JOINT STRATEGY FOR CAMI4.0 EXCELLENCE IN CE/EU COOPERATION

D.T1.3.2 – A report on the CEUP 2030 Strategy Implementation Blueprint

Version 4.0

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Document Control

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PP	Restricted to other programme participants	
RE	Restricted to a group specified by the consortium	RE
CO	Confidential, only for members of the consortium	

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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 Europe **A**dvanced **M**anufacturing and **I**ndustry **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 use-cases disseminated within the project, 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 pilot actions to promote a joint RIS3 for CAMI4.0 Excellence in CE/EU.

Report Context

The overall objective of the first portion of the project is to enhance skills, capabilities and knowledge of people in charge of local, regional and (trans)national Research, Technology and Innovation policies within the triple-helix context.

The challenge manifests in two sub-objectives which are:

(1) To train and empower people to work in the environment of new technologies (strategically and operatively) regarding policy-relevant decisions

(2) To pool a critical mass of trained stakeholders to generate sufficient power for policy-making and appropriate selection, adaption and fine-tuning of already proven tools, instruments and methodologies.

In order to harness the power of the pooled critical mass of trained stakeholders, and effectively empower people to work together to improve sustainable linkages among actors of the innovation systems for strengthening regional innovation capacity in Central Europe, the partners have endeavoured to create a vision and mission for the CEUP 2030 consortium. This initial strategic step, is known as the Strategic Implementation Blueprint. This report represents the first half of the Strategic Implementation Blueprint, called the Joint Strategy for CAMI4.0 Excellence in CE-EU Cooperation.

This report is based on, and aligned to existing CAMI4.0 strategic papers. The Partners drew inspiration from the work they have been involved in over the past programming period, in keeping with the vision of the Interreg Central Europe's experimental call on result capitalisation. This report describes the processes the Partners have worked on together to filter out the most practicable and future-robust strategies of the selected CE/EU project base, with a specific focus at each territorial level to demonstrate the unique approach to advanced manufacturing encompassed in strategy planning so far. The report showcases the

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vision, mission and key stakeholder network which will be harnessed to create and strengthen sustainable linkages on the topic of advanced manufacturing and industry 4.0. It also details the common basic vision and objectives for all the Trend and Innovation Networks, along with the specific partner composition, an analysis of key strengths, weaknesses, opportunities and threats, and the specific objectives for each Trend and Innovation Network.

The next steps of the Strategic Implementation Blueprint, is to formulate the Action Plan for CAMI4.0 Excellence in CE/EU Cooperation. The Action Plans are designed for a quick start of cooperation in the project on the CAMI4.0 topics, along with a future-robust approach which can develop into the Policy Implementation Framework for CAMI4.0 (WPT3). The Action plan will be based on a set of use-case pitched by each Partner to meet the specific objectives for the Trend and Innovation Networks, and overall anticipate and fast-track policy strategies to promote aligned S3/RIS3 for CAMI4.0 Excellence.

Audience

This document is directed at all stakeholders of the CEUP 2030 Partnership, and provides detailed insights on how the Partners plan their strategic outlook for the project, their thematic work within it, and the support it can bring to each Partner's territorial area, along with the transregional area of Central Europe. The appropriate status of this deliverable is reflected in the "Dissemination Level" table, on the Document Control page of this report.

The CEUP 2030 Partnership would like to invite all interested stakeholders to join in the project's extensive workshop series to continue discussions on the topics highlighted within this report. More detail can be found on the project's website, by contacting the Lead Partner, Krakow Technology Park, or by contacting the Partner operating in the region or country of your interest.

Change Control Procedure & Structure

The Deliverable Responsible: Karlsruhe Institute of Technology **(PP05)** created this report, which is hosted on the Project's common repository and on the Partnership's public website.

The document is under standard change control protocols whereby Partners are requested to give feedback on the draft version within five working days. Feedback will be incorporated and final version will be issued by KIT. Thereafter the PPs have five additional working days for any final comments. At any time, partners believe a project methodology should change, the request should be brought to the Deliverable Responsible (KIT/PP5) and the Work Package Leader (PTP/PP8) 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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1. Introduction

The European Union is the world's biggest exporter of manufactured goods, and is a global market leader for high-quality products (ManuFUTURE, 2019: 10). In an analysis of the economy of 45 regions in the European Union, manufacturing contributed more than 30.0 % of the non-financial business economy employment, largely concentrated in central Europe (Eurostat, 2020:12). 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. Though RIS3 sets strong signals: (1) the lack of transparency in access to knowledge and markets, (2) insufficient cooperation and linkages between the innovation actors in and between regions / countries, (3) missing policy alignments & cooperation; continues to create real challenges in the CE innovation eco-system.

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. Six of these excellent projects are highlighted in Figure 1

Figure 1 Overview of the Six Projects Capitalized during CEUP 2030 (Source: Consortium Generated)

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. Through these methods, Partners build action-oriented pilot projects to promote and capitalize on cross-regional collaboration good practice to promote regional innovation smart-specialisation added value in key technology areas: Intelligent Production Systems, Smart Materials, Robotics and Automation, and finally Artificial Intelligence. These action-oriented pilot projects or "RIS3 alignment Instruments" are used as a basis of providing evidenced-based recommendations to policy-makers, who are interested in ensuring that long-term development fit of policy-instruments sustainably meet the challenges and opportunities facing Central European manufacturing.

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1.1. Output and Project Context

In an effort to reach these objectives, the consortium built a Strategy Implementation Blueprint. The blueprint guides the Partner's efforts to develop meaningful action and exchange on the challenges facing Central Europe's manufacturing sector, with a focus on leveraging opportunities within the discipline of advanced manufacturing and industry 4.0.

Fundamentally the Blueprint has two parts, a joint strategy and dedicated use-case oriented action plans. Within the pages of this document sits the Joint Strategy, setting the vision and high-level working objectives for the Trend and Innovation Networks ("TIN"). The action plans follow by February 2021, and provides the Consortium's steps to improve, upgrade and implement their use-cases.

Across the project, the validation process takes place refining and integrating the partner's vision with the needs, concerns and future foresight knowledge of various stakeholders. The Partners will work to build a common vision on advanced manufacturing and Industry 4.0 for Central Europe's manufacturing future, culminating in the presentation of the Policy Implementation Framework. Through this process, each partner develops two RIS3 Alignment Instrument Pilot Projects (Twenty total). These pilot projects act as optimal models to promote cross-regional development and transnational collaboration in the area of Advanced Manufacturing and Industry 4.0. With these models the Partners move their reflections on excellent outcomes from the previous programming period, to a series of action-oriented pilots which engage with critical development. Together the Partners and their stakeholder network generate a sustainable transnational RIS3 ecosystem, aligned for action in the coming programming period. A visualisation of this process can be seen in Figure 2.

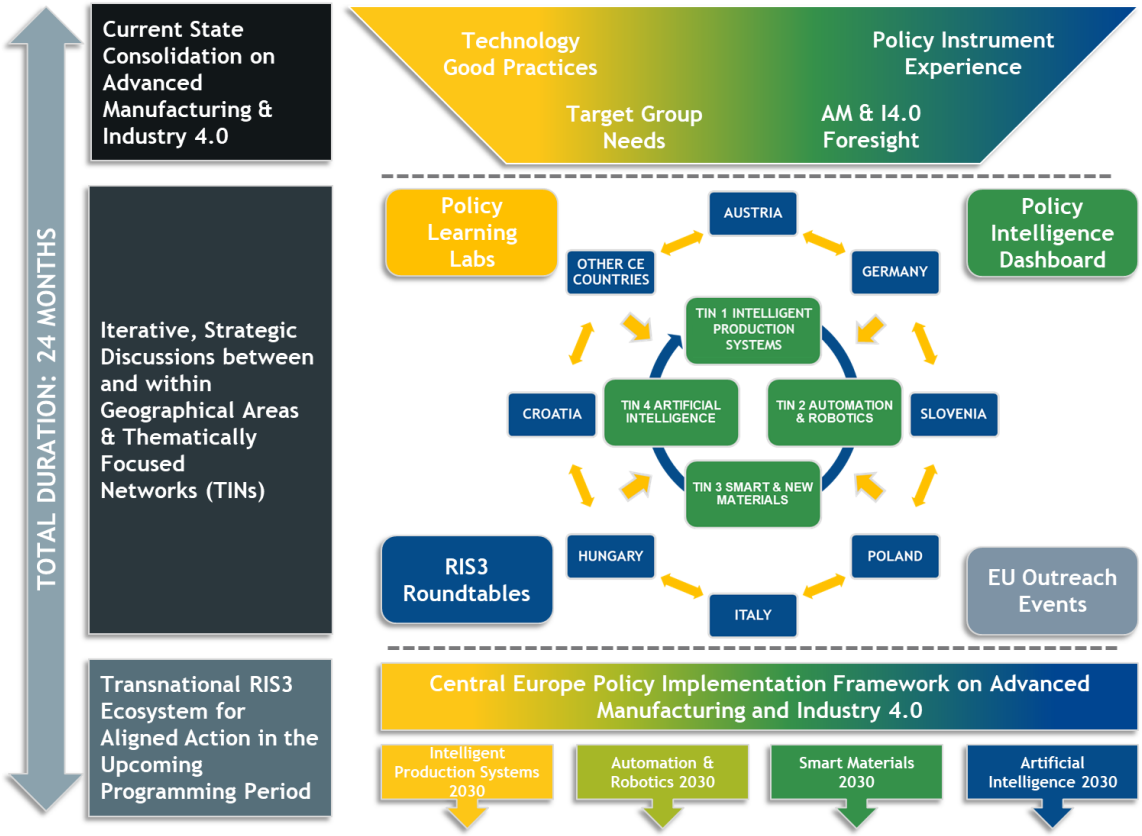

Figure 2 Project Design and Focus (Source: Author Generated)

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1.2. Methodology

The Strategy Implementation Blueprint, developed in CEUP 2030, acts as an input and impulse into a series of iterative, strategic discussions within thematically focused working groups (Trend and Innovation Networks), and within geographical areas. The strategic discussions occur across the full project, and therefore the blueprint acts as a guide. The guide essentially leads the Partners towards the creation and presentation of the CEUP 2030 Policy Implementation Framework, the project's strategic output, which is the culmination of the work fostered by the partners across the full project leading to a common vision for the CAMI4.0 topics, specifically, and Industry 4.0 in Central Europe, more generally.

The project follows and incorporated the following strategy building principle phases across the project:

- **Phase 1 - Building a Common Understanding** – this is characterised by a trust building and learning exchange process between the Partners and their stakeholder networks. Whereby each Partner explains their regional and national vision, along with the mission of their organisation to help deliver this vision.
- **Phase 2 - Strategy & Action Plan Formulation** – this phase is characterised by multi-lateral and bi-lateral discussions between the partners, and those defined as "TIN" Leaders, who will help facilitate cooperation in the project's key thematic focus areas. These discussions act as "Pre-TIN" activities, which allow each Partner to set their role associated to each working group, along with build their views into the objective setting for each thematic area.
- It is both expected and assumed in the project structure that these objectives and the associated action plans which are used to guide implementation of the objectives are working documents. With this status, they can be refined from the iterative discussions expected to emerge from November 2020 to November 2021.
- **Phase 3 - Strategy & Action Plan Implementation** – this phase has not begun, but will be embedded in the work of the TINs and the functional role of each Partner, whereby the Consortium builds and delivers on its objectives by taking meaningful steps towards the implementation of dedicated use-cases on the topics of advanced manufacturing and industry 4.0.
- **Phase 4 - Strategy & Action Plan Evaluation** – this phase is ongoing, and occurs as a by-product of consistent stakeholder dialogue. Within the final phases of the project, a dedicated recommendations document with evaluated use-cases will be produced.

The Strategy Implementation Blueprint ("Blueprint") sets a basis of common understanding between the partner regions involved in the project, on the four CAMI4.0 focus areas. It carries two aspects, (1) Joint Strategy and (2) Action Plans, containing PP use-cases for the four CAMI4.0 Topics. As previously described, the Blueprint sets a baseline for cooperation between partners, and will evolve through iterative discussions across the project.

Through these discussions, use-case ideas will be formalised with the development & implementation (in certain cases) of two RIS3 Alignment projects, which are used to monitor the sustainable development of the common model for each CAMI4.0 Topic. These projects will be marketed under the Policy Implementation Framework, which ultimately represents a strategy and action plan which have gained support and buy-in from policy-relevant stakeholders. A visualization of the entire strategy building process, from Blueprint to Policy Implementation Framework, described above can be found in Figure 3.

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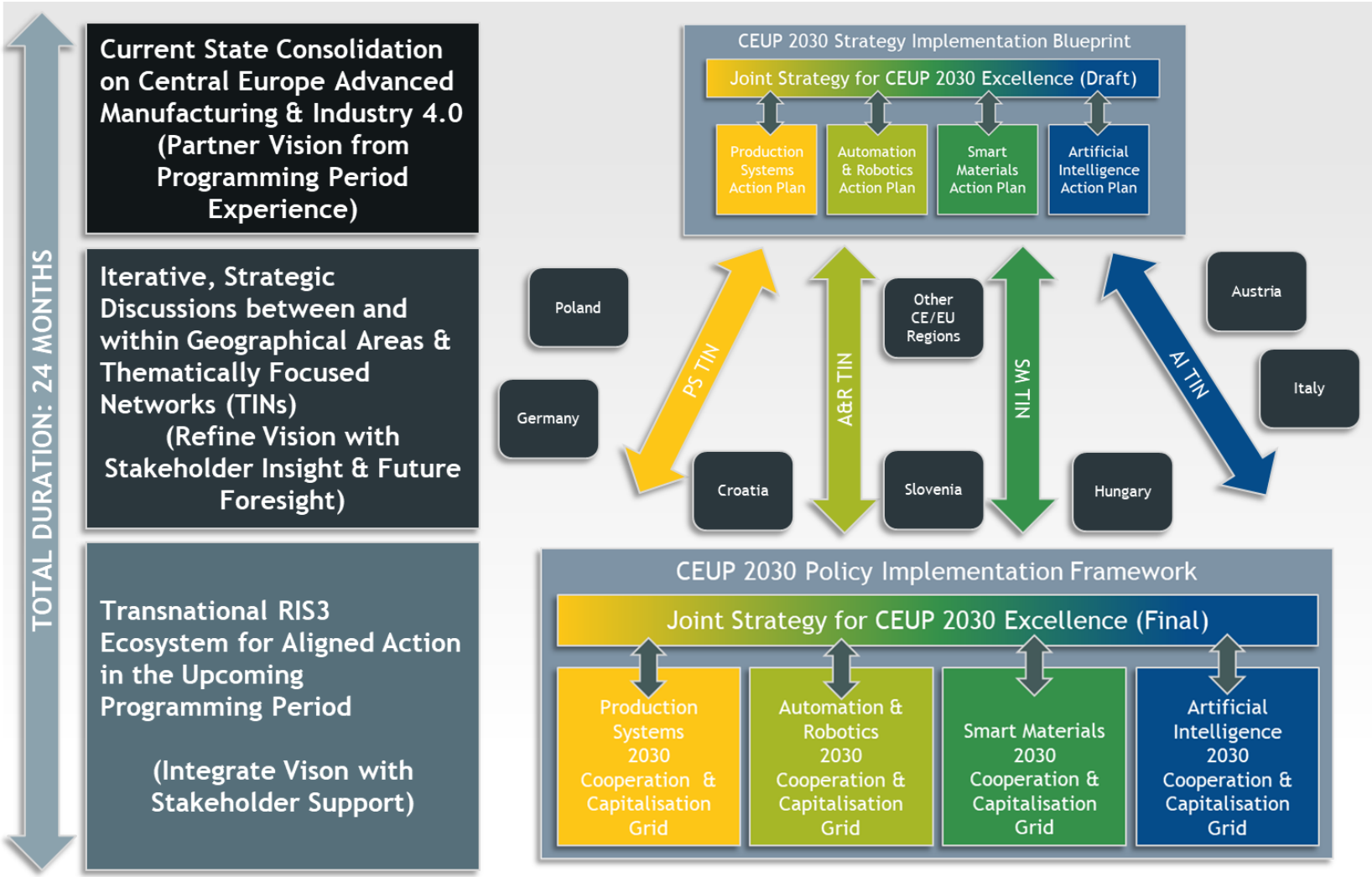

Figure 3 Strategy Building Process within CEUP 2030
(Source: Author Generated)

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By balancing expectations from the application form, and good practice developed from PPs across multiple regional, national and transnational projects, the following components, visualised in Figure 4 will be prioritised as the operating units of the CEUP 2030 Strategy:

- Vision for Central Europe's Advanced Manufacturing Future
  - Each territorial area's vision for its advanced manufacturing future;
  - An overview of the policy instruments, or policy tools, which are available to the territorial area's eco-system in order to achieve this future;
  - The role and composition of CEUP 2030's territorial area stakeholder eco-systems, to specify for whom and with whom the partnership is working;
- Trend & Innovation Network Introductions and Objectives, including:
  - The final CAMI4.0 Topic, definition and sub-topics;
  - The composition of the working group's membership from within the Consortium;
  - The key partnership strengths, weaknesses, opportunities and threats;
  - The objectives of the TIN working group, and their strategic aims associated to the specific CAMI4.0 Topic.

As shown in Figure 4, this strategic orientation leads to the development of dedicated action plans, which will follow by February 2021 and leads to the completion of the Strategy Implementation Blueprint.

The next steps are clarified in the final section of this report. Within the remaining pages of this document one can find the results of the strategic partnership analysis and the resulting Joint Strategy for CEUP 2030 Excellence.

Figure 4 Joint Strategy Blueprint Components (Source: Author Generated)

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1.3. Key Definitions for Strategy Building in CEUP 2030

This section provides users of this Strategy report, some key definitions which are useful for understanding the development of CEUP 2030's structure and strategic intent:

I. **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.

II. **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).

III. **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 organisation, or an organisation which has a mandate to deliver an instrument

IV. **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)

V. **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 organisations in engaging with the CAMI4.0 topics.

VI. **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.

VII. **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.

VIII. **Policy Implementation Framework:** This is a named project output, also called "CEUP 2030 Policy Framework – Synergising 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 capitalisation 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.

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2. National and Regional Perspectives on Central Europe's Advanced Manufacturing Future

The purpose of this section is to provide a snapshot of the national and regional visions which exist associated to the topic of Central Europe's advanced manufacturing and Industry 4.0 futures. The logic behind this presentation, is to provide a spotlight on the unique activities of each region via synthesized perspectives gathered by the Partnership based on their roles in the region and their previous experience in strategic initiatives. In management theory, a vision statement identifies where an organization wants or intends to be in future or where it should be to best meet the needs of the stakeholders. **Within CEUP 2030, this vision** is formulated by taking a geographical view. The formulation of the strategy combines the regional and national strategies of the territorial area associated to each Partner organisation. It is a base principle of this report, that through the vision, a territorial area reflects on the challenges faced by its stakeholders and presents the key perspectives on the future it seeks to achieve. The visions address multiple technology stream solutions and multifaceted cooperation, but demonstrate the unique differences faced by different corners of this macro-regional territorial area.

This section also provides an over view of the mission of the partner and their eco-system in supporting the national and regional vision to be achieved. Again, in management theory a mission describes the role by which an organization intends to serve its stakeholders. It describes why an organization is operating and thus provides a framework within which strategies are formulated. It describes what the organization does (i.e. present capabilities and strengths), who all it serves (i.e. target group and network stakeholders) and what makes an organization unique (i.e. what is its functional role). **Within CEUP 2030, this mission** is formulated by providing a view of the functional role, capabilities and strengths, and the stakeholder network of each Partner. It has been raised in multiple discussions that understanding these components, first on a disaggregated level (i.e. what each partner brings to the mix), and then on a partnership-wide level (what the partners can bring together), is critical to formulate a common mission. The partnership focuses on building understanding of what each other can bring to deliver the strategy and simultaneously, what is their organisation's role in the eco-system to address its target group needs.

Quick Access

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2.1. Poland

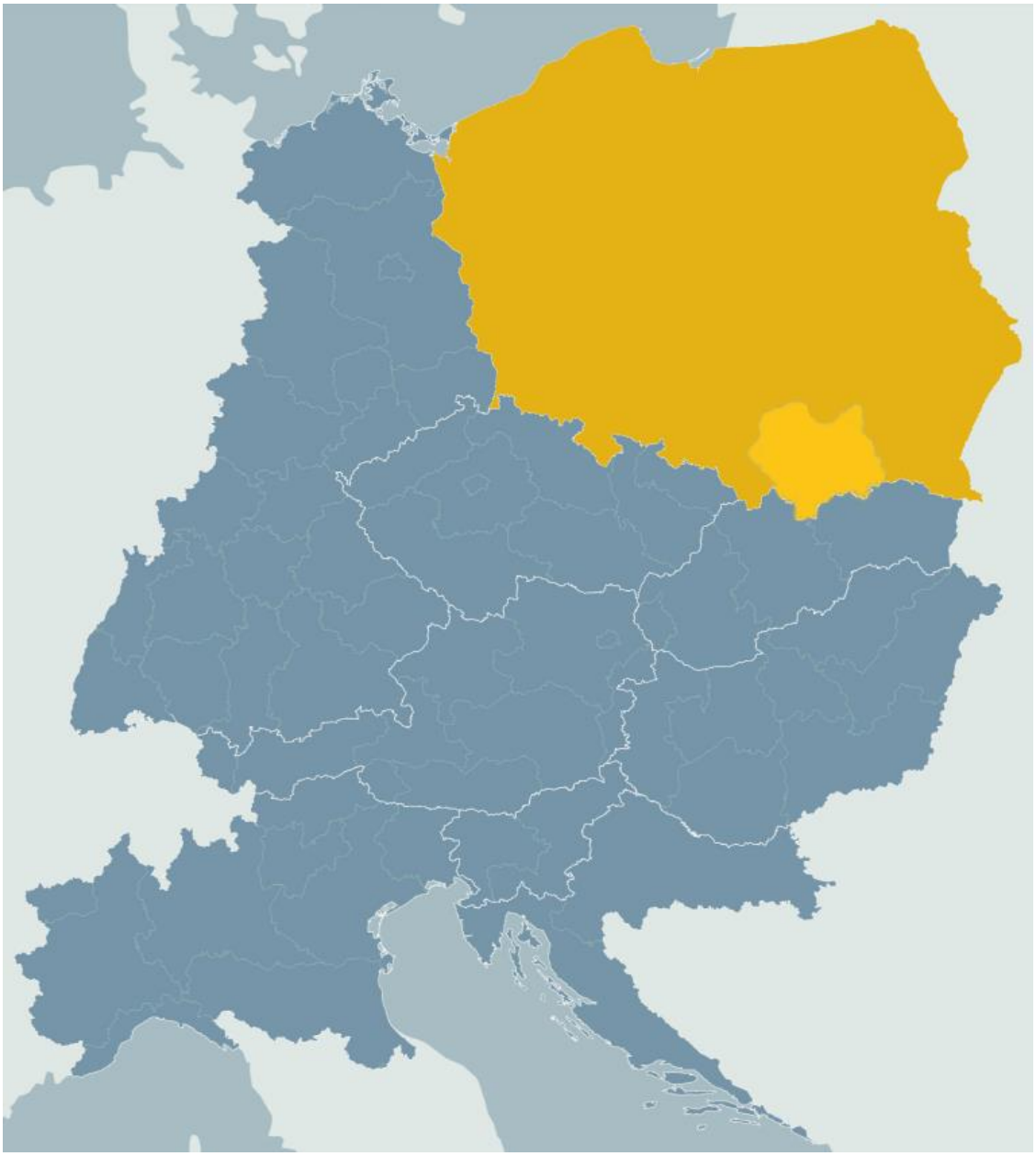

Figure 5 Map of Central Europe, with a Spotlight on Poland and Malopolska

(Source: Author Generated)

Manufacturing accounts for 27% of Poland's GDP, and Poland is the sixth largest manufacturing country in the European Union. In 2017, manufacturing grew by 6.2%, outpacing the country's overall 4.6% GDP growth rate. In 2016 the Future Industry Platform was announced as part of the Responsible Development Plan ('Morawiecki Plan') by the Ministry of Finance and Development. Providing industrial financing over a 25-year period, the Morawiecki Plan pursues an agenda of reindustrialisation through new partnerships, export-oriented support measures and comprehensive regional development. The main mission of Future Industry Platform is to act as an integrator of all stakeholders interested in Industry 4.0 as well as an accelerator of the digital transformation of Polish industry.

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2.1.1. Spotlight on Malopolska's Vision

To increase the innovation potential of the region the focus is the promotion and investment in the smart specialisations of the region. The region recognizes the importance of advanced manufacturing by positioning it in Malopolska's 7 smart specializations. Within this specialisation Malopolska companies operate predominantly in the areas of repair, maintenance and installation of machinery and equipment. 45% of the entities are located in Krakow. In the last 15 years the sector is becoming a strong point of the regional economy. The region witnesses an increase in industrial production sold and an increase in the employment in the industry. Currently the Regional Innovation Strategy is evaluated and upgraded, including the evaluation and development of the policy instruments for the next programming period.

2.1.2. Policy Instrument Overview

Within the framework of tools available to stakeholders in the region, there are a number of options which exist to support the development of advanced manufacturing and industry 4.0 competencies and address sectoral, value chain and target group challenges via technology-oriented cooperation. Some examples are as follows:

International: H2020, Digital Europe, HORIZON EUROPE, Interreg CE;

National: Smart Growth Operational Program (vouchers for innovations for SMEs), Acceleration programs (for example: Impact Poland 2.0, KPT scale up etc.), co-financing of research and development projects (Fast track), Polish-Taiwanese competition (co-financing of projects in the Smart Vehicles including AI and electromobility area), Polish Development Funds – ventures (mainly for startups);

Regional: The Regional Operational Program of the Malopolska Voivodeship 2014-2020 (De minimis aid, Regional Investment Aid, Aid for research and development projects, Aid for advisory services, Training aid, INNOVATION Vouchers, subsidies for the SME, consulting vouchers), private funds.

2.1.3. Polish CEUP 2030 Eco-System

The Polish eco-system in CEUP 2030, is led by the Lead Partner, or Partner 1, Krakow Technology Park (KPT). The section begins by providing an overview of KPT, including a description of the organisation's functional role in meeting the region and national-level advanced manufacturing and industry 4.0 vision, plus the goals, capabilities, and strengths the organisation has to achieve these aims. In addition to KPT, there are a number of other stakeholders who are critical to the CEUP 2030 innovation network development who will also be profiled within this section.

2.1.3.1. *Introduction to Krakow Technology Park*

Kraków Technology Park is a business support organisation acting as one of 5 national Digital Innovation Hubs (5G, automation & robotics, AI, AR&VR, IIoT, cloud computing, BIM, 3D). KPT is a centre for the provision of complex services (one-stop-shop), where businesses can improve their competences related to streamlining production processes and obtain support in the process of selection and implementation of solutions that make use of digital

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technologies. Beside support for entrepreneurs it also supports regional administration in understanding the companies needs and shaping regional strategy policies on AM &I4.0.

Table 1 Aims, Capabilities and Strengths of Krakow Technology Park (Source: Author Generated)

Institutional Aims for Advanced Manufacturing and Industry 4.0	
(1) Support of regional companies in the process of selection and implementation of solutions that make use of digital technologies (2) Collaborative exchange to share experiences (3) Access to new collaboration partners (4) Access to new join project initiatives (5) International expertise network for exchange of know-how and best practices (6) Support of regional administration in definition of strategic goals (7) Support start-ups and SMEs from regional ecosystem in implementing AM & Industry 4.0 in their businesses (8) Exchange transnational best practices and lessons learnt within study visit, B2B meetings, training platforms etc. (9) Organize tailored conferences, seminars, speed dating and industry weeks	
Capabilities	**Strengths**
Services Infrastructure (Laboratories) Consulting services Expertise and know-how Trainings Financial support and access to finance Partner search & matchmaking Project management Network	One-stop-shop for the region Large industrial partners Research partners Start-ups as solution providers VC network Good cooperation with local/regional/national administration

2.1.3.2. *Overview of Other Key Stakeholders*

Within the project network, there are strategic connections which have been built across the last programming period, and will be fostered in order to address the gaps and capitalize on the opportunities associated to the topic of Advanced Manufacturing and Industry 4.0. Within the context of Krakow Technology Park, the following stakeholders have been identified:

Table 2 Critical Polish Stakeholders for CEUP 2030's goals for CAMI4.0 Excellence (Source: Consortium Generated)

S3 Policy Stakeholders	National Ministry of Development Poland's Future Industry Platforms Marshall Office of Malopolska Region, Department of Corporate Governance and Economy

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	Polish Agency for Enterprise Development National Centre of Research & Development Malopolska Regional Development Agency
Networking-Support Stakeholders	Existing Network of DIH/hub4industry partners (T-Mobile, ASTOR, Grupa Azoty) Universities: AGH University of Science and Technology, Cracow University of Technology, Jagiellonian University, University of Economy SMEs: Autenti, Kangur Electronics, Astor, Protech, ES-System, Reality Games, Velis, Merit Poland, Transition Technologies Existing network of KTP Scale-up Partners (Tauron, Grupa Azoty, Es-system, Woodward, Werner Kenkel, Lafarge, JMP Flowers, VOX, Velvet Care, Warbud, Voxel, Aluprof) Large Enterprises in the Polish Investment Zone and LE: Comarch, Fideltronik, EC Group, Woodward Poland, Wisniowski, Oknoplast Marshall Office of Malopolska Region, Municipality of Krakow Digital Poland Foundation https://www.digitalpoland.org/ Polish Initiative for the Advancement of Artificial Intelligence PP-RAI - Coordination committee consists of 9 members who represent each o5 founding societies.
Training-Support Stakeholders	University of Science and Technology AGH (Largest Polish technical university) University of Technology of Krakow University of Economics ASTOR Competence Centre Technology Transfer Offices Jagiellonian University Kosciuszko Institute (specialized in cybersecurity), BIM Klaster Foundry Research Institute (Łukasiewicz Research Network)
Other Stakeholders	Malopolska Regional Develoment Agency Regional Chamber of Commerce Malopolska Centre of Entrepreneurship Enterprises (The Map of Polish AI is the most comprehensive development on the Polish market for and about the artificial intelligence industry. It contains information on almost all companies operating in Poland which offer services in the field of modern technologies. https://www.digitalpoland.org/assets/publications/mapa-polskiego-ai/map-of-the-polish-ai-2019-edition-i-report.pdf)

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2.2. Austria

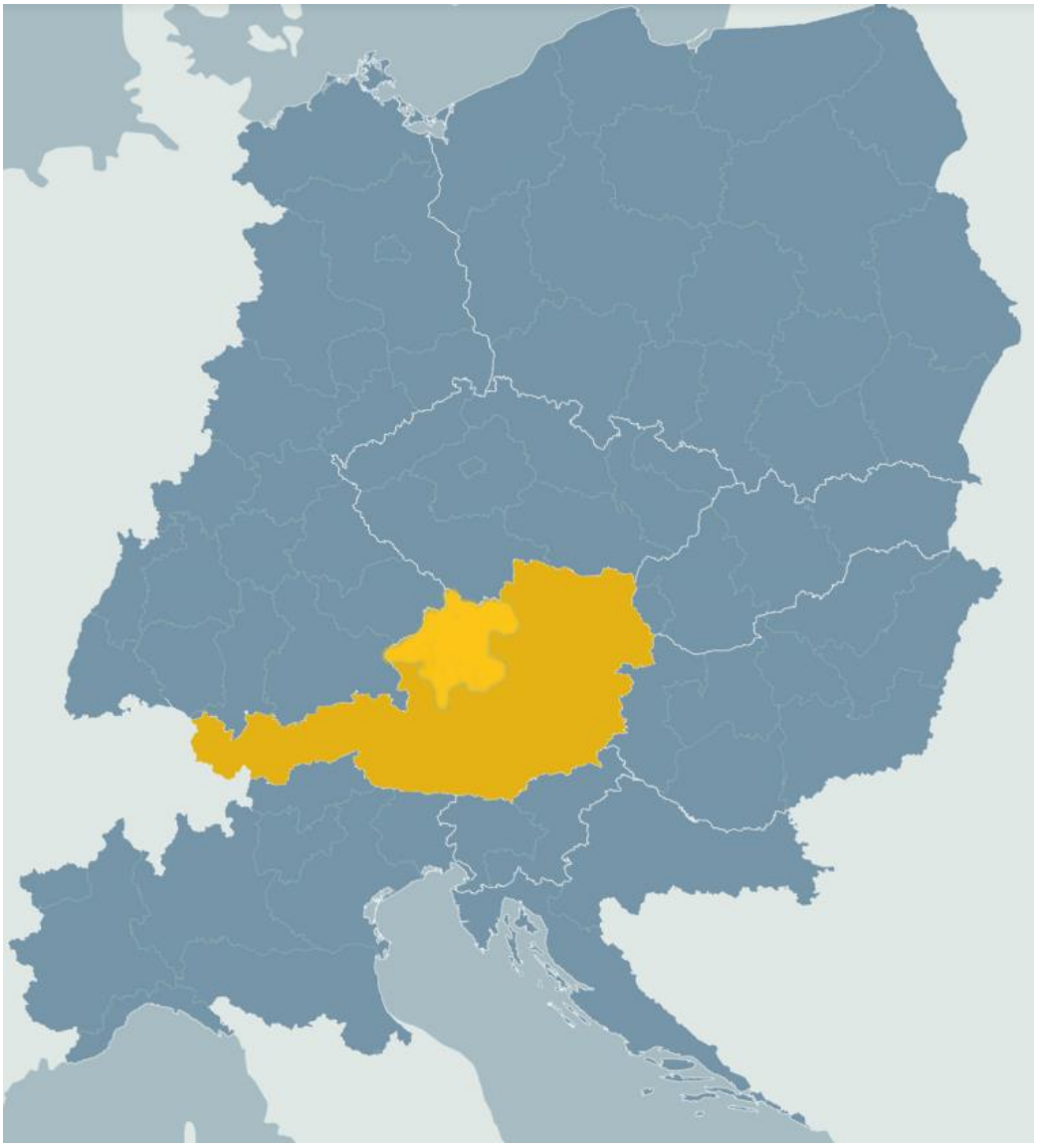

Figure 6 Map of Central Europe, with a Spotlight on Austria and Upper Austria (Source: Author Generated)

Austria is a leading nation regarding Industry 4.0, especially in:

- the development and application of technology,
- R&D, and
- the transfer of technology (e.g. through pilot factories)

Austria has a specific effort to create new high-quality jobs and preserve existing high-quality jobs in Austrian industry. They also look to transfer of industrial achievements (e.g. welfare state principles, social partnership) into the digital sphere.

There is a general orientation towards "technological limits" with the intention to reach technological limits within Austria and to further push the limits from Austria. The Austrian Flagship program "Production of the future" includes the following components:

- Cooperative R&D Projects Industrial Research or Experimental Development
- Transnational Cooperative R&D Projects Industrial Research or Experimental Development
- Exploratory Project Pilot Study for R&D Project
- Flagship Projects Industrial Research or Experimental Development

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- Endowed Professorships funded by the Ministry of Transport, Innovation and Technology (BMVIT) / financed by the Austrian Marshall Plan Foundation
- R&D Infrastructure

Austria's current government aims at strengthening Austria's contribution regarding the development of future technologies ("Wirtschaft 4.0").

2.2.1. Spotlight on Upper Austria

In order to stand out in the face of global competition and make Upper Austria future-proof over the long term, it is necessary to project a uniform image of the future that can be flexibly adapted to new trends and developments. The region's strategy for industry 4.0 and advanced manufacturing research and innovation is formalized around four principles:

- Fit for Digital Age (digital transformation)
- Fit for Sustainable Solutions (efficient and sustainable industry and manufacturing)
- Fit for Human-Centered Technology (systems and technologies for people)
- Fit for New Mobility (connected and efficient mobility)

In order to achieve this, there has been the creation of a strategic operating framework to monitor and deliver these goals

2.2.2. Policy Instrument Overview

Within the framework of tools available to stakeholders in the country, there are a number of options which exist to support the development of advanced manufacturing and industry 4.0 competencies and address sectoral, value chain and target group challenges via technology-oriented cooperation. Some examples of subsidy or funding-oriented instruments which stakeholders have access to are as follows:

International: H2020, Digital Europe, Horizon Europe, Interreg Central Europe, Interreg Alpine Space;

National: funding programs of the FFG and the aws (national level), e.g. "Production of the Future", "ICT of the Future" or the grant "aws digitalization";

Regional: different funding schemes of Austrian federal states, e.g. through "Business Upper Austria" or "Wirtschaftsagentur Wien"

Some examples of additional tools which are used by stakeholders within this territorial area are as follows:

- Workshops with multiple stakeholders covering different perspectives
- Co-Development of Roadmaps
- Experience Exchange sessions
- Participation in Councils
- Constant communication with stakeholders of platform and policy makers
- Common projects with several partners

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2.2.3. Austrian CEUP 2030 Eco-System

The Austrian eco-system in CEUP 2030, is led by Partner 2, PROFACOR GmbH (PRO), and Partner 3, the Association Industry 4.0 Austria (PIA). The section begins by providing an overview of PIA and PRO, including a description of the organisation's functional role in meeting the region and national-level advanced manufacturing and industry 4.0 vision, plus the goals, capabilities, and strengths the organisation has to achieve these aims. In addition to these two Partners, there are a number of other stakeholders who are critical to the CEUP 2030 innovation network development who will also be profiled within this section.

2.2.3.1. *Introduction to Association Industry 4.0 Austria*

PIA acts as the enabling platform for Industry 4.0 in Austria, encompassing all major stakeholders in AT: policy makers, employees/employers, scientific and academic institutions, NGOs, intermediaries. All activities of PIA are strictly pre-commercial.

PIA acts through information & experience exchange and multi-stakeholder dialogue.

Table 3 Aims, Capabilities and Strengths of Association Industry 4.0 Austria (Source: Author Generated)

Institutional Aims for Advanced Manufacturing and Industry 4.0	
(1) Aligning different stakeholder interests for the advancement of Austria regarding Industry 4.0 (2) Stronger international collaboration in the area of Industry 4.0	
Capabilities	**Strengths**
Experience in the reduction of complexity regarding Industry 4.0 Role as a "honest broker" Embodiment of various perspectives Flexibility of formats (> 20 different formats and methodologies)	Expert Pool of >700 people 10 topic-specific expert groups regarding different aspects of Industry 4.0 Trust towards PIA and among partners Existing collaboration with relevant policy makers on the regional and national level In-depth knowledge and expertise in sub-topics of Industry 4.0 through funded projects with partners

2.2.3.2. *Introduction to PROFACTOR GmbH*

PROFACTOR is an applied research company with headquarters in Steyr and Vienna. The company conducts applied production research in the field of industrial assistive systems and additive micro/nano manufacturing. PROFACTOR researches for the competitiveness of the European Industry.

PROFACTOR's technological developments strive for efficiency and sustainability, and work to benefit society. PROFACTOR acts as an interface between science and business. In more than 1,700 projects, PROFACTOR has demonstrated what can be created with applied production research: Innovation. PROFACTOR enable its customers to be a step ahead and work to ensure Europe's continued industrial prosperity.

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

Table 4 Aims, Capabilities and Strengths of PROFACTOR GmbH (Source: Author Generated)

Institutional Aims for Advanced Manufacturing and Industry 4.0	
(1) Initiate new funded projects by enlarging the network (2) Promoting Systems for industrial assistance and additive micro/nano manufacturing (3) Interesting stakeholders of different players to new technologies	
Capabilities	**Strengths**
The team consists of 75 employees from 15 academic fields, working across disciplines to find solutions for the manufacturing industry. PRO set standards in robotics, image processing, simulation, and functional surfaces and nanostructures. PRO has three OpenLabs and create a place to think out of the box and, above all, to think ahead. PRO's OpenLabs are open to its customers and partners.	PROFACTOR was active in app. 1650 projects and in more than 120 European projects the last 20 years.

2.2.3.3. *Overview of other Key Stakeholders*

Within the project network, there are strategic connections which have been built across the last programming period, and will be fostered in order to address the gaps and capitalize on the opportunities associated to the topic of Advanced Manufacturing and Industry 4.0. Figure 7 provides an overview of PIA's stakeholder network.

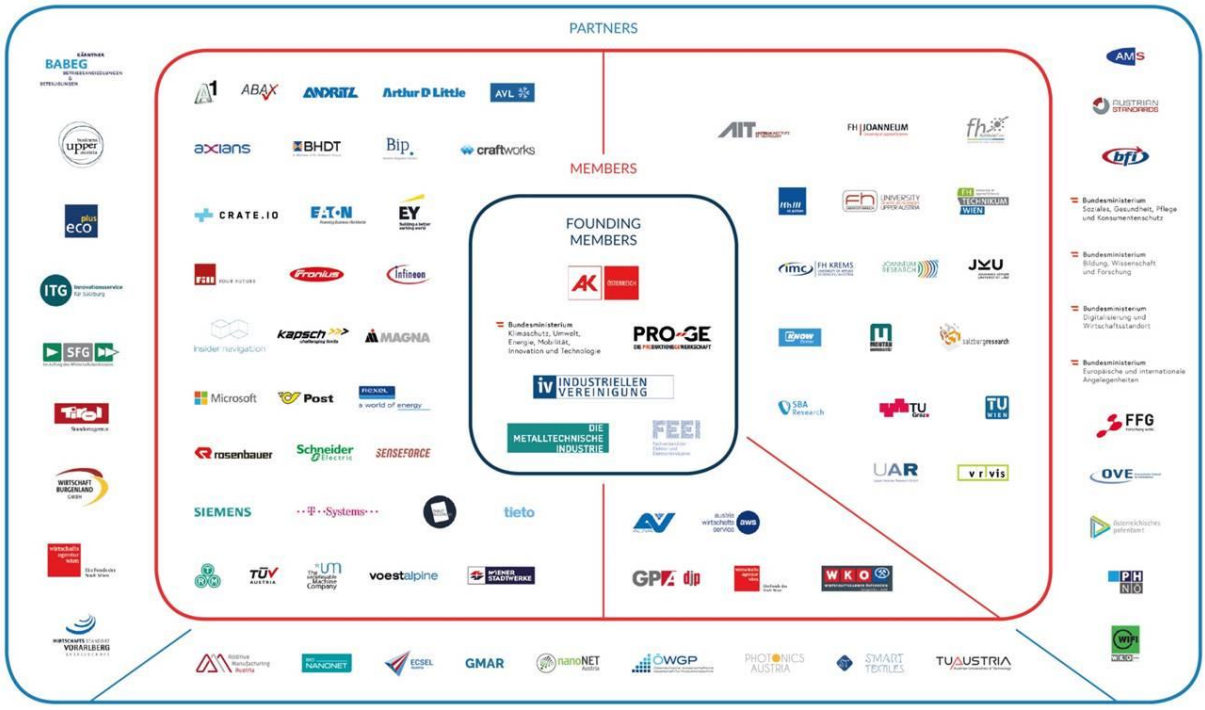

Figure 7 PIA's Stakeholder Network (Source: PIA, 2020)

Within the context of both PIA and PRO, the following stakeholders have been specifically identified:

Table 5 Critical Austrian Stakeholders for CEUP 2030's goals for CAMI4.0 Excellence (Source: Consortium Generated)

S3 Policy Stakeholders	Federal Ministry of Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK) Regional and Economic Agencies of Austrian Federal States Further Ministries and representative groups (e.g. employers/employees) Regional and Economic Agencies of Upper Austria
Networking-Support Stakeholders	BMK Technology Platforms: • AAL Austria • Additive Manufacturing Austria • Data Intelligence Offensive (DIO) • Photonics Austria Funding agencies such as AWS and FFG and the regional funding agencies from the nine federal states in Austria. Intermediaries such as the Austrian Patent Office, the Austrian Public Employment Service (AMS) and the Austrian Network for Electronics (OVE). Technology Platforms: • GMAR • EFFRA • EU Robotics
Training-Support Stakeholders	Universities, Universities of Applied Sciences, for example Technical University of Graz, and University of Applied Sciences Upper Austria; Research organisations, such as the Know-Center in Styria, the Austrian Institute of Technology (AIT) and Salzburg Research. Training institutions for employers/employees (BFI, WIFI) Training facilities at RIC (Gunskirchen)
Other Stakeholders	Upper Austrian Research Business Upper Austria

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2.3. Germany

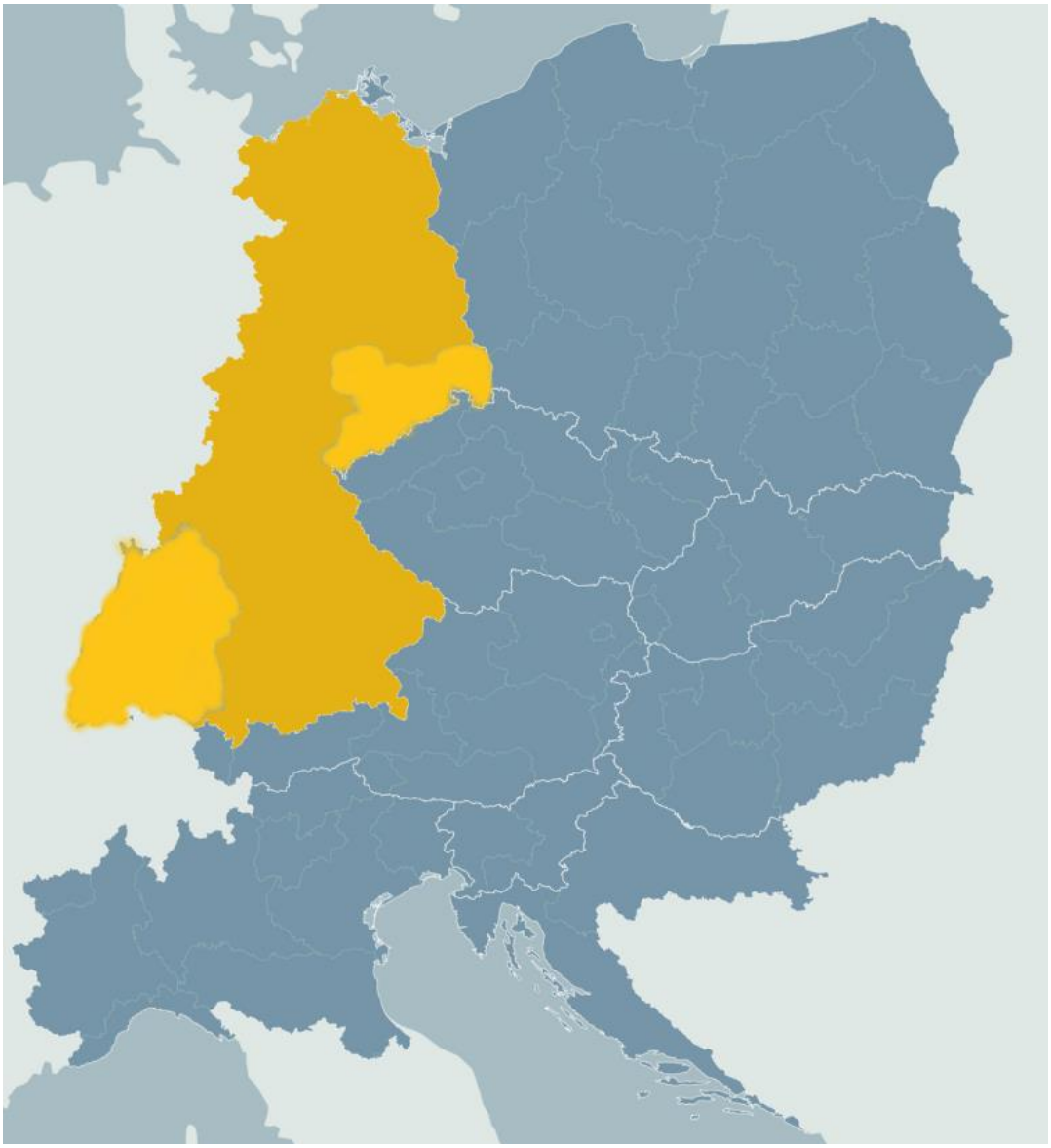

Figure 8 Map of Central Europe, with a Spotlight on Germany, Saxony and Baden Württemberg
(Source: Author Generated)

Germany has one of the strongest industrial economies in the world. The manufacturing industry's share of gross value is approx. 23 %, maintaining those levels for the last 20 years, and Germany's industrial companies make a major contribution to the country's prosperity. Germany set up an Industrial Strategy to improve entrepreneurial conditions, reinforcing new technologies and preserving technological sovereignty. The Industrial Strategy 2030 aims to invest in technologies, to activate the production potential of digitalisation with respect to artificial intelligence, Industry 4.0, and autonomous and trustworthy data infrastructure, digital platforms and the mobility of the future. Apart from that, the effective mitigation of climate change is pursued as well as the development and promotion of the bioeconomy and lightweighting.

Germany unveiled the High-Tech Strategy 2025 (HTS 2025) in 2020, to show how Germany can use research and innovation to shape its future. It aims to provide orientation for all the players involved in innovation.

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Under the HTS 2025, support for research and innovation is geared to the needs of the people, for example in the areas "Health and Care", "Sustainability, Climate Protection and Energy", "Mobility", "Urban and Rural Areas", "Safety and Security" and "Economy and Work 4.0" (Field of Action I).

It will help put Germany at the forefront of the next technological revolutions, keep jobs in Germany and safeguard it's prosperity. In order to prepare people for coming changes, the support for new technologies will go hand in hand with investment in training and continuing education and the involvement of society. (Field of Action II)

2.3.1. Spotlight on Saxony

Generally, Saxony sets 4 main goals to ensure innovation success. Amongst those, providing favourable conditions for successful innovators, expanding its position in global value chains, encouraging the culture of innovation in all sectors and attracting intelligent and talented people from around the world is part of the Saxon innovation strategy.

Topic clusters like smart materials, integrated sensors/actuators and resource-efficient production are detailed areas of interest, to name a few.

Relevant topics for the German federal state of Saxony are:

- Nano technologies
- Micro and nano electronics
- Photonic
- New materials
- Biotechnologies
- Advanced production technologies

2.3.2. Spotlight on Baden Württemberg

The Federal State of Baden-Württemberg, located in central Germany, is a world leading epicenter of manufacturing innovation. The state's strategic partners include Bosch, Daimler, Festo, Porsche, and SAP in addition to an ecosystem of thousands of high-tech SMEs involved in smart factory applications and digital technologies. But the state is in fierce competition for the world's most intelligent technologies, the best ideas and the brightest minds. The state's new innovation strategy as decided in February 2020 states that, in the future, Baden-Württemberg will invest in the growth of future areas identified by the strategy. These are

- Digitization, Artificial Intelligence and Industry 4.0, www.wirtschaft-digital-bw.de;
- Sustainable mobility, strategy dialogue automotive industry;
- Health economy, forum health location Baden-Württemberg;
- Resource efficiency and energy transition as well;
- Sustainable bioeconomy.

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2.3.3. Policy Instrument Overview

Within the framework of tools available to stakeholders in the region, there are a number of options which exist to support the development of advanced manufacturing and industry 4.0 competencies and address sectoral, value chain and target group challenges via technology-oriented cooperation. Some examples are as follows:

Instruments are mainly Research funding that is financed by regional, national or international institutions.

The Fraunhofer institutes are centres of applied research for the immediate utility of economy and the benefit of society. One part of the research volume is contributed by German federal or the Länder governments. The other part is generated through contract research on behalf of the industry and publicly funded research projects. Funding instruments are national funding schemes of the Federal Ministry of Education and Research BMBF (Unternehmen Region, Twenty20 - Partnership for Innovation). Partly, the focus is placed on SMEs in Eastern Germany and is thus very relevant for Saxony. The Twenty20 approach aims primarily at inter-, trans- and multidisciplinary cooperation as well as openness and transparency in the East German innovation landscape. On regional level, the Saxony Economic Development Corporation (WFS-Wirtschaftsförderung Sachsen GmbH) assists Saxon companies to grow and expand but also promotes the business location Saxony. The Sächsische Aufbaubank – Förderbank SAB offeres funding programs for different target groups and thus also has a funding branch for research, innovation and technology. On the European level there is the Horizon 2020 Research and Innovation program.

Karlsruhe Institute of technology belongs to the Helmholtz Association of German Research Centers. The Helmholtz association is the largest scientific organisation in Germany. It is a union of 18 scientific-technical and biological-medical research centers and the researchers of the Helmholtz association are tasked with 'Solving the grand challenges of Science, Society and Industry'. The Helmholtz association has an annual budget of €4.56 billion of which 72% is raised from public funds and the rest in the form of contract funding. The Karlsruhe Institute of Technology naturally receives most of its funding from the different Helmholtz Programmes and is aligned with the Helmholtz vision. The various CAMI 4.0 topics also form various parts of the Helmholtz vision for the future.

Research funding is also directly financed through various funding initatives, project calls etc based either by the state of Baden-Württemberg (Allianz Industrie 4.0 Baden-Wurttemberg; Central Innovation Programme for Small and Medium Sized Enterprises, Funding Scheme; Karlsruhe Nano Micro Facility (R&D Alignment Network on Functional Micro and Nano Materials) financed nationally by the federal government of Germany, the European Union (H2020, other FP) as well as through direct collaboration with industrial partners on bi-lateral cooperation projects (Vanguard Initiative).

2.3.4. German CEUP 2030 Eco-System

The German eco-system in CEUP 2030, is led by Partner 4, Fraunhofer Institute for Machine Tools and Forming Technologies (IWU), and Partner 5, Karlsruhe Institute of Technology (KIT). The section begins by providing an overview of IWU and KIT, including a description of the organisations' functional role in meeting the region and national-level advanced manufacturing and industry 4.0 vision, plus the goals, capabilities, and strengths the organisation has to achieve these aims. In addition to IWU and KIT, there are a number of

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other stakeholders who are critical to the CEUP 2030 innovation network development who will also be profiled within this section.

2.3.4.1. *Introduction to Fraunhofer Institute for Machine Tools and Forming Technologies*

Fraunhofer IWU is an engine for innovations in the research and development of production technologies. Around 600 employees at our locations in Chemnitz, Dresden and Zittau open up potentials for competitive manufacturing. The scientific research and contract research focus on components, processes and the associated complex machine systems. As leading institute for resource-efficient production, Fraunhofer IWU concentrates on the development of efficient technologies and intelligent production plants for manufacturing components for car bodies and powertrains and on optimizing the related forming and cutting manufacturing processes. Key success factors include the development of lightweight structures and technologies for processing new materials as well as functional integration in assemblies.

Table 6 Aims, Capabilities and Strengths of Fraunhofer Institute for Machine Tools and Forming Technologies
(Source: Author Generated)

Institutional Aims for Advanced Manufacturing and Industry 4.0	
(1) Help small and medium sized enterprises to improve processes, products and services through digital technologies (2) Offer a variety of different marketing tools and techniques (designing information materials, web content, scientific publications) (3) Support in terms of digitalization, qualification and information (4) Offer online trainings and seminars in topics like cloud-based manufacturing, digitalization strategies or machine learning	
Capabilities	**Strengths**
The core competencies are: ➢ Mechatronics / Adaptronics ➢ Smart Materials ➢ Internet of Things ➢ Networking Infrastructure Diverse expertise and know-how in mobility, production systems and life science	Strong business ties with over 150 partners in Europe's biggest network for smart materials aiming to achieve a paradigm shift in the product, to trigger the commercial breakthrough of those materials and to strengthen the culture of cooperation. Smart Materials database Good reputation Intent to connect research and practice

2.3.4.2. *Introduction to Karlsruhe Institute of Technology*

The Karlsruhe Institute of Technology (KIT) consistently continues its role of pioneer in the German science system. As "The Research University in the Helmholtz Association," the KIT will make full use of its synergy potential. In the years to come, the duties of a national research institution and of a state university will be merged further step by step.

Henceforth, the KIT will concentrate even more strongly on the topics of Energy, Mobility, and Information. In this way, the KIT aligns its major research areas to the long-term

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challenges facing society in order to develop sustainable solutions of urgent problems of the future. Energy, mobility, and information have traditionally been strong research areas at the KIT; their perfect merger in fundamental research and their application are essential, for instance, to the success of the "energiewende."

Table 7 Aims, Capabilities and Strengths of Karlsruhe Institute of Technology (Source: Author Generated)

Institutional Aims for Advanced Manufacturing and Industry 4.0	
(1) KIT will concentrate even more strongly on the topics of Energy, Mobility, and Information. This way, the KIT aligns its major research areas to the long-term challenges facing society in order to develop sustainable solutions of urgent problems of the future (2) Further progress and emphasize an Innovation Culture that nourishes a founding spirit. To promote tech transfer through start-ups and continuing as one of the most successful universities. (3) KIT intends to merge even more closely natural sciences, engineering, economics, humanities and social sciences	
Capabilities	**Strengths**
KIT possesses an outstanding research infrastructure, from modern laboratory equipment to high-performance computing systems to globally visible large-scale facilities. The large-scale facilities at KIT open up new research horizons, are drivers of technological development, and offer users unique experimentation options. In the CAMI 4.0 topics as well the KIT has laboratories, institutes as well pilot lines in all 4 topics.	KIT is among the 100 most innovative universities in the world (Reuters TOP 100 Ranking 2015), supporting staff members and students alike in launching promising ideas on the market. The KIT plays a major role in promoting and supporting regional industrial partners with research focussing on the problems of the future, in manufacturing, mobility, AI as well Energy and nanotechnology.

2.3.4.3. *Overview of Other Key Stakeholders*

Within the project network, there are strategic connections which have been built across the last programming period, and will be fostered in order to address the gaps and capitalize on the opportunities associated to the topic of Advanced Manufacturing and Industry 4.0. Within the context of IWU and KIT, the following stakeholders have been identified:

Table 8 Critical German Stakeholders for CEUP 2030's goals for CAMI4.0 Excellence (Source: Consortium Generated)

S3 Policy Stakeholders	Industrie- und Handelskammer Chemnitz, Chamber of Commerce ,https://www.chemnitz.ihk24.de/ Staatsministerium für Wirtschaft, Arbeit und Verkehr (SMWA), http://www.smwa.sachsen.de/ Sächsisches Staatsministerium für Wissenschaft und Kultur (SMWK), https://www.smwk.sachsen.de/ Futuresax, https://www.futuresax.de/ Projektträger Karlsruhe, https://www.ptka.kit.edu/ Cluster Portal BW, https://www.clusterportal-bw.de/ Arena 2036, https://www.arena2036.de/en/

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	Wirtschaftsministerium BW, https://wm.baden-wuerttemberg.de/de/startseite/ Ministerium für Arbeit und Wohnungsbau BW IHK Karlsruhe, https://www.karlsruhe.ihk.de/
Networking-Support Stakeholders	Kompetenzzentrum Maschinenbau Chemnitz/Sachsen e.V.,https://www.kmc-chemnitz.de Arbeitskreis Werkzeugmaschinen e.V., https://www.arbeitskreis-werkzeugmaschinen.de/ Mittelstand 4.0, Kompetenzzentrum Chemnitz, https://betrieb-machen.de/ VEMASinnovativ, https://www.vemas-sachsen.de Futuresax, https://www.futuresax.de/ Innovation and Relations Management KIT, MicroTEC Südwest, https://www.microtec-suedwest.de/ Vanguard initiative Allianz I4.0, https://www.i40-bw.de/
Training-Support Stakeholders	Fraunhofer-Gesellschaft, https://www.fraunhofer.de/ TU Chemnitz, https://www.tu-chemnitz.de/ Cluster of Excellence MERGE, https://www.tu-chemnitz.de/MERGE/merge_technologies.php.de TU Dresden, www.tu-dresden.de Trinity Network, http://trinityrobotics.eu/ Karlsruhe Institute of Technology IMVT Karlsruhe Institute of Technology IAM Karlsruhe Institute of Technology IAI Hochschule Karlsruhe (University of Applied Sciences) Fraunhofer IPA
Other Stakeholders	Network smart³I materials -solutions - growth, www.smarthoch3.de Mercedes Benz AG, Newtec GmbH, Stratasys, Apium additive technologies GmbH, Notion Systems GmbH; KUKA AG, Franka Emika GmbH

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2.4. Italy

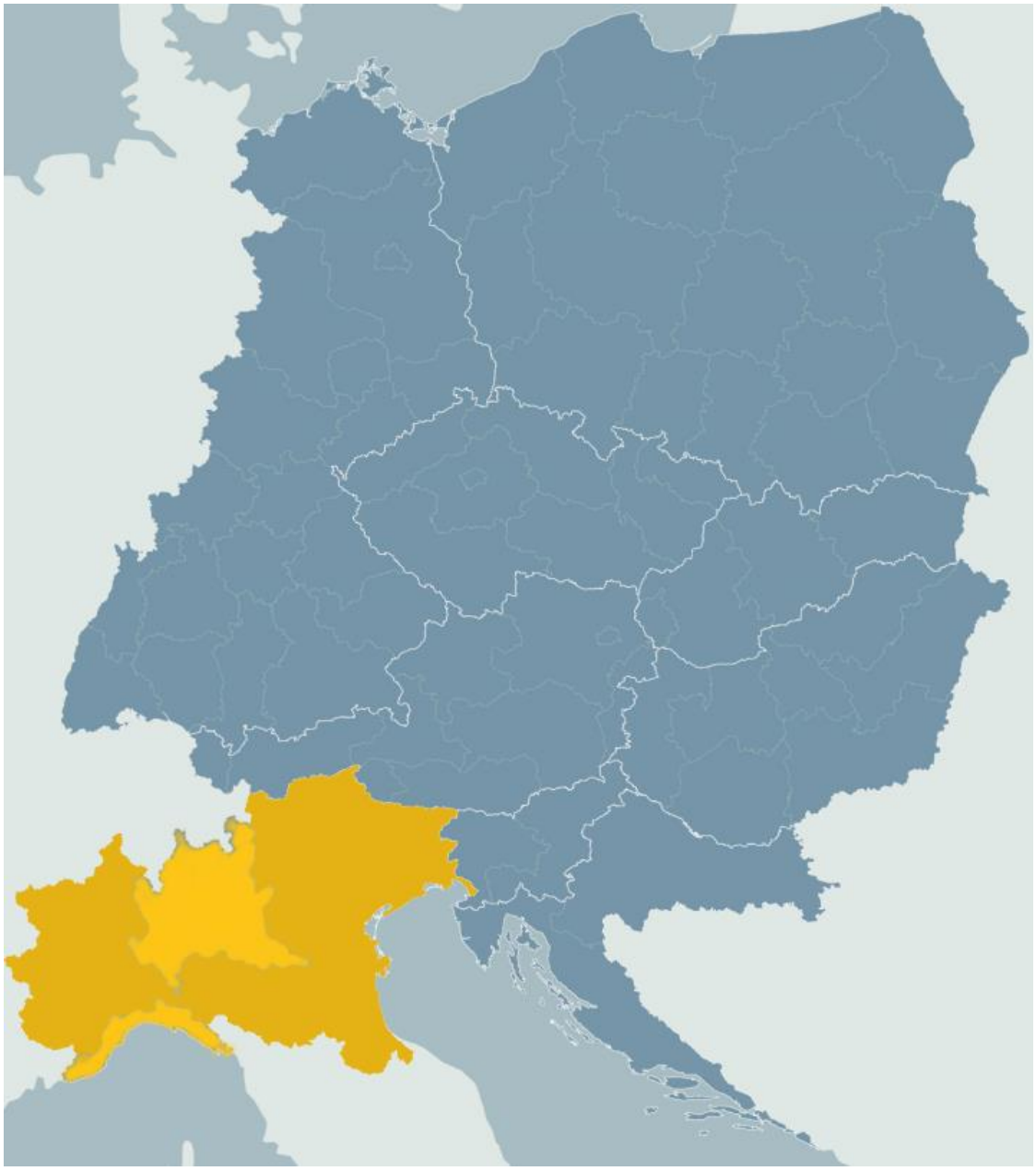

Figure 9 Map of Central Europe, with a Spotlight on Italy, Lombardy and Liguria (Source: Author Generated)

Italy is an industrial country. Italian manufacturing companies represent the engine that drives the country's economic growth and development thanks to their ability to produce wealth and employment, make associated industries and services flourish, and contribute to the country's financial, economic and social stability. It is therefore in Italy's interest to create an environment that is favourable to business. Industrial policy is back on top of the Government's agenda and the tools that we has been introduced are tailored to the trademark entrepreneurial spirit within the Italian economy. Some example are:

- Encouraging private investment in Research and Development for product and process innovation to ensure the competitiveness of enterprises in the future.
- Supporting innovative enterprises at all stages of their life cycle

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Manufacturing sector plays a relevant role also in the national economy and the national government adopted in 2016 a national plan (Piano Industria 4.0) to support companies investment toward industry 4.0.

Based on the characteristics of Italian manufacturing sector (i.e. large number of SMEs, high-quality research centres and universities supporting companies, limited number of big companies), the plan was focused on fostering:

- Innovation investment: promote private investments on technologies and I4.0 equipment and on R&I
- Competences: develop I4.0 competences in companies through dedicated training courses as well as investing in targeted educations
- Enabling Infrastructures: development of adequate infrastructures and contribute to the definition of standards
- Public instruments

2.4.1. Spotlight on Lombardy

In the programming period 2014-2020 Lombardy Region intervention framework focused on 7 Specialisation Areas to consolidate the leadership of the key regional actors in their respective markets/fields.

Due to the strategic importance of Lombardy Manufacturing Sector, the Region has defined Advanced Manufacturing as one of the specialisation area of its S3.

Accordingly, programmes and public investment are targeting key priorities topics identified in collaboration with regional stakeholders. These topics are:

- Innovative production processes
- Smart & Adaptive production systems
- High efficiency production systems
- Personalised products production
- Sustainable production systems

2.4.2. Spotlight on Liguria

Liguria has four key priorities associated to its vision and strategic intent for advanced manufacturing and industry 4.0:

- Enhance existing realities starting from universities of excellence in a brownfield logic and according to clear specialization logics on Industry 4.0 technologies
- Intensify university-business relations through the establishment of joint partnerships according to a market orientation and sustainable planning from an economic and financial point of view.
- Giving visibility, scale and scope to initiatives even with an unprecedented form of financing and promoting their complete placement within the European DIH network being set up.
- Creation of competence centers highly specialized in Industry 4.0 themes

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2.4.3. Policy Instrument Overview

Within the framework of tools available to stakeholders in the region, there are a number of options which exist to support the development of advanced manufacturing and industry 4.0 competencies and address sectoral, value chain and target group challenges via technology-oriented cooperation. Some examples are as follows:

At EU level a number of calls are available targeting these topics, but not all the companies are mature enough to undertake these projects considering that although more convenient in terms of funding rate they usually require big effort with respect to regional projects. At this level **open calls** represent another important instrument to support technology-oriented cooperation. Regarding the topic of Smart and new materials, interesting opportunities could come from the upcoming **Green Deal calls.**

At national level, the measures funded in the framework of Italian Industry 4.0 Plan, supported companies to invest in new capital goods, tangible assets and intangible assets (software and IT systems) for the technological and digital transformation of their production processes. This initiatives was coupled with the establishment of DIH in the territory to support companies in the identification of their technology maturity level and guide them toward effective investment.

Lombardy Region financed a number of R&I projects through **POR-FESR**. These calls were specifically targeted to innovations and had the aim to bring research results to market thanks to the collaboration between research stakeholders and companied of different size. Besides big projects requiring a considerable investment, Lombardy Region has also funded innovation through vouchers, namely **S3-INNODRIVER**. This instrument was designed specifically to support companies in the acquisition of innovation services from regional suppliers but it also include measures to support patenting and Seal of Excellence.

Liguria Region, through the definition of its Smart Specialization Strategy, identifies the specialization areas with the greatest potential for innovation and development on which to concentrate investments. This document constitutes a conditionality to access ERDF, ESF and EAFRD funds. SIIT is one of the main subjects that can influence this strategy.

Moreover, at local level, chamber of commerce throughout diverse Italian regions issued **"Digital Vouchers I4.0"** to support SMEs toward digitalisation journey targeting specifically companies who need to introduce and uptake enabling technologies to pave the way toward major digitalisation action.

Finally, AFIL is also involved in **ADMA initiative** network, funded by a tender of the EU Commission. The initiative has developed a methodology and designed a scan tool for companies who want to assess their level of maturity in specific transformation areas with the support of advisors. Thanks to this instrument companies can be guided toward FOF identifying proper investment as well as funding instruments available.

2.4.4. Italian CEUP 2030 Eco-System

The Italian eco-system in CEUP 2030, is led by Partner 6, Lombardy Intelligent Factory Association (AFIL), and Partner 7, Intelligent Integrated System Technology (SIIT). The section begins by providing an overview of AFIL and SIIT, including a description of the organisations' functional role in meeting the region and national-level advanced manufacturing and industry 4.0 vision, plus the goals, capabilities, and strengths the

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organisation has to achieve these aims. In addition to AFIL and SIIT, there are a number of other stakeholders who are critical to the CEUP 2030 innovation network development who will also be profiled within this section.

2.4.4.1. *Introduction to Lombardy Intelligent Factory Association*

AFIL is the regional cluster for Advanced Manufacturing. It has been formally recognised by Lombardy Region in 2013 with the specific role of supporting the elaboration of the regional S3 as well as the work programme contents. Indeed, this is one of the pillars of AFIL's mission which is regularly updating its roadmap based on the R&I priorities emerged from the dialogue with its heterogeneous groups of associates.

In its role of intermediary organisation, AFIL has a strong relationship also with its associates which are industrial as well as research stakeholders. In this context, while collecting relevant inputs on needs and priorities to deliver to the regional institution, the cluster is operating to ensure connections and collaborations among members and to raise awareness on strategic and relevant topics in the Advanced Manufacturing context

Table 9 Aims, Capabilities and Strengths of Lombardy Intelligent Factory Association (Source: Author Generated)

Institutional Aims for Advanced Manufacturing and Industry 4.0	
(1) Increasing companies' awareness on existing opportunities on Industry 4.0. (2) Transfer of best practices (3) Fill the existing gap between research and market favoring the collaboration among researchers and companies toward testing and applications (4) Matching services to support companies in identifying Competence Centers or solution providers having specific competences on Industry 4.0 and infrastructures. (5) Support in accessing private and publicly available funds. (6) Transfer input on key priorities to policy makers	
Capabilities	**Strengths**
Road mapping: identification of stakeholders needs and priorities, matching with regional, national and European trends for the elaboration of R&I roadmaps **Awareness creation and innovation scouting:** organization of several meetings and events, ranging from institutional events to thematic workshops for increasing awareness on key topics, from specific working groups to support companies on certain needs to matchmaking events. **Support in project ideas generation and funding opportunity monitoring** **Regional and Interregional ecosystem Building and networking** **Facilitate access and connection with innovation infrastructures**	Consolidated and formalised relationship with Lombardy Region About 150 Associates representing different categories (Universities, Research centres, companies, associations…) Wide network of relationships with diverse regional, national and EU actors Active involvement in several EU strategic networks (i.e. Vanguard, S3Platform, DIH, I4MS, etc.) At global level, AFIL has recently started a collaboration with WEF being recognised as Lombardy Advanced Manufacturing Hub (AMHUB)

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2.4.4.2. *Introduction to Intelligent Integrated System Technology SIIT S.c.p.a*

SIIT SCpA was founded in 2005 with the aim to create an integrated system among large industries, small and medium-sized businesses, the University of Genoa, public institutions, research and finance, with particular attention to the development of industrial research and technology transfer activities, with a direct line with the Region of Liguria, the Ministry of Economy and the Ministry of Universities and Scientific Research.

Table 10 Aims, Capabilities and Strengths of Intelligent Integrated System Technology SIIT (Source: Author Generated)

<table>
<tr><th colspan="2">Institutional Aims for Advanced Manufacturing and Industry 4.0</th></tr>
<tr><td colspan="2">(1) orientation, in particular for SMEs, through supporting companies in assessing their level of digital and technological maturity;
(2) training, to promote and spread Industry 4.0 skills through classroom training and real applications, in order to support companies in adapting to new scenarios and obtaining concrete benefits in terms of reducing costs and increasing competitiveness;
(3) implementation of innovation projects, industrial research and experimental development, also of a collaborative nature, and supply of technology transfer services in the Industry 4.0 area, through actions to stimulate the demand for innovation by companies, in particular SMEs.</td></tr>
<tr><th>Capabilities</th><th>Strengths</th></tr>
<tr><td>SIIT SCpA represents an aggregation of a regional nature, whose main aim is to promote and favour production competitiveness in the areas of interest.
The Technology District supports the growth of high technology companies by creating a permanent exchange of knowledge between Large Industry, Small and Medium Enterprises, Universities, Research Centers and Institutions.</td><td>Involving talent, companies, public and private funding, SIIT develops programs and projects with strong repercussions on the Ligurian entrepreneurial fabric.</td></tr>
</table>

2.4.4.3. *Overview of Other Key Stakeholders*

Within the project network, there are strategic connections which have been built across the last programming period, and will be fostered in order to address the gaps and capitalize on the opportunities associated to the topic of Advanced Manufacturing and Industry 4.0. Within the context of AFIL and SIIT, the following stakeholders have been identified:

Table 11 Critical Italian Stakeholders for CEUP 2030's goals for CAMI4.0 Excellence (Source: Consortium Generated)

S3 Policy Stakeholders	Regione Lombardia Confindustria Lombardia Finlombarda Camera di Commercio, industria, artigianato e agricoltura di Genova Digital Innovation HUB Liguria SAFE CLUSTER

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Networking-Support Stakeholders	DIH Lombardia Local DIHs network Camere di Commercio (Lombardia) Confindustrie Associazione DIXET KUKA IIT Istituto Italiano di tecnologia TECHTERA NEXT TECHNOLOGY TECNOTESSILE SOCIETA NAZIONALE DI RICERCA R L
Training-Support Stakeholders	Politecnico di Milano STIIMA-CNR MADE Università degli Studi di Bergamo Università degli Studi di Brescia Camere di Commercio - Confindustrie Osservatorio Politecnico di Milano Università degli Studi di Genova Consiglio Nazionale delle Ricerche IIT
Other Stakeholders	CFI – Cluster Fabbrica Intelligente AIDAM - Associazione Italiana di Automazion e Meccatronica (Italian association of Automation and Mechatronics) CSMT – Centro Servizi Multisettoriale Tecnologico (Technological and multisectoral services center) UCIMU – Unione Costruttori Italiani Macchine Utensili (Italian Union of machines manufacturer) AMINET

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2.5. Hungary

Figure 10 Map of Central Europe, with a Spotlight on Hungary and Western Transdanubia (Source: Author Generated)

Overall vision is support Hungarian manufacturing companies in the shift towards new production modes. The shift is planned to be supported by re-organization of the public support structure, both institutionally and call-wise. Universities are desired to be the focal points of the changes. Territorial Innovation Platforms were organized in the recent 12 months, to act as acceleration centers of the paradigm change.

On national level there are various initiatives that cover the area of advanced manufacturing and industry4.0. For example the Industry4.0 platform – coordinated by the Academy of Science, a high level body, focusing on manufacturing industries. Large companies are members and national institutions. Furthermore, the Artificial Intelligence Coalition, a recent top-bottom initiative of the government, targets various sectors, from manufacturing through health to education. Table 12 provides an overview of Hungary's sectoral aims.

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Table 12 Overview of Hungarian Sectoral Aims (Source: Consortium Generated)

Sectors	Aims	Production Systems	Robotics & Automation	Smart & New Materials	Artificial Intelligence
Automotive	FDI promotion and plant extensions	X	X		
	Education: BsC, MsC in electric engineering with Universities and PBN		X		X
	Training – digital skills – am-LAB	X	X		X
	EIT Manufacturing Hub PBN	X	X		
Wood & Furniture	Kronospan Cluster – FDI and new supplier park	X	X	X	X
	Education – Kronospan Design Academy – am-LAB				X
Health Industry	Health- and social care related applied research projects				X
	Intelligent Cities Challenge (ICC)	X	X	X	X
	AI applications in health care				X

2.5.1. Spotlight on Western Transdanubia

Population: 1 million people; Universities: 4 – Széchenyi, Sopron, ELTE, Pannon; GDP — EUR 21 500 per PPS in 2017; GDP: Industry — Services:48 %; Agriculture 4 %; Number of overnight stays: 9.5 Million people

Northern part of the region is dominated by Audi AG and its suppliers, the middle part by TIER3 and TIER4 international suppliers, meanwhile the southern part has wood and furniture. Recent initiative is an autonomous drive test track in the southern part. Large multinationals dominate the economic performance, with limited local company pool. In tourism the thermal spa network represents internationally respected value.

With regards to advanced manufacutring and industry 4.0, Western Transdanubia is interested to apply advanced manufacturing applications in a holistic way and to achieve upgrade of the value added. The transformative changes have social, economic and political consequences, each of which has to be respected.

2.5.2. Policy Instrument Overview

Within the framework of tools available to stakeholders in the region, there are a number of options which exist to support the development of advanced manufacturing and industry 4.0 competencies and address sectoral, value chain and target group challenges via technology-oriented cooperation. Some examples are as follows:

Transnational

- EIT Manufacturing's broad portfolio of calls;
- Horizon Europe's instruments, especially the new operative programme.
- Digital Europe Programme
- International cascade funding schemes

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Local / Regional

- Intelligent City Challenge program – where the city of Szombathely and PBN are partners – includes economic restructuring objective, led by PBN – including elaboration of projects with funding map to be submitted with the Commission's support
- Szombathely 2030 strategy – a comprehensive development program in order to promote industrial diversification, striving for environmental sustainability, exploiting innovative opportunities based on intelligent approaches.

2.5.3. Hungarian CEUP 2030 Eco-System

The Hungarian eco-system in CEUP 2030, is led by Partner 9, Pannon Business Network Associations (PBN). The section begins by providing an overview of PBN, including a description of the organisation's functional role in meeting the region and national-level advanced manufacturing and industry 4.0 vision, plus the goals, capabilities, and strengths the organisation has to achieve these aims. In addition to PBN, there are a number of other stakeholders who are critical to the CEUP 2030 innovation network development who will also be profiled within this section.

2.5.3.1. *Introduction to Pannon Business Network Associations*

PBN is a leading public economic development organisation in the west Pannonian region, which focuses on assisting Hungarian SMEs in competitiveness development via focusing on application of digitalization; focus areas are robotics, data science, AR and VR, 3Dsolutions. Furthermore, PBN provide management support, realized by value stream analysis, audits, customized trainings, facilitated by an accredited digital innovation hub subsidiary, with the brand name am-lab. Additionally, PBN has a vast international reach: representing over 450 European partners and 70 international projects; 140 Hungarian contracted businesses that are active in the manufacturing industries. Finally, PBN is part of the EIT Manufacturing Network as EIT Manufacturing Hub Hungary

Table 13 Aims, Capabilities and Strengths of Pannon Business Network Associations (Source: Author Generated)

Institutional Aims for Advanced Manufacturing and Industry 4.0	
(1) Machine Learning / Data Science Institute – partnership with UniBo, Bi-Rex and with the regional universities (2) EIT Manufacturing exploitation – kick-off of gazelle factory, application support of smart materials, EIT i4.0 calls promotion (3) Digital skills related trainings – new insight and skills for the am-LAB training curriculum (4) Health- and social-care related applied research – application of data science with local institutions (5) European DIH certificate – recognition of am-LAB-led consortium (6) Connectivity to Intelligent City Challenge Program	
Capabilities	**Strengths**
Training and applied research. In 4 areas 9 different technological areas are covered,	• Strong business connections – 150 manufacturing SME mentored in 2018 and

with in-house engineering and economist staff. The core areas: 1. Robotics – industrial, collaborative, mobile and indoor autonomous drone 2. Data Science – natural language processing, ML algorithms, especially in segmentation, correlation and classification. 3. Extended Reality – augmented and virtual reality applications, focusing on AR 4. 3Dtechnologies – 3Dprinting, 3Dscanning, prototyping and CGI technologies for 3Danimation	2019, 50 of them 10 integrated digitisation applications • Modern digital device portfolio with experienced engineering staff, specialized each on dedicated field • Good reputation nationally and internationally, due to 1.5 decades of permanent and committed work • Willingness to learn and adapt from good practices

2.5.3.2. *Overview of other Key Stakeholders*

Within the project network, there are strategic connections which have been built across the last programming period, and will be fostered in order to address the gaps and capitalize on the opportunities associated to the topic of Advanced Manufacturing and Industry 4.0. Within the context of Pannon Business Network, the following stakeholders have been identified:

Table 14 Critical Hungarian Stakeholders for CEUP 2030's goals for CAMI4.0 Excellence (Source: Consortium Generated)

S3 Policy Stakeholders	City of Szombathely; Vas County Authority (ASP of CEUP2030)
Networking-Support Stakeholders	Kronospan Cluster Professio Cluster (automotive) MediCluster (health industry)
Training-Support Stakeholders	University of Sopron (wood and furniture) Hefele Secondary School (furniture) ELTE University Széchenyi István University Budapest Technical University Óbuda University Szeged University
Other Stakeholders	Large multinationals in the region – Schaeffler, BPW Savaria, Ivy Technologies, TDK-EPCOS, Kronospan Scientific Association of Machinery Engineers Zala Zone autonomous car track

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2.6. Slovenia

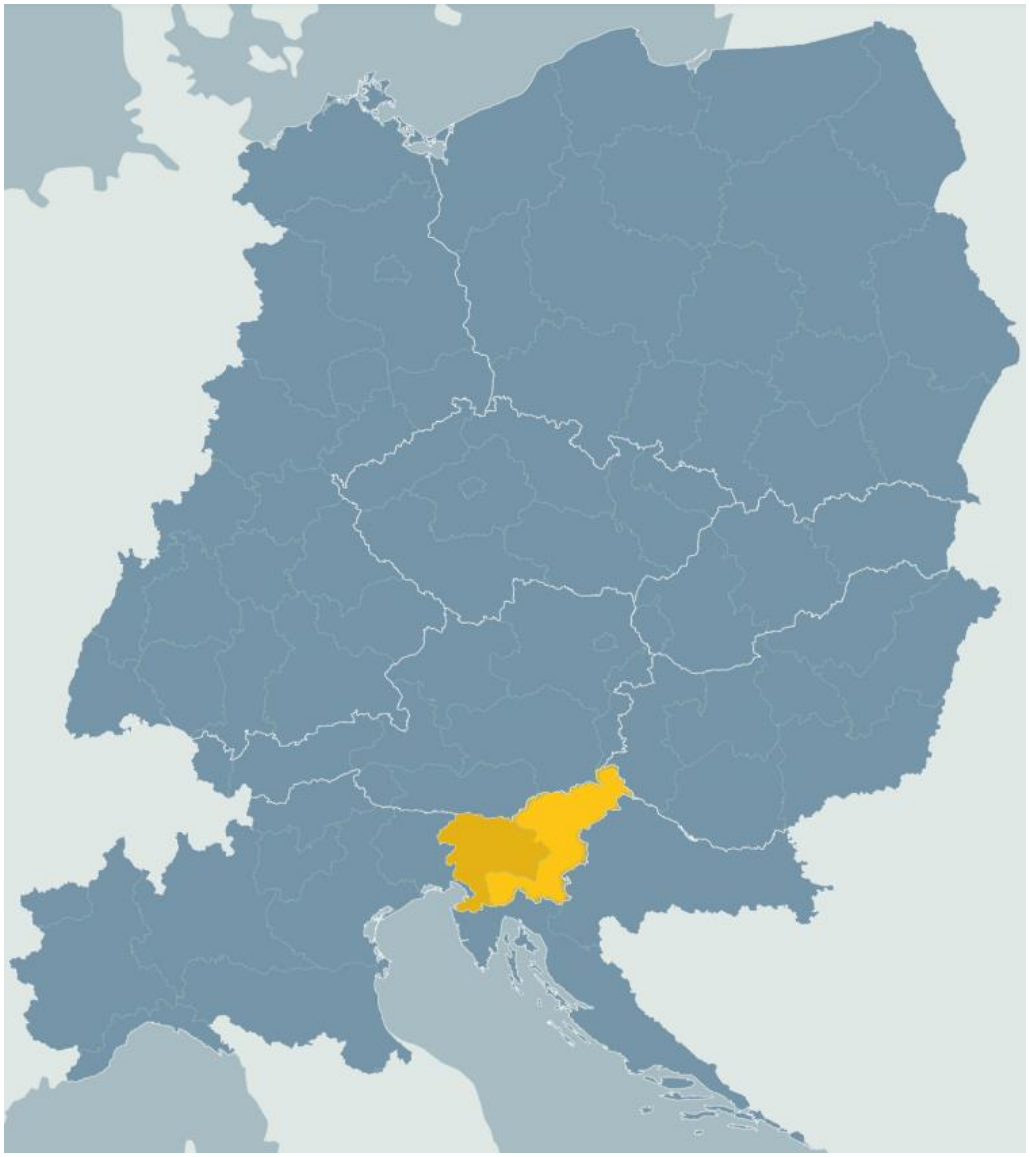

Figure 11 Map of Central Europe, with Spotlight on Slovenia and Eastern Slovenia (Source: Author Generated)

With regards to S3, Slovenia wishes to build on its natural assets, focus on its specifics and support the achieved broader public consensus with regard to the vision of the green Slovenia, which should be:

Clean and healthy and as such attractive for life and work;

Circular, since it will base its development on the principles of circular economy;

Serene because Slovenia is serene / calm , whereas with a shift to the innovative society it is also becoming serene / bright, making Slovenia inspiring and open, open to new ideas, talents and for experimentation, which is enabled and encouraged by our tolerance and safe environment

The strategic objectives of the S3 are therefore:

(1) To develop and position Slovenia as an attractive ecological country of innovation, focused on the development of medium- and high-tech and comprehensive solutions

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in clearly and strategically defined niche areas where Slovenia has capacities and competences to compete on the global market.

(2) To establish state of the art, responsive, dynamic, strategically-guided, inclusive and globally connected research, innovative and entrepreneurial eco-system.

The vision of the strategy from 2017 was "SUSTAINABLE TECHNOLOGIES AND SERVICES FOR HEALTHY LIVING" which should place Slovenia as a green, active, healthy and digital region with top conditions for creation and innovation, aimed at developing medium and high technology solutions in niche areas.

A similar vision appears in the new draft of the Slovenian industrial strategy, where the vision is that the Slovenian industry is green, creative and smart. (Osnutek - Slovenska inustrijska strategija, dne 6.9.2020). In priority niche areas, which also includes Industry 4.0, Slovenia will move from a follower to a co-creator of global trends, which is the mission of the Slovenian Smart Specialisation Strategy ("S4"). The key target variable S4 is the increase in value added per employee, which will be measured at the level of individual areas of application. At the aggregate level, the success of the S4 implementation will be reflected in (until 2023):

(1) Increased share of high-tech intensive products in exports - an increase of 22.3% to the EU-15 average of 26.5%;
(2) Increased share of exports of services with a high share of knowledge in total exports - from 21.4% to 33%, which means halving the gap to the EU average;
(3) Raise overall entrepreneurial activity from the current 11% to at least the level of the EU average, i.e. 12.8%.

The priority area of the S4 strategy was also Industry 4.0, which combines areas of application in, there is a dominant actor or. a group of strong actors, which often also has established cooperation with the scientific sphere, where opportunities are not used in terms of:

a) more strategic alliances of strong private sector players in order to offer more comprehensive solutions and, consequently, joint market presence;
b) enhanced links with research organizations in product development in the light of future needs in the medium and long term;
c) stronger links with small and medium-sized enterprises in terms of strengthening not only suppliers but also the creation of development networks, and
d) encouraging the emergence of new product lines through encouraging the emergence of new companies,
e) modernization and digitization of production processes and management of the entire production cycle

2.6.1. Spotlight on Eastern Slovenia

Eastern Slovenia is a relatively industrial area with developed focuses in the metal, food, automotive, construction sector. Multiple cross-sectoral industry 4.0 technologies can assist SMEs to become more:

a) competitive
b) standardized & included in
c) transnational vertical supply chains

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d) green and thus consumer &
e) environment friendlier

Tourism and its complementary innovative products /services for the convenience of guests and local population (high quality of living for smart mobility, living, health and well being) can be upgraded (accessibility of information, convenience of communication and commuting, short reaction time to inquiries, and higher quality of services).

Introducing novel IT solutions and apps, accessible also for SMEs at all stages of business process (purchase, production, sales and post sales services) can be monitored in real time due to sensors and data collection, quick analysis performed by HPC and artificial intelligence algorithms

2.6.2. Policy Instrument Overview

Within the framework of tools available to stakeholders in the region, there are a number of options which exist to support the development of advanced manufacturing and industry 4.0 competencies and address sectoral, value chain and target group challenges via technology-oriented cooperation. Some examples are as follows:

"E-Business 2019-2022" - Public tender for the establishment or upgrade of electronic commerce in SMEs in the period 2019-2022: small values ("digital vouchers" for raising competencies, preparation of digital strategy, digital marketing, cyber security)

P4D-C19 - Incentives for the digital transformation of SMEs The purpose of the tender is to stimulate the growth and development of supported companies and to eliminate the consequences of the covid-19 pandemic on the basis of investments in the use of digital business in their supply and / or sales chains, increase of management capacities, introduction of digital business models, implementation of investments for the purposes of digital transformation into production and operation of supported companies, increase of added value per employee and preservation of jobs in supported companies. The investments will enable companies to restructure and modernize business and production processes and introduce new digital business models, thus maintaining the market position in the short term and strengthening the position in existing and long-term penetration into new markets and niche markets.

P4L 2020 - Incentives for SMEs for the development and introduction of new products in the wood industry 4.0. The purpose of the tender is to introduce new or improved products in the field of processing and treatment of wood and wood products (wood share more than 50%) and to eliminate the long-term consequences of the covid-19 pandemic on companies in the wood processing industry by strengthening investments in modernizing restructuring and modernization of production for companies and thus maintaining the market position in the short term and strengthening the position on existing ones in the long term and penetrating new markets and niche markets.

Public tender for granting liquidity loans in problem and border problem areas - B1 granting liquidity loans in problem and border problem areas in the territory of the Republic of Slovenia - purchase of new or used equipment and working machines, purchase of intangible fixed assets, administrative costs, material costs, costs of services in creating products and providing services.

Public tender "Promoting sustainable business strategic transformation and development of new business models in Slovenian companies for easier integration into global value

chains" The aim of the public tender is to increase the international competitiveness and export intensity of small and medium-sized enterprises through a sustainable business strategic business transformation.

Public tender EUROSTARS The purpose of the call for proposals is to implement the Eurostars 2 program. This is a program that co-finances SMEs and their R&D-intensive partners in the implementation of their joint innovative projects, which have a short market entry time.

Seed Capital - Convertible loan for start-up of innovative companies (EUR 75,000); The purpose: to provide quasi - equity financing for innovative companies in the seed phase, which have difficulty accessing the financing of commercial banks or. other classical forms of financing;

Support for Strategic Development and Innovation Partnerships (SRIP) -support for strengthening research and development-innovation (RDI) cooperation of independent stakeholders: companies, research organizations and other relevant development stakeholders operating in each area of application of the Smart Specialization Strategy 2014-2020, with systematic integration into international value chains, ensuring a comprehensive support environment in SI).

Strengthening the competencies and innovation potentials of companies (co-financing the inclusion of highly educated professionals in companies, with the aim of promoting innovation, strengthening the competencies of companies with interdisciplinary knowledge, establishing an effective innovation infrastructure and strengthening research and development departments in companies).

Tax incentives for investment in research and development The tax relief is intended for successful companies that operate at a profit. It is an incentive, as they can reduce their tax due to risky research and experimental development (R&D) activities, which are not completely predictable in nature. Therefore, companies can also plan R&D expenditure in such a way that they achieve two effects at the same time - a competitive advantage with R&D activity and a lower tax base for this amount. The tax relief amounts to 100% of investments in R&D activity. The net effect is determined by the tax rate, which depends on the legal formal form (legal or natural person). Most of the relief is claimed by companies, for which the tax rate is currently 19%.

Vouchers - Digitization vouchers are an incentive for micro, small and medium-sized enterprises with the possibility of 60% co-financing of 4 key areas of digitization. Public calls for digitization vouchers are published by the Slovenian Enterprise Fund (SPS). Topics: raising digital competencies, digital marketing, preparation of digital strategy and cyber security.

Other measures: RDI, financial instruments of Slovene Enterprise Fund, SID Bank (SID – Slovenska izvozna in razvojna banka, d.d., Ljubljana).

SUPPORTING ENVIRONMENT:

- Digital coalition / SRIP ICT horizontal network / Digital innovation hub of Slovenia / DIH from the EC list / Slovenian Chamber of Commerce (GZS)-Association for Informatics and Telecommunications (ZIT), Entities of innovative environment (technology parks, incubators,…)

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2.6.3. Slovenian CEUP 2030 Eco-System

The Slovenian eco-system in CEUP 2030, is led by Partner 8, Pomurje Technology Park (PTP). The section begins by providing an overview of PTP, including a description of the organisation's functional role in meeting the region and national-level advanced manufacturing and industry 4.0 vision, plus the goals, capabilities, and strengths the organisation has to achieve these aims. In addition to PTP, there are a number of other stakeholders who are critical to the CEUP 2030 innovation network development who will also be profiled within this section.

2.6.3.1. *Introduction to Pomurje Technology Park*

PTP as a member of Association of Slovenian Technology Parks and Business Incubators, as subject of state acknowledged innovative environment, also member of SRIP FOF, Pomurje Chamber of commerce and Technology Park with start-up and scale-up program, acting as DIH Smart Manufacturing plays a role of technology transfer actor, with facilitating capabilities, providing a huge network of expert infrastructure and accordingly expert HR, and striving to service SMEs also with co-financing possibilities, it reaches not only in statistical region of Pomurje but more and more covering the area and various sectors in whole Slovenia, especially when representing Slovenia as a sole partner in transnational projects of KTT.

Table 15 Aims, Capabilities and Strengths of Pomurje Technology Park (Source: Author Generated)

<table>
<tr><th colspan="2">Institutional Aims for Advanced Manufacturing and Industry 4.0</th></tr>
<tr><td colspan="2">(1) PTP's vision is:
a. to become a competent, relevant and connecting intermediate for industry by providing required resources (R&D, funding, KTT, testing infrastructure…).
b. to have the ability to co-create programmed funding schemes for SMEs, which will contribute to continuance and thus easier planning for SMEs in their digital transition.
c. to foster its position engaging with industry on daily base, to provide a competent source of realistic bottom-up information (needs of AM & I 4.0) for policy level as well as a link to pool of solution in CAMI 4.0 topics for the needs of SMEs.
(2) PTP's goals are to:
a. to gain the trust (through quality of services);
b. to gain the ability to transnationally connect to industry actors and policy stakeholders so joint initiatives for support to industry could reach EU level (commission) for future initiatives.</td></tr>
<tr><th>Capabilities</th><th>Strengths</th></tr>
<tr><td>Testing premises
Trainings
Pilot experiments financed as pilots from transnational projects
Experienced personnel in project management (together with SMEs writing applications for funding R&D development)</td><td>Past references
Experience in obtaining funding for SMEs
Cooperation with policy level stakeholders
Inclusion into regional development road-mapping</td></tr>
</table>

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Wide international network of concrete/specific expert knowledge and infrastructure	Created network of technology (solution) providers and so link/access to latest technology solutions

2.6.3.2. *Overview of other Key Stakeholders*

Within the project network, there are strategic connections which have been built across the last programming period, and will be fostered in order to address the gaps and capitalize on the opportunities associated to the topic of Advanced Manufacturing and Industry 4.0. Within the context of PTP, the following stakeholders have been identified:

Table 16 Critical Slovenian Stakeholders for CEUP 2030's goals for CAMI4.0 Excellence (Source: Consortium Generated)

S3 Policy Stakeholders	SRIP PMiS (Smart Cities and Communities) / Institute Jožef Stefan SRIP Factories of the Future (Institute Jožef Stefan) (AI Section) Slovenian Artificial Intelligence Society (SLAIS) Centers of excellence: PoliMat & NAMASTE & NIN SRIP MATPRO (Slovenian Chamber of Commerce) Horizontal ICT network / Slovenian Chamber of commerce Ministry of Education, Science and Sport / Ministry of Economic Development and Technology / Ministry of Health / Government Office for Development and European Cohesion Policy
Networking-Support Stakeholders	Competence center CLASS (cloud computing) Competence center OPCOMM (open communication platform for integrated services) Competence center STV (modern management technologies) Center of excellence: BIK (biosensors, instrumentation and process control) Institute Jožef Stefan / Artificial Intelligence Lab ICT innovation network /Slovenian Chamber of Commerce IJS / Department of Automation, Bio-cybernetics and Robotics **CO Nanocenter** (Nanoscience and Nanotechnology) CO NAMASTE (improved and new non-metallic materials, components and devices) CO NIN (improved and new non-metallic materials, components and devices) SRIP Food / SRIP Health / SRIP Mobility / SRIP Smart cities & communities / SRIP Circular Economy/ SRIP MATPRO ICT innovation network /Slovenian Chamber of Commerce AI4SI (Artificial intelligence for Slovenia)- Slovenian Chamber of Commerce Jožef Stefan Institute: ➢ Artificial Intelligence Laboratory ➢ Department of Knowledge Technology ➢ Department of Intelligent Systems

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Training-Support Stakeholders	**University of Ljubljana:** ➢ Faculty of Computer and Information Science ➢ Faculty of Electrical Engineering (Machine Intelligence Laboratory) ➢ Faculty of Mechanical Engineering (LASIM Laboratory) ➢ Faculty of Polymer Technology **University of Maribor:** ➢ Faculty of Electrical Engineering, Comp Science & Informatics ➢ Faculty of Mechanical Engineering in Maribor ➢ Faculty of Informatics studies Novo mesto (FIŠ) ➢ Faculty of Organizational Sciences in Krani **Institute of Chemistry** **University of Nova Gorica** Slovenian Chamber of Commerce/ Association of: a) metal; b) chemical industry Faculty of Natural Sciences and Engineering / Department of Materials and Metallurgy
Other Stakeholders	Institute of Information Science (IZUM), Public Agency SPIRIT, 4PM DIH, DIH Smart production (PTP) Technology Parks, Development Centers, Centers of excellence, clusters (Automotive, TCS); Companies and R&D Centers of Yaskawa, Daihen; SMEs: VIRS, Varstroj, ROBOTEH, Autotech, AXIOMTECH, SMEs: Metronik, Telekom Slovenije, Arctur, XLAB, FMC Group, LOTRIČ Metrology Institute for metal materials and technologies (IMT); Industrial Association of Toolmakers (TECOS); Slovenian National Building and Civil Engineering Institute (ZAG); SIJ Group, Štore Steel (both steel); Impol, Talum (both Al); Magneti Lj (magnets); Helios (coatings); Cinkarna (Zn), Zlatarne Celje (Au); AquafilSLO (filaments), ATOTECH (surface finishing solutions)

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2.7. Croatia

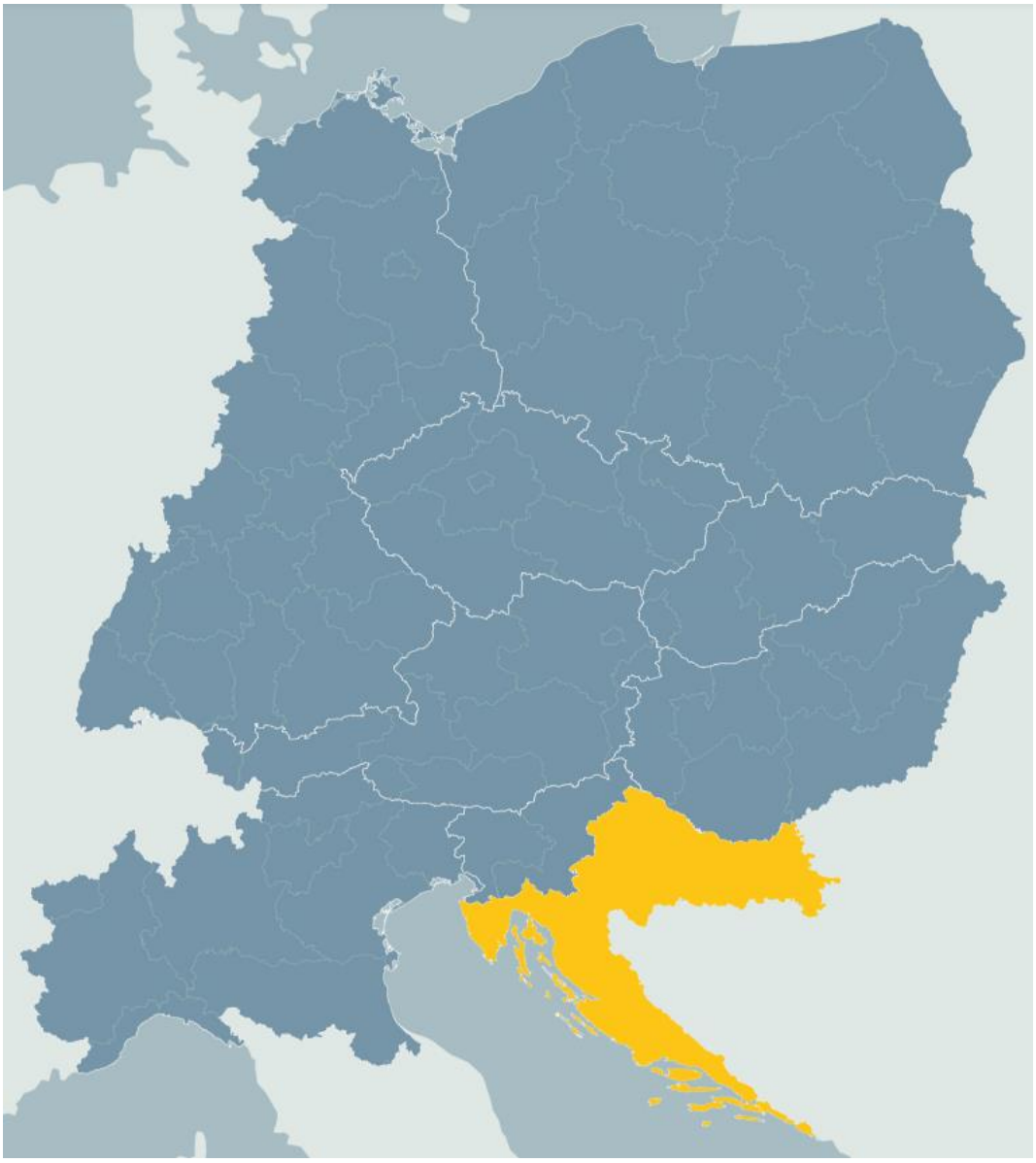

Figure 12 Map of Central Europe, with spotlight on Croatia (Source: Author Generated)

To transform the Croatian economy and increase its competitiveness, this will be achieved by concentrating knowledge resources and linking them to a limited number of priorities. Furthermore, Croatia seeks to blend existing knowledge, human potential and natural geographical advantages to help country's control of its economic and social cohesion, to turn Croatia from primarily a touristic destination to a country of well-educated, skilled citizens working on the development of R&D for innovation as a basis of economic prosperity.

The Croatian S3 focuses on a limited number of priority sectors, defined on the basis of strengths and R&D potential for the development of export-based innovations. The final result is the selection of 5 priorities:

1) Health and Quality of Life,
2) Energy and Sustainable Environment,
3) Transport and Mobility,
4) Security and
5) Food and Bio-economy.

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In addition, Croatia has identified two cross-cutting themes that can create the greatest added value and can foster the emergence of new economic activities, increase the productivity of the Croatian economy and create new and sustainable employment opportunities.

The cross-cutting themes are KETs and ICT.

Key Enabling Technologies (KETs), as technologies of the future, will provide the technological building blocks and the main source of innovation that will enable a wide range of product applications in the S3 priority areas, including those needed to develop low-carbon energy technologies, improve energy and resource efficiency, promote the fight against climate change or enable healthy aging.

ICT sector integration within many economic activities can be particularly used across large number of industries. It is also a source of dramatic change in business practices of other industrial activities. Characteristics of the ICT industry are innovation, support to higher added values of industry segments and high dependence on continuous technological progress.

Furthermore, key stakeholders in the region are working to deliver on this vision, such as the Croatian Robotics Digital Innovation Hub (CROBOHUB). This DIH, hosted within Innovation Centre Nikola Tesla (ICENT) acts as one-stop-shop, helping Croatian and South-East European companies to digitalize their business through efficient orchestrating of various stakeholders in robotic innovation ecosystem such as research institutions, business support institutions and businesses operating in the field of robotics that may contribute to the development and application of advanced robotic systems in manufacturing. CROBOHUB also provides connections with investors, facilitates access to financing for digital transformations, help connect users and suppliers of robotic innovations across the value chain and foster synergies between digital and other key enabling technologies (such as biotech and advanced materials).

2.7.1. Policy Instrument Overview

Within the framework of tools available to stakeholders in the region, there are a number of options which exist to support the development of advanced manufacturing and industry 4.0 competencies and address sectoral, value chain and target group challenges via technology-oriented cooperation. Some examples are as follows:

- **EUREKA & Eurostars** - international funding programs for SMEs wishing to collaborate on R&D projects that create innovative products, processes or services for commercialization
- **Integrator** – cooperation of SMEs to establish supplier relationships with Integrator companies by creating new innovative products and services and to become part of their value chain in the targeted strategic segment.
- **Innovation in S3** – This call encourages SMEs to commercialize product / service innovation exclusively in line with the identified priority thematic areas and cross-cutting themes of the Smart Specialization Strategy (S3). The award of grants will support innovative SMEs that are focused on the production and marketing of innovative products / services, which will contribute to increasing exports and thus the competitiveness of the Croatian economy in the global market.
- **Proof of Concept** - The goal of the program is to support innovation at an early stage of research in order to provide pre-commercial capital for technical and commercial

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verification of the innovative concept and to strengthen the capacity and capacity of the private sector for research, development and innovation.

2.7.2. Croatian CEUP 2030 Eco-System

The Croatian eco-system in CEUP 2030, is led by PP10 HAMAG BICRO (HB). The section begins by providing an overview of HB, including a description of the organisation's developing role in meeting the region and national-level advanced manufacturing and industry 4.0 vision, plus the goals, capabilities, and strengths the organisation has to achieve these aims. In addition to HB, there are a number of other stakeholders who are critical to the CEUP 2030 innovation network development who will also be profiled within this section.

2.7.2.1. *Introduction to Croatian Agency for SMEs, Innovations and Investments*

HAMAG-BICRO (HB) as an implementing agency could communicate with responsible Ministry of Economy and Sustainable Development to incorporate Industry 4.0 into future calls, as a direct topic. On the other hand, HB being the national innovation agency could serve as integrator institution in the implementation of common Strategy for Industry 4.0. HB implements most of the innovation S3 programs/instruments and at the same time plays the role of the Technical Secretariat for the National Innovation Council that is in charge of monitoring of S3 2016.-2020.

Table 17 Aims, Capabilities and Strengths of Croatian Agency for SMEs, Innovation and Investments
(Source: Author Generated)

Institutional Aims for Advanced Manufacturing and Industry 4.0	
(1) become competent and experienced in the field of Advanced Manufacturing & I 4.0. (2) to act as a connection between stakeholders in triple-helix and to strengthen linkages within the innovation system in Croatia. (3) In order to be more effective, it is important to co-create programmed funding schemes for SMEs and to incorporate Industry 4.0 into future calls, as a direct topic.	
Capabilities	**Strengths**
The Agency's activities are within the competence of the Ministry of Economy and Sustainable Development as an independent institution, but also working closely with Ministry of Education and Science, Ministry of Regional Development and EU Funds and other policy creators. Agency is included in almost all relevant initiatives and bodies responsible for programming and strategy development in the area of entrepreneurship and innovation, on the national and regional level.	HAMAG-BICRO programs have had a crucial positive impact for the Croatian innovation system and represent an important source of funding but also beyond that, professional and networking capacities for customized support and mentoring for innovative SMEs Integrator institution between all the relevant triple-helix stakeholders.

2.7.2.2. *Overview of other Key Stakeholders*

Within the project network, there are strategic connections which have been built across the last programming period, and will be fostered in order to address the gaps and capitalize

on the opportunities associated to the topic of Advanced Manufacturing and Industry 4.0. Within the context of HAMAG BICRO, the following stakeholders have been identified:

Table 18 Critical Croatian Stakeholders for CEUP 2030's goals for CAMI4.0 Excellence (Source: Consortium Generated)

S3 Policy Stakeholders	Ministry of Economy and Sustainable Development Ministry of Science and Education Ministry of Regional Development and EU Funds
Networking-Support Stakeholders	Croatian Independent Software Exporters – CISEx Croatian Chamber of Commerce Croatian Employers' Association Croatian Artificial Intelligence Association Bussines support organizations: Step Ri, Zagreb Innovation Centre - ZICER, Terra Tehnopolis, Technology park Varaždin Ericson Nikola Tesla Enterprise Europe Network – sector group ICT Industry and Services, and sector group Materials
Training-Support Stakeholders	Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb Ruđer Bošković Institute Faculty of Electrical Engineering and Computing, University of Zagreb Faculty of Textile Technology, University of Zagreb Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, University of Split
Other Stakeholders	SMEs from the field, for example: CAD CAM Group d.o.o., Codel d.o.o, EAG Center Technologies d.o.o., HSTEC d.o.o., HT-EUREP d.o.o., ININ informatički inženjering d.o.o., IZIT d.o.o., Micro-Link d.o.o., Vanado d.o.o., Proton EL d.o.o., TOPOMATIKA d.o.o., X-LOGIC d.o.o.

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3. Trend & Innovation Network Introductions and Objective Descriptions

The purpose of this section is to provide an introduction and overview to the key working group and innovation network structure in CEUP 2030, the Trend and Innovation Network. Trend & Innovation Networks (TINs) will be organised as digital communities of stakeholders anchored around the four 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.

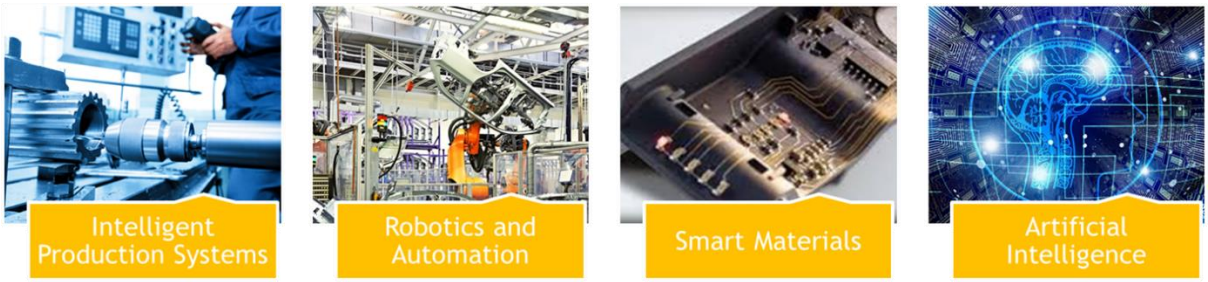

Figure 13 Overview of the four main CAMI4.0 Topics (Source: Consortium Generated)

As mentioned earlier, the TINs are innovation networks, constructed of two stakeholder communities. On the one hand, the TIN is comprised of key triple-helix-oriented stakeholders at regional level, who are critical for anchoring expertise and knowledge to target groups essential to the economic development of each region. On the other hand, the network is comprised of inter-regional connections between these regional communities, championed by the Partners of CEUP 2030 and fostered through the capabilities and competencies of each PP organisation and their network. The structure and processes of the TINs enable the partners to generate and gather professional input for direct and future-robust policy implementation.

CEUP2020 Trend and Innovation Networks are a key project output meant to promote discussion on trend and innovation foresights in order 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 the purpose laid out of this strategic report, the Partners have worked together in what were called "Pre-TIN discussions", to set the strategic goals and detailed objectives to be pursued by each TINs, including concrete activities to be implemented by each partner as well as more strategic actions to be conducted in cooperation with all the partnerships. In management theory, **objectives** are defined as goals that an organization wants to achieve over a period of time in order to reach the vision and deliver the mission. These are the

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foundations of planning, and should lead to concerted actions in order to mobilize the vision and mission into reality. **Within CEUP these objectives** are formalized in the strategy, and represent the PPs views on the common-areas of action which could be done together, based on harmonizing the functional role and target group challenges, which the PP and their regions face for delivering their vision and mission on Advanced Manufacturing (generally), and more specifically for the four CAMI4.0 Topics.

To begin, it was agreed that there are common objectives for all TINs. These objectives set the overarching obligations of what the innovation networks should look to deliver as a physical output in order to promote the robust input to policy making. Thereby clarifying the mediums by which future foresight discussions and technology experts will be engaged.

- ***Workshops***
  - Trend and Innovation Network "TIN Tech Trend Dialogue Meetings (TTTDM), 40 Meetings hosted by the Partners from November 2020 to November 2021
  - Thematically focused discussions on the CAMI4.0 topic or sub-topics.
  - Foster matchmaking among participants (and between participant groups)
  - Technical panels to address key challenges.
- ***Roadmaps***
  - Strategic documents, including guidelines for policy makers with technology foresight, sector risks and constraints, and good practice experiences.
  - Building on results from the PLL (highlighting existing gaps between policy and innovation)
  - Leveraging on inputs collected from Workshops and considering future priorities.
- ***Use-Cases/Flagship Projects***
  - Definition of five use-cases (20 in total) to be developed within the network to establish interregional connections;
  - Analysing upcoming calls to identify appropriate funding opportunities;
  - Exploiting synergies of ongoing initiatives
- ***Community Building***
  - Setting clear links to the Policy Implementation Framework (final phase of strategic recommendations);
  - Reinforcing connections between the eco-systems of different regions, especially related to the opportunities for long-term, cross-programme collaboration.
  - Supporting policy-makers of different regions in creating new cooperation opportunities.

The remaining pages of this document introduce the four TINs, describe the composition of roles the partners take within the TINs, the key strengths weaknesses opportunities and threats facing the TIN, and finally the specific objectives each TIN will champion.

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3.1. Intelligent Production Systems

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** aims to include different interconnected topics that require to be investigated together in order to achieve a holistic development of the entire production system.

The TIN in CEUP 2030 will have a specific sub-topic focus in the following areas:

Subtopic 1: Smart Sustainable Manufacturing
Definition
Sustainable manufacturing (SM) or green manufacturing is defined as a method for manufacturing that minimises waste, minimises energy usage and reduces the environmental impact of the whole manufacturing process chain. These goals will influence the product design, workflow, logistics as well as operational principles of parts in service. The future trends in sustainability explore topics such as circular economies, life cycle assessment, energy optimised production planning and smart sensor networks with the ability to prepare, pre-process, filter and transport vast amounts of data. This is applicable for example for the creation of smart grids, where smart sensor networks are introduced for energy management, and these systems can run applications for power monitoring, forecasting, coordination of distributed energy storage.

Sub Topic 2: Production in the domain of big data
Definition
Big data is a catchall term for a suite of storage, organization, and analysis techniques developed for massive data sets. In manufacturing, Big Data is defined as exceptionally large data sets, potentially numbering into the billions of rows and parameters, e.g. video footage, images, audio and sensor data and can include data collected at every stage of production, including data from machines, devices, product and operators. Big data can also be applied for the separation of correlation and causality, for isolating outliers as well as for novel classifications. This can enable a whole range of use cases such as predictive maintenance, quality prediction, anomaly detections, life cycle optimisation, supply chain management, production/demand forecasting and as well as the optimisation of overall throughput and yield.

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Sub Topic 3: Additive Manufacturing based hybrid process chains
Definition
Additive Manufacturing (3D Printing) opens up a whole range of design and functional opportunities to create innovation in production as well as in product itself. However, problems exist in adapting AM technologies to work well together with conventional manufacturing processes. The role of AM technologies within hybrid manufacturing chains as well as the challenges faced while adopting AM are a focus within this topic. Insight will also be provided on when, where, why and how AM should be adopted as well as current and future use cases and business cases for AM in manufacturing. Both the scale and scope benefits of adopting AM will be discussed as well current trends in functional printing technologies and precision additive manufacturing.

Sub Topic 4: Scalable Flexible Manufacturing
Definition
Scalable flexible production systems describe 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. Topics within this sphere include modular production; these systems are characterized by standardized components and defined interfaces. This topic also shows synergy with other fields such as automation and robotics and approaches such as the Agile Assembly Architecture, Evolvable Assembly Systems or Reconfigurable Micro Assembly Systems are parts of ongoing research and will be touched upon.

3.1.1. The Intelligent Production Systems TIN Working Group Structure

The Partners will take the following roles, detailed in Table 19, 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 19 Intelligent Production System TIN Working Group Members

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

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3.1.2. Where will the Intelligent Production Systems TIN Go?

In order to determine the strategic orientation of the TIN, the partners analysed the strengths, weaknesses, opportunities and threats they perceive associated to the topic of IPS, their organisation and the working partnership. The results of this analysis can be found in Table 20.

Table 20 Intelligent Production Systems SWOT

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
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

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3.1.3. How will the Intelligent Production Systems TIN Get There?

Following a detailed review of Partner inputs associated to the topic of IPS, along with bilateral and multilateral discussions, the following objectives, detailed in Table 21, were determined. With these objectives the partners explain how they will take advantage of the Partnership's strengths, and capitalize on emerging opportunities to overcome potential weaknesses and mitigate threats.

Table 21 Objectives Table of the Intelligent Production Systems TIN

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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3.2. Automation & Robotics

Automation and Robotics 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 TIN has chosen to work on the following sub-topics:

Sub Topic 1: Robotic and Assistive Systems
Definition
Robotic and Assistive Systems focuses on systems, which are combining human and machine interaction, intelligence and processing power, human expertise and machine power. The aim of industrial Assistance Systems is to support human beings in a in a volatile, richly varied and highly flexible production. The cognitive abilities of these assistance systems are constantly being improved.

Sub Topic 2: Machine Vision – Zero Defect Manufacturing for Automation
Definition
The ultimate goal of any kind of quality control is to avoid defective parts. Technologies related to achieving this goal are summarized under the strategic topic of "Zero Defect Manufacturing".

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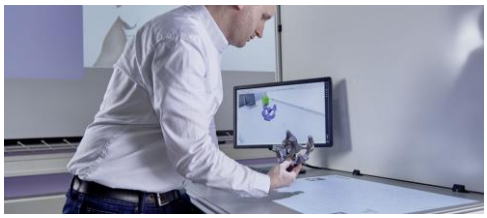
Sub Topic 3: Augmented and virtual reality, visualization
Definition
Visual Computing combines established and scientific methods for position determination, tracking technologies and machine learning to drive the following innovations. This includes Systems with higher-value perception and assistance options, Smart devices and tools and also Collaborating robots.



Sub Topic 4: Simulation and Modelling, Flexible Production Systems
Definition
Flexibility and Interoperability is becoming – in addition to price and quality strategies – an increasingly important competitive factor. Networked machines, software, employees, suppliers, customers are a reality. Unfortunately, the design and engineering of software for decentralised and distributed socio-technical production systems is reaching quite often its limits. PROFACTOR researches and develops infrastructure and algorithms for flexible production systems, assist people in making decisions which can't be reached with methods based on experience alone. Plant operators can, for example, by means of model-based methods test system configurations that are most promising for a particular product version or the current process status.

Sub Topic 5: Robots for non-Industrial Applications, Man machine collaboration
Definition
Robot for non-industrial Applications such as agriculture or medical robots have a high potential to transfer industrial solutions into other domains. Therefore, also the aspect of safety and human machine (robot) collaboration is very important.

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3.2.1. The Automation & Robotics TIN Working Group Structure

The Partners will take the following roles, detailed in Table 22, within the Automation & Robotics TIN working group structure. These roles have been chosen to optimally address technology and content relevant competencies within the CEUP 2030 partnership:

Table 22 Automation & Robotics TIN Working Group Structure

Working Group Members	
Leader	**PROFACTOR**
Core Member	**Learner**
☒ Krakow Technology Park (KPT) ☒ Karlsruhe Institute of Technology (KIT ☒ Intelligent Integrated Systems Technology (SIIT) ☒ Lombardy Intelligent Factory Association (AFIL) ☒ Pannon Business Network Association (PBN)	☒ 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)

3.2.2. Where will the Automation & Robotics TIN Go?

In order to determine the strategic orientation of the TIN, the partners analysed the strengths, weaknesses, opportunities and threats they perceive associated to the topic of Automation & Robotics, their organisation and the working partnership. The results of this analysis can be found in Table 23.

Table 23 Automation & Robotics SWOT

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).

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Opportunities	Threats
KTP create a common structure and tailored financial instruments to support SMEs implement automation and robotics. PRO technical research projects on AI human robotics systems and real time collaboration PIA generating a network for infrastructure facility sharing KIT technical research project on universal machines AFIL create bespoke training and best practice sharing to promote cultural acceptance and uptake for robotics technologies PTP applied research on pick & place robotics in the agricultural sector (cross-sector collaboration)	(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).

3.2.3. How will the Automation & Robotics TIN Get There?

After reviewing the Partner inputs associated to the topic of Automation & Robotics, along with bilateral and multilateral discussions, the following objectives, detailed in Table 24, were determined. With these objectives the partners explain how they will take advantage of the Partnership's strengths, and capitalize on emerging opportunities to overcome potential weaknesses and mitigate threats.

Within the topic of Automation & Robotics, the partners have chosen to set technical objectives, to provide a narrower focus associated to the topic of Automation & Robotics, based on the Partner competencies and stakeholder needs. In addition, the Automation & Robotics TIN has agreed to the common project-oriented objectives to promote dialogue and exchange with policy makers, and network sustainability.

Table 24 Objectives Table of the Automation & Robotics TIN

Number	Objective Name	Objective Description
Technical Objectives		
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

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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)
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
Project / Policy Upgrading Oriented Objectives		
6	Action plan generation for 2021 to 2027, with a goal to create a sustainable network structure	
7	Delivery of 10 workshops, gathering insight to determine if existing policy instruments are sufficient to deliver these technical objectives, and providing suggestions for the policy intelligence dashboard	
8	Creating models (via policy pilot projects aka use cases in practice) of optimal formulations of how to deliver these technical objectives (it can be through private collaboration, through public financed means, at regional national or transnational level - the purpose is to show that there are ways to overcome the gaps with some limitations.)	
9	Creating a strategy document which highlights if there are strategic gaps or burdens which prevent this system from allowing the technical objectives to be achieved	
10	Presenting & promoting dialogue on the success of the models implemented so far & and lessons learnt / further need to achieve these technical objectives and future developments in the topic.	

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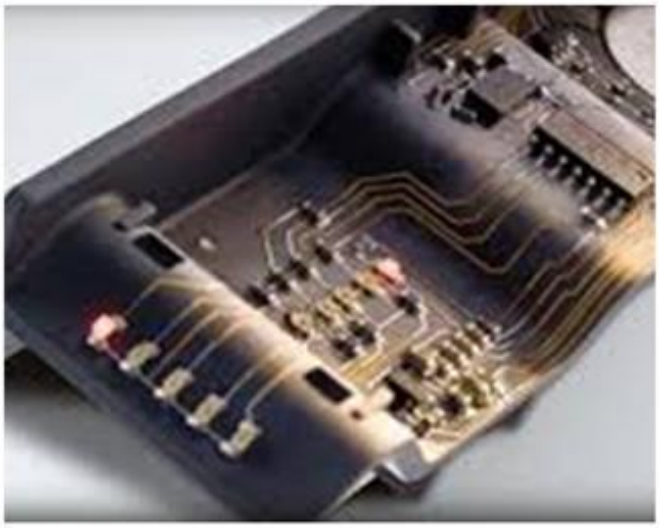
3.3. Smart and Advanced Materials

Smart and Advanced Materials, also called intelligent or responsive materials, refers to designed materials that have one or more properties that can be significantly changed in a controlled fashion by external stimuli, such as stress, moisture, electric or magnetic fields, light, temperature, pH, or chemical compounds. Smart materials are the basis of many applications, including sensors and actuators, or artificial muscles, particularly as electroactive polymers (EAPs). Smart materials are understood to show interaction with the environment. They are innovative and functional materials for industry 4.0.



The TIN focus area are smart material applications from production to the final product, with a focus on the following sub-topics:

Sub Topic 1: Smart structures & systems
Definition
There is an ongoing need to increase the functional density in technical systems. Known electromechanical or electromagnetic solutions, however, have physical limits when it comes to miniaturization. This is where smart structures based on smart materials come into play, enabling an increase in functionality with simultaneous further miniaturization. This is achieved by merging function and structure at the material level to form a smart system.

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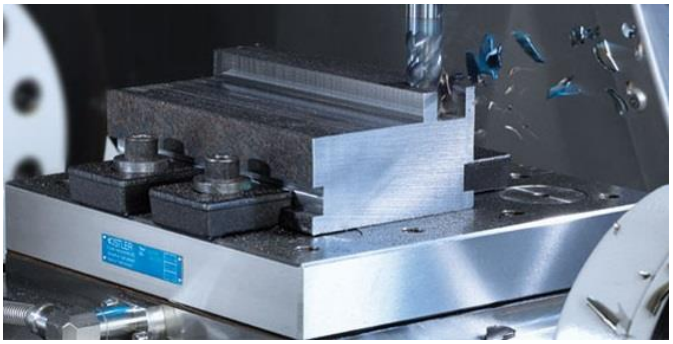
Sub Topic 2: Process-related sensor technology
Definition
To minimize the reject rate in production processes, knowledge of the process characteristics is essential. The more precisely one knows the process and can determine data about the process, the more precisely one can control or regulate the process in real time. Smart materials make it possible to measure such process properties, e.g. forces, accelerations, temperature, close to the point of action and to make them available for process control. 

Sub Topic 3: Smart materials network
Definition
Connecting partners in the area of smart materials is crucial for the development of new and innovative products. The focus should be on developing connections between the partners in that technology field. IWU can contribute via the network smart³|materials, solution, growth.

Sub Topic 4: Functional printing
Definition
The individualization of products is becoming increasingly important. However, today's production technologies are often adapted to mass production (automotive industry, cell phone industry, household appliances), often tool-bound and investment-intensive. Thus, it pays off only from a high number of identical products. Functional printing, on the other hand, allows products to be customized from a quantity of 1.

3.3.1. The Smart & Advanced Materials TIN Working Group Structure

The Partners will take the following roles, detailed in Table 25, within the Smart & Advanced Material working group structure. These roles have been chosen to optimally address technology and content relevant competencies within the CEUP 2030 partnership. What is especially interesting with the topic of Smart & Advanced Materials is the fact that there will be no core member partners of the working group, with all Partners choosing to learn and expand their network competencies about this new and exciting topic:

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Table 25 Smart & Advanced Materials TIN Working Group Structure

Working Group Members	
Leader	**Fraunhofer Institute for Machine Tools and Forming Technology**
Core Member **No Core Member Partners**	**Learner** ☒ Krakow Technology Park (KPT) ☒ Association Industry 4.0 Austria (PIA) ☒ PROFACTOR (PRO) ☒ Karlsruhe Institute of Technology (KIT ☒ Intelligent Integrated Systems Technology (SIIT) ☒ Lombardy Intelligent Factory Association (AFIL) ☒ Pannon Business Network Association (PBN) ☒ Pomurje Technology Park (PTP) ☒ Croatian Agency for SMEs, Innovations and Investments (HAMAG)

3.3.2. Where will Smart & Advanced Materials TIN Go?

In order to determine the strategic orientation of the TIN, the partners analysed the strengths, weaknesses, opportunities and threats they perceive associated to the topic of Smart & Advanced Materials, their organisation and the working partnership. The results of this analysis can be found in Table 26.

Table 26 Smart & Advanced Materials SWOT

Strengths	Weaknesses
(1) Experience of partly extensive project work with smart materials and their applications (2) Broad scope of projects: production technologies, lifestyle, architecture and mobility (3) Access to partnerships, connections and (interdisciplinary) networks (4) Material development facilities existing (5) Manufacturing orientation and number of manufacturing companies addressable (6) Closeness to the market, knowledge about the areas in which the developments have to go to (7) Lots of basic research available	(1) More knowledge about the materials needed (2) Limited capacity to influence policy makers. (3) Limited access to funding (4) Limited in-house capacities (5) Missing commercialisation strategies

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Opportunities	Threats
(1) Establish new co-operations in the field of smart materials resulting in fruitful project proposals (2) Connect through DIH on a European level (3) It is a concrete topic, which can be easily communicated to businesses, and thus, there are good recruitment possibilities (vast amount of use cases and tangible projects that can be useful for them). (4) Labs and testing infrastructure are in place (5) 3D and 4D printing opportunities (6) Recent and inspiring hype of the topic which open interesting use case applications (7) Diversity of the topic (Application areas: medical/textile…)	(1) Slowdown in fostering actions or decreased action efficiency due to the current COVID-19 situation. (2) Difficulties to achieve a sufficient number of target indicators. (3) High investment and development costs. (4) Patent protection can be an issue. (5) Unpredictable development time. However, development time is crucial to reach the properties to commercialize. (6) Standardization need to find the right application → high research investment can lead to miss the hype cycle. (7) Dependency on public funding.

3.3.3. How will Smart & Advanced Materials TIN Get There?

After reviewing the Partner inputs associated to the topic of Smart & Advanced Materials, along with bilateral and multilateral discussions, the following objectives, detailed in Table 27, were determined. With these objectives the partners explain how they will take advantage of the Partnership's strengths, and capitalize on emerging opportunities to overcome potential weaknesses and mitigate threats.

By nature of the competencies within the Partnership, the focus of the Smart & Advanced Materials topic will circulate around the topic of learning, knowledge transfer and exchange and set impulses on creating development corridors.

Table 27 Objectives Table of the Smart & Advanced Materials TIN

Number	Objective Name	Objective Description
1	Networking	Connect the partners via the TIN to broaden the scope of reach and promote future development of smart materials topics. Use the competencies of existing networks in the partnership.
2	Project Proposals	Promote the discussion about the possibilities for concrete project work between the PP or stakeholder of the TIN.
3	Coordinate use case definition and actions	Refine technological best practices to inform and raise awareness among the different stakeholder groups (policy makers, business, research institutions).
4	Project related objectives	Deliver 10 workshops as required in CEUP2030 and provide suggestions for the PID, create models for technical objectives delivery and a strategy document as well as lessons learnt.

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3.4. Artificial Intelligence

Artificial intelligence (AI) refers to systems that display intelligent behaviour by analysing their environment and taking actions with some degree of autonomy to achieve specific goals. *(European Commission)*

AI-based systems can be:

- Software based, acting in the virtual world (e.g. voice assistants, image analysis software, search engines, speech and face recognition systems)
- AI can be embedded in hardware devices (e.g. advanced robots, autonomous cars, drones or Internet of Things applications).

AI has a wide range of applications in diverse sectors, but the working group is going to focus mainly on manufacturing context, with the specific goal to address the most common challenges highlighted by industrial stakeholders. Therefore, the TIN has chosen to work on the following sub-topic areas, defined below:

Subtopic 1: Advanced Analytics	
Definition	***The Challenge***
Systems that learn from data (through direct observation or instruction), identify patterns and, based on mathematical models, make decisions with minimal human intervention.	Acquire dataset which are big enough to allow analysis. This may be difficult, in particular for small companies. Allow systems to learn automatically without human intervention or assistance and adjust actions accordingly.

Subtopic 2: Recognition Technologies	
Definition	***The Challenge***
Recognition technologies (i.e. facial recognition, emotion recognition, object detection, image processing, NLP) are meant to improve machine learning algorithms with a variety of data coming from different sources and with increasing precision. For example, the	Natural Language Processing (NLP) and recognition technologies have to deal with the complexity and ambiguity of the "environment" they are targeting. Nowadays cutting-edge deep learning techniques are applied to automated

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interpretation and processing of human language used to analyse free text and extract a huge number of relevant information, is offering companies the opportunity to improve operations and services.	language analysis to try to overcome these issues.

Sub Topic 3: Decision Management	
Definition	***The Challenge***
Decision management systems has raised a number of benefits for companies allowing faster decisions, detection of risks and process automation. AI methods and techniques are increasingly being embedded in decision Support System to gather and analyse evidence, identifying and diagnosing problems, proposing possible courses of action and evaluating the proposed actions. The aim of the artificial intelligence techniques embedded in an intelligent decision support system is to enable these tasks to be performed by a computer.	Manufacturing companies collect several data on manufacturing processes, supply, customers and their preferences, the defects of products and control processes as well as customers' feedback. They accumulate large amounts of data, where you can find the information you need to make right decisions in the different stages, but it is not always easy to make an efficient use of those solutions and systems due to the huge amount of data to be managed as well as the need of selecting the right ones to b turn them into information.

Sub Topic 4: AI-enhanced hardware and robotics	
Definition	***The Challenge***
Set of technologies applied to machines to automate the tasks that are repetitive and with no value added, allowing humans to focus on more conceptual and strategic activities.	The integration of AI methods and technologies in a company requires to take specific actions toward the creation of new competences and skills, by hiring new employees or training the workforce. Besides technical competences, raise awareness on the benefits that these technologies are bringing is fundamental to foster workers acceptance on digital transition.

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3.4.1. The Artificial Intelligence TIN Working Group Structure

The Partners will take the following roles, detailed in Table 28, within the Artificial Intelligence Material working group structure. These roles have been chosen to optimally address technology and content relevant competencies within the CEUP 2030 partnership.

Table 28 Artificial Intelligence TIN Working Group Structure

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

3.4.2. Where will the Artificial Intelligence TIN Go?

In order to determine the strategic orientation of the TIN, the partners analysed the strengths, weaknesses, opportunities and threats they perceive associated to the topic of Artificial Intelligence, their organisation and the working partnership. The results of this analysis can be found in Table 29.

Table 29 Artificial Intelligence SWOT

Strengths	Weaknesses
(1) Wide network of partners at EU level (2) Heterogeneity: Some partners have technical capabilities; others are acting as intermediaries so we are a complementary group (3) Connections and opportunities to discuss with policy makers (4) Access to a widespread network of infrastructures and competences	(1) Some regions may have difficulties in engaging industrial stakeholders (2) Lack of technical capabilities in some partners so there would be the need to focus on non-technical use-cases more oriented to collaborations and policy improvement (3) Large number of outputs and objectives. Risk to lose the focus in such a limited timeframe (4) Some partners may have difficulties in engaging policy actors

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Opportunities	Threats
(1) Capitalisation of connections with other projects and initiative such as European DIH (2) Exploitation of results in the new Interreg programming period (3) Alignment with H2020 cascade funding for the development of use-cases	(1) Duplications with respect to other initiatives and confusion in our end-users (2) COVID-19 restrictions may slow-down some activities and reduce the impact of TINs (3) Misalignment between project objectives and policy makers expectation

3.4.3. How will the Artificial Intelligence TIN Get There?

After reviewing the Partner inputs associated to the topic of Artificial Intelligence, along with bilateral and multilateral discussions, the following objectives, detailed in Table 30 were determined. With these objectives the partners explain how they will take advantage of the Partnership's strengths, and capitalize on emerging opportunities to overcome potential weaknesses and mitigate threats.

Table 30 Objectives Table of the Artificial Intelligence TIN

Number	Objective Name	Objective Description
1	Thematic workshops	Organisation of 10 TTTDM in alignment with WP2 activities. The TIN Tech Trend Dialogue Meetings will be thematic workshops organised by PP focusing on the TIN topics or sub-topics. These workshops have the objective of raising awareness on the thematic proposed, sharing industrial best practice as well as latest R&I achievements and fostering the matching among stakeholders working on a specific challenge
2	Roadmap elaboration	AI TIN will develop strategic document(s) highlighting R&I priorities in the area of Artificial Intelligence, collecting the inputs coming from the different regions emerged during PLL and TTTDM and from the grounded experience of PP. These documents will contain strategic guidelines to be shared with Policy Makers at different levels (regional, national, European) and with the aim to highlight which are the needs of the diverse regional stakeholders to further develop and uptake Artificial Intelligence in manufacturing context.
3	Use-case design and development	Although TIN will be organised at regional level involving triple-helix stakeholders, thanks to periodic alignment meeting PPs will guarantee the connection among these networks fostering the identification and development of use-cases on specific applications that are potentially interesting for a group of partners (and their stakeholders). In particular, focusing on the sub-topics targeted and related challenges at least 5 use-cases will be developed by the TIN, which can result in new collaboration or new projects to be

		presented under upcoming calls in regional, national, trans-national or EU programmes. To achieve this objective, TIN member will particularly exploit synergies with cascade funding in ongoing H2020 projects and with the EDIH initiatives.
4	Support the design of PID	AI TIN can support the design and development of CEUP Policy Intelligence Dashboard, analysing which are the available policy instruments that can support the deployment of AI applications and assess whether they are sufficient to meet stakeholders needs or if gaps still exist.

4. Conclusions

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. In order to harness the power of the pooled critical mass of trained stakeholders, and effectively empower people to work together to improve sustainable linkages among actors of the innovation systems for strengthening regional innovation capacity in Central Europe, the partners have endeavoured to create a vision and mission for the CEUP 2030 consortium. This initial strategic step, is known as the Strategic Implementation Blueprint. This report represents the first half of the Strategic Implementation Blueprint, called the Joint Strategy for CAMI4.0 Excellence in CE-EU Cooperation.

This report is based on, and aligned to existing CAMI4.0 strategic papers. The Partners drew inspiration from the work they have been involved in over the past programming period, in keeping with the vision of the Interreg Central Europe's experimental call on result capitalisation. This report has described the processes the Partners have worked on together to filter out the most practicable and future-robust strategies of the selected CE/EU project base, with a specific focus at each territorial level to demonstrate the unique approach to advanced manufacturing encompassed in strategy planning so far.

The report showcases and details:

- the vision, mission and key stakeholder network which will be harnessed to create and strengthen sustainable linkages on the topic of advanced manufacturing and industry 4.0 within the CEUP 2030 project, and across Central Europe.
- the common basic vision and objectives for all Trend and Innovation Networks; and
- the specific partner composition, an analysis of key strengths, weaknesses, opportunities and threats, and the specific objectives for each Trend and Innovation Network.

4.1. Next Steps

The next steps of the Strategic Implementation Blueprint, is to formulate the Action Plan for CAMI4.0 Excellence in CE/EU Cooperation. The Action Plans are designed for a quick start of cooperation in the project on the CAMI4.0 topics, along with a future-robust approach which can develop into the Policy Implementation Framework for CAMI4.0 (WPT3).

The Action plan will be based on a set of use-case pitched by each Partner to meet the specific objectives for the Trend and Innovation Networks, and overall anticipate and fast-track policy strategies to promote aligned S3/RIS3 for CAMI4.0 Excellence. These use-cases will be built on the unique challenges faced by each Partner's territorial area, but ultimately reflect the joint strategy in practice.

The CEUP 2030 Partnership would like to invite all interested stakeholders to join in the project's extensive workshop series to continue discussions on the topics highlighted within this report. More detail can be found on the project's website, by contacting the Lead Partner, Krakow Technology Park, or by contacting the Partner operating in the region or country of your interest.

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5. Abbreviations

Abbreviation	Explanation
AF	Application Form
ASP	Associated Partner (i.e. Strategic Partner)
IPS	Intelligent Production Systems
AI	Artificial Intelligence
R&A	Robotics and Automation
CAMI4.0	Central European Advance Manufacturing and Industry 4.0
PI	Policy Instrument
PIF	Policy Implementation Framework
PLL	Policy Learning Lab
PP	Project Partner
RIS3	Regional Innovation Strategy for Smart Specialisation
S3	Smart Specialisation Strategy
S4	Slovenian Smart Specialisation Strategy
SBU	Strategy Boost & Upgrade
TGP	Technology Good Practice
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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INDUSTRIE 4.0 AUSTRIA

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Fraunhofer IWU

HAMAG BIRO

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