentioned the need to support employee's education to enhance not only decision-makers' understanding but also all the employees who will take part of this transition. It seems very crucial that everyone understands the benefits of digitalization and the benefits from IPS solutions in optimizing the processes and that everyone work with each other to enhance this change. And therefore, partners need to foster exchanges especially between the different types of stakeholders (AFIL)

To foster this change towards digitalization, a few recommendations were made. First, it is important to share best practices and initiatives to be able to build upon what has already been done. Then, there is an urgent need to identify the major challenges that hinder the development of innovative solutions. Finally, DIHs have a major role to play in enhancing this change towards Industry 4.0 and digitalization (PBN) and therefore they should raise awareness on their activities and capabilities to support businesses in their transition phase.

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Therefore, the main outcomes have been collected and reported on the following table:

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

OUTCOMES	BENEFITS
Identification of regional expertise and competences	Thanks to experts talks including Round Tables, the audience and the full partnership were able to better understand the full ecosystem in IPS. This was very useful to be able to forecast trends and answer and face current needs and challenges. Sharing best practices, providing insights on progress and status in IPS should facilitate inter-regional collaborations and initiatives, well beyond CEUP2030 project.
Awareness of IPS impacts at industrial level	The sharing of best practices specifically focused on industrial ecosystems allows to give concreteness to innovative proposed solutions, attracting SMEs and enterprises to invest on the topic. It was showcased in a few presentations the need for SMEs to get onboard in the topic of IPS. Furthermore, for public administration and academic & research stakeholders, TTTDMs represented the opportunity to understand the real needs of industries and to create innovation supporters out of them. It is crucial that future cooperation focus on answering current trends and challenges that were identified through the presentations during the TTTDM.
Raise awareness on key challenges in the IPS sector	The expert panels enabled not only to create a better understanding of the current ecosystem regarding IPS technologies but also to express the current key challenges. For instance, a special need to develop skills and competences on IPS has been identified. Moreover, specific support for SMEs in their transition towards IPS models need be defined and further developed.
Awareness on current opportunities	To answer these market needs, it has been showcased that all types of stakeholders need to be involved and engaged. Therefore, current cooperation could focus on showing and discussing the current opportunities on IPS solutions to understand their effectiveness and how to include and implement new policy tools in future programmes. Raising awareness on existing supporting instruments is the first steps to build a joint transnational strategy supporting IPS transition and be able to fill in the gaps. Therefore, it is crucial that Policymakers not only raise awareness on current funding opportunities but also are aware of current needs and challenges so they can develop appropriate supporting strategies and funding opportunities.
Creation of active networks and communities	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 IPS.

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4.1.3. Key Lessons Learned

Following the TTTDM events, partners had to reflect on the lessons learned. During the TTTDM, PPs and their experts tried to showcase the current trends and applications of mainly companies and research centres in the IPS field. These speakers mainly showcased their best practices while communication on their needs and challenges. The overall objective was to provide evidence on the benefits that can be brought thanks to IPS-driven solutions in terms of process efficiency, predictive maintenance of technologies and products, support for operators, quality of outputs, etc. Thanks to Round Tables and Interactive Discussions, a common understanding was built on IPS opportunities and challenges for both SMEs and Large Enterprises. Therefore, through the experts' presentation and the open discussions, different lessons learnt have been collected

First, there is a need to foster this type of events or at least to enhance exchanges between different types of actors on the field of IPS. These TTTDMs showcased different types of initiatives and enable participants to identify key stakeholders (IWU) to build upon future cooperation. Thus, all these exchanges have a common purpose which is to enhance cooperation activities and raise awareness on the benefits of Industry 4.0 especially for SMEs.

Therefore, enhancing digitalization is a current key challenge to be able to further develop and implement IPS solutions. Indeed, even though a wide interest for innovative projects have been identified (KIT), there is a crucial need to integrate more SMEs and decision makers (PTP). Fostering this integration should enable more harmony on funding opportunities aimed at innovative SMEs.

Finally, skills and competences need to be fostered to support employees working in or with Industry 4.0 (HAMAG). In this objective, specific offers aimed at improving digital competences need to be developed and to be communicated to as many stakeholders as possible (PBN).

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 IPS TTTDM reporting, CEUP2030, 2021)

Strengths	Weaknesses
• The online format enabled partners to reach a wider number and types of participants and from further countries in case of workshops held in English language. • The introduction presenting the CEUP2030 project and defining IPS was very useful as there is a real need in increasing awareness on this topic IPS. • Presenting current initiatives through the implication of SMEs and companies was very relevant as it enables the ecosystem to connect and for the Policymakers to understand market	• The online format due to COVID-19 hindered open-talk and therefore trust for future cooperation. It has been demonstrated that physical events facilitate the exchanges especially starting new interactions. • In general, online events hinder direct cooperation and talks. It is emphasized by the fact that only the speakers have their cameras on and therefore the audience can't see the other participants. • Online events make it harder for participants to participate even if the

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needs and be able afterwards to build appropriate supporting opportunities including funding. • In this objective, Round Tables enabled experts to express their opinions and point of view on IPS solutions and engage discussion. • Q&A sessions enabled the participants to raise their questions and concern regarding IPS which was even more relevant for this topic as it is one of the 4 central CAMI Topics (AI, Smart Materials, IPS, Automation and Robotics) and it required the most raising awareness efforts to the full ecosystem. • Videos were implemented by a few partners which was a good way to catch attention of the participants. Indeed, changing the format of presentation during the event enabled the participants to refocus on the event • Quizzes and surveys through Mentimenter/ Zoom Survey enabled not only the organising PP to better understand and categorize their participants in terms of countries/ types of organization/ opinions on the topic of IPS but also enabled the participants to take part in the event and feel directly involved in it. • Regarding the speakers, this type of event enables them to broaden their network, being able to be reached afterwards by not only the other speakers but also the audience.	event allowed them. For instance, even though most of the partners implemented Q&A sessions, it is harder for participants to asks their question as they don't have an overview of the audience. • A lack of involvement from Public Administration has been noticed which needs to be fostered to understand the ecosystem and raise awareness on current strategies and funding opportunities especially targeting SMEs. • Providing a strong and detailed agenda enhances participation of interesting and relevant stakeholders. Indeed, providing knowledge on what is going to be discussed enabled the participants to know exactly if the TTTDM fitted their interest and needs and therefore enhanced qualitative exchanges. It would therefore be recommended to issue detailed Agendas for further exchanges to gain in quality in the networking sessions.

4.1.3.2. Content of the TTTDMs

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

Strengths	Weaknesses
• The topic of IPS was well defined and discussed from the start of the TTTDM to enable the full audience to understand the experts afterwards. • Experts were invited to talk about IPS on specific topics such as Additive Manufacturing, Big Data and 3D Technologies. The TTTDMs facilitated the full ecosystem to build a common	• More focus on IPS solutions needs to be fostered. There is still too little knowledge and connections in the ecosystem especially between different types of stakeholders who should work together to enhance the appearance of IPS solutions. However, these types of events (TTTDM) provided a good start for all these stakeholders to engage

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understanding on specific topics included in IPS field. • The TTTDMs not only facilitated the construction of a common understanding but also enabled to raise awareness on key challenges such as the need to increase the skills in IPS field. There is a need to foster and create trainings services to support employee's education. • The TTTDMs also enabled the concerned DIH to raise awareness on their activities and for them to foster their understanding while building new offers. • The TTTDMs not only start building a common understanding on the needs and challenges of IPS but also raise acceptance of this new field and trend.	discussion and foster common understanding on the topic of IPS. • These TTTDM should have more focused on raising awareness on potential funding opportunities to implement IPS solutions.

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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 IPS TTTDM events showcased the relevancy of communication to foster common understanding towards the subject of Intelligent Production Systems, 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 16 - 5 Key Takeaways (Source: Author generated from IPS TTTDM reporting, CEUP2030, 2021)

First, there is generally a great interest in Industry 4.0, and therefore exchanges should be fostered to enhance understanding and identify key partners to build new cooperation.

Second, a need to support SMEs especially in their transition towards Industry 4.0 and IPS solutions are crucial. SMEs have a lot to gain by implementing Industry 4.0 concepts but also a lot to lose as they have less resources than bigger companies. It is crucial to support SMEs by providing testing facilities to learn about how to functionally adopt these intelligent production systems before they invest; for example, where will additive manufacturing techniques bring them added-value, to understand where flexible production systems can be implemented to improve their efficiency, and to utilize big-data or intelligent data-mining for advancing their own business model. Plus, there is a need to generally raise awareness on support-centres for accessing this type of test-before-invest activity, such as DIHs activities.

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Therefore, to enhance future cooperation, events such as the TTTDM need to be implemented on a regular basis to make sure that partners exchange on current projects and initiatives and on best practices on IPS. Through the implementation of the TTTDM, it has been demonstrated that these events need to not only have expert presentations but also find ways to include the audience into the discussion through round tables, networking sessions, surveys, etc. This should enhance the integration of a wider audience and therefore should emphasize the connection between key stakeholders through a better understanding of the ecosystem.

Then, to accelerate the changing process, it is crucial to not only raise awareness on potential funding opportunities but also to develop appropriate funding schemes to support SMEs in their digital transformation and in their appropriation of IPS solutions. Therefore, again communication and exchanges are key to enhance understanding between the stakeholders and especially between different types of stakeholders such as Decision makers and SMEs.

Finally, to support the changing process, it is key to develop understanding and therefore competencies of individuals regarding IPS and Industry 4.0 topics. Therefore, offers should be developed and awareness should be raised on these services to accelerate the process. It is therefore key to enhance cooperation between service providers and SMEs to enable SMEs to be aware of what is available and for service providers to identify the market needs.

5.2. Connection to Flagships project

The IPS TTTDMs were also aimed at supporting the definition, development and submission of the IPS flagship projects. For each topic including IPS, 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. KIT coordinated the activities within the partnership and it was anticipated that the TIN leader together with the identified core partners IWU, PRO, PIA, PTP will be defining and submitting IPS flagship projects.

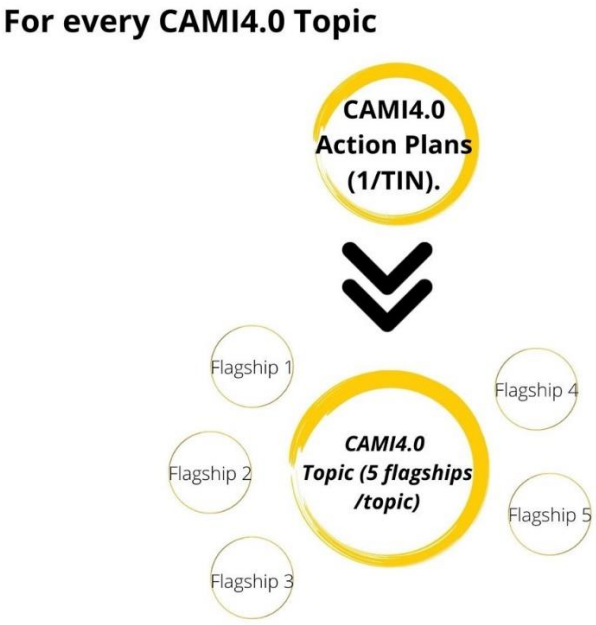

Figure 17 - Actions to deliver 5 Flagships project/ TIN (Source: DT3.3.1, CEUP2030, 2021)

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The table below summarize the Flagship/ Use Case from Partners included in the TIN IPS:

Table 12 - IPS Use Cases/ Flagships (Source: DT1.3.3, CEUP2030, 2020)

Partners' Name	Flagship/ Use-Case name	Short description	Policy Instrument
KIT	Next Generation Factory Pilot Lines	Realization of implementing a manufacturing process chain that is capable of achieving production of products with a lot size of 'one' while still using mass production methodologies.	Horizon Europe
IWU	PRO Future	Creation of a cluster aimed at fostering digitalization of industrial production (Industry4.0), targeting the whole value chain and company processes focusing locally on the new German federal states (Saxony, Saxony-Anhalt, Brandenburg) and SMEs in the region.	Clusters4future of the BMBF (German Federal Ministry of Education and Research)
PRO	EDIH - ASSIST4SME	EDIHs offer services such as): Test before invest, Skills and training, Support to find investment, innovation ecosystem and networking.	Part National Financing/ Part European Financing via the Digital Europe Programme
PIA	Share4.0 – SK-AT	Establish a strategically sustainable, result-oriented cooperation of the key actors from all participating regions for a Smart Industry Network SK-AT. This is done by establishing a practicable, coordinated working basis regulated by a cross-border governance model for research and innovation.	Interreg V-A Slowakei – Österreich 2014- 2020; Ministry of Agriculture and Rural Development of the Slovak Republic.
PTP	Smart Factory Demonstration Center	Slovenia is slowly catching on more developed countries with established demo/pilot plants or	Multiple: National funds such as (LEARNING MANUFACTURING

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		centers. For knowledge transfer, it would make sense to establish links between similar centers in CE (test before invest physical plant).	LABORATORIES (1,5 m€ from March 2021 on) SIO (2020-2022)) + ERDF Funds, such as (HORIZON-CL4-2021- TWIN-TRANSITION- 01-07: Artificial Intelligence for sustainable, agile manufacturing (IA) HORIZON-CL4-2021- DATA-01-03: Technologies for data management (IA) HORIZON-CL4-2022- DATA-01-04: Technologies and solutions for data trading, monetizing, exchange and interoperability (IA) 184)
PBN	Purchase of autonomous production line(Teaching and Learning Factory) and smart material board and further developments	The Teaching and Learning Factory "TLF" (cyberphysical factory) is a manufacturing unit with online, remote access to broaden cross-border services directly related to digitization competencies of the partners. The topics data science, autonomous robotics and 3Dprinting are integrated, enabling stakeholders to provide internationally competitive research and training infrastructure.	Interreg V-A Austria-Hungary Cooperation Programme 2014-2020; Interreg Central Europe Programme

5.3. To build upon the Common Policy Use Case in IPS

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 IPS as shown in the figure below. Indeed, we observed a great common interest on Additive Manufacturing including 3D printing for instance. 9/10 of the partners introduced strong knowledge through experts on this sub-topic. Data Management towards Intelligent Production Systems seems also to represent a great interest for the partners as almost half of them focused on it during their TTTDM. An interesting outcome is however the lack of focus on Smart Sustainable Manufacturing during the TTTDM that could be fostered in future actions.

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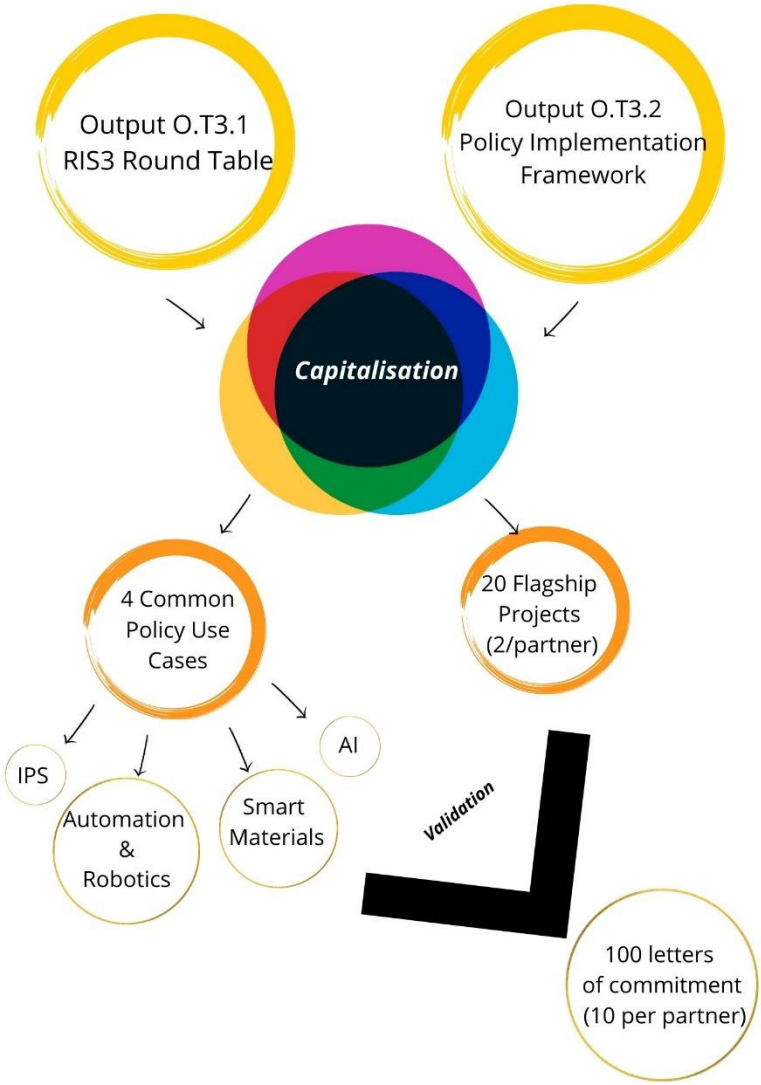

Figure 13 - Overview of WPT3 (Source: DT.3.3.1, CEUP2030, 2021)

To build the Common Policy Use Case as part of WPT3 activities, not only should the members of the IPS 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 14. IPS TIN Strengths & Resources (Source: DT1.3.3, CEUP2030, 2020)

Partner Name	Resources and Capabilities for IPS	Strengths and Competencies for IPS
KIT	• Large advanced manufacturing laboratories • Hybrid process chain development pilot lines including 3d printed, robots control systems etc. • Large scale energy infrastructure in the form of ENERGY LAB 2.0 • Large part and process characterisation facilities	• Process optimisation • Information Management • Additive manufacturing and functional 3D printing • Database management • Part and process characterisation • Precision Process development for metal additive manufacturing

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IWU	• E3 research factory for resource-efficient production • Applied expertise in embedded sensors and actuators through industry- relevant projects • 3D printing • Good regional involvement in research and industry	• Skills in topics related to I4.0 and mechatronics • Offer workshops and project pitches for ideas on smart production • Testing components for I4.0 solutions • Possibility of close partnership with industrial partners and joint research
PRO	• App. 50 high skilled researchers in production research • App. 100 Industrial partners • App 25 research partners	• 25-year experience in production research • 130 EU projects in production research, app. 300 national funded projects
PIA	• 4,8 FTEs working towards enhancement of Industry 4.0 in Austria • Well established structures and different formats • Pool of 700 experts to be involved in work regarding the topic	• High level of expertise through members • Functioning system regarding the exchange of good practices and experiences • R&D Roadmap, created collaboratively with industry & science partners

PTP	• None „in-house“
	• PTP acts as intermediate and links SMEs with needs with most competent solution providers and strives to find funding options (no fixed cost of staff or infrastructure);
	• Networks of partners and competences:
	  • DIHs-international,
	  • SRIPs-national,
	  • Tech parks networks)
	• Trainings in soft skills like LEAN / coaching & Tailor-made solutions for SMEs
	• Consulting management and help at tender applications for SMEs
		• Versatile and transnational networks with partnering institutions
		• Various trainings (where & when needed external competent lecturers on contract)
		• We strive to find funding options for both parties (SME with need and solution provider)
		• Wide network of production companies (target market to implement big data analytics and sensors)

PBN	For 3D polymer and resin- based printing available technologies at am-LAB: • Ultimaker 3 Extended • Extreme Builder 1000 • Prusa i3 MK2 • Formlabs Form 2	• 3D polymer and resin -based printing • Cooperation in flexible, agile short supply chain management • Research on re-used filament technology together with university laboratory

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Moreover, 4 specific sub-topics were pulled out in this topic IPS as mentioned in the Section Results:

- **Smart Sustainable Manufacturing** defined as a method for manufacturing that minimizes waste, minimizes energy usage and reduces the environmental impact of the whole manufacturing process chain.
- **Production in the domain of Big data** to deal with storage, organization, and analysis techniques developed for massive data sets.
- **Additive Manufacturing based hybrid process chains** to create innovation in production as well as in product itself.
- **Scalable flexible Manufacturing** described a complete process chain that is capable of adapting to changes, be it either due to changes in demand, supply, design etc. or changes inflicted by changes in external conditions such as policy, crisis etc.

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 IPS sector:

Table 15. SWOT on IPS CAMI 4.0 Topic (Source: DT1.3.2, CEUP2030, 2020)

Strengths	Weaknesses
1. A lot of overlaps in needs 2. A large interdisciplinary, international network with potential for exploitation of complementarities 3. Experience in participation/creation of international projects/collaborations within the topic. 4. Ability to support each other to provide a balance. 5. Access to facilities, equipment, experts etc. as needed by the network for any joint cooperation. 6. Access to large external triple helix stakeholder networks. 7. Strong political contacts and networks 8. Rich catalogue of best practices and lessons learnt	1. Human resources availability dedicated to the project and its objectives are limited for some PPs. 2. Guaranteeing policy influencing stakeholder engagement for some PPs. 3. Competition from other already existing networks (e.g. ones created by regional governments) 4. Lack of a technical expertise within some topics of Intelligent Production Systems for some PP. 5. Satisfactory completion of all objectives, and achieving all goals expected without delays caused by Covid 19 or other unexpected circumstances. 6. Ensuring active engagement and participation of companies for participating in events, providing use cases or joining project consortiums is difficult. 7. Lack of an official mandate for Interreg projects on a regional/national level

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Opportunities	Threats
1. Creation of New project ideas on topics important for the PPs 2. Creating consortiums of PP and aiming for projects using regional, transregional or EU funding. 3. Strengthening links to the central/eastern European partners. 4. Turning COVID-19 into an opportunity for sharing best practices on resilient production systems 5. European DIHs 6. New Interreg Programming period 7. Cascade funding for H2020 partnerships	1. Lack of follow up on the network after the project 2. Not reaching quantitative targets for engagement or participation 3. Failure to agree on common topics/projects of interests to collaborate on 4. High competition from existing networks/clusters in the region 5. Policymakers not aware of CEUP 2030 6. Overlaps of initiative, need to clarify our value proposition 7. Future S3 strategy road mapping on national level not having awareness of the topic

All of this knowledge should enable the TIN IPS 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 IPS solutions.

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 IPS. Therefore, the purpose of this document was the reporting of the TTTDM in IPS aimed at creating and fostering a common understanding of the ecosystem in IPS solutions. Particularly, the TTTDMs organized by PPs have been detailed in terms of methodology, participating stakeholders, outcomes, and lesson learned.

In summary, 333 stakeholders from 7 countries were involved in expert workshops on Intelligent Production Systems. The workshops were held exclusively online, and utilised plenary presentation, round-tables, and live-surveys 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 IPS, from SME adoption of predictive maintenance technologies, to the utilisation of open-source resources to promote the functional use of big-data in industry. The TTTDM's validated that the sub-topics chosen by the partnership are relevant for the future of Intelligent Production Systems. In one area – sustainable production systems – there was less interest from the stakeholder community, however this could also be a great opportunity to foster it through further actions and may be through the definition of the Common Policy-Use Case.

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6.2. Next Steps

Partners need first to acknowledge all the progress made on IPS thanks to the TTTDM, the definition and submission of their flagships and the exchanges especially with the IPS TIN.

They now have to 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 IPS solutions.

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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	

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