# PID IN PRACTICE 3: POLICY IMPLEMENTATION RELEVANT TECH RADAR ON SMART MATERIALS

D.T2.3.4 – PID in practise 3 – Policy Implementation relevant Tech Radar Smart Materials

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## Document Control

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| Dissemination Level | | |
|---|---|---|
| PU | Public | |
| PP | Restricted to other programme participants | |
| RE | Restricted to a group specified by the consortium | |
| CO | Confidential, only for members of the consortium | CO |

| Document History | | | |
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# 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 policy pilot actions to promote a joint RIS3 for CAMI4.0 Excellence in CE/EU.

## Work Package and Activity Overview

The overall objective of WPT2 links to the project's specific objective of ensuring awareness and shared sustainable responsibility on using research, technology and innovation knowledge resources in CE/EU for enhancing policy decision support.

The challenge manifests in two sub-objectives which are:

- To coordinate technology experts across the CE/EU regions for solution-oriented trend monitoring (the Trend and Innovation Networks)
- To streamline, process and manage the knowledge for improved policy decision making, in a practicable and sustainable manner (Policy Intelligence Dashboard).

The specific activity which is of relevance for this document is Activity A.T2.3, which is a common activity for all WPs and covers the development of the project's Policy Intelligence Dashboard, which should translate the Trend & Innovation Network knowledge into future robust policy and strategy building. It is designed to establish strong partnerships around the 4 main CAMI4.0 topics in order to raise awareness and ensure a shared sustainable responsibility on using RTI knowledge resources in CE/EU for enhancing policy decision support. The Trend Innovation Networks (TIN) will be equipped with practicable, efficient policy tools, available on Policy Intelligence Dashboard (PID). Both those instruments will be exploited by the partners to select and channel appropriate decision-relevant information out of the daily big data cloud, assess it and provide understandable knowledge in a compact and high-quality format.

Specifically, the practical activities which are supported in this document are:

- Establishing links to key good – practice tools which can power the policy intelligence dashboard;
- Explain the process for the key requirements of the Policy Intelligence Dashboard;



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- Establish the working processes to develop these key requirements into a wireframe/base operating framework;
- Establish the working processes to develop the tech radar and risk heat maps on technology trends;
- Develop a link to the use-cases the Partners will develop on policy-instruments.

## Project-Relevant Reference Material & Reading Prerequisites

(1) **CE1662 CEUP 2030 Application Form** (Version 1, 07/2019): The application form regarding CEUP 2030 for Interreg Central Europe

(2) **Guidance on Harvesting Agenda** (D.T2.1.1; Version final, 04/2020): A guidance document for A.T2.1 on harvested methodologies for the Trend & Innovation Networks and Policy Intelligence Dashboard.

(3) **Harvesting Agenda on CAMI 4.0 for Trend & Innovation Networks and Policy Intelligence Dashboard** (D.T2.1.2; version 2.0, 11/2020): A report and selection grid for best-in-class use of identified outputs and results in WPT2

(4) **Policy Intelligence Dashboard (PID) Design & Elaborate Technology Radar to improve CE/EU (DT.2.3.1.; version 3.0, 04/2022): A manual to establish the IT-based Policy Intelligence Dashboard, with CAMI4.0 Tech Radars and Industry Risk Heat Maps on Technology Trends**

**All documents** can be found on the project's central repository - Alfresco

## Scope of Document & Deliverable Summary

Deliverable D.T2.3.4 is defined in the Application Form as a Trend Radar and Risk Heat Map on Smart materials developed under joint Policy Intelligence Dashboard for the four 4 CAMI4.0 topics. The PID in Practise for SM represents a Tech Radar (TR) including a Risk Heat Map where policy-relevant data sources (use cases, policy instruments, organisations and networks) are identified and classified with a goal to transfer and deliver relevant content for decision makers. The database of use cases collects 10 the most representative case studies collected within CEUP2030 project, as well as recommended and varied by PPs policy instruments dedicated to CAMI4.0 topics and descriptions of flagships originating from the project partnership. To deliver the tool that is functional and answers the expectations of the varied stakeholders groups a model of PID is to be tested with a balance group of stakeholders. DT2.3.2 presents the scope of the survey and delivers feedback received (test transfer to practice among target groups; feedback loops with regional/national stakeholders. The structure of Trend Radar and Risk Heat Map on SM is in line with manual which provides the guidance required to establish an IT-based Policy Intelligence Dashboard which evidences CAMI4.0 Technology Radars and Risk Heat Maps on Technology Trends (DT.2.3.1)

This document contains the summary of PID in Practise demonstration testing and insights and conclusions collected valuable for further development of PID. It represents the "Policy Intelligence Dashboard in Practice", which highlight technology trends for SM – one of the four CAMI4.0 topics. The Document provides background insight necessary to deliver the Dashboards along with implementation procedures and testing procedures. The purpose of



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the PID in practice 3: Policy implementation relevant Tech Radar on Smart materials (T2.3.4) is to provide the Partners the information which is required to create the Policy Intelligence Dashboard for smart materials technology. which is a part of the key output of WPT2.

| | | | | | |
|---|---|---|---|---|---|
| **Output O.T2.2** | CEUP 2030 Policy Intelligence Dashboard – Refocusing technology trend insights for policy makers | The Policy Intelligence Dashboard monitors, fine-tunes and streamlines policy relevant data on technology trends for a fast-track assessment based on a solid data gathering and evaluation (Tech Radars, A.T2.3). The PID will be tested in a common transnational manner, established and anchored in the activated stakeholder scheme (PLLs, TINs). The PID methodology sets the base for the joint policy exploitation with pilots as well as a future planning for 2021-2027 in T3 and beyond project´s end. | S.O.1.1 - Number of tools and services developed and/or implemented for strengthening linkages within the innovation systems | 1,00 | 11.2021 |

## Audience

This document is directed at all project partnership members, because all PPs are asked to participate in the development of the Policy Intelligence Dashboard and in testing its content.

## Change Control Procedure & Structure

The Deliverable Responsible: Pomurje Technology Park, Slovenia **(PP8)** created this document and it is hosted on the Project's common repository in the appropriately named deliverable folder. The document is under project deliverable 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 PTP. 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 (PTP/PP8) and the Work Package Leader (AFIL/PP6) to consolidate feedback from other partners, and then further integrate and disseminate the final agreed changes. A new version of the document should be created, and recorded in the document's "Document History" table.



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# Abbreviations

| Abbreviation | Explanation |
|---|---|
| AF | Application Form |
| ASP | Associated Partner (i.e. Strategic Partner) |
| 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 |
| SBU | Strategy Boost & Upgrade |
| TGP | Technology Good Practice |
| TIN | Trend & Innovation Networks |
| TTTDM | TIN Transnational Technology Dialogue Meeting |



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# 1. Key background information

## 1.1. AT2.3 activity within CEUP2030 project

Within WPT2 and between work packages, Activity T2.3 Establish PID to translate TINs work into future robust policy & strategy building is highly embedded within the other work of CEUP 2030. This is primarily because the PID is the partnership lasting model of how to deliver insight (beyond workshops) in an ongoing and sustainable way to key policy-making stakeholders (and also other stakeholders) who are interested in the four CAMI4.0 topics specifically or Industry 4.0 and Advanced Manufacturing in Central Europe, more generally.

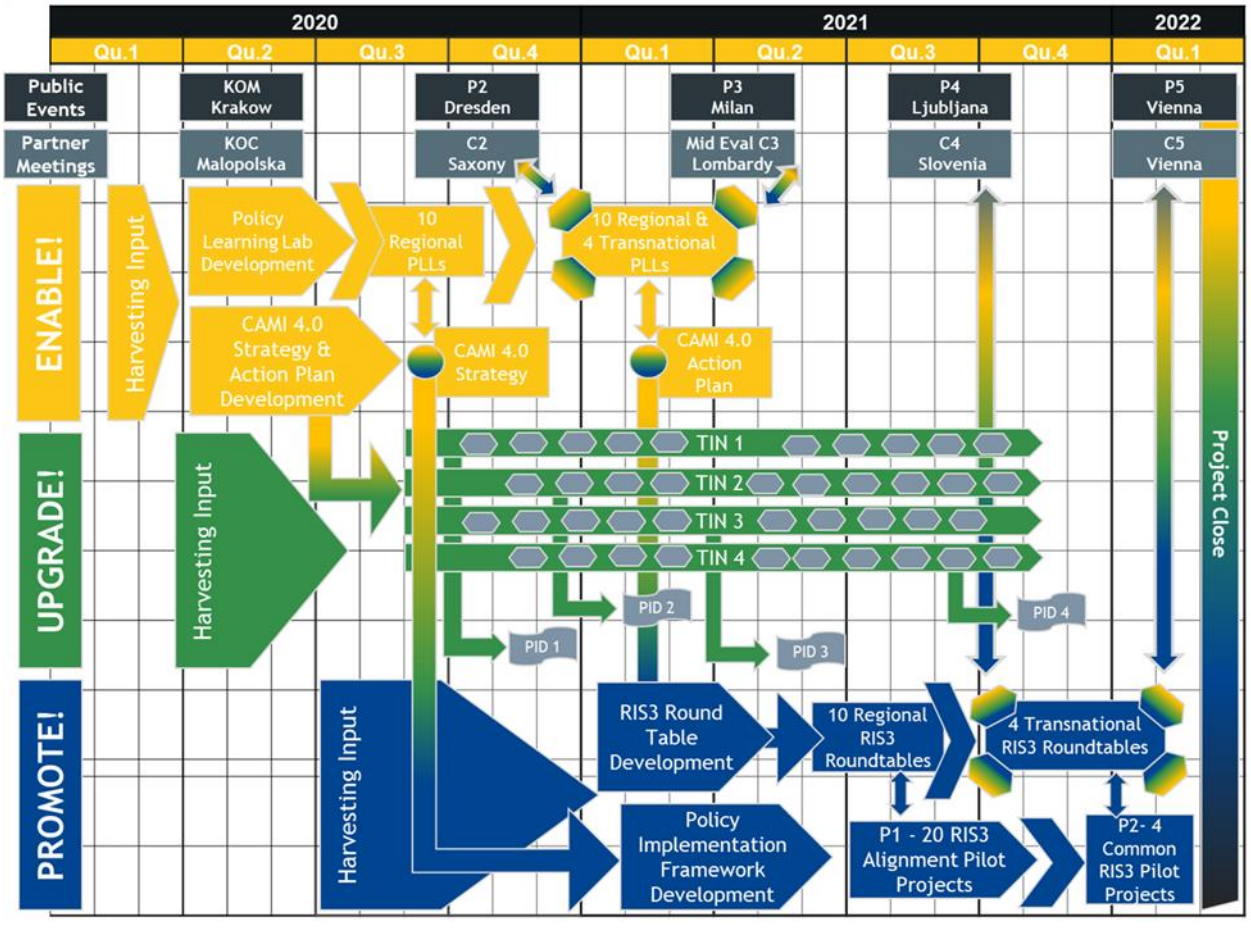


**Figure 1 CEUP 2030 Plan on a Page (Source: Author Generated)**

In particular, within AT2.3, four main activities have been performed:

- AT2.3.1 PID design & elaborate technology radars to improve CE/EU policy making (Responsible: PP1/KPT)
- AT2.3.2 PID in practice 1: Policy implementation relevant Tech Radar on Intelligent Production System (Responsible:PP10/HAMAG)
- AT2.3.3 PID in practice 2: Policy implementation relevant Tech Radar on Automation and Robotic (Responsible:PP3/PIA)



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- **AT2.3.4 PID in practice 3: Policy implementation relevant Tech Radar on new materials (Responsible:PP8/PTP)**

- AT2.3.5 PID in practice 4: Policy implementation relevant Tech Radar on Artificial Intelligence (Responsible:PP9/PBN)

## 1.2. AT2.2 - Connection to the Trend & Innovation Networks

The strongest connection exists between the PID and the Trend & Innovation Networks (TINs). This is because it is the insights, and input from the TIN Dialogue Sessions, which should be used to fill and validate the PID in Practice. The TINs are the "playground" where key foresight discussions should take place. These discussion points, technology foresight and development interpretations should be recorded within the PID in Practice. The TINs are directly connected to the Policy Learning Labs (AT1.2) and RIS3 Round Tables (AT3.2)

The PLLs and the RIS3 Roundtables (the consortia's workshop series with policy-influencing stakeholders, and the lasting policy-making stakeholder engagement forum), are key areas where the Partnership should gain insight on the PID in Practice key Target Group. It is via exchange and presentation of concepts within these forums that the Policy Intelligence Dashboard will gain its purpose & its relevance.

The Policy Intelligence Dashboard is connected to the Policy Implementation Framework (PIF) and the Strategy Implementation Blueprint (WPT1). The Partners should be working to align the information provided in the PID, particularly success stories, to those recommendations which are provided in the use-cases delivered in the final phase of the project. The insights provided in the PID should lead stakeholders reviewing the document, to a logical understanding about what is presented in the Policy Implementation Framework. For instance, by trying to capitalise on a specific good practice or by trying to align for specific support for an emerging technology area.

This also means that Partners should be using all conversations associated to the development of the draft use-cases for the Strategy Implementation Blueprint, to be considering what would be effective use cases to present in the Policy Intelligence Dashboard.



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# 2. Description and goal of the Policy Intelligence Dashboard

Policy Intelligent Dashboard is the most complete one-stop-shop for policy makers and policy influencing stakeholders as research technology organizations and enterprises operating around intelligent production system area. PID gathers in one place practical and streamlined knowledge and insight on technology trends and potential industry impact for the entire innovation eco-system. Smart materials area represents a Tech Radar including a Risk Heat Map, where policy-relevant data sources as use cases, financial instruments, flagships and organizations are presented with a goal to support, transfer and enrich policy decision making processes in the area of this technologies. The Smart materials Trend & Innovation Network (TIN) established under CEUP2030 project played a big role in creating the PID. Community of stakeholders representing different target groups established around IPS discussed and shared trend and innovation foresights on the IPS topic. This community built on the stakeholders involved in PLL in WPT1 and were enriched with key experts identified by each partner. In order to foster the discussion on trend and innovation foresight on the IPS topics, 10 TTTDM - TIN Tech Trend Dialogue meetings were organised by CEUP2030 partners involving the regional stakeholders identified in the community. Besides their regional configuration, TINs also had an interregional dimension thanks to action of PPs that guaranteed connections among the different network exploiting the synergies that emerged during TINs development. In particular, PPs contributed and fostered the identification and development of use-cases in each network that can be concretely implemented in flagship projects involving partners from different regions, either PPs or their stakeholders. In summary, 265 stakeholders from 7 countries were involved in expert workshops on the CAMI 4.0 Topic S&A Materials. The workshops were held mainly online except two (IWU and HAMAG), and utilised plenary presentation, roundtables, and Q&A sessions which allowed live discussion on the current and future trends, the current needs and challenges, and the opportunities offered by the ecosystem. The experts mainly from Business and Research Centres provided insights on the development on innovative solutions. The TTTDM's validated that the sub-topics chosen by the partnership are relevant for the future of S&A Materials. In one area – Smart Material Network – there was less interest from the stakeholder community, however this could also be a great opportunity to foster it through further actions and may be through the definition of the Common Policy-Use Case as all the partners acknowledged the need to enhance exchanges by the implementation of regular TTTDM or at least regular exchanges between stakeholders. Moreover, this last sub-topic, represents a great interest for IWU, which is the leader of this CAMI 4.0 topic.The Smart materials TTTDMs were also aimed at supporting the definition, development and submission of the SM flagship projects, use cases and policy instruments. All these above mentioned feedback from stakeholders helped to create and developed the Policy Intelligence Dashboard. The PID is built around a core project principle, that policy-makers can directly benefit, and create onward benefits for the entire innovation eco-system, when they have practical and streamlined knowledge and insight on technology trends and potential industry impact.

The Partnership will, in total, create four "PID in Practice", one for each CAMI4.0. This document presents D.T2.3.4 PID in practice 3: Policy implementation relevant Tech Radar on Smart materials /PP8/PTP, due in March 2022



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PID smart materials represents a Tech Radar (TR) including a Risk Heat Map (RHM), where policy-relevant data sources (use cases, organisations, actors, instruments) are identified and classified with a goal to transfer and interpret to policy-decisions. Key use cases should be presented in an easy- way enabling interactive enquire of knowledge and understanding of the key technologies and with contact details to hosting organisation.

# 3. Policy implementation relevant Tech Radar on Smart Materials

Policy implementation relevant Tech Radar on Smart materials is located on the website http://ceup2030pid.eu/ and integrate knowledge and insight developed from dialogue occurring within the Partnership's workshop series includes the following elements for each CAMI4.0 topics :

- Introduction
- Analysis of theTech Radar
- Risk Heat Map
- Summary of the flagships
- Interesting use-cases
- Policy instruments
- Tools

This document D.T2.3.4 PID in practice 3: Policy implementation relevant Tech Radar on smart materials includes all above mentioned elements.



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## 3.1. Introduction

The challenges facing the manufacturing eco-system in Central Europe vary across geographical area. Within this section, the members of the CEUP 2030 Consortium have captured some of the key needs which exist at three levels: Sector, Value-Chain, Actor/Target Group.

Achieving Europe's goals of increased value-added production, energy efficiency, CO2 reduction, and implementation of the circular economy, requires new ways of using new and smart materials. Smart materials and material systems/structures have already demonstrated the potential to achieve this goal. However, implementation has been limited due to the materials' operational reliability as well as issues of recyclability and dependence on rare elements. In addition, cost concerns or lack of efficient manufacturing processes prohibit the wider implementation of such technologies. The next step is the implementation of these technologies in a wide range of commercial applications allowing the exploitation of the characteristics of smart materials. As the application of smart materials are dominated by SMEs in the EU, extending their innovation potential for smart materials applications is important for maintaining their market position and has a significant impact in improving EU competitiveness.

From the CEUP2030 perspective, the basic idea of the concept is to enhance the access to knowledge in the wide area of new materials research and achieve research capitalization for SME´s in the different CE countries participating in the planned endeavor. The majority of partners focus on smart textiles, polymers and circular & sustainable materials. To achieve this knowledge boost, the partners want to create a Central European community and facilitate triple helix exchange.

**General overview of the main CAMI topic and its subtopics**

Smart materials called also 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 CEUP 2030 TIN for S&AM has a key focus on the topic of learning, knowledge transfer and exchange and set impulses on creating development corridors, this is especially because most of the actors in the Consortium are learners with regards to the topic.

Subtopics

- **Subtopic 1: Smart structures & systems**

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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- **Subtopic 2: Process-related sensor technology**

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

- **Subtopic 3: Smart materials network**

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.

- **Subtopic 4: Functional printing**

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.

## 3.2 Analysis of the Tech Radar

The Tech Radar and Risk Heat Map for Smart Materials under CEUP 2030 Policy Intelligent Dashboard offer open access to policy-relevant data sources as use cases, policy instruments, organisations and networks, technology trends in the most convenient, practicable and efficient way. They present impact of emerging technology and applications of Smart Materials, with the most easy-to digest and streamlined knowledge and insight on technology trends and potential industry impact.

Smart materials are defined as materials that sense and react to environmental conditions or stimuli (e.g., mechanical, chemical, electrical, or magnetic signals). They offer a range of unique characteristics and have been used in a variety of products, ranging from household goods and novelty items to aviation, energy & construction sectors, automotive components and medical devices. They are the topic of extensive research and all manner of new applications will emerge in the future, reflecting both technological developments and a growing awareness of their capabilities.

From the past two decades, science and technology have made great improvements in synthesizing the new materials. They are divided mainly into four categories which are polymers, ceramics, metals, and smart materials. Among them, smart materials are becoming more popular because they have various applications as compared to standard materials. The special materials that can change their properties such as materials which can change its shape just by adding some heat or can change its phase instantly when placed near magnet are called smart materials.



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Smart materials are also known as advanced materials or intelligent materials. They cannot be defined by a single specific definition. They can be defined as materials that can recoil their original shape to specific stimuli, or they can be defined as advanced materials that can respond smartly to environment changes. Smart materials are categorized on the basis of their properties such as active and passive, passive smart materials have ability to transfer a type of energy e.g. optical fibers are able to transfer electromagnetic waves. They are being developed for applications in numerous manufacturing sectors such as in the aerospace industry, biomedical industry, and general manufacturing industries.

Possible New Materials applications in the I4.0 and advanced manufacturing:

AUTOMOTIVE APPLICATIONS

In a modern passenger car there are several electromagnetic actuators for different functions, including comfort systems for the driver and passengers, actuators for engine control or vehicle control, servo- microactuators for power systems and aerodynamics. New approaches based on smart materials, instead of the traditional electromagnetic motors, can simplify in most cases the actuation, performing the same function with reduced size, weight and cost, optimising the movement and also offering the opportunity to implement new functions. The use of SM actuators as an alternative to electromagnetic motors for automotive applications, particularly for comfort purposes, shows some main advantages: smooth direct movement with high torque or force, no additional mechanism, noiseless operation and intrinsic reliability, since the motion is related to the physical properties of the material.

3D PRINTING FOR SOFT ROBOTICS

3D printing is an additive manufacturing (AM) process defined as the process of joining materials to make objects from 3D model data, usually layer upon layer, as opposed to subtractive manufacturing methodologies, such as traditional machining. 3D printing can deliver parts of very sophisticated and complex geometries with no need of post-processing, built from custom-made materials and composites with near-zero material waste, while being applicable to a diversity of materials, including smart materials such as shape memory polymers and other stimulus-responsive materials. One of the main example of the design freedom offered is that conventional assemblies can be restructured in a single complex structure that could not be manufactured with the current manufacturing processes. Another driver of the 3D printing technology is that it is environmentally and ecologically favourable. 3D printing technologies and methods are growing frequently in terms of application and market share, spreading into various manufacturing divisions, such as robotics, motorized, health and aerospace and are expected that this substantial growth will continue over the next few years. 3D printing has a limitation of speed and difficult scalability so currently the work on soft robotics is going on within the technological constraints of currently available 3D printers. 3D printing is a very slow process, but this is not a major issue, as no-one at this initial stage is looking for the mass production of soft robots. The high specificity and ability to print the most complex shapes makes 3D printing an extremely attractive choice for the fabrication of soft robots. However, one fundamental concern in using 3D printing technology for developing soft robots is that 3D printable soft materials have a large tendency to deform



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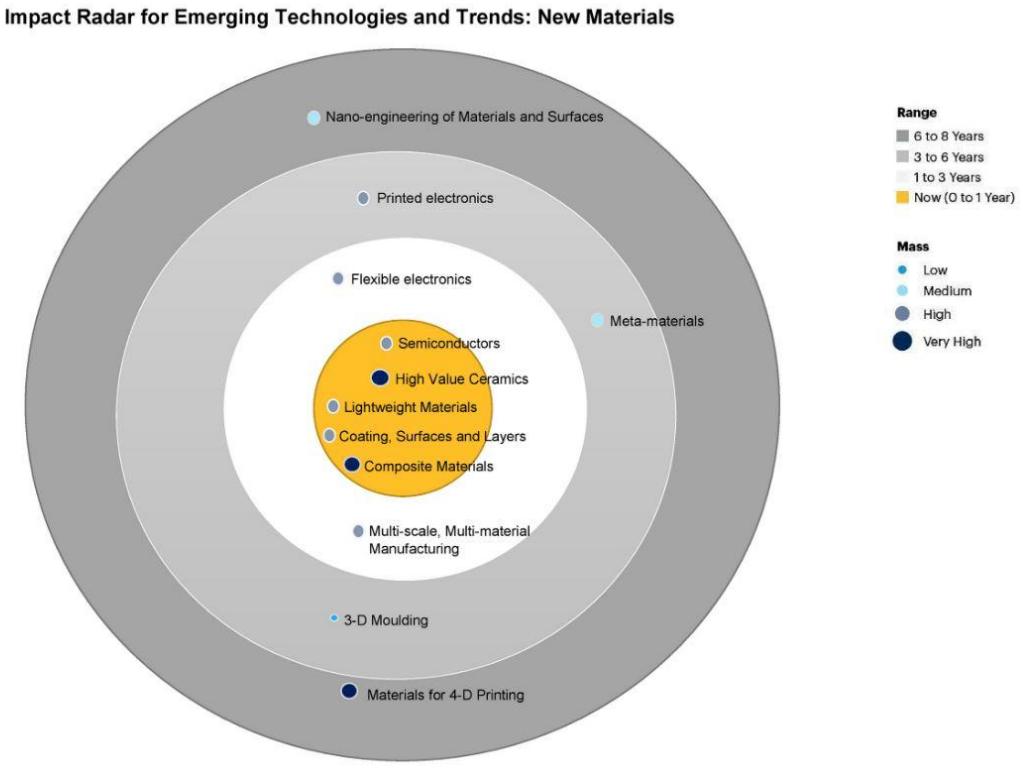
under the normally used forces during the building process due to their own weight so a support material becomes a necessity.

SMART GRID AND NANOTECHNOLOGIES: A SOLUTION FOR CLEAN AND SUSTAINABLE ENERGY

Smart materials have played significant contribution towards the energy sector and development of buildings.The challenge is to meet the demands of urbanization in an economically viable, socially inclusive, and environmentally sustainable fashion resulting with using materials and components with zero footprint. According to a World Energy Council study,3 global demand for primary energy is expected to increase by between 27% and 61% by 2050. Climate change is expected to lead to changes in a range of climatic variables, most notably temperature levels that will have impact on mterails used for prefabrication. Cyber-physical integration facilitates smart factories with high efficiency that are capable of fabricating high quality customized products.

The current barrier of mass production on location will be overcome with personal-and customized fabrication. Another popular trend aims at creating functional parts/machines in just a single step of fabrication. Due to the opportunities provided by the novel AM technologies, the design and production challenges are only restricted by the imaginations of the individuals.

Smart materials like Shape Memory Alloys (SMA), piezoelectric materials, Carbon Fiber Reinforced Polymer (CFRP), Shape Memory Polymer (SMP) etc. are the materials that make up the backbone for latest aerospace and automotive application.




Gartner Top Strategic Technology Trends for 2022



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Future of smart materials:

Trends 2022

The global market for smart materials will grow rapidly, since it will be the market for the whole supply chain. It will have important impact on multisectorial markets as aviation, automotive, construction, medical into the several areas where smart materials are used, including implant material, sensors and actuators, structural materials, shape memory, smart fluid, alloys, as well as by type of material.

Shape memory alloy based on nickel, copper, titanium, aluminium and a few others. Advances in metallurgy and computer analyses and design of alloys has opened the door to an unlimited class of materials, where computer is used to explore the potential characteristics of an alloy before it is manufactured.

4D printing is one of the innovative technologies that creates notable innovations in the medical field. It merges multi-material 3D printing and the combination of smart materials into the printable material to develop an exciting new technology called 4D printing, having a structure that can modify its shape, memorise the shape and return to it after deformation. For the COVID-19 pandemic, this technology proves to be useful in the manufacturing of smart medical parts, which helps treat infected patients.

As compared to 3D printing, 4D printing adds time as an additional element in the manufactured part. 4D printing uses smart materials with the same printing processes as being used in 3D printing technology, but here the part printed with smart materials change their shape with time or by the change of environmental temperature, which further creates innovation for patient treatments.

4D printing manufactures a given part, layer by layer, by taking input of a virtual (CAD) model and uses smart material. This paper studies the capability of smart materials and their advancements when used in 4D printing.

New industries are rapidly introducing smart materials to tailor and optimize the production.

## 3.3. Risk Heat Map

## 3.4 Summary of the flagships

Looking back at the beginnings of the CEUP2030 project, the partners analyzed their ecosystems and gathered needs in the 4 Technology innovation networks. For smart materials, the main issues were the need for best practice examples, more inter-organizational and international connectedness, and access to expertise, technologies, and knowledge. After this analysis and the talks among the TIN group, the common issues and challenges in the flagships mainly are letting SMEs participate from research results and knowledge, building strong networks and communities along with technical concepts as well as internationalization.

## STEPUP smart³ (GER)

The purpose of the project is to further develop the services and USPs for companies in the region. The overall goal should be to increase the number of the memberships in smart³ network and of cooperations /cooperation projects to boost the impact of the smart materials community. The project aims at identifying and developing new cooperation partners in Germany and internationally, establishing new offers in English, generally new



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services to provide incentives and stimulate innovation and participate in roadshows and events.

## Strategic Community on Advanced Materials (ITA)

Plastic sector is one of the most relevant area for Lombardy economy and AFIL constituency involves a good number of stakeholders operating in this field. However, the activities in this context were mainly associated to sustainability and Circular Economy rather than on innovative materials. Since this is a key aspect for the future development of this sector, AFIL wants to foster the creation of a new Strategic Community focused on functional plastics. The "Advanced Polymers" Strategic Community should represent the regional capabilities and expertise in the field along the whole value-chain and identify research challenges and industrial needs to foster the innovation. Once set up the working group, the Strategic Community should plan activities aimed at increasing the regional competitiveness and constitute new synergies and collaborations at interregional and European level, for example within Vanguard Initiative.

## EU-ALLIANCE (ITA)

EUropean ALLiance for International business development on Advanced materials and coNnectivity for defenCe and sEcurity markets. EU-ALLIANCE aims to support SMEs internationalisation in the fields of technical textile, connectivity and advanced materials to address dual use markets in four targeted countries: The United States, Canada, Japan and Indonesia. It gathers 6 clusters specialized in each covered thematic: technical textile and advanced materials (Techtera, CS-POINTEX and NTT), defence and security (NDIV) and connectivity (SIIT and Systematic). The different partners are complementary to each other in terms of skills, networks, SME members and international experiences to set up the most efficient partnership possible and demonstrate their abilities to work together in a cross sectoral environment. In this regard, the use case will clearly intensify cluster and business network collaboration across borders and across sectoral boundaries.

## GREEN 4.0 (SLO)

The scope of the project is to improve regional ecosystems' innovation capacities for supporting the transition to sustainable business models in CE manufacturing sector, by piloting customized innovation models which create new regional and transnational value chains, link manufacturing companies with solution providers and private equity, increase knowledge and user acceptance regarding smart manufacturing (green industry, digitalization) and transfer piloted programs and tools to RIS3 authorities.



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## 3.5. Interesting use-cases

### SmaDi - Digitalisation of smart materials and their manufacturing processes

Technical progress in recent decades has led to mechanical systems being combined into mechatronic systems with the help of electrical control and data processing. So-called “smart materials” play a central role in this process. These have the distinctive property of reacting to external influences (such as electrical, magnetic and thermal stimuli), e.g. by deformation. Due to the complex material behavior, which depends on the manufacturing process, the targeted development of smart materials requires an exact description of the properties and the necessary manufacturing processes. In the interdisciplinary consortium SmaDi, consisting of researchers from complementary fields of computer science, materials science and engineering, efficient ways of accessing and analysing large amounts of data from experimental tests and simulations are therefore being developed for the first time across different smart materials. Approaches for material production and application are derived from this and an application-specific comparison is made possible. On the one hand, the focus is on comprehensive modelling and computerbased description of the smart materials under consideration. On the other hand, an information technology query system is being established that answers abstract queries about the materials using the existing models and data. The results aimed for in the SmaDi consortium will therefore considerably reduce the research effort in the selection and optimization of materials in the future and lead to tailor-made product developments, from which above all the SMEs involved in the market will benefit. In perspective, this reduces the market entry hurdles for suppliers of smart materials and thus enables the development, establishment and dissemination of future-oriented products. Based on the overarching approach for smart materials, the information technology solutions developed can also be transferred to other material classes and can be used in cooperation with the MaterialDigital innovation platform for other utilization sectors.

### Končar Power Transformers Ltd. Smart Digital Assistance

Končar Power Transformers Ltd. is a Croatian company engaged in the development, design, production, testing, sale, and servicing of power transformers. They specialize in the production of large power transformers of voltages up to 1000 kV, which are currently exported to 90 countries around the world. Transformers are designed to provide maximum grid availability through long lifecycle, maximum efficiency, connectivity, and optimized operation. Each transformer is adjusted to the customer's needs and on average two products are produced in series. Due to different customer needs, there are no standard parts. To increase sustainability and facilitate the flexibility of production, systems for smart digital assistance, tracking of metal parts and measurements in production have been implemented in production processes. Prior to the implementation of these systems, the necessary digitization and optimization of production processes and infrastructure was carried out. Smart Digital Assistance is a system consisting of a mobile stand and a large touch screen that allows employees easier access to the necessary documents and information in the workplace. The Smart Digital Assistance system currently provides digital information on work orders, technical documentation (drawings, BOMs) and work instructions. New parts of



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the system are being developed that will enable digital management of checklists, maintenance, and registration of working hours. The Metal Part Tracking system provides current information on the status of deliveries from the supplier and the location of the product in the warehouse. This information is very useful due to the large number of metal parts that make up each product. The system is based on RFID technology, and implemented using fixed antennas, forklifts with RFID and GPS antennas, mobile portals with antennas and handheld readers. Information on the status and location of the product obtained by reading RFID tags is stored directly in the ERP system. The Measurements in production system processes a large amount of data collected from various sensors and thus provides various information from the production process itself such as air quality inside the plant and the condition of machines. Additionally, it enables inspection of input material dimensions and product quality control. Control of dimensions of input materials and semi-finished products is performed by 3D scanning and automatic comparison with CAD models. Product quality control is performed during the production process using sensors that automatically measure the dimensions of product components. After checking each dimension, the system automatically enters its status within the checklist.

## A meta material with variable rigidity ready for industrial applications

The Austrian Polymer Competence Center Leoben (PCCL) is a leading centre for cooperative research in plastics technology and polymer sciences. The PCCL helps to create innovative products through the development of new materials with complex properties. One material that was recently developed at the PCCL is a meta material (i.e., an artificial material engineered to have certain properties) with variable and definable stiffness in three dimensions. The new material can be created through additive manufacturing (3D printing) from different raw materials like plastics or metal. The structure developed allows independent, local and gradual stiffness variation over several orders of magnitude creating interesting areas of potential application within the manufacturing sector. For instance, the material could be used in the manufacturing of machines or medical equipment like prosthetic implants

## FiberEUse project: composite materials reuse, Lombardy

FiberEUse (Large scale demonstration of new circular economy valuechains based on the reuse of end-of-life fiber reinforced composites) project was aimed at integrating innovative solutions and processes in a holistic approach in order to allow composite recycling and reuse in valueadded products. It focused on glass and carbon fiber reinforced polymer composites (GFRP and CFRP) used as structural materials in many manufacturing sectors like transport, constructions and energy due to their lightweight and corrosion resistance, that nowadays are mostly landfilled. The project based on the realization of three macro use-cases, further detailed in eight demonstrators:



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## 3.6.Policy instruments (PIs) which might influence the development of the flagships

### Vanguard Initiative | I3 Interregional Innovation Investment

The Vanguard is based on interregional collaboration and the establishment of synergies among different EU regions based on S3strategies. Tts self-evident, thatdeveloping this community will generate benefit for local stakeholders but it can also represent a value added for the other territories to which we will be connected. Considering that the use-case is focusing on the generation of a community of stakeholders around an interest topic (i.g. Smart Materials), the Vanguard Initiative is opportunity toconnect with regionswho are developing innovation projects on smart and new materials.

### Funding Scheme. Cosme Call Cos -Clus Int-2020-3-01

The main objective of this action is to intensify cluster and business network collaboration across borders and also across sectorial boundaries and to support the establishment of European Strategic Cluster Partnerships. Every SME in Europe, Japan, US, Indonesia and Canada could benefit from EU-ALLIANCE

### Horizon-CL4-2022-Resilience-01-10: Innovative Materials for Advanced (Nano)Electronic Components and Systems (RIA)

Actions under this topic address one or more of the following technologies:

- Innovative materials design and processing for devices based on new and emerging technologies, including advanced methods of data driven materials design, for e.g. spintronics, neuromorphic, in-materio computing multisensing, photonics, nano-mechanics advanced ferroelectrics or biosensing;
- Heterogeneous integration of new materials (such as PZT, graphene, titanium oxide or aluminium oxide, etc.) for miniaturised sensor and actuator modules.

### Horizon-CL4-2022-Resilience-01-13: Smart and Multifunctional 12 Biomaterials for Health Innovations (RIA)

Multifunctional biomaterials play a major part in shaping the future of Advanced Therapies and Medical Devices. Health applications may include but are not limited to tissue engineering, artificial organs, implants, bioinks for bioprinting platforms, microfluidics, bioactive scaffolds, wearable and implantable devices, in-vitro diagnostics etc. This topic is open for international cooperation where the EU has reciprocal benefit, while excluding industrial competitors from countries where the safeguarding of IPRs cannot be guaranteed.

### PRO: Profactor GmbH (Austria)

The Austrian partners of transnational and application-oriented research and development projects can apply for funding under one of the two FFG programs: Intelligent Production



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or Basic Program, as part of the European Research Area Network M-ERA.NET "From materials science and engineering to innovation for Europe."

## The Innosup Initiative

The INNOSUP initiative addresses the challenge to develop new cross-sectoral industrial value chains across the EU, by building upon the innovation potential of SMEs. The EU needs to support the development of emerging industries, which will provide the growth and employment of the future. The reindustrialisation of the EU's industrial base has to focus on the development of long-term internationally competitive goods and services that require combining different competences and innovative solutions. The development of new industrial value chains calls for the collaboration and integration of different innovation actors, including large enterprises and especially SMEs, across different sectors towards the implementation of a joint vision.

## Comet - E.G. Pro²Future-Products and Production Systems of the Future

COMET is a Austrian Program which was established 20 years ago. It is a program for research for and with Industry. Companies have to pay app . 50% of the budget (20 Mio € for 4 years) in Cash and InKind, so the research must be on a high level and in the interest of the companies. Its not an SME program, is more related to research for and with Large Industry. It si very specific instrument targeted to the industry. COMET is an European wide best practice example combining high level research with industrial interests.

## Pushing Innovation in Manufacturing Through Different Approaches

"Production of the Future" is a national Austrian funding scheme that aims to promote cooperation between business and science, build up human resources and develop research infrastructure. The production of competitive products and the increase in productivity to secure economic growth in Austria are the funding scheme's goals. Projects with a particularly high innovation content and increased development risk are the focus of funding.

There are two opportunities for receiving funding from "Production of the Future": National submission opportunities are regularly offered for funding regular R&D projects, lighthouse projects, and R&D services. Furthermore, endowed professorships and research infrastructure projects such as "Industry 4.0 pilot factories" were funded in order to make innovative production technology and ICT accessible to both scientists and companies. Transnational submission opportunities exist via the European Research Area Network M-ERA.NET "ERA-NET for research and innovation on materials and battery technologies, supporting the European Green deal". Bilateral submission opportunities have existed with China since 2014.



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## Technology Promotion by the Sächsische Aufbaubank Sab (Central 13 Development Agency of the Free State of Saxony)

To make it easier for companies to access new technologies, the Free State of Saxony has set up a range of support measures. They can take advantage of these support opportunities to introduce innovative products and processes in their companies and thus increase the competitiveness.The following funding measures are available:

- R&D project funding in the form of individual company projects or joint projects in cooperation between companies and/or companies and research institutions. The measures serve to develop new or improved products and processes.
- Technology transfer funding (exclusively for SMEs) can be used to promote the acquisition of technical knowledge for the realization of new products or processes or those adapted to a new state of the art. Adaptation developments and consulting services can also be part of the project. The grant amounts to 50% of the eligible costs.
- The innovation award (exclusively for SMEs) supports the use of external R&D service providers for the development of new or improvement of existing products, processes and services as well as technical support in the implementation phase with grants of 50% of the eligible costs, a maximum of 2 innovation awards per applicant and year.
- The KETs pilot line funding serves to implement research results in a pilot line. The aim is to achieve industrial production maturity. It should be noted that investment in the line is only funded through depreciation during the
- By promoting the employment of InnoExperts, the recruitment and employment of highly qualified personnel is supported. These can be, for example, university graduates, young scientists, researchers or engineers.

In this way, the innovative strength and competitiveness of small and medium-sized enterprises (SMEs) in Saxony in particular are to be strengthened. As a rule, personnel expenses are funded for up to 30 months with a funding rate of 50%.

- The InnoTeam program supports cooperation between small and medium-sized enterprises and universities or research institutions in the formation of competence teams. Funding is provided for InnoTeams with three to twelve members, each of whom has a degree in economics, natural sciences or engineering. Applicants receive a grant of up to 100 percent of the eligible expenses for each position created, depending on the funding level and the size or form of the enterprise, over a period of usually 36 months.
- Funding for a transfer assistant supports the recruitment and employment of persons with relevant professional experience in science or business. Transfer assistants have the task of supporting SMEs through information and advisory services in the identification and planned transfer of technological knowledge from technology providers for the preparation and realization of product or process innovations or to prepare research results from science for industry. Funding is provided for personnel expenses for up to 48 months with a funding rate of 50%.



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## Piano Nazionale Di Ripresa e Res Ilienza

The Italian national COVID-19 recovery plan is called Piano Nazionale di Ripresa e Resilienza (PNRR) and it is aligned with the European Next Generation EU (NGEU) programme to facilitate Recovery and Resilience after pandemic. The plan consists in a set of actions on three main strategic axes: digitization and innovation, ecological transition, and social inclusion. The short-term objective is to address the economic and social disruption caused by the pandemic crisis. In the medium-long term, the Plan intends to remove structural weaknesses of the Italian economy, namely innovation, territorial, generational and gender gaps. Finally, PNRR will lead the country along a path of ecological and environmental transition.

## Zwanzig20 Program/Initiative Smart³, Funding Scheme from the 14 German Federal Ministry of Education and Research

Eastern Germany has outstanding economic and scientific expertise. The program "Zwanzig20 – Partnership for Innovation" systematically expands these for the future. With "Zwanzig20 – Partnership for Innovation", the German Federal Ministry of Education & Research (BMBF) has added a new approach to the "Enterprise Region" funding programs, which is aimed at supra-regional, inter-, trans-and multidisciplinary collaborations between partners and stands for openness and transparency. Those are the main gaps which had to be addressed by means of a program. The Zwanzig20 program, which is endowed with up to 500 million euros, is designed to systematically expand the outstanding economic and scientific competencies built up in eastern Germany for the future through cross-regional and interdisciplinary collaborations. The aim is to overcome boundaries in thinking, as well as boundaries of technologies, scientific disciplines, industries, markets and organizational cultures. The aim is to identify future issues with high social and economic relevance and to develop concrete, economically viable solutions for them. One of the Zwanzig20 funded projects consortia is the smart³ initiative focusing on a paradigm shift in innovations through smart materials. The instrument is focused on a network and cluster building approach and alliances of a new kind. Zwanzig20 requires project consortia to strategically network and position themselves across all eastern German states with one or more partners from western Germany and beyond, including at the international level. To this end, the funded consortia have initiated new, open and reflexive processes of network management and forced the establishment of new kinds of innovation structures.

## Manifestazione di Interesse Regione Lombardia e Uniocamere

The regional initiative Manifestazione di Interesse per lo sviluppo di filiere produttivi ed ecosistemi industriali in lombardia will support projects aimed at:

- enhancing and consolidating the productive chains, services and industrial, productive, and economic ecosystems existing in Lombardy
- identify new supply chains and new ecosystems emerging in the region
- stimulating business combinations and synergies by encouraging the exchange of skills and the achievement of common objectives for consolidation and development of industrial ecosystems and supply chains



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- innovate and improve the quality of the production process of the supply chain and increase the competitiveness and attractiveness of industrial, productive, and economic sectors and ecosystems on national and international markets

Priority areas for project proposals where CEUP2030 CAMI4.0 topics could be involved are sustainability and circularity, innovation and technology transfer, digitization, research and intellectual property and training.

## S3 Strategy (Italy)

The Smart Specialization Strategy (S3) of Lombardy Region for the period 2021-2027 continues the path taken with the previous 2014-2020 of declination of an "integrated trajectory" of development of its territory. The objective is the identification of areas of competencies and innovative potential priorities in terms of industrial transformation and resilience of the Lombardy economic and productive system, as well as emerging technological areas to focus regional investment over the next seven years. In particular, the priorities of Lombardy identified on Advanced Manufacturing related to Smart Materials are:

- Developing production technologies and validating advanced materials/ smart materialsà SM flagship and related activities
- New tools and technologies for industrial design, co-design, and end customer interaction.

## Public Tender for the Promotion of Large Investments for 15 Higher Productivity and Competitiveness in the Republic of Slovenia

The purpose of the public tender is to encourage companies to sustainably invest by investing in more advanced technology and automation of business processes, which will contribute to decarbonization and green and digital transition and enable greater productivity in the long run, better recovery, resilience, growth and competitiveness. The aim of the public tender is: raising the productivity and long-term competitiveness of companies while ensuring sustainability or decarbonization or decarbonization and digitalization of operations, higher added value of products and services in Slovenian exports and higher positioning of Slovenian companies in global value chains, maintaining higher value-added jobs, strengthening global and local value chains and increasing the competitiveness of links in supply chains, more even regional distribution of investments.



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## Slovenian Sustainable Smart Specialization Strategy (S5)

The Smart Specialization Strategy is the basis for the implementation of European cohesion policy in the programming period 2021-2027 and is linked to investments within Policy Objective 1 – Smart Europe. In the first half of 2020, the Government Office for Development and European Cohesion Policy started the renovation of S4. The activities were mainly focused on the renewal of the necessary analytical bases and the revitalization of the business discovery process (EDP). Slovenian Sustainable Smart Specialization Strategy (S5) for the period up to 2030 In the programming period 2021-2027, the new Smart Specialization Strategy in Slovenia set the goal of a green transition, which we understand as "innovative, low-carbon, digital and knowledge-based transformation of the economy and society. As a central issue for recovery from the pandemic, he emphasizes that the transition to a low-carbon circular economy is not only an environmental necessity, but is becoming an increasingly important factor in ensuring long-term productivity growth and resilience of the economy and society. The economic recovery from the covid-19 crisis will thus be closely linked to the goals of significantly reducing net greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels and achieving climate neutrality by 2050. The 2021 Productivity Report thus proposes guidelines for a successful transition to the new normality, followed by the S5 concept, namely: (i) staff development and future skills, (ii) the role of public finances in promoting smart, digital-innovation transformation, and (iii) sustainable transformation into a low-carbon and circular economy.

# 4. Conclusions & Next Steps

Deliverable D.T2.3.4 is defined in the AF as a Trend Radar and Risk Heat Map on Smart materials developed under joint Policy Intelligence Dashboard for the four 4 CAMI4.0 topics.

The structure of Trend Radar and Risk Heat Map on Smart materials is in line with manual (DT.2.3.1) that provides the guidance required to establish an IT-based Policy Intelligence Dashboard to evidence CAMI4.0 Technology Radars and Risk Heat Maps on Technology Trends. To deliver the tool that is functional and answers the expectations of the varied stakeholders groups a model of PID was tested with a balance group of stakeholders. Testing as a critical part of the PID in Practice exercise covered 40 surveys cross the full partnership, with each Partner facilitating a minimum of 4 stakeholders to review the PID in Practices.

The tests were addressed to the community built within CEUP2030: those organisations who were attending the PLL and RIS3 Round Table and also new actors from business, RTO and RTD. The Project Partners gained insight from 4 stakeholders for each PID in Practice.

These experts provided feedback on the process of gathering content for input into the PID in Practice concerning on the functionality, usability and quality of content.

To ensure simplicity and effectiveness of the PID in Practise validation process, test survey will be organised using Microsoft Forms.

The summary of PID in Practise demonstration testing, insights and conclusions collected valuable for further development of PID will be attached as Annex to the deliverable D.T2.4.2- Interim Evaluation & Impact Assessment Report on TIN and PID in CE/EU policy context



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## 5. Call to Action

The model, associated to each CAMI4.0 topic, which the PPs delivered for the PID have been tested with a balanced group of stakeholders and the recommendation and insights collected should be analysed, verified and implemented if relevant. The scope of modification of PID content will be agreed by relevant Deliverable Responsible Projects Partners and Lead Partner.

## 6. Next steps

KPT and PBN will integrate the recommended list of improvements on PID in brochure and PID website platform.



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